

P 1046 - TH 0896

**EFFECT OF DATES OF SOWING ON GROWTH, YIELD, QUALITY AND
ECONOMICS OF INTERCROPPING OF CASTOR (*Ricinus communis* L.,)
WITH CORIANDER (*Coriandrum sativum* L), REDGRAM
(*Cajanus cajan* L) AND SESAMUM (*Sesamum indicum* L.)
AS CONTINGENCY PLANNING FOR WEATHER ABERRATIONS**

BY
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M.Sc. (Agri.)

THESIS SUBMITTED TO
MARATHWADA AGRICULTURAL UNIVERSITY
IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR
THE AWARD OF THE DEGREE OF
Doctor of Philosophy
IN
(AGRONOMY)

T 896



DEPARTMENT OF AGRONOMY
MARATHWADA AGRICULTURAL UNIVERSITY
PARBHANI (M. S.)

1983

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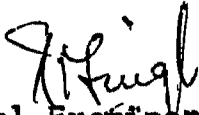


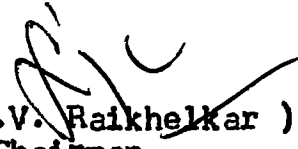
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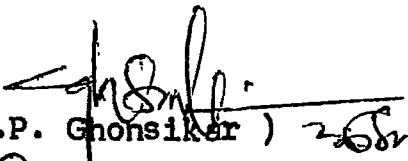
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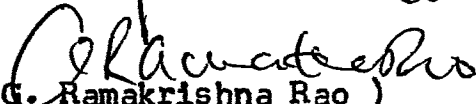

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The assistance and help received during the course
of this investigation have been fully acknowledged.

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Guide

Dated: December 16, 1983

ACKNOWLEDGEMENTS

With great pleasure, I express my deep sense of gratitude and sincere regards to my guide Dr S.V.Raikhelkar, Head, Department of Agronomy, Marathwada Agricultural University, Parbhani, for his guidance, encouragement and critical review of the manuscript, with patience and personal interest at every stage till the preparation and presentation of this thesis.

I am very much thankful to the advisory committee members Dr D.N. Borulkar, Dr C.P. Ghonsikar, Head, Department of Soil Science and Agril. Chemistry and Dr G. Ramakrishna Rao, Prof. of Bio-Meteorology, M.A.U., Parbhani for their valuable suggestions and guidance during the course of this investigation.

I wish to express my thanks to Dr V.B. Shelke, Prof. of Agronomy, Dr M.V. Dhoble, Agronomist, Dryland Agril. Research Centre and Prof. E.A. Khating and the staff of Dryland Agricultural Research Centre, Parbhani for providing facilities for field experimentation. The work was aided by S/Shri U.V. Kale and B.D. Thakur of Dryland Agril. Research Centre, Parbhani.

I am also extremely thankful to Dr K.R. Pawar, Director of Research, Marathwada Agricultural University, Parbhani for his suggestions and guidance.

I am very much thankful to all the other staff members of the Department of Agronomy who have cooperated in the present investigation and wished me all success.

I express my sincere thanks to Profs. B.S.Kulkarni, H.S. Achary and P.R. Waghmare, Department of Economics and Statistics for their suggestions and assistance in the statistical part of this thesis.

I am highly indebted to Andhra Pradesh Agril. University for granting me study leave to take up my Ph.D. studies at Marathwada Agricultural University, Parbhani.

No words are enough to express my whole hearted sense of reverence to my parents Shri G.Luxmiah and Sow. Narsubai for their fervent encouragement and building my educational career. The help rendered by my wife Sow. Prabhavati and my sons Chi. Sivaramasagar, Ramsundersagar and Lakshminarasimhasagar deserve all appreciation for cheerfully sharing the responsibilities in odd hours.

Parbhani


(G. CHANDRASAGAR)

Dated : December /6, 1983

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INTRODUCTION

I INTRODUCTION

Weather aberrations have become a common feature of rainfed farming in India. This may be due to the disturbance of ecological balance in nature due to several reasons. In spite of adverse weather conditions agricultural scientists at different Dryland Agriculture Centres are experimenting to devise a contingency plan for cropping under changing weather conditions. Any technology developed for rainfed area should therefore be able to maximise the benefits of a good season and minimise the ill effects of an unfavourable one (Swaminathan, 1976). The results of research work under A.I.C.R.P. for Dryland Agriculture during the last 10 to 12 years has brought great hopes of stabilising the agricultural production in spite of worst droughts of 1972-73 and 1982-83. Still there is scope for increasing and stabilizing agricultural production including oilseeds and pulses by adopting suitable alternate intercropping according to the changing weather conditions.

The principal source of water for dryland crops is rain, a major portion of which is received during the monsoon period. The monsoon period is beset with breaks of rain in almost all parts of the country. Bursts of rain alternated with 'breaks' partial or general, are not uncommon. Thus rainfed farming has to bear the pangs of vagaries of monsoon

rains. There are atleast four important aberrations in the rainfall behaviour (Venkateswarlu, 1983). They are ,

- i) the commencement of rains may be quite early or considerably delayed.,
- ii) there may be prolonged breaks, during the cropping seasons,
- iii) there may be spatial or temporal aberrations, and
- iv) the rains may terminate considerably early or continue for longer periods.

To quantify the aberrations in the monsoon rains, rainfall data for 108 years at Solapur were analysed. The analysis revealed that the above situation of aberrations have occurred in drought prone areas of Maharashtra State during 1971, 1974 and 1976 in the recent years (Patel et al., 1981). Besides these years, 1972 was the lowest rainfall year which resulted in total failure of both Kharif and rabi crops. They further observed that fluctuation in the arrival schedule of monsoon and further optimum conditions to take up sowings are found to vary from late July to late August. During 1974 it was possible to sow crops by early August. If sowings of the traditional kharif crops like cotton, groundnut and sorghum were done after 15th July, there w is reduction in yield and in economic return too. In addition to this early and late onset of monsoon, breaks of long duration of 2-3 weeks (or even more) which create the situations of plant-water stress leading to

reduction in agricultural production were also revealed in the analysis of rainfall data. The frequency and probabilities of such breaks have been worked out for the state as well as for the several regions of the country.

Parbhani district of Marathwada region which is identified as assured rainfall zone also experienced such long breaks in monsoon rains in the recent few years (Anonymous, 1980). These situations compell the farmer to ~~harvest~~ the standing crops like green gram, black gram etc. All these situations are certainly aberrant and as and when they occurred required the implementation of the contingency planning techniques developed by Dryland Agriculture Research Centres, which aim at increasing and stabilizing crop production in dryland areas. These contingency planning techniques includes (i) choice of suitable crops(ii) choice of suitable varieties (iii) alternate crop strategies (iv) mid season corrections and (v) crop life saving measures.

Earlier work on mid season corrections at Akola Centre under the All India Coordinated Research Project of Dryland Agriculture (Anonymous, 1975) showed that if sowings were delayed, crops like setaria, pigeonpea and castor were found suitable.

Similarly, in the Solapur region for sowing in the end of July, crops like setaria, horse gram, kidney bean, pigeon pea, sunflower and castor were found suitable (Anonymous, 1975).

Crop production per unit area, per unit time in drylands can be increased through cropping intensity. The cropping intensity in semi arid areas is generally 100 indicating that a single crop is taken during a year (Venkateswarlu, 1981). If the rainfall is about 700 mm there is definite availability of moisture for more than a single crop during the rainy season but not for two crops. In such areas adoption of optimised intercropping system increased cropping intensity. It was found that growing sorghum with green gram at Akola or with pigeonpea as intercrop at Hyderabad and Udaipur is more profitable than sorghum alone. Similarly, pearl millet with pigeonpea is better than pearl millet alone in Solapur. A combination of groundnut and pigeonpea was more productive than having groundnut alone at Bangalore (Balasubramanian et al., 1982).

Intercropping castor with coriander at Parbhani (Shinde, 1977 and Venkateswarlu, 1983) was profitable for sowing during 2nd fortnight of July or 1st fortnight of August.

However, the information generated so far on contingent crop planning strategy for aberrant weather conditions

for this region is insufficient as far as pulses and oilseed crops are concerned. Further research is therefore needed in this direction.

With this object in view the present study on the "Effect of different dates of sowings on the growth, yield, quality and economic returns of intercropping of castor with coriander, pigeonpea and sesamum as contingency planning for weather aberrations" was undertaken at Dryland Agricultural Centre, Marathwada Agricultural University, Parbhani.

REVIEW OF LITERATURE

II

REVIEW OF LITERATURE

Very little amount of work is reported in the past on alternate crop strategies for aberrant weather conditions, particularly under delayed onset of monsoon.

The studies made so far on weather aberrations particularly rainfall; the research work done on alternate crop strategies, on cropping intensities (intercropping) and its effect on growth, yield, economic returns and quality of the component crops and on time of sowing is reviewed in this chapter.

2.1 Weather aberrations :

Patil et al. (1981) studied the weather data from the available records of 110 years for Solapur and stated that out of the several elements of weather, rainfall has a key position in success of dry farming and pointed out that the common aberrations are delayed onset of a monsoon, early withdrawal of monsoon and dry spells during the rainy months (monsoon) and they also stated that these situations have occurred during 1971, 1974 and 1976 in recent years. Besides these years, 1972 was the lowest rainfall year which resulted in total failure of both kharif and rabi crops.

Senghi (1982) reported that lack of pre-monsoon showers, delayed onset of monsoon, long breaks in rainfall during August, early termination of rainy season and continuous cloudy weather during October - November were the type of aberrations noticed in Hyderabad region.

Venkateswarlu (1983) studied the 50 years weather data for different regions of the country and identified at least four important aberrations in the rainfall behaviour viz.,
 i) the commencement of rains may be quite early or considerably delayed, (ii) there may be prolonged 'breaks' during cropping seasons, (iii) there may be spatial and/or temporal aberrations and (iv) the rains may terminate considerably early or continue for longer periods.

2.1.1 Onset of monsoon :

2.1.1.1 Delayed onset of monsoon :

Though it is observed that the onset of South-West monsoon in Marathwada region is received some times after second week of June but it is only monsoon air mass during this period and actually, monsoon rains are received in the second fortnight of June. Thus in the year 1979 the monsoon was delayed for 15 days and the sowing rains were received during the last 10 days of June (Anonymous, 1979).

Patil et al. (1981) stated that even though the monsoon is expected to be arrived by mid-June in Maharashtra,

such situation is experienced rarely. More-over, they stated that in recent past since the year 1971, it was only possible during the years 1977 and 1979 to sow the crops by mid-June, and in recent years in 1974 it was only possible to sow crop by early August. Based on these facts they further stated that fluctuations in the arrival schedule of monsoon and further optimum conditions to take up sowing were found to vary from late July to late August.

Sanghi (1982) reported that rainfall favourable for plant growth is usually received during the month of July at Hyderabad. He stated that the probability of getting a weekly rainfall of more than 28 mm is about 50 per cent during this month. He further stated that though the heavy rains are also received during September, the probability for a given rainfall is relatively lower than in July.

Singh (1982) analysed the climatic data of 50 years (1921-70) on the dates of arrival and withdrawal of south-west monsoon for 17 regions/ meteorological sub-division viz., Tamil Nadu, North-interior Karnataka, South-interior Karnataka, Rayalaseema, Telengana, Central Maharashtra, Vidarbha, Gujrat, Orissa, Bihar plateau, East Uttar Pradesh, West Uttar Pradesh, West Madhya Pradesh, Haryana and Delhi region, Punjab, East Rajasthan and West Rajasthan, and as an illustration in East-Rajasthan, he reported that the median date of onset of south-west monsoon was 27th June, mean date 25th June, standard

deviation, 11 days and coefficient of variation, 32 per cent. He further stated that the duration of south-west monsoon in the region was as short as 15 days in 1924 and as long as 158 days in 1933. Summing up all these situation he stated that the variability in the South west monsoon rainfall is the main characteristic associated with the monsoon, this variability in rain fall from week to week, month to month, season to season and year to year caused unpredictable dry spells and floods which have severe effect on crop and soil management and crop production.

Venkateswarly and Singh (1982) and Venkateswarlu (1983) studied the climatic data of 50 years, on the dates of arrival of monsoon for different regions of the country and reported that in 10 per cent of the years monsoon is delayed as much as beyond 21st June in Madhya Maharashtra.

2.1.2 Breaks in monsoon :

Patil et al. (1981) defined "Break" as a period receiving less than 15 mm rainfall in the consecutive weeks, the normal rainfall during the week being more than 5 mm. Based on this criterion the frequency and duration of breaks at few location in Solapur and Ahmednagar districts were studied by these workers. They concluded that a duration of break of more than four weeks and frequency of more than three times usually result in failure of crops and such occurrences are usually experienced during kharif and hence kharif season is considered risky.

Daily rainfall analysis of the past 30 years (1951 to 1980) was done for Marathwada region Parbhani, and it was reported that the average dry spell duration of above 7 days increased from first to last decade (1951-60) and (1971 to 1980) for August and September months. It was also reported that the longest average dry spell of 13 days duration was found in July of 1971 -80 decade whereas the average duration of dry spell of 10 days was observed for all the decades during July (Anonymous, 1980).

Singh (1982) worked out frequency of occurrence of dry and wet spells on weekly basis for the cropping period (from 21st to 45th Met. week) for individual years for a period of 30 years (1941 to 1970) for Hyderabad region and indicated Met. week numbers 26, 27, 28, 34 and 41 as dry weeks and week numbers 30, 31, 32, 37 and 39 as wet weeks.

Sanghi (1982) stated that a break in rainfall for less than two weeks is a common feature during the month of August, which does not cause any severe damage to the well established dry land crop. But a long break of 2-4 weeks was harmful for sorghum crop particularly in case of hybrids as it leads to delay in flowering thereby exposing the crop to greater risks of earhead bug damage. He cautioned about the extremities of break and stated that breaks in monsoon for more than four weeks may lead to severe reduction in yield of

sorghum as well as castor because of wilting. However, he viewed liberally and stated that such probability of gap is very meagre.

Venkateswarlu and Singh (1982) and later Venkateswarlu (1983) with refinements and updated results reported that breaks of long duration of 2-3 weeks (or even longer) create the situation of plant water stress leading to reduction in agricultural production. They further added that, another important factor in relation to breaks in the monsoon rains and the consequent droughts is the physical properties of the soil particularly its water holding capacity. They quoted that in a soil with high storage capacity, 15 days of dry spell, may not affect the crop but in the other soil of low moisture storage capacity with 5 days rainless situation show wilting symptoms.

2.1.3 Early withdrawal of monsoon :

It was reported that the monsoon withdrew from Parbhani, Nanded and Beed districts as early as 10 September during 1976-77. The withdrawal was early by 10 days from the region and there were no post monsoon showers received throughout the Marathwada region during the year 1980-81 (Anonymous, 1976-77).

Several Scientists of different centres under the All India Coordinated Research Project for Dryland Agriculture evaluated the climatic data of the last 50 years (1921-1970)

on the dates of withdrawal of monsoon and came out with valuable information. For Hyderabad region, Sanghi (1982) stated that nearly 18 per cent of the years may experience early withdrawal of monsoon i.e. during the third week of September. For Eastern Rajasthan, the median date of withdrawal of monsoon was 23rd September as compared to mean date of 22nd September, standard deviation of 16 days and coefficient of variance of 24 per cent. For Royalseema, Venkateswarlu and Singh (1982) and Venkateswarlu (1983) stated that South-west monsoon withdrew from the region as early as 15th September (1925, 1964) and it persisted upto 31st December (1933, 1935, 1936). They further reported that the probability analysis of the withdrawal dates of the South-west monsoon on fortnightly intervals revealed that in over 55 per cent of years it withdraws from the region in the period from 25th September to 15th October, but in 4 per cent of the years monsoon can withdraw any where during the first fortnight of September and in 10 per cent of years it withdraws from the region during the month of December.

2.2 Crop production strategies for aberrant weather conditions :

All India Coordinated Research Project on Dryland Agriculture has one of its objective to devise means of increasing and stabilizing production in dryland agriculture by selecting suitable crops and varieties and by evolving

contingency plans for seasonal aberrations. To meet this objective several research programmes were taken up from the inception of the project, among them the important are (i) choice of crops, (ii) choice of varieties and (iii) alternate crop strategies. The review on the research carried out so far on these aspects is as follows.

Venkateswarlu (1983) observed that the sowing of crop depended on rains in dryland because rains may commence quite early or delayed considerably and the same crop cannot be sown over time as the yields might be reduced because of pests and diseases or shorter growing season. He emphasised that the meteorological information presented in appropriate format on the seasonal pattern and the variability of soil water are of great significance in evolving the cropping pattern, which will enable the sustained superior productivity over larger period of times in future. He reasoned that only by having thorough knowledge of the soil water variability as judged from the evaluation of long term past climatic record it is possible to select crops and varieties and formulate cropping system which will minimise the effects of seasonal drought and flash floods. He observed that by an interse comparison of crops sown on different dates, all the research centres could identify the most suitable crops at a given point in time and based on this data the alternate crop strategies have been developed by all the centres.

2.2.1 Choice of crops :

Patil et al. (1981) reported that for success in crop production careful selection of crops is very essential and the crop selected should be drought resistant and should have maximum moisture use efficiency. They observed that the total moisture required to mature a crop did not vary much from crop to crop but it varied with its duration. From the research findings carried out since 1971 they suggested a fairly stable crop pattern and recommended that pearl millet should be considered on priority basis for its inclusion in cropping so also pigeonpea. They clearly pointed out that in case of early sowing groundnut is the best crop and in the event of late sowing it would be advisable to replace it with sunflower.

Experiments were conducted at Hissar to identify efficient kharif crops during 1971-1975. Pearl millet(hybrid) cluster beans, green gram and cowpea were sown from 6th July till 26th July at 6, 7, 4 and 3 days interval respectively. It was reported that the pearl millet hybrid has the highest yield potential both as regards to grain and fodder. Under near average and favourable rainfall condition(in 1971 and 1975 respectively) it proved to be the most efficient crop. Cluster beans was next best under average rainfall conditions. It was further reported that during the year of adequate and well distributed rainfall conditions(1975), cowpea performed better than all other legumes and occupied the second position.

In dry years particularly when the monsoon withdrew early (1972 and 1974) leguminous crops of cluster beans and green gram tended to give more yield than pearl millet on account of extensive root system and lesser vegetative growth in comparison with pearl millet. Pearl millet exhausted the surface moisture soon on account of extensive roots in the upper 60 cm and suffered great set back if the rains received during its reproductive phase. Cluster beans is more stable than pearl millet. Green gram is more remunerative, it is protected from virus diseases and insect attack. Summing up the above remarks it was reported that pearl millet could continue to be the main kharif crop on account of its high yield potential both as regards grain and fodder. However, in view of two years out of every five years being dry years, area under green gram and cluster beans may be extended as far as practicable (Anonymous, 1976).

Based on the analysis of the rainfall data from 1911 to 1965, the Dryland Centre at Ananthpur concluded that the practice of sowing crops with May rains is extremely risky because of the 4-6 week drought period in June and July. It is stated that the reliable rains were received from 27th August to 14th October and taking advantage of these rains the Dryland Centre, Ananthpur recommended that crops like pigeonpea, castor and mesta can be sown with May rains, while crops like pearl millet, setaria, cowpea, dolichos lablab and D.biflorus and sunflower may be sown later in the season from

third week of July to third week of August (Anonymous, 1977).

Spratt and Chowdhury (1978) observed that many minor traditional crops grown are not the most productive for the region and crop substitution in such cases are advantageous. They cited examples of growing a temperate crop like wheat in southern India or a frost sensitive crop like safflower in the north where its production potentials are visibly low but yet the farmer cultivate these crops for economic or social reasons. They pointed out that the introduction of long staple varieties of cotton (Gossypium barbadense) to irrigated areas has reduced the demand for dryland cotton (Gossypium arboreum/herbaceum) and thus, dryland cotton areas are available for a substitute crop like sorghum, in Bellary region, chickpea was found superior over wheat, in Varanasi, maize and sorghum over upland rice, in Ranchi, soybean over green gram and safflower over wheat in Indore, mustard over wheat in Agra and Eruca Sativa over wheat in Hissar and safflower over wheat in Bijapur. Similar suggestions were also made by Venkateswarlu and Singh (1982), Balasubramanian et al., (1982) and after updating by Venkateswarlu (1983).

Sanghi (1982) pointed out that sorghum and castor are the most important dryland crops grown in the red soils of Hyderabad region. Pigeonpea is mainly grown as an intercrop with sorghum in a row proportion of 1:4 or more. Pearl millet, cowpea, green gram are grown as intercrops within the sorghum rows.

Experiments conducted at Central Arid Zone Research Institute, Jodhpur indicated that pearl millet, green gram and sunflower crops are suited for cultivation under normal kharif conditions on drylands of Western Rajasthan. Sunflower has the potential to replace sesamum being more moderate under delayed monsoon conditions, Green gram, kidney beans and sunflower crops hold promise and castor, sunflower and mustard can be grown successfully on conserved soil moisture when the monsoon recedes (Anonymous, 1973).

2.2.2 Choice of varieties :

With the era of hybrids and high yielding varieties the average grain yields obtained over many years of crop evaluation revealed that the yield potential of cereals are far higher than those of oilseeds or pulses indicating the importance of crop improvement programme in the latter crops. These hybrids and high yielding varieties may not fare any better than the traditional varieties in years of poor rainfall. But these are capable of capitalising the better seasons. And rainfall being a random phenomenon good years tend to be as frequent, if not more as the bad ones in the long run. It is necessary to capitalise on good rainfall years so that in the long run a farmer is better off if he chooses hybrids and high yielding varieties.

Different hybrids and varieties have been identified for weather aberrations by different centres under All India coordinated Research Project for Dryland Agriculture. For Hissar, cluster bean cultivar Durgapur Safed-25 and 197 and green grams cvs. S-8 and S-9 were found suitable (Anonymous, 1976), for Ananthpur district (Andhra Pradesh) green gram varieties HB-45, pearl millet variety HB-3, Setaria variety H-1, sunflower variety EC 68415 were found suitable (Anonymous, 1977), for Royalseema region mesta cultivar AMV-1, redgram cultivar PM-1, castor variety Aruna, groundnut variety Kadiri 71-1, pearl millet variety BJ-104, setaria variety I.Sc. 377, sunflower cultivar Latur Selection, cowpea cultivar K-11 and horse gram cultivar VZM-1 were found suitable (Venkatanadbachari et al., 1979) and (Anonymous, 1977). For Rajasthan (Singh, 1981) bajra cultivar BJ-104, green gram cultivar T-44, 288-8, sesamum cultivar T-13, cluster bean cultivar FS-277, kidney bean cultivar T-18, castor cultivar Aruna and cowpea F-568 were found suitable. For Western Rajasthan pearl millet HB-3, green gram cultivar S-12 and S-8 sunflower EC-69874 and EC-68414, castor cultivar Aruna, GH-3 are the promising varieties (Anonymous CAZI. Technical Bulletin No.1). For Solapur (Patil et al., 1981) redgram cultivar No.148, castor cultivar SA-1, NPH-1 and 157-B and pearl millet hybrids were found promising. For Hyderabad castor cv. Gauch-1 and Aruna, sorghum cv. CSH-5 and CSH-6 (Sanghai 1982) were found suitable.

Venkateswarlu (1983) made refinements and updated the research findings made so far at various Centres under All India Coordinated Research Project for Dryland Agriculture and prepared the list of kharif crops which can replace the traditional ones. For Akola Centre sorghum cv. CSH-5/ CSH-9 and CSH-1 were found suitable for normal and late sowing conditions respectively. For Ananthpur Centre groundnut cv. Kadiri-1 and THV-2 or Kadiri-3 were found suitable for normal and late sowing conditions respectively, for Bangalore Centre finger millet cvs. Indaf-1 or Indaf-3 and PR 202(Godavari) were found suitable for normal and late sowing conditions respectively, for Bellary Centre sorghum cvs SPV-86 or CSH 8R or CSH 7R and M-35-1 were found suitable for normal and late sowing conditions respectively, for Bhubaneswar Centre rice cvs. Ratna or Kumar and DR-92 were found suitable for normal and late sowing conditions respectively, for Dantiwada Centre sorghum cvs CSH-5 or CSH-6 for grain and S-1048 or Malwan for fodder were found suitable for normal and late sowing conditions respectively, for Dehradun Centre, maize cvs G-5 or G-2 or Vikram and Ageti were found suitable for normal and late sowing conditions respectively, for Hissar Centre green gram cvs. Varsha and S-9 were found to be suitable for normal and late sowing conditions respectively, for Hoshiarpur Centre wheat cvs. WL-410 and C-306 were found suitable for normal and late sowing conditions respectively.

for Jhansi Centre, sorghum cvs. CSH-5 and CSH-6, SPV-224 were found suitable for normal and late sowing conditions respectively, for Jodhpur Centre green gram cvs S-8 and S-9 for cowpea cvs. FS-68 and K-11 were found suitable for normal and late sowing conditions respectively, for Udaipur maize cvs Ganga-5 and Bassi selected, Sathi and sorghum cvs. CSH-5 and CSH-6 were found suitable for normal and late sowing conditions respectively and for Varanasi Centre, green gram cvs Varsha or K-851 and T-44 were found suitable for normal and late sowing conditions respectively.

2.2.3 Alternate crop strategies :

Information generated through research on crop planning under normal and aberrant weather conditions is reviewed here as under :

The rainfall at Hissar is highly variable from year to year and within the season several types of abnormalities like late onset, drought spells and early recession do take place. The experiments were conducted at All India Coordinated Research Project for Dryland Agriculture, Hissar to evolve strategies suitable for normal and late sown conditions. The results indicated that pearl millet is not a suitable crop for seeding in late kharif seasons. Cluster bean is the most suitable crop for growing under late conditions. There is no significant difference between various varieties of cluster beans. However, Durgapur Safed-25 and 197 have given better

yields than the other strains tried. Green gram can be sown successfully provided suitable plant protection measures are taken. Strains S-8 and S-9 are suitable for these conditions (Anonymous, 1976). Cowpea is another leguminous crop which gives satisfactory yield under late sowing conditions (Venkateswarlu et al., 1979; Venkatanadhachary et al., 1979).

Experiments conducted at Dryland Research Centre, Ananthpur (Royalseems region) indicated that for early onset of monsoon (last week of May to end of June) green gram variety HB-45, or cowpea, sorghum, redgram, mesta, castor may be sown, for normal onset (July) groundnut, redgram, castor and mesta were found suitable, for late sowing (August), pearl millet variety HB-3, setaria variety H-1, sunflower variety EC-68415 were found suitable and for very late sowing (early September) onset of monsoon, pearl millet variety HB-3, sunflower variety EC-68415, black gram variety T-9 and horse gram were found suitable. It was further stated that groundnut should be sown as early as possible and latest by the last week of July. It is also pointed out that if the early season is droughty and the yields of groundnut are likely to be low, sunflower may be inter sown in groundnut rows of 90 cm (Anonymous, 1977) and Venkateswarlu et al., 1979).

The yields of pearl millet crop in Ahmednagar districts are rather low because of highly uncertain rainfall,

extremely low moisture holding capacity of the shallow soils and above all the low rainfall during the Met. weeks of 31, 32, 33, 34 and 35 (from 6th August to 2nd September) when pearl millet could be in boot leaf to early dough stage and is most sensitive to moisture stress. It is recommended that shallow soils (upto 22.5 cm depth) can be used for growing short season crops upto mid of August and the sequence should be in the order of pearl millet, green gram, black gram, sesamum, cowpea, dolichos bean and horse gram. If conditions for sowing kharif crops are not obtained till mid August the strategy should be, growing horse gram and Dolichus lablab for fodder. It is further recommended that medium deep soils (upto 22.4 to 45 cm depth) can be used for sowing kharif crops like pearl millet, sunflower sesamum, redgram, green gram, cowpea, horse gram, dolichus etc for grain, and after August these soils can be used for growing fodder legume (Anonymous, 1977).

✓ Bhalerao (1978) observed that the yields in dryland can be stabilised by mid season correction of crop planning and reported that for late onset of monsoon upto 15th July crops like hybrid sorghum may be sown in place of cotton, green gram and black gram. For further delay in monsoon, he suggested hybrid pearl millet or sunflower. He further stated that similar advantage may also be taken on extended monsoon by sowing the crops like safflower/ gram followed by kharif sorghum. He also suggested intercropping of crops like green gram, black gram,

groundnut and redgram with sorghum, pearl millet or cotton for aberrant weather conditions to minimise total crop failure.

Umrani(1978) stated that the agricultural production in the Deccan rabi zone is unstable due to fluctuation of rainfall from year to year. He felt the necessity of evolving technology both for normal and aberrant weather situations. He carried out the analysis of rainfall data for 100 years at Solapur and pointed out five typical situations of weather aberrations and concluded that crops like pearl millet , green gram and groundnut failed under delayed sowings and need to be replaced by setaria, castor or sunflower.

Experiments conducted at Central Arid Zone Research Institute, Jodhpur came out with the recommendations that HB-3 variety of pearl millet and green gram variety viz., S-12 and S-8 were the most efficient in utilizing rainfall and stored moisture giving increased yield over the conventional local varieties (i) the variety S-8 of green gram also is suited for late sowing when monsoon is delayed(ii) sunflower variety EC-69874 and EC-68414 were promising for normal as well as late sown kharif conditions (iii) incase of castor crop variety Aruna and GH-3 can give remunerative yields on the drylands of Western Rajasthan (Anonymous,CAZRI Tech. Series No.1).

Venkateswarlu et al. (1979) and later Sanghi (1982) suggested for Hyderabad region(entire Hyderabad, Nalgonda district, parts of Medak, Kareemnagar, Mahboobnagar and

Warangal district) for normal monsoon which started with pre-monsoon showers in the last week of May (Rohini Karthe) even though the onset of monsoon is 10th June in the region sorghum was found suitable. In case of lack of pre-monsoon showers but normal monsoon, short duration sorghum cvs. CSH-5 or CSH-6 were found suitable so that the ear bug pest is avoided or alternate crop of pearl millet which is not affected by the pest was found suitable.

Intercropping of sorghum, redgram or pearl millet redgram in 2:1 proportion were found suitable. Following the sowing of cereal crops either as sole crop or as intercrop sowing of castor variety Aruna or Bhagya from the last week of June to middle of July was found suitable. For the long gaps in rainfall when sorghum is affected by severe moisture stress ratooning with the receipt of subsequent rains in the last week of August or early September is suggested. For delayed onset of monsoon (mid-July to mid-August) finger millet (Godavari) is suggested, for very late onset of monsoon (mid-August to early September) cowpea varieties C-152/EC-4216, setaria variety I.Sc. 701, sunflower variety EC-68414 or Morden, safflower variety A-300 and horse gram local variety were found suitable.

Experiments conducted at Akola region (Akola, Amravati, Wardha, Yeotmal, Parbhani, Buldhana, East and West Khandesh districts of Maharashtra State and parts of Adilabad

and Nizamabad district of Andhra Pradesh) indicated that crops like pearl millet, whose water requirement is low and sunflower which is a photo-insensitive crops were found suitable for normal onset of monsoon followed by long gaps in rainfall. For delayed onset of monsoon the choice of crops gets narrowed down, the traditional crop area of cotton and groundnut will have to be reduced. The crops like pearl millet and sunflower for shallow soils (less than 45 cm), pearl millet, sorghum (CSH-1 and CSH-4) and variety 302 redgram, pearl millet and sunflower for deep soils (more than 90 cm) were found suitable to meet the weather aberration. For early stoppage of rains towards the end of monsoon the early maturing variety of sorghum like CSH-1 and CSH-4 and 302 would always give better performance than the traditional varieties (Anonymous, 1974).

Singh (1981) suggested on the experience gained over years at the Central Arid Zone Research Institute, Jodhpur that cereal crops (Pearl millet etc.) when sown late in the season resulted in low and unremunerative grain yields. Grain legumes and oilseed crops (castor bean, sunflower etc) on the other hand give reasonably good yields. Spratt and Chowdhury (1978), Venkateswarlu (1980 and 1982), Balasubramaniam et al. (1982) brought out the recommendations on alternate crop strategies for different centres in India to meet the weather aberrations.

Raikhelkar et al. (1980) conducted field trials at Parbhani during 1977-78 and 1978-79 and concluded that for sowing in the month of June crops like green gram, black gram, hybrid sorghum, groundnut and redgram may be used. If the monsoons are delayed upto first fortnight of July, crops like hybrid sorghum, groundnut, sunflower and redgram may be sown. If the monsoons are still delayed till second fortnight of July, the crops like redgram, sunflower, pearl millet may be sown, but there will be reduction in yields (than normal) and in economic returns too.

Patil et al. (1981) observed that under late sown conditions (beyond 15th July) because of delayed onset of monsoon in the Solapur region the yield of some of the traditional crops like groundnut, pearl millet etc are reduced to considerable extent creating a difficult situation for oils and grains. They suggested setaria variety (Arjun) redgram variety (NO.148), sunflower variety (EC-69874), castor variety (NPH-1) and horse gram in place of the traditional variety for sowing during kharif to end of July or early August. For still late sowing upto August end they suggested redgram, sunflower and castor. For rains during August and sowing late August to early September castor is suggested.

2.3.1 Intercropping for cropping intensity :

Venkateswarlu (1981) reported that cropping intensity in dryland is generally low, only one crop is taken during a year. However, he further reported, that the research information in the project has provided ample evidence that the cropping intensity could be increased by rainfall areas. He observed that in areas with 650 to 750 mm rainfall intercropping and in regions with above 750 mm with good soil moisture storage capacity sequence cropping are possible. He further observed that systems of mixed cropping are age old practices and in a way cover the principle of risk distribution in Agronomy. He observed that intercropping leads to better utilization of resources both in terms of space and time. He reported that some of the suitable intercrop for different regions are growing sorghum with green gram at Akola are with pigeonpea as intercrop at Hyderabad and Rewa or groundnut at Indore is more profitable than sorghum alone. Similarly, he reported that pearl millet with pigeonpea is better than pearl millet alone in Solapur and Bijapur and a combination of maize and pigeonpea was more productive than having maize alone in Ranchi.

Balasubramanian et al. (1982) reported that adoption of optimised intercropping system increased cropping intensity and crop production per unit land area is decisively more in comparison to sole cropping and pointed out that the same intercrop combination as most suitable as referred by the earlier scientists.

Venketeswarlu et al. (1979) reported that the semi arid tropical region of Hyderabad, with their poor soil moisture storage and growing season of 150 days can support only an intercropping system for increasing crop intensity. The ideal intercrops for the region are sorghum and pigeonpea. The traditional system of mixed cropping is inefficient. Experiments and verification trials on farmer's fields proved that a full yield of sorghum and 60 per cent of the pigeonpea yield could be achieved by (1) switching over to high yielding hybrids of sorghum (CSH-5/CSH-6) and 150 day varieties of pigeonpea (Hy-2) (2) using 40-30-0 kg N, P_2O_5 and K_2O /ha (3) adopting suitable plant protection measures, and (4) resorting to a 2:1 system of planting with 120,000 plants/ha population of sorghum and 40,000 plants/ha population of pigeonpea at 45 cm. Attempts are now in progress for achieving full yield of pigeonpea as well.

2.3.2 Intercropping as an insurance against weather aberrations :

Ayyangar (1942) reported that some crops are often grown as mixtures to guard against the risk of total failure of harvest in unfavourable years.

Aiyer (1949) reported that castor semi looper pest in some years causes severe defoliation, a mixed crop of horse

gram or groundnut in castor rows often serves as an effective insurance against complete failure of the former.

Evans and Shreedharan (1962) reported that the intercropping of castor bean with groundnut or soybean also form insurance in reduced yield of castor bean.

Guruswamy Raja(1968) concluded that by adopting mixed cropping in unirrigated arborium cotton with seven crops including castor and coriander, the advantage of insurance against aberration of weather and consequent failure of one of the component crops are easily derived.

Weiss(1971) reported that drought resistant qualities of castor plants have led to its being considered as a form of drought insurance.

Rahja (1973) reported that in dryland areas, the redgram (Cajanus cajan) is commonly grown as mixed with such crops as sorghum, finger millet, small millets, castor, sesamum etc. These crops make use of moisture at different depth and therefore, provide an insurance against aberrant weather conditions.

Experiments conducted at Dryland Research Station, Ananthpur, indicated that the risk of powdery mildew in coriander could be minimised by adopting safflower, coriander intercropping(Anonymous, 1977).

Spratt and Chowdhury (1978) observed that traditionally farmers have discovered compatability of certain crops and have minimised the risk in production e.g. Cajanus cajan (Pigeonpea) and sorghum. If one crop should fail due to drought, insect damage or disease the other takes up the extra resources and yields proportionally more. Optimum population of both component crops make the system more productive and less risky.

Sanghi (1982) observed that the problem of semi looper on castor is relatively less in those fields which have been sown in a mixed cropping system with cowpea.

2.3.3 Intercropping for stability, productivity and profitability :

2.3.3.1 Intercropping for productivity :

Yadav and Amarsingh (1973) reported that intercropping of legume in castor gave significantly high yield (40.25 per cent increase) over pure crop of castor.

Chandrasekaran et al. (1974) reported that in trial during 1965-67 sesamum in pure stands or in mixture with redgram(Cajanus cajan) gave similar average seed yield of 177-178 kg/ha, redgram in the mixture gave additional seed yield of 126 kg/ha. The yield of sesamum in mixture with sorghum, Pennisetum americanum or groundnut were decreased to



60 to 92.5 kg/ha but the three companion crops gave yields of 106 and 25 kg grain and 462 kg unshelled nuts/ha respectively.

Tarhalkar and Rao (1975) reported that intercropping in sorghum, with soybean, groundnut, pigeonpea, castor and sunflower resulted in increased yield. Increase in yield with the three intercrops were 88, 78, 57.7, 57.3 and 22.6 per cent respectively. By intercropping in castor, the percentage increase in castor yield with the intercrops like soybean, groundnut, sorghum and pigeonpea were 82.7, 98.8, 21.1 and 117.9 respectively.

✓ Shinde (1977) reported that the total physical grain yield of coriander (380 kg/ha estimated from coriander + castor) in coriander + castor intercropping system was significantly increased over solid coriander (85 kg/ha) indicating 346.6 per cent increase.

Kalyan Singh et al. (1978) reported that black gram when intercropped in Cajanus cajan grown in rows 75 cm apart had no adverse effect on its yield and gave additional seed yield of 610 kg/ha.

Rao and Willy (1979) reported 90 per cent of sole sorghum yield and about 52 per cent of the sole pigeonpea yield in cereal/legume intercropping system while Venkateswarlu et al. (1979) reported full yield of sole sorghum and 60 per cent

of the sole pigeonpea yield in the sorghum and pigeonpea intercropping system and stated that attempts are now in progress for achieving full yield of pigeonpea as well.

Chowdhury (1979) reported that out of 112 trials conducted from 1971-72 to 1977-78 at the Cooperating Research Centres of the All India Coordinated Research Project on Dryland Agriculture, 28 trials were selected for his reporting productivity. He pointed out that in 10 of 28 trials the total physical output (not necessarily income) of intercrops was higher than the yield of either components as sole crops.

Ramanathchetty and Bhaskara Rao (1979) reported that analysing total production in intercropping is meaningless since the potential of different crops varied. Alternatively they suggested that the indices of efficiency of intercropping systems such as LER, RYT, monetary returns etc may be subjected to analysis of variance for assessing the efficient intercropping system.

Desai and Goyal (1980) reported that the highest total production was obtained^{ed} with castor + sesamum(1:1) followed by soybean + sesamum. Castor + sesamum(1:1) was superior probably because castor was of longer duration and most of its reproductive growth took place after the harvest of sesame. When the tall castor was grown in inter-rows of

sesame placed 60 cm apart, there was not much competition but when castor + sesamum were grown in a ratio of 1:2 and other combinations in which space between rows decreased, there was a decline in yield.

It was reported that (Anonymous, 1982) total production (redgram + sesamum) was highest in redgram + sesame intercropping system. There was a reduction of 0.56 q/ha in yield of redgram and 1.11 q/ha of sesame when compared to the solid planting of respective crops. The LER was also maximum 1.76 in the above treatment.

2.3.3.2 Intercropping for profitability :

Prabhakara Reddy et al. (1965) obtained extra net profit of Rs. 60/ha (62 per cent increase) by sowing castor and groundnut mixture as compared to pure crop of castor.

Jain and Bajpai (1971) reported more net profits when legume was intercropped with sesame.

Tarhalkar and Rao (1975) obtained total income of Rs. 4394, 4840 and 3185/ha (net profit of Rs. 2709, 2990 and 2415/ha) by adopting intercropping of castor with groundnut; sorghum and pigeonpea respectively as compared to the total income of Rs. 3317/ha (net profit of Rs. 2017/ha) by sowing sole crop of castor.

Saraf et al. (1975) reported that pigeonpea intercropping with green gram was most profitable in 1972 which gave a net return of Rs. 828/ha giving an additional profit of Rs. 446/ha over pure crop of pigeonpea. The pigeonpea and black gram intercropping was next giving a net return of Rs. 791/ha. The most profitable combination in 1973 appeared to be pigeonpea + cowpea, fetching a net income of Rs. 2047/ha with additional income of Rs. 484/ha over pure crop of pigeonpea. The mean net returns over two years were however in favour of pigeonpea + cowpea intercropping.

Shinde (1977) reported highest net return of Rs. 2470/ha when coriander was intercropped with castor.

Mahatim Singh et al. (1977) reported that by intercropping pigeonpea with black gram, green gram and soybean increased total seed yield and net profit by 42.4, 17.6 and 9.1 per cent respectively, compared with *Cajanus cajan* in pure stands. Intercropping with cowpea or *Setaria italica* was not profitable.

At Coimbatore (AICRPO, 1979) it was reported that intercropping sesame was observed to be more remunerative than its pure cultivation.

Rao et al. (1979) stated that apart from the competitive effects, prevailing prices become an additional

and important factor in choosing components of intercropping system. Out of the seven profitable systems, four are sorghum based and the rest are based on pigeonpea, groundnut and castor, but even in these cases sorghum formed the intercrop component.

Chowdhury (1979) from the 112 trials conducted from 1971-72 to 1977-78 at the Coordinating Research Centres of the AICRP for Dryland Agriculture, reported that 28 trials were selected for his report. He stated that in 10 of 28 trials, gains (in monetary terms) from intercropping were indicated ranging from very low to very high (range Rs.10/ha to Rs. 1810/ha). The average gain came to Rs. 831/ha. In the remaining 18 trials income losses were indicated. These ranged from Rs.10/ha to Rs.2450/ha averaging Rs.566/ha. Of the 11 regions reporting, only Ranchi region reported consistent gain from intercrops over sole crops. The LERs at these stations were high, ranging from 1.40 to 1.96 indicating only small reduction in the yield of components when intercropped.

Chinnappan and Palaniappan(1980) reported that growing intercrops in between the rows of castor resulted in a substantial reduction in the seed yield of castor but the loss was more than made up by the yield from the intercrops. Castor + sorghum, castor + sorghum + black gram combinations gave the maximum net returns. Taking pure castor was ^{the} least remunerative.

Desai and Goyal (1980) reported that the gross return of castor + sesame (1:1) was higher than the return from any other combination and sesame pure. The pooled analysis of the data also indicated high significant differences in gross returns among combinations. The returns from castor + sesamum (1:1) was significantly high. However, no significant differences were observed between sesame pure (45 cm) and sunflower + sesame (1:1) and castor + sesame (1:2). Similarly, the returns from groundnut + sesame and sunflower + sesame were on par with each other. These findings are similar to those observed at Jalgaon (AICRPO, 1977) but differed from those observed at Tindivanam (AICRPO, 1977) where a high significant differences in profit was observed between returns of groundnut + sesame and other combinations. The maximum return was from castor + sesamum (1:1) ratio, which was 19.8 per cent and 75.5 per cent higher than the returns from sesame pure at 45 cm and 30 cm respectively.

2.3.3.3 Intercropping for stability :

Freyman and Venkateswarlu (1977) conducted series of experiments on the best alternative with sorghum as the base crop. The results indicated that eventhough the sorghum yield was affected it was amply compensated by the good yield of pigeonpea and this system alone was found to be most economical and stable for Hyderabad region. Similar conclusions were also made by Morchan et al. (1977).

Rao et al. (1979) stated that the analysis of the stability of the species under competitive stress using regressive approaches (Breese and Hill, 1973) pointed sorghum as the most stable crop followed by pigeonpea, castor and groundnut, groundnut was most sensitive to competition. They further reported that it will not be possible just to interchange species in the above intercropping system. Similar findings were reported by Venkateswarlu et al. (1979).

Patil et al. (1981) observed that under rainfall situation deviating from - 26 to + 50 per cent the intercropping system pearl millet + redgram was more stable as compared to pure crops tested at Solapur.

2.3.4 Component crops in intercropping :

2.3.4.1 Castor as an intercrop :

Wilson (1942) reported that the better performance of groundnut and castor mixture was due to the effect of legume in association with non-legume.

Mixed cropping of groundnut with sorghum, pearl millet, redgram, castor and cotton has been reported to be more remunerative (John et al., 1943) than raising groundnut as a sole crop.

Aiyer (1949) observed that at Tindivanam the monetary return was more from mixed cropping of groundnut with sorghum, setaria, redgram, castor than the pure crop of groundnut.

It was reported (Anonymous, 1956) that the mixed cropping system of cotton and groundnut, castor and groundnut and groundnut alone gave significantly higher income than the pure crop of castor, cotton and mixture of castor and cotton

It was reported (Anonymous, 1958) that castor and pearl millet mixture was on par with control giving significantly more monetary returns to castor and green gram mixture.

Evans and Shridharan (1962) reported that the overall gain in production per hectare in trial in which castor was intercrop^{ped} with either groundnut or soybean.

It was observed (Prabhakara Reddy et al., 1965) that growing castor mixed with groundnut and green gram was better than raising pure castor in respect of yield and monetary returns.

Guruswamy Raja (1968) reported that castor mixed with arboreum cotton was found suitable for Tinnis tract of Madras.

Dorairaj et al. (1973) reported that SA₂ a new castor variety is high yielding, early maturing, dwarf and drought resistant suitable for mixed cropping with bunch type of groundnut in Tamil Nadu.

Rah^aja (1973) stated that mixtures of shallow rooted crops such as rice, finger millet, sorghum, italian millet etc.

with deep rooted crops like redgram, cotton, castor etc are compatible which tap the resources with the upper and lower layers of the soil.

It was reported (Anonymous 1959b) from the findings of research carried at Regional Oilseed Research Station, Kadiari that the suitable component crops that can be sown mixed with castor are groundnut, redgram, green gram and setaria italica . Amongst these most suitable crop is groundnut.

Kulkarni (1959) reported that it is profitable to raise mixed cropping of castor and groundnut.

Lai and Lawton (1962) observed that sesame inter planted with castor makes more growth than when planted with maize, largely as a result of less competition for light and nutrients. Similarly, castor was more vigorous when associated with sesame rather than maize.

Patel (1964) reported increased production of castor by growing with chillies and cotton.

Yadav and Amarsingh (1973) reported significantly high yield of intercropping of soybean in castor over pure crop of castor.

Sudershan Shastri (1973) obtained increased yields from pearl millet, sorghum and castor when grown as intercrop than grown as pure crop and reported that setaria and castor

and sesamum and castor combination recorded lower Et/day as compared to pure setaria and pure sesamum.

Tarhalkar and Rao (1975) reported that dwarf varieties of castor 157 B or 413 A are amenable for intercropping. They further reported that the total monetary returns were more in castor sorghum mixture though the yield of castor was less.

Shinde (1977) reported better performance of coriander and castor intercropping as compared to sole cropping at Parbhani.

Spratt and Chowdhury (1978) reported that castor + cowpea and castor + setaria are most suitable intercropping system at Hyderabad.

Patil et al. (1981) reported that compact castor varieties like 157-B proved to be total failure in castor + pearl millet intercropping system because of shading effect of base crop of pearl millet, so it was felt to sow castor as mid season correction crop in late kharif so that its vegetative growth is reduced and problem of semi looper can also be minimised by August planting.

Venkatanadhachary et al. (1979) observed that for Royalseema region in Andhra Pradesh intercropping with drought tolerant crops like pigeonpea and castor with risk involving crops like groundnut i.e. groundnut and castor combination were found suitable and remunerative.

Sanghi (1982) reported that the problem of semi-
hooper on castor is relatively less in the mixed cropping of
castor and cowpea combination.

The National Seminar on a decade of dryland agricultural
research in its Annual Workshop meeting recommended promising
intercropping systems for various regions. For Hyderabad,
it was reported (Anonymous 1982) castor + sorghum (1:1) and
for Jodhpur castor + cowpea (fodder) (1:1), castor + cowpea
(1:1) and castor + sorghum (1:2) as promising intercropping
system.

Intercropping of castor with black gram in the ratio
2:1 gave the highest gross return at Hyderabad (Anonymous 1982)

2.3.4.2 Coriander as an intercrop :

Aiyar (1949) reported that monetary values of all
mixtures like bengal gram, coriander and horse gram with cotton
were less than that of pure cotton.

From the mixed cropping experiments conducted at
Agricultural Research Station, Kovilpatti, Madras, it was
reported that (Anonymous 1959a) total kapas yield was high
for cotton plus coriander mixture.

Kumarnathsingh (1961) observed that coriander grown
in sugarcane gave satisfactory performance in all respects.
He further reported that growing coriander with October planting
sugarcane will help to keep down the cost of cane cultivation.

Devotta and Chowdipal (1962) observed that the yield of coriander was very low when grown as mixed crop in rainfed cotton.

Guruswamy Raja(1968) found that with extra expenditure of Rs. 25/ha over the pure crop of unirrigated cotton, mixed cropping with crops like horse gram, black gram, tenai, groundnut, coriander, castor and gingelly can be successfully cultivated though cotton yield is slightly lower in mixed crop. The addition of other produces increases the total value and also adopting this practice, the advantage of mixed cropping can be easily derived.

Natarajan and Muthusankaranarayana (1975) found that the yield of sunflower was not influenced by different intercrops like black gram, horse gram, cowpea, coriander, and cotton. However, the yields of these crops were suppressed significantly. In another experiment they found that cotton intercropped with coriander gave substantially more kapas yield than pure cotton.

The experiment on mixed cropping at Siruppa indicated that (Anonymous 1976a) the yield of cotton was reduced by 32.4 per cent due to intercropping with coriander.

Experiments conducted at Dryland Research Centre, Ananthpur indicated that (Anonymous 1977) the risk of powdery mildew in coriander could be minimised by adopting safflower + coriander intercropping.

Shinde et al. (1982) reported that the dry matter accumulation of coriander was influenced by intercropping coriander + castor intercropping.

2.3.4.3 Pigeonpea as an intercrop :

At International Crop Research Institute for semi-arid tract, Hyderabad, the beneficial effect of two base crop (Pigeonpea and sorghum) with different intercrops (pearl millet/ setaria/sorghum/soybean/cowpea/ redgram) were recorded under inadequate supply of moisture and nutrients (Anonymous 1975-76).

Studies conducted at ICRISAT, Hyderabad for testing the suitability of low growing legume green gram, black gram, groundnut, cowpea as third intercrop in redgram + cereal intercropping system showed that in alfisols the introduction of cowpea, black gram, green gram and groundnut did not have the significant affect upon the grain yield of the rapid growing base crop of upright setaria (cereal). There was a significant depression in pigeonpea grain yield when low growing legumes were introduced. However, the total monetary returns were greater in three crop intercropping system than two crop intercropping system (Anonymous 1976-77).

Rao and Willy (1979) found that 90 per cent of sole sorghum yield and about 52 per cent of sole pigeonpea yield was obtained in cereal-legume intercropping system.

Kaul and Sekhón (1974) reported reduction in red gram yield when it was associated with groundnut.

At Bhubaneswar intercropping redgram T-21 in paired rows of 30-120-30 cm apart + transplanted ragi in 2:2 proportion is recommended (Anonymous AICRP for Dryland Agriculture).

Freyman and Venkateswarlu (1977) conducted a series of experiments on the best alternative with sorghum as the base crop. They ~~reported~~ ^{reported} that even though the sorghum yield was effected, it was amply compensated by the good yield of pigeonpea and this system alone was found to be most economical and stable for Hyderabad region.

2.3.4.4 Sesamum as an intercrop :

Lai and Lawton (1962) observed that sesamum interplanted with castor make more growth than when planted with maize, largely as a result of less competition for light and nutrients. Similarly, castor was more vigorous when associated with sesamum rather than maize.

Jain and Bajpai (1971) reported more net profit when different legumes were intercropped with sesame.

Chandrasekaran et al. (1974) reported that in treatments during 1965-67 sesamum grown in pure stands or in mixture with red gram(*Cajanus cajan*) gave similar average seed yield of 177-178 kg/ha, redgram in the mixture gave

additional seed yield of 126 kg/ha. The yield of sesame or groundnut were decreased to 60- 92.5 kg/ha but the three companion crops gave yields of 106 and 25 kg grain and 426 kg unshelled nuts/ha respectively.

Desai and Goyal (1980) reported that in field trials in the 1976-78 rainy season sesamum was grown alone or intercropped in 1:1 or 2:1 ratio with bunch or spreading groundnut, castor, soybean, or sunflower. Yield varied markedly between years but intercropping always increased total oilseed production. Highest total production was obtained with castor as the intercrop, followed by soybean both in 1:1 ratio. Most of the reproductive growth of castor followed the sesame harvest, but competition reduced yield when the ratio was one castor to two sesame. Sesame grown alone gave high yield at 45 cm than 35 cm spacing.

It was reported (Anonymous 1982) that total production (redgram + sesame) was highest in redgram sesame intercropping system where 100% population of redgram and 50% population of sesame was maintained. In this treatment there was reduction of 0.56 q/ha in yield of redgram and 1.11 q/ha of sesame when compared to solid planting of respective crops. In this treatment the LER was also maximum (1.76). The treatment was followed by treatment where 100% population of each crop was maintained.

2.4 Effect of sowing dates :

Spratt and Chowdhury (1978) stated that early sowings are always better for kharif crops but one reason for

manipulation of the traditional dates of sowing or changing to varieties with a shorter growing season is the risk of having of grain maturity(harvest) occurring during rainy part of the season, but he stated that there is always a risk with kharif cropping. He further stated that in many cases the traditional sowing time(often based on lunar calender) are not the best especially for improved varieties.

2.4.1 Castor :

At Government Agricultural Research Farm, Kalyanpur, yields of castor sown on 7th July and 7th August were more than that of 12th September and 1st week of October (Anonymous 1955).

Kulkarni (1959) stated that most suitable period for sowing of castor is between 3rd week of June and 1st week of July because October sown castor was heavily infested with jassids.

It was reported that the yield of first sown castor crop i.e. 3rd July sowings, at Government Agricultural Research Farm, Kalyanpur was poor as a result of severe rains and water logging in field when the castor plant was young(Anonymous 1959c).

Experiments conducted at Agricultural Research Institute, Sabour indicated that (Anonymous, 1959d) early sowing of castor on 1st July, 16th July and 1st August, recorded

898, 793 and 606 kg/ha yield which were higher than that of October and November sowings.

From the experiments conducted at Oilseeds Research Station, Farikota, it was observed (Anonymous, 1959c) that yield from 1st July sown crop was the highest than that of 1st August and 1st September sown crop.

Balasubramanian (1959) reported that the ideal period for sowing castor at Tindivanam seems to be 28th July to 3rd August.

The results of the experiments conducted on oilseeds crops in Andhra Pradesh (Anonymous, 1960) indicated that the optimum time of sowing of castor has been found to be early July.

Evans and Sridharan (1962) reported that the yield per plant of late sown castor in groundnut was reduced by 40 per cent.

Anubhava Narin and Lala Amarnath (1962) reported that there was no significant difference due to dates of sowing in kharif and rabi seasons, however, early sowing i.e. 1st July in kharif and 1st October in rabi tended to give more yield than subsequent sowings.

Jayaraj (1966) studied the effect of influence of sowing dates on pest incidence and found that there was

progressive increase in jassid incidence with delay in sowing, but sowing date had not influenced the relationship between pest population and yield. In June and July the incidence of hopper burn ranged from 3.7 to 29.7 per cent, whereas in late sowing there was considerable increase in damage to the extent of 70.4 per cent in August and 89.9 per cent in September sowing.

Ankineedu et al. (1975) reported that the sowing of castor should be completed before the first week of July as delayed sowing result in progressive reduction in yield.

Deokar et al. (1977) reported that delay in sowing of castor after 15th July reduced yield and no pod formed with sowing on 15th September. The highest average seed yield of 1.49 t/ and 1.26 t/ha were obtained by sowing on 15th and 1st July respectively.

Shinde (1977) reported that sowing of castor on 33rd Met. week produced significantly more grain yield over earlier dates of sowing.

Patil et al. (1981) reported that good yields of castor were obtained under plenty of moisture and the yield levels were satisfactory even for late sowing from end of July to early September, so that its vegetative growth is reduced and the problem of semi-looper can also be minimised by August planting.

Sanghi (1982) investigated the yield levels of castor over different dates and reported that castor yield levels are not significantly reduced even when sowings are delayed upto second week of July.

2.4.2 Coriander :

Aiyer (1950) reported that sowing dates of coriander varied in different localities. In West Bengal and Uttar Pradesh the seeds are sown during the cold season, in Maharashtra during monsoon and in Tamil Nadu in autumn, in Mysore and some parts of Tamil Nadu coriander is grown in two seasons from May to August and from October to January.

Wakankar and Nigam (1961) stated that in the different districts of Guna, Rajgarh and Saugar of Madhya Pradesh, coriander is grown on large scale under irrigation during rabi season.

Nikitina (1975) reported that the best results were obtained by sowing coriander from mid-March to end of April or in September at Dagastan Experimental Station, VIR, Laningrade, USSR.

Central Indian Medicinal Plant Organisation (Anonymous, 1976b) reported that the best sowing time of coriander at Bangalore is second week of September.

Shinde (1977) reported that the grain yield of coriander was significantly influenced by various sowing dates, sowing on 27th Met. week produced significantly more yield over later dates of sowing.

2.4.3 Pigeonpea :

Saxena et al. (1973) from the results of the experiments conducted at Pantnagar on sowing time of pigeonpea T-21 (May 20, June 5, June 20, July 5 and July 20) reported that delaying planting dates resulted in conspicuous reduction in yield and the optimum time of sowing pigeonpea is 1st fortnight of June.

Rathi et al. (1974) reported that the optimum sowing time for pigeonpea variety T-21 was June 10 for Meerut conditions. A linear reduction in yield was recorded thereafter.

Rathi and Tripathi (1978) conducted trials on early maturing Arhar variety T-21 for the two consecutive years 1971-72 and 1972-73 with four different dates of sowings (June, 10, 20, 30 and July 10) and reported that the highest yield in both the seasons was recorded when sown on June 10. A linear reduction in grain yield was recorded thereafter. The reduction in yield was reported to be 22.9 and 29.0 per cent for delay in sowing after one month of the optimum i.e. July 10 for the two seasons respectively.

Narayanan and Sheldrake (1979) reported that pigeonpea are normally sown in June or July in India at the beginning of the monsoon, but the trials conducted at Hyderabad by sowing in October and November as winter crop indicated that the duration of the crop especially of the medium and late cultivars was much reduced. In 1955-56 October sown pigeonpea gave yields comparable with those of normal season, but much lower yields were produced by sowing in November. Medium and late varieties significantly out yielded early ones.

2.4.4 Sesamum :

Tilakraj et al. (1971) reported that the optimum time of sowing for rainfed sesamum crop at Gurudaspur was middle of July.

Srinivasulu et al. (1972) reported early August as the optimum time of sowing for rainfed sesamum in Karur tract of Tamil Nadu.

Bhattacharya (1973) reported that in trials on lateritic uplands with three sesame cultivars sown on four dates at 15 days interval between 22nd May and 7th July Cv. B-4 sown on 7th June gave the highest seed yield (398 kg/ha).

Surya Prakash Rao and Venkatachari (1979) reported that irrespective of sowing season for sesamum peak growth of rate was observed at 60th day after sowing.

Dhanwan et al. (1979) reported that delay in sowing of sesame from 4th July to 4th August effected seed yield, seed weight, oil content, oil yield and oil composition of sesame Cv. No.1 and Haryana Till No.40.

It is reported at Punjabrao Krishi Vidyapeeth, Akola Maharashtra State that seed yield differences due to varieties and different dates of sowing from 26th to 32nd Met. week were not significant (Anonymous, 1980).

2.5 Moisture and nutrient availability in intercropping :

Results of few investigation indicated that intercropping has the advantage of better utilization light, space, nutrients and moisture as crops with different growth habits, compete and spreading type slow and fast growing and different root system are grown in association within the same area by modifying the planting pattern.

Ayyanger and Ayyar (1942) stated that intercropping legume increased the availability of lime potash and phosphorus content in the soil by the solvent action and their ability to raise these nutrients to the surface layer because of the deeper root system.

Dalal (1974); Liboon and Harwood(1975) reported greater nutrient uptake by intercropping especially nitrogen because of variation in their demand at different growth stages.

Dalal (1974), Hall (1974) reported greater uptake of potassium by intercropping.

Yadav and Saxena (1975) concluded that mixture of pulses and cereals are quite compatible from the point of view of nutrient and moisture.

Hegde (1977) reported that the 'P' needs of intercropping system of pigeonpea or mung was 74 kg P_2O_5 /ha whereas 54 kg P_2O_5 /ha was optimum for pigeonpea.

Shukla et al. (1977) reported that intercropping of sunflower and especially black gram in pigeonpea increased the N, CP, P and K content of the pigeonpea seeds. While intercropping of pearl millet (*Pennisetum typhoides*) decreased them.

De et al. (1978) grew maize alone and in intercropping with soybean and green gram and reported that W.U.E. was 10.3 for maize pure, 16.8 and 19.4 in intercropping system with soybean and green gram respectively.

Willey (1979), Snaydon and Harris (1979) reported that the yield advantage in intercropping may be due to below ground resources use by the roots of the component crops far from different soil layers, thus in combination they may exploit a greater total volume of soil.

MATERIALS AND METHODS

III

MATERIALS AND METHODS

The details of the material used and the methods adopted in the present investigation are summarised in this chapter.

3.1 Site :

The experiment was conducted at the Dryland Agricultural Research Centre, Parbhani during the consecutive kharif seasons of 1980-81 and 1981-82 on plot numbers 119 and 124 respectively, on well drained vertisol which have the physical and chemical characteristics as given in Table 1.

Table 1: Physical and chemical characteristics of vertisol soils of the experimental plots at Dryland Agricultural Research Centre, Parbhani.

Particulars	Plot No.119 1980-81	Plot No. 124 1981-82
Depth (cm)	0-100 cm	0-100 cm
<u>Mechanical composition</u>		
Coarse sand (%)	6.71	5.40
Fine sand (%)	10.10	9.98
Silt (%)	26.17	20.40
Clay (%)	52.50	47.85
Textural class	Clay	Clay
Organic carbon (%)	0.50	0.49
Total nitrogen(%)	0.038	0.048
Available phosphorus(%)	0.0024	0.0008
Total potassium (%)	0.063	0.063
pH	8.20	8.10

The soil in the experimental plots was clayey in texture, low in nitrogen, moderate in available phosphate and high in available potassium. The moisture constants of the soils were estimated and are given in Table 2.

Table 2: Moisture constants of the soil.

Particulars	1980-81	1981-82
	Plot No. 119	Plot No. 124
Field capacity(0.33 bar) per cent	34.14	33.2
Wilting point(15.0 bar) per cent	13.8	13.5
Bulk density (g/cc)	1.33	1.33
Soil depth(0-100 cm)		

The moisture retention capacity of the experimental plots was quite high. The cropping history of the experimental site for the past three years is presented in Table 3.

It would be seen that residual effect of previous cropping was not much varied.

3.2 Climatic conditions :

Parbhani is situated at 400 meters above mean sea level and geographically falls on latitude 19°-16' North and has a sub-tropical climate. Climatologically it is classified under assured rainfall zone of monsoon (June- October).

NORMAL (1947-1980)

1980

1981

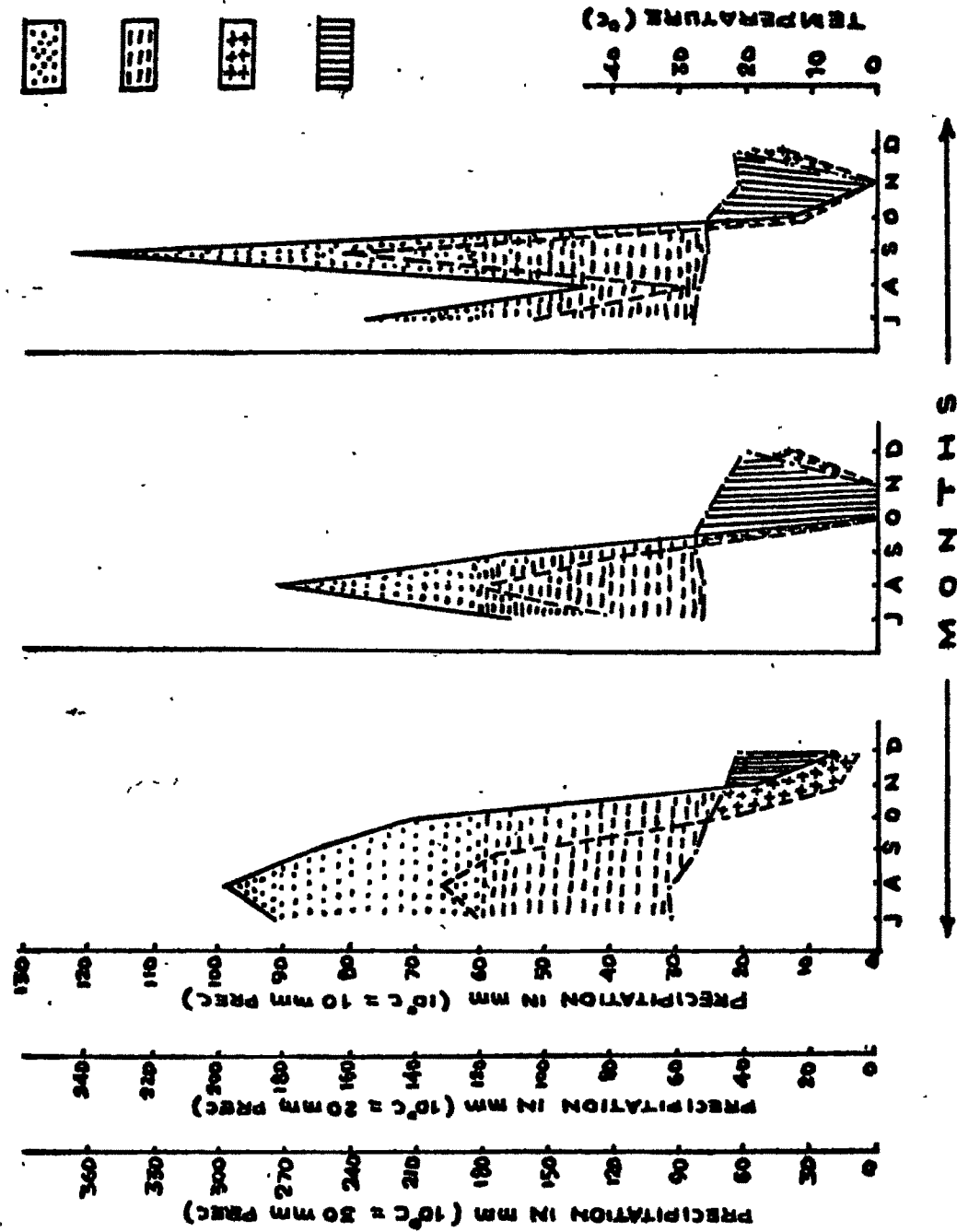


FIG.1. CLIMATIC DIAGRAM OF PARBHANI

Table 3: Cropping history of the experimental plot :

Year	Season	Plot No. 119	Year	Season	Plot No. 124
1977-78	<u>Kharif</u>	Jowar	1978-79	<u>Kharif</u>	Mung
	<u>Rabi</u>	Fallow		<u>Rabi</u>	Fallow
1978-79	Summer	Fallow	1979-80	Summer	Fallow
	<u>Kharif</u>	Cotton		<u>Kharif</u>	Jowar
	<u>Rabi</u>	Fallow		<u>Rabi</u>	Fallow
1979-80	Summer	Fallow	1980-81	<u>Summer</u>	Fallow
	<u>Kharif</u>	Jowar		<u>Kharif</u>	Fallow
	<u>Rabi</u>	Fallow		<u>Rabi</u>	Fallow
1980-81	Summer	Fallow	1981-82	Summer	Fallow
	<u>Kharif</u>	Present experiment		<u>Kharif</u>	Present experiment

Rainfall distribution, temperature and relative humidity regimes and evaporation data recorded at the Agricultural Meteorological Observatory, Marathwada Agricultural University, Parbhani, during the period of experimentation along with the normals (1947 to 1982) are presented in Appendices I and II and depicted in Fig.1

Rainfall during 1980-81 was concentrated in 4th week of July to 2nd week of September and upto end of September during 1981-82, while the normal concentration is in 1st week of July to end of September (1947 to 1982). The total annual rainfall received during 1980-81 was 893.2 mm in

61 rainy days and 779.8 mm in 82 days during 1981-82 against the annual normal rainfall (1947 to 1982) of 937.16 mm rain in 68 days. The rainfall during the cropping period for each of the year of experimentation was 442.8 and 558.5 mm during 1980-81 and 1981-82 as against the normal of 651.9 mm (1947 to 1982) during the same cropping period. In the wet cropping periods of 1980-81 and 1981-82 a maximum amount of rainfall of 181.7 mm during August 1980-81 and 242.9 mm during September 1981-82 was received as against the average normal maximum of 198.9 mm received during August (1947 to 1982). Rainfall is thus erratic. The onset of monsoon was also varied it was delayed by 15th days during 1977-79 and it was early during 1980-81.

Data on decadal rainfall analysis for Parbhani region from 1951 to 1980 (Appendices III and IV) have shown a wide variation in the total decadal rainfall, 779.7 mm(1951-60), 823.8 mm (1961-70) and 7634.9 mm(1971-80). The total decadal rainfall was lower during the last decade, indicating an average normal rainfall of only 763.49 mm as against the normal annual rainfall of 937.15 mm (1947 to 1982).

Variations were also observed in the number, duration and spread of the wet and dry spells from season to season. A total of 14 and 22 wet spells during monsoon periods of 1980-81 and 1981-82 are observed respectively. The average annual number of wet spells of 21.6, 20.7 and 18.2^{units} are shown in the decadal rainfall analysis data for the decades 1951-60, 1961-70 and 1971 to 1980 respectively. This indicates a

wide variation and decreasing trend in number of wet spells during the last decade i.e. 1971-1980. The data have also shown the largest duration of wet spells of 14 days with 363.3 mm rainfall in August during the decade 1961-70. This was repeated after 10 years during 1980-81 but with less amount of rainfall (206.8 mm) during the same month of August. Monthwise distribution of wet spells also indicated wide variation from season to season, and decade to decade. The average monthly total wet spells varying from 3.9 to 5.9 during the months of September and July respectively during the respective decades of 1971-80 and 1951-60 are pointed out while the maximum number of wet spells of 4 each during the months of June and September months are received during 1980-81, and wet spells during the months of August are received during 1981-82.

Similarly, the data for the experimental periods revealed the dry spells of 2 weeks duration in the 2nd and 3rd week of July occurred consecutively during 1980-81 and 1981-82. The decadal rainfall analysis indicated the highest average dry spell of 13 days duration in the month of July during the last decade of 1971-80 in comparison to the highest average dry spell of 10 days duration in the month of June during the decade of 1951-60. These trends indicate the increasing number of dry spells over the succeeding decades.

The activity of monsoon is also varied between season to season. The activity of monsoon, recorded as early as 10th September during 1976-1977 and 1980-81.

The weekly average maximum and minimum temperatures also varied widely during the same cropping periods over the normal as well as within the season of experimentation. The normal weekly average maximum temperature (1947-82) varied from 30°C (December) to 34.1°C during the cropping period and the normal weekly average minimum temperatures varied from 11.3°C (December) to 23.6°C (August). While these temperatures i.e. weekly maximum temperature during (1980-81 varied from 27.9°C (August) to 36.5°C (October) and during 1981-82 it varied from 28.74°C (November) to 34.7°C (July). Similarly, the maximum average temperature varied from 11.7°C (December) to 23.5°C (August) during 1980-81 and from 8.04°C (November) to 23.7°C (July) during 1981-82.

All these situations summarily lead to the conclusion that aberrant weather conditions are forcing ahead in the assured rainfall zone of Parbhani district since the last decade i.e. 1971-80 onwards and require urgent measures of crop planning for increasing and stabilising food production in dryland agriculture.

3.3 Experimental details :

3.3.1 Design and treatments :

In the present investigation two factors experiment,

i.e. three sowing dates and ten cropping treatments including six single base crop treatments intercropped with three intercrops each crop intercropped separately in either a single row or two rows and four controls of sole crop treatments were tested. The design adopted was "Factorial Randomized Block Design" with three replications.

<u>Sowing dates:</u> 3	<u>1980-81</u>	<u>1981-82</u>
D ₁ = 29th Met.week(16 to 22 July)	16th July	16th July
D ₂ = 31st Met.week(30 July to 5th August)	30th July	30th July
D ₃ = 33rd Met.week(13th August to 19th August)	13th Aug.	14th Aug.

<u>Cropping treatments:</u> 10
T ₁ = Sole crop of castor
T ₂ = Sole crop of castor + one row of coriander (as intercrop)
T ₃ = Sole crop of castor + two row of coriander (-do-)
T ₄ = Sole crop of castor + one row of pigeonpea (-do-)
T ₅ = Sole crop of castor + two rows of pigeonpea(-do)
T ₆ = Sole crop of castor + one row of sesamum (-do-)
T ₇ = Sole crop of castor + two rows of sesamum (-do-)
T ₈ = Sole cropping of coriander
T ₉ = Sole cropping of pigeonpea
T ₁₀ = Sole cropping of sesamum.

The gross and net plot sizes were 6.30m x 6.30m and 5.4 m x 5.4 m respectively. The number of rows of base crop castor were constant in all the intercropping treatments viz.,

7 and 6 in gross and net plots respectively. The number of rows in case of intercrops varied with the treatments and are presented in Table 4.

Table 4: Number of rows of intercrops and sole crops in gross and net plot area

Treatment	Crop	Gross plot	Net plot
Castor + 1 row of coriander	Coriander	8	6
Castor + 2 row of coriander	Coriander	14	12
Castor + 1 row of pigeonpea	Pigeonpea	8	6
Castor + 2 row of pigeonpea	Pigeonpea	14	12
Castor + 1 row of sesamum	Sesamum	8	6
Castor + 2 row of sesamum	Sesamum	14	12
Sole cropping of coriander	Coriander	21	17
Sole cropping of pigeonpea	Pigeonpea	14	12
Sole cropping of sesamum	Sesamum	14	12

3.3.2 Layout :

The experimental field was laid out as per the plan after preparatory cultivation before sowing. The plan of layout is depicted in Fig.2. The layout consisted of 90 experimental plots in three replications, each replication consisted 30 plots (3 dates x 10 treatments).

3.4 Cultivation :

The schedule of cultivation operations are given in Table 5.

R-I

D ₁ T ₆	D ₁ T ₇	D ₁ T ₈	D ₁ T ₉	D ₁ T ₁₀
D ₂ T ₂	D ₂ T ₃	D ₂ T ₄	D ₂ T ₅	D ₂ T ₆
D ₂ T ₇	D ₂ T ₈	D ₂ T ₉	D ₂ T ₁₀	D ₂ T ₁₁
D ₂ T ₁₂	D ₂ T ₁₃	D ₂ T ₁₄	D ₂ T ₁₅	D ₂ T ₁₆
D ₃ T ₁	D ₃ T ₂	D ₃ T ₃	D ₃ T ₄	D ₃ T ₅
D ₃ T ₆	D ₃ T ₇	D ₃ T ₈	D ₃ T ₉	D ₃ T ₁₀

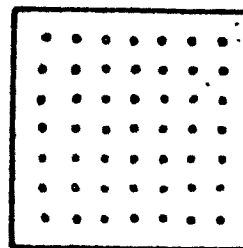
R-II

D ₁ T ₁	D ₁ T ₂	D ₁ T ₃	D ₁ T ₄	D ₁ T ₅
D ₂ T ₆	D ₂ T ₇	D ₂ T ₈	D ₂ T ₉	D ₂ T ₁₀
D ₂ T ₁₁	D ₂ T ₁₂	D ₂ T ₁₃	D ₂ T ₁₄	D ₂ T ₁₅
D ₃ T ₁	D ₃ T ₂	D ₃ T ₃	D ₃ T ₄	D ₃ T ₅
D ₃ T ₆	D ₃ T ₇	D ₃ T ₈	D ₃ T ₉	D ₃ T ₁₀
D ₃ T ₁₁	D ₃ T ₁₂	D ₃ T ₁₃	D ₃ T ₁₄	D ₃ T ₁₅

R-III

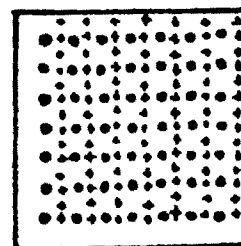
D ₁ T ₁	D ₁ T ₂	D ₁ T ₃	D ₁ T ₄	D ₁ T ₅
D ₂ T ₆	D ₂ T ₇	D ₂ T ₈	D ₂ T ₉	D ₂ T ₁₀
D ₂ T ₁₁	D ₂ T ₁₂	D ₂ T ₁₃	D ₂ T ₁₄	D ₂ T ₁₅
D ₃ T ₁	D ₃ T ₂	D ₃ T ₃	D ₃ T ₄	D ₃ T ₅
D ₃ T ₆	D ₃ T ₇	D ₃ T ₈	D ₃ T ₉	D ₃ T ₁₀
D ₃ T ₁₁	D ₃ T ₁₂	D ₃ T ₁₃	D ₃ T ₁₄	D ₃ T ₁₅

↑
N



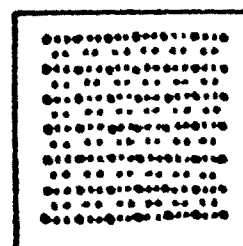
(A)

SOLE CROP OF CASTOR
90cm X 90cm



(B)

SOLE CROP OF CASTOR
+
1 ROW INTERCROP



(C)

SOLE CROP OF CASTOR
+
2 ROWS OF INTERCROP

DESIGN : FACTORIAL RANDOM-
MISED BLOCK DESIGN

REPLICATIONS : 3

PLOT SIZE : 6.3 M X 6.3 M

FIG. 2. PLAN OF LAY OUT

Table 5: Schedule of cultural operations

Sr. No.	Field operations	Year of expt. I/II	First sown crop		Second sown crop		Third sown crop	
			July 16	August 13/14	July 30	August 13/14	Frequency	Dates
			Frequency	Frequency	Frequency	Frequency	Frequency	Dates
1	2	3	4	5	6	7	8	9
1.	Ploughing with tractor	I	1	10.7.1980	1	10.7.1980	1	10.7.1980
		II	1	7.7.1981	1	7.7.1981	1	7.7.1981
2.	Harrowing with wooden harrow	I	2	12.7.1980	2	12.7.1980	2	12.7.1980
		II		13.7.1980		13.7.1980		13.7.1980
		II	2	9.7.1981	2	9.7.1981	2	9.7.1981
				10.7.1981		10.7.1981		10.7.1981
3.	Cleaning the field	I	1	14.7.1980	1	14.7.1980	1	14.7.1981
		II	1	11.7.1981	1	11.7.1981	1	11.7.1981
4.	Experimental layout	I	1	14.7.1980	1	14.7.1980	1	14.7.1980
		II	1	12.7.1981	1	12.7.1981	1	12.7.1981
5.	Rowmarking with marker	I	1	15.7.1980	1	29.7.1980	1	11.8.1980
		II	1	13.7.1981	1	29.7.1981	1	11.8.1981
6.	Fertilizer application	I	1	15.7.1980	1	29.7.1980	1	12.8.1980
		II	1	15.7.1981	1	29.7.1981	1	13.8.1981
7.	Splitting and soaking of coriander seed in water	I	1	15.7.1980	1	29.7.1980	1	12.8.1980
		II	1	15.7.1981	1	29.7.1981	1	13.8.1981
8.	Drilling of coriander seed and dibbling of castor, pigeonpea and sesamum seed	I	1	16.7.1980	1	30.7.1980	1	13.8.1980
		II	1	16.7.1980	1	30.7.1980	1	14.8.1981
<u>Post sowing operations for castor</u>								
9.	Gap filling	I	1	28.7.1980	1	14.8.1980	1	25.8.1980
		II	1	31.7.1981	1	12.8.1981	1	26.8.1981

Contd....

Table 5(Contd.)

1	2	3	4	5	6	7	8	9
10. Thinning		I	1	28.7.1980	1	14.8.1980	1	25.8.1980
		II	1	31.7.1981	1	12.8.1981	1	26.8.1981
11. Weeding		I	3	20.8.1980	3	3.9.1980	3	20.9.1980
				3.9.1980		14.10.1980		30.10.1980
				14.10.1980		24.10.1980		10.11.1980
		II	3	23.8.1981	3	4.9.1981	3	18.9.1981
				4.9.1981		15.10.1981		27.10.1981
				15.10.1981		25.10.1981		7.11.1981
12. Dusting of 10% BHC		I	2	6.8.1980	2	21.8.1980	2	2.9.1980
				16.8.1980		1.9.1980		12.9.1980
		II	2	6.8.1981	2	28.8.1981	2	4.9.1981
				16.8.1981		1.9.1981		14.9.1981
13. Spraying of Malathion		I	2	26.8.1980	2	11.9.1980	2	22.9.1980
				4.9.1980		18.9.1980		29.9.1980
		II	2	25.8.1981	2	12.9.1981	2	24.9.1981
				3.9.1981		19.9.1981		2.10.1981
14. Picking of castor		I	3	15.11.1980	3	30.11.1980	2	15.12.1980
				22.11.1980		7.12.1980		30.12.1980
				30.11.1980		15.12.1980		-
		II	3	16.11.1981	3	30.11.1981	2	16.12.1981
				23.11.1981		7.12.1981		30.12.1981
				30.11.1981		15.12.1981		-
15. Threshing and winnowing		I	2	16.12.1980	2	5.1.1980	2	21.1.1980
				31.12.1980		20.1.1980		21.1.1980
		II	2	16.12.1981	2	4.1.1982	2	21.1.1982
				31.12.1981		20.1.1982		22.1.1982
<u>Post sowing operations for coriander</u>								
16. Gap filling		I	1	28.7.1980	1	14.8.1980	1	25.8.1980
		II	1	31.7.1981	1	12.8.1981	1	26.8.1981

Contd...

Table 5(Contd.)

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1	2	3	4	5	6	7	8	9
17.	Thinning	I	1	28.7.1980	1	14.8.1980	1	25.8.1980
		II	1	31.7.1981	1	12.8.1981	1	26.8.1981
18.	Weeding	I	2	20.8.1980	2	3.9.1980	2	20.9.1980
		II	2	3.9.1980	2	20.9.1980	2	27.9.1980
			2	23.8.1981	2	4.9.1981	2	18.9.1981
				4.9.1981		18.9.1981		25.9.1981
19.	Harvesting of coriander	I	1	15.10.1980	1	3.11.1980	1	17.11.1980
		II	1	15.10.1981	1	3.11.1981	1	16.11.1981
20.	Threshing and winnowing of coriander	I	1	25.10.1980	1	14.11.1980	1	27.11.1980
		II	1	26.10.1981	1	15.11.1981	1	27.11.1981
<u>Post-sowing operation for pigeonpea</u>								
21.	Gap filling	I	1	28.7.1980	1	14.8.1980	1	25.8.1980
		II	1	31.7.1981	1	12.8.1981	1	26.8.1981
22.	Thinning	I	1	28.7.1980	1	14.8.1980	1	25.8.1980
		II	1	31.7.1981	1	12.8.1981	1	26.8.1981
23.	Weeding	I	2	20.8.1980	2	3.9.1980	2	20.9.1980
		II	2	3.9.1980	2	14.10.1980	2	30.10.1980
			2	23.8.1981	2	4.9.1981	2	18.9.1981
				4.9.1981		11.10.1981		27.10.1981
24.	Spraying Endrin	I	1	17.9.1980	1	4.10.1980	1	20.10.1980
		II	1	3.9.1981	1	4.10.1981	1	20.10.1981

Contd...

Table 5(Contd.)

1	2	3	4	5	6	7	8	9
25.	Harvesting and staking	I	1	1.12.1980	1	17.12.1980	1	1.1.1981
		II	1	1.12.1981	1	17.12.1981	1	1.1.1982
26.	Threshing and winnowing	I	1	8.12.1980	1	26.12.1980	1	11.1.1981
		II	1	9.12.1981	1	24.12.1981	1	10.1.1982
<u>Post sowing operation for sesamum</u>								
27.	Gap filling	I	1	28.7.1980	1	14.8.1980	1	25.8.1980
		II	1	31.7.1981	1	12.8.1981	1	26.8.1981
28.	Thinning	I	1	28.7.1980	1	14.8.1980	1	25.8.1980
		II	1	31.7.1981	1	12.8.1981	1	26.8.1981
29.	Weeding	I	2	20.8.1980	2	3.9.1980	2	20.9.1980
		II	2	3.9.1980	2	14.10.1980	2	30.10.1980
			2	3.8.1981	2	4.9.1981	2	16.9.1981
				4.9.1981		15.10.1981		27.10.1981
30.	Harvesting and staking	I	1	18.11.1980	1	3.12.1980	1	18.12.1980
		II	1	16.11.1981	1	2.12.1981	1	17.12.1981
31.	Threshing and winnowing	I	1	25.11.1980	1	10.12.1980	1	25.12.1980
		II	1	23.11.1981	1	19.12.1981	1	24.12.1981

Note : I = 1st year 1980-81

II = 2nd year 1981-82

3.4.1 Preparatory cultivation :

The land was ploughed about 15 cm deep. It was subsequently harrowed with blade harrow to achieve fine tilth, Last harrowing was given after the receipt of showers in the month of July.

3.4.2 Seed and spacing :

The seeds of castor cv. J-1, coriander local, pigeonpea cv. T-21 and sesamum cv. N-85 were used. Castor cv. J-1 was developed at Gujrath and is a dwarf short duration heavy branching variety. A spacing of 90 cm between rows and 90 cm within rows was used for sole as well as for all the treatments where castor is a base crop. Pigeonpea cv T-21 was developed at Kanpur. It is an early tall, erect, loose branching seed medium, high yielding variety. A spacing of 45 cm between rows and 20 cm within rows in sole cropping was used, while a spacing of 20 cm within rows in single rows planted in between castor rows and 30 cm between rows and 20 cm within rows in two rows of pigeonpea planted in between two castor rows was adopted. Sesamum cv. N-85 (T-85) is a white seeded kharif season variety. A spacing of 30 cm between rows and 10 cm within rows was used for sole cropping while in single rows 10 cm within the rows and 30 cm between rows and 10 cm within the rows in two rows of sesamum planted between two rows of castor was adopted. Coriander a local variety was spaced at 30 cm between rows in sole cropping and 2 rows of intercropped between 2 rows of castor was adopted.

3.4.3 Fertilizer application :

Twenty five kg N and 50 kg P_2O_5 /ha was applied all as basal dose 5 cm away in 5 cm deep by the side of rows before sowing.

3.4.4 Sowing, gap filling and thinning :

Coriander seed was rubbed and soaked in water for 24 hours before sowing. The experimental field was laid out into plots as per the plan. The plots were marked by marker and sowing was done as per the plan given in Fig.2.

Sowing was done three times as per the treatment after receipt of sufficient rains and at optimum moisture level. Gap filling and thinning was taken up in order to maintain the required plant population.

3.4.5 Cultural operations :

Three weedings were given during the growth period of castor. Two weedings each for the first, second and third sown crops were given during the growth period of pigeonpea and sesamum while two weedings were given during the growth period of coriander.

3.4.6 Crop protection :

The first and second sown castor crops were found to be infested with castor semi looper (Achoe janata) during the year 1980-81 but only traces were noticed during 1981-82.

Attack of castor semi looper was noticed on 19th and 21st days after sowing of the first and second sown castor during 1980-81. To control this pest dusting twice with 10% BHC was accomplished at the rate of 20 kg/ha on the day it was first noticed and later after 10 days interval. Malathion was also sprayed twice at the rate of 200 litres of 0.2 per cent concentration 20 days after the second time dusting of 10% BHC. During 1981-82 although no pest attack was noticed yet dusting and spraying was done as precautionary measures.

3.4.7 Harvesting and threshing :

Three picking from the 1st and 2nd and only two from the third sown castor experimental plots were taken during the maturity period of castor. The harvesting period of castor ranged from 137 days to 139 days after sowing during both the years of 1980-81 and 1981-82. Coriander was harvested ranging from 90 days after sowing to 95 days after sowing during both the years. Pigeonpea was harvested ranging from 137 days after sowing to 140 days after sowing during 1980-81 and 1981-82. Sesamum was harvested ranging from 124 days after sowing to 126 days after sowing during both the years of 1980-81 and 1981-82.

3.5. Emergence :

Uniform emergence increased precision of experimentation. Number of plants emerged in each net plot were counted and

recorded. Number of coriander plants emerged in one meter row length at few places in each net plot were counted and plant population per net plot was calculated theoretically. Similarly the number of plants per net plot at harvest were counted.

3.6 Bio-metric observations :

3.6.1 Castor : Sampling techniques :

Five plants were randomly selected from each net plot area of castor. Each selected plant was marked by a peg nearby and a string around it was tied for demarcation. All the selected plants were labelled and the bio-metric observations were recorded at 30 days interval. The schedule of observations recorded on castor, coriander, pigeonpea and sesamum crops during the course of investigation are presented in Table 6.

A. Castor :

3.6.2 Height :

The height was measured in cm from base of the plant to the base of the fully opened top leaf of the main shoot. After the spike emergence the height was measured upto the base of the spike of the main shoot.

3.6.3 Number of functional leaves per plant :

The leaves of castor are simple and palmate. Total number of fully opened leaves per plant was recorded at 30 days interval.

Table 6: Schedule of observations

Sr. No.	Particulars	Frequency	Days after sowing	No. of plants observed per plot
1	2	3	4	5
A. <u>Castor</u>				
I. <u>Preharvest studies</u> :				
1.	Height of main shoot(cm)	5	30 to 120 days at 30 days interval, and at 135 days	5
2.	Number of functional leaves per plant	5	-do-	5
3.	Number of branches per plant	4	-do-	5
4.	Number of internodes per plant	5	-do-	5
5.	Petiole length(cm)	5	-do-	5
6.	Leaf area(dm ²)	5	-do-	5
7.	Dry matter per plant(g)	5	-do-	1
8.	Dry matter of stem(g)	5	-do-	1
9.	Dry matter of leaves(g)	5	-do-	1
10.	Dry matter of petioles(g)	5	-do-	1
11.	Dry matter of spikes (including capsules)	5	60 to 120 days at 30 days interval and at 135 days	1
12.	Number of spikes per plant	5	75 to 135 days at 50 days interval	5
13.	Number of capsules per plant	5	-do-	5

Contd...

Table 6(Contd.)

1	2	3	4	5
14. Mean length of spike per plant (cm)	5	75 to 135 days at 15 days interval		5
II. <u>Post harvest studies</u> :				
1. Weight of capsules per plant (g)	1	At harvest		5
2. Number of capsules per plant	1	-do-		5
3. Weight of grains per plant(g)	1	-do-		5
4. Weight of capsules per plot (kg)	1	-do-		All plants in net plot
5. 1000 grain weight (g)	1	-do-		per plot
6. One litre volume grain weight (g)	1	-do-		-do-
7. Hulling percentage	1	-do-		-do-
8. Weight of stalk per plot(kg)	1	-do-		-do-
9. Grain to stalk ratio	1	-do-		-do-
B. <u>Coriander</u>				
I. <u>Pre harvest studies</u> :				
1. Height of the plant(cm)	5	30 to 90 days at 15 days interval		5
2. Number of functional leaves per plant	5	-do-		5
3. Number of branches per plant	4	45 to 90 days at 15 days interval		5

Contd...

Table 6(Contd.)

1	2	3	4	5
4.	Dry matter per plant(g)	5	30 to 90 days at 15 days interval	2 2
5.	Dry matter of stem per plant(g)	5	-do-	2
6.	Dry matter of leaves per plant(g)	4	30 to 75 days at 15 days interval	2
7.	Dry matter of grains per plant(g)	3	45 to 75 days at 15 days interval	2
8.	Number of umbels per plant	4	45 to 90 days at 15 days interval	5
9.	Number of grains per plant	4	-do-	5
II. <u>Post harvest studies</u> :				
1	Weight of grains per plant (g)	1	At harvest	5
2.	Weight of straw per plant (g)	1	-do-	5
3.	Yield of grains per plot(kg)	1	-do-	All plants in net plot
4.	Yield of straw per plot (kg)	1	-do-	-do-
5.	1,000 grain weight(g)	1	-do-	-do-
6.	Grain to straw ratio	1	-do-	-do-
C. <u>Pigeonpea</u> :				
I. <u>Pre harvest studies</u> :				
1.	Height of the plant(cm)	8	30 to 135 days at 15 days interval	5
2.	Number of functional leaves per plant	8	-do-	5

Contd...

Table 6(Contd.)

1	2	3	4	5
3.	Leaf area (cm ²)	8	30 to 135 days at 15 days interval	5
4.	Number of branches per plant	8	-do-	5
5.	Dry matter per plant(g)	8	-do-	2
6.	Dry matter of stem per plant(g)	8	-do-	2
7.	Dry matter of leaves per plant(g)	8	-do-	2
8.	Dry matter of grains per plant(g)	3	90 to 120 days at 15 days interval	2
9.	Number of pods per plant	4	90 to 135 days at 15 days interval	5
10.	Number of grains per plant	4	-do-	2
II. <u>Post harvest studies</u> :				
1.	Weight of pods per plant(g)	1	At harvest	5
2.	Weight of grains per plant(g)	1	-do-	5
3.	Weight of straw per plant (g)	1	-do-	5
4.	Yield of grain per plot (kg)	1	-do-	All plants in net plot
5.	Yield of straw per plot (kg)	1	-do-	-do-
6.	1,000 grain weight(g)	1	-do-	-do-
7.	Grain to straw ratio	1	- do-	-do-

Contd...

Table 6(Contd.)

1	2	3	4	5
D. <u>Sesamum</u> :				
I. <u>Pre harvest studies</u> :				
1. Height of the plant(cm)	7	30 to 120 days at 15 days interval		5
2. Number of functional leaves per plant	7	-do-		5
3. Number of branches per plant	6	45 to 120 days at 15 days interval		5
4. Dry matter per plant(g)	7	30 to 120 days at 15 days interval		1
5. Dry matter of stem per plant (g)	7	-do-		1
6. Dry matter of leaves per plant(g)	7	-do-		1
7. Dry matter of pods per plant(g)	5	45 to 105 days at 15 days interval		1
8. Dry matter of grains per plant(g)	5	-do-		1
9. Number of pods per plant	6	45 to 120 days at 15 days interval		5
10. Number of grains per plant	6	-do-		1
II. <u>Post harvest studies</u>				
1. Weight of pods per plant	1	At harvest		5
2. Weight of grains per plant (g)	1	-do-		5
3. Weight of straw per plant (g)	1	-do-		5
4. Yield of grains per plot (kg)	1	-do-	All plants in net plot	
5. Yield of straw per plot(kg)	1	-do-	-do-	
6. 1,000 grain weight(g)	1	-do-	-do-	
7. Grain to straw ratio	1	-do-	-do-	

3.6.4 Leaf area per plant :

The maximum length and maximum breadth of the 3rd leaf from the apex was measured in cm at 30 days interval and the leaf area per plant was computed by the formula.

$$AP = (L \text{ max. } \times B \text{ max. } \times C) n$$

Where,

AP = leaf area per plant in sq.dm.

L max = maximum leaf length

B max = maximum leaf breadth

C = (0.5666) constant calculated for castor J-1 based on weighted regression model proposed by Memp (1960).

n = number of leaves per plant

3.6.5 Leaf area index (LAI) :

Since the crop yield is to be assessed per unit of ground area, instead of per plant, the leaf area existing on unit ground area was proposed by Wetson (1952). The measurement is known as leaf area index.

$$LAI = \frac{\text{Leaf area per plant in sq.cm}}{\text{Ground area per plant in sq.cm}}$$

3.6.6 Length of the petiole :

The length of the petiole of the third leaf was measured in cm from the attachment to the shoot to the base of the leaf.

3.6.7 Number of branches per plant :

The branches arising from the axil of the leaf on the main shoot and the branches arising from the axil of the leaf on the primary branches were recorded.

3.6.8 Number of internodes per plant :

The number of internodes from the base of the plant to the base of spike on the main shoot were recorded.

3.6.9 Number of spikes per plant :

Usually the main axis and the branches terminate in inflorescence in castor. The inflorescences first appears in the form of a bud and the bud develops into a raceme. In castor both the pistillate and staminate flowers are borne on the same penduncle and thus it forms a monoecious raceme. The number of racemes (spikes) per plant were recorded.

3.6.10 Length of the spike :

The length of spike on which fruits are borne and the number of fruits gives a measure of compactness. This can be expressed in terms of fruits per linear length.

The length of each spike in cm was measured from the base of the spike to the tip of the spike.

3.6.11 Number of capsules per plant :

The plants which were randomly selected were used for scoring the number of capsules per plant.

3.6.12 Number of grains per plant :

There are usually three locules in each castor fruit. Each locule bears a single seed. The number of grains per plant are scored after threshing the dried fruit.

3.6.13 Dry matter accumulation studies :

For the dry matter accumulation study, one plant from each plot was selected at random at every stage of the sampling. The plant so selected was uprooted and its roots were removed. The aerial portion of the plant was divided into various plant parts like stem, leaves, petiole, spike and capsules as the case may be according to the stage of growth. These separated plant parts were collected in separate brown paper bags, properly labelled air dried in the first instance and then dried in hot air oven with thermostat control, at the temperature of 65°C for 24 hours. The oven dried samples of leave, stem and pods from each plot were weighed with top pan balance and recorded in grams. The final constant weight was recorded as dry matter weight in g per plant.

3.6.14 Weight of capsules per plant :

Fully matured capsules from randomly selected plants were harvested dried and weighed on monopan electrical balance

(accuracy upto mg) later threshed cleaned and grain weight also recorded similarly. Total of each treatment were made and averaged over 5 plants for weight of capsules and grain per plant.

3.6.15 Weight of straw per plant :

The weight of straw of five randomly selected plants were taken on monopan electrical balance after harvest (accuracy upto mg).

3.6.16 Test weight :

Test weight studies included 1000 seed weight and 1 litre grain weight.

a) one thousand kernal weight

One thousand kernal of 5 samples in each treatment were weighted in g to note the test weight.

b) Volume weight :

Weight of one litre grain sample(measured with a round glass vessel(capacity 1000 cc) from each treatment plot was recorded in g.

3.6.17 Grain to straw ration

The weight of grain of five randomly selected plants and the straw weight at harvest were recorded for arriving grain to straw ratio.

3.6.18 Yield of grain and straw :

At maturity, the five sample plants were harvested separately for observations. The net plots were marked and pickings from each net plot were made and kept for sundrying. The weight of clean dry capsules was recorded and threshed with hand and cleaned by winnowing and clean grain per net plot was recorded. The straw yield was recorded after it was cut and dried. Grain to straw ratio was computed from the yield of the grain and straw obtained from each net plot.

3.7 Coriander :

3.7.1 Bio-metric observations :

Biometric observations were recorded at 15 days interval commencing from 30 days after sowing upto 90 days. Observations on height of plants, number of branches, number of leaves, spread of the plant, number of umbels, number of grains, dry matter accumulation, weight of grain, weight of straw per plant were recorded as per schedule given in Table 6.

3.7.2 Yield studies :

Yield of grains and stalk per net plot were recorded in kg, grain to stalk ratio was also estimated. Test weight studies were taken up.

3.8 Pigeonpea :

3.8.1 Bio-metric^c observations :

Bio-metric observations were recorded at 15 days

interval commencing from 30 days after sowing upto 135 days.

Observation of height of plants, number of branches, number of leaves, leaf area(as given below), number of pods, number of grains, dry matter accumulation, weight of pods, weight of grains, weight of straw per plant etc were recorded as per schedule given in Table 6.

3.8.1.1 Leaf area :

The maximum length and maximum breadth of central leaf of pigeonpea of the 3rd leaf from apex was measured at 30 days interval and the leaf area per plant was computed by the formula.

$$AP = (L \times B \times C) n$$

Where,

AP = leaf area per plant in sq.cm

L and B = Refer to length and breadth of central leaf

C = 1.705 constant calculated for pigeonpea variety T-21 based on weighted regression model proposed by Kemp (1960) and Ndewula Senyimba (1972).

3.8.2 Yield studies :

Yield of grains and stalk per net plot were recorded in kg. Grain to stalk ratio and test weight studies were also taken up.

3.9 Sesamum :

3.9.1 Bio-metric observations :

Bio-metric observations were recorded at 15 days interval commencing from 30 days after sowing upto 120 days. Observations on height of the plant, number of leaves, number of branches, number of pods, number of grains, dry matter accumulation, weight of pods, weight of grains, weight of straw per plant etc were recorded as per schedule given in Table 6.

3.9.2 Yield studies :

Yield of grains and stalk per net plot were recorded in kg and grams. Grain to stalk ratio and test weight were also taken up.

3.10 Growth analysis :

Data on growth characters viz., height and dry matter accumulation per plant were further analysed by working out the growth functions viz., AGR, RGR, RA and LAI.

3.10.1 Absolute growth rate (AGR) :

Absolute growth rate is the total gain in height or weight within a specific time interval. It is generally expressed as cm per week in case of plant height or g per week in case of dry matter production per plant and is calculated by the following formulae.

$$\text{AGR} = \frac{(H_2 - H_1)}{(t_2 - t_1)} \dots\dots \text{height}$$

$$\text{AGR} = \frac{(W_2 - W_1)}{(t_2 - t_1)} \dots\dots \text{Total dry matter weight}$$

Where,

H_2 and H_1 and W_2 and W_1 refer to plant height and dry matter weight of plant and t_2 and t_1 time respectively.

3.10.2 Relative growth rate (RGR) :

According to Blackman (1919) the increase in the dry matter of plant is a process of continuous compound interest, wherein the increment in any interval adds to the capital for subsequent growth. The rate of increment is known as RGR and this growth constant was worked out at 30 days interval by the formula given by Fisher (1921).

$$RGR = \frac{(\text{Log}_e W_2 - \text{Log}_e W_1)}{t_2 - t_1}$$

Where,

W_1 and W_2 are the total dry matter weight at the time t_1 and t_2 respectively. RGR is expressed as g/g/day.

Log_e = Napier logarithm (Logarithm to the base of e or 2.3026).

3.10.3 Leaf area index (LAI) :

Since the crop yield is to be assessed per unit of ground area, instead of per plant, the leaf area existing on unit ground area was proposed by Wetson (1952). The measurement is known as leaf area index.

$$LAI = \frac{\text{Leaf area per plant in sq.cm}}{\text{Ground area per plant in sq.cm}}$$

3.11 Statistical analysis and interpretation of data :

Data obtained on various variables of the main crop of castor and component crops were analysed by 'Analysis of variance' method (Panse and Sukhatme, 1967). The total variance (S^2) and degrees of freedom ($n-1$) were partitioned into different possible sources. The significance of treatment were computed by 'F' test. Critical differences at 5% level of significance was calculated where significant differences among the treatments were observed.

3.12 Simple correlation and regression studies :

3.12.1 Simple correlation studies :

Simple correlation coefficients(r) were computed between weight of grain in (g) per plant (y) and the morphological characters(x).

The procedure and formula described by Snedecor and Cochran (1968) were adopted and significance was tested.

$$r = \frac{XY}{\sqrt{(x^2)(y^2)}}$$

3.12.2 Simple regression studies :

Simple regression coefficients(b) were computed between weight of grains per plant(Y) and those morphological characters(X) studied for simple correlations. The 'sb' values

were computed for and tested for significance as per the procedure and formula described by Snedecor and Cochran(1968).

$$b = \frac{XY}{X^2}$$

$$t = \frac{b}{sb}$$

The regression equation $Y = \bar{Y} + b (X - \bar{X})$ was adopted for each character and the values of constant 'a' were computed for prediction of Y on X.

3.13 Pooled analysis :

The simple technique of analysis of variance may not be valid under two different seasonal conditions, if the error variance in the season are not of the same order and interaction (treatment x season) is also significantly different. Hence pooled analysis of economic returns castor grain equivalent castor grain yield and LERs of two years was carried out as per method described by Panse and Sukhatame (1967). Bartlett's test was applied to examine the homogeneity of variance due to error. The error variance was found to be heterogeneous. Hence, weighted analysis was carried out.

3.14. Analysis for stability parameters :

Stability parameters were calculated for the treatment with the help of Eberhart and Russel Model(1966). The regression of each treatment on an environmental index (dates of sowing) and a function of squared deviation from

this regression would provide estimate of the desired stability parameters for gross returns, total yield and LERs. These parameters are defined with the following model.

$$Y_{ij} = U_i + B_i I_j + S_{ij}$$

Where,

$$\begin{aligned} Y_{ij} &= \text{treatment mean of the } i \text{ th treatment at the } j \text{ th environment (} i = 1, 2 \dots v_i \text{)} \\ &= 1, 2 \dots n \end{aligned}$$

$$U_i = \text{mean of the } i \text{ th treatment over all environments}$$

$$B_i = \text{regression coefficient that measures the response of the } i \text{ th treatment to varying environments}$$

$$S_{ij} = \text{deviation from regression of the } i \text{ th treatment at the } j \text{ th environment and}$$

$$I_j = \text{environmental index obtained as the mean of all treatments at the } j \text{ th environment minus the grand mean}$$

$$I_j = (\sum_i Y_{ij} / J - \sum_i X_i \sum_j Y_{ij} / te), \sum_j I_j = 0$$

First the mean of each treatment was calculated for the gross economic returns, total yield and LERs in different environments and then arranged in a two way table for the estimation of stability parameters as shown in Table 7.

Table 7: Two way table for estimation of stability parameter.

Treatment (Inter- cropping systems)	Environments (Dates of sowing, D ₁ , D ₂ , D ₃ , D ₄ , D ₅ , D ₆)						Total Y _i (i)	Mean Y _i
1	T _{1e1}	T _{1e2}	T _{1e3}	T _{1e4}	T _{1e5}	T _{1e6}	T ₁	U ₁
2	T _{2e1}	T _{2e2}	T _{2e3}	T _{2e4}	T _{2e5}	T _{2e6}	T ₂	U ₂
⋮								
n	T _{ne1}	T _{ne2}	T _{ne3}	T _{ne4}	T _{ne5}	T _{ne6}	T _n	U _n
Total	Y ₁	Y ₂	Y ₃	Y ₄	Y ₅	Y ₆	GT	-
Mean	$\bar{Y}_1$	$\bar{Y}_2$	$\bar{Y}_3$	$\bar{Y}_4$	$\bar{Y}_5$	$\bar{Y}_6$		

Mean: Mean of the i th treatment = i/e

Where,

i = summation of i th treatment over all the environments.

e = number of environments

3.14.2 Environmental index (I_j) :

$$I_j = \left(\sum_i Y_{ij} \right) - \frac{\sum_i X_i Y_{ij}}{t} \quad 1$$

$$J = I_j = 0$$

Where,

I_j = environmental index

$\sum_i Y_{ij}$ = summation of all the treatment for j th environment

t = number of treatments

$\sum_i Y_{ij}$ = summation of all the treatments over the environments

te = number of treatments x number of environments.

The environmental index (I_j) is equal to the d_i (additive treatment contribution of i th treatment) of Perkin and Jinks 1968).

3.14.2 Regression coefficient (b_i)

The first stability parameter is a regression coefficient. The regression coefficient of the treatment mean on environmental index was estimated for each treatment in the experiment as follows.

$$b_i = \frac{\sum Y_{ij} I_j}{\sum I_j^2}$$

Where,

$\sum Y_{ij} I_j$ = Ss of the treatment x environmental index in j th treatment

$\sum I_j^2$ = SS for environmental index.

The appropriate analysis of variance is given in Table 8 with this model the sum of squares due to environment and treatment x environment are partitioned into environment (linear), treatment x environment (linear) and deviations from the regression model.

Table 8: Analysis of variance for stability parameter

Source of variance	d.f.	Sum of squares
Total	$(te - 1)$	$\sum_j Y^2 - cf$
Treatment(t)	$t - 1$	$\frac{1}{e} \sum_i Y_i^2 - cf = Y^2_j$
Environment(Envs)	$(e - 1)$	$\frac{1}{t} \sum_j Y^2_j - cf = Y^2_j$
Treatment x environments	$(t-1)(e-1)$	$\sum_j Y^2_j - cf - Y^2_j - Y^2_i$
Envs(linear)	1	$\frac{1}{t} (\sum_j Y_j I_j)^2 / \sum_j I_j^2) MS_2$
T x Envs(Linear)	$(t - 1)$	$\sum_j (\sum_i Y_{ij} I_j)^2 / \sum_j I_j^2) - Envs$ (linear)
Pooled deviation	$t(e - 1)$	$\sum_j S^2_{ij} \dots MS_3$
Treatment (t)	$(e - 1)$	$(\sum_j Y^2_{ij} - \frac{(\sum_i Y_i)^2}{e} - (\sum_j Y_{ij} I_j)^2 / \sum_j I_j^2)$
Treatment (T)	$(e - 2)$	$(\sum_j Y^2_{ij} - \frac{Y^2_T}{e}) - \frac{(\sum_i Y_i - j i_j)^2}{\sum_j I_j^2}$ $= JS^2 T_j$
Pooled error	$e(r-1)(t-1)$	

3.14.3 Deviation from regression :

The performance of each treatment can be predicted by using the estimate of parameters $Y_{ij} = \bar{Y}_i + b_i I_j$ where Y_i is the estimate of the U_i . The deviation ($S_{ij} = Y_{ij} - \hat{Y}_{ij}$) are

squared and summed to provide an estimate of another stability parameter (S^2_{di}).

$$S^2_{di} = (J S^2_{i_j} / e - 2) - S^2_{e/r}$$

Where,

$S^2_{e/r}$ is the estimated of the pooled error (or the variance of a treatment mean at the j th environment and $J S^2_{i_j} = (J Y^2_{i_j} - \frac{Y^2_{i_j}}{e}) - (J Y_{i_j} I_j)^2 / J I_j^2$

3.14.4 Environment linear :

Environment(linear) as were calculated as follows

$$1/t = (J Y_j I_j)^2 / J I_j^2$$

Where,

$$(J Y_i I_j) = \text{Envs.L.} \times \text{Env. index I} + \dots + \text{Emvn} \times \text{Env (index)}$$

$$J I_j^2 = \text{SS for environmental index}$$

$$t = \text{number of treatments}$$

3.14.5 Treatment x Envs.(linear) :

Treatment x environment(linear) as were calculated as

follows :

$$(J Y_{i_j} / J I_j^2) - \text{Env. (Linear SS)}$$

Where, $(J Y_{i_j} I_j)^2 = t_{ie1} \times \text{Envl.index } i + \dots$

$$t_{ie3} \times \text{Env.index } 3 + t_{ie1} \times \text{Env.index } i +$$

$$t_{2e1} \times \text{Env. index I} + t_{2e3} \times \text{Env. index I} + \dots$$

$$t_{ne_n} \times \text{Env. index } n$$

$$J I_j^2 = \text{SS for environmental index}$$

3.14.6 Test for significance :

Stable treatment is one with $b_i = 1.0$ and $S^2_{di} = 0$.

The significance of the differences among the treatment means

$H_0 = u_1 = u_2 \dots u_t$ can be tested approximately by the F test, $F = MS_1/MS_3$ with homogenous deviation mean squares since MS_3 with pooled deviation.

$B_1 = B_2 = \dots B_t$ thus 'F' test will be approximately the same as $F = MS_1/MS_3$ treatment x environment with standard analysis of variance. If there are differences among treatment in their response to varying environmental index, the F value will be larger.

The hypothesis that there are no treatment differences among treatments for their regression on the environmental index $H_0 = B_1 = B_2 \dots B_t$ can also be tested approximately by 'F' test.

$$F = MS_2/MS_3$$

Thus all the linear variances were tested against pooled deviation mean squares (MS_3). An approximate test of the deviation from regression for each treatment can be obtained $F = (I J S^2_{1j} / e-2)$ pooled error. The test of significance carried for the stability parameters e.g. for environmental index and regression coefficient are as follows.

$$S.E. = \sqrt{\text{Error MS} / r e}$$

$$T = I_j - u / SE$$

Thus, L.S.D. for IJ is equal to $SE \times t_{0.05}$.

The hypothesis that any regression coefficient does not differ from unit can also be tested by approximate 't' test. The SE and 't' for regression coefficient were calculated as follows.

$$SE(b) = \sqrt{\text{Deviation MS} / J^2 I_j^2}$$

$$t = (b-1) / SE(b)$$

Thus L.S.D. for $t-1$ is equal to $SE; b \times t 0.05$

3.15 Soil moisture studies :

3.15.1 Sampling techniques :

The moisture content of the representative treatments was determined from 0-15, 15-30, 30-60 and 60-90 cm soil layers at 15 days interval from 15 days after sowing till harvest.

Soil samples for moisture studies were taken up with the help of screw auger. In each treatment soil samples were taken at two spots selected at random from net plots and the soil was thoroughly mixed to form a composite sample for each layer of sampling separately. Then the samples were transferred immediately to aluminium soil moisture boxes and covered with polythene sheet to avoid heating in field due to insolation. The soil moisture boxes with samples were transported to laboratory by drying and weighing of samples.

3.15.2 Weighing and drying :

The soil samples were weighed (W_1) immediately and then transferred to oven with thermostat control. The samples were dried at a temperature of 105°C till constant weight was obtained (W_2). The loss in soil moisture was expressed in percentage on oven dry weight basis.

$$\text{Soil moisture percentage (oven dry weight basis)} = \frac{W_1 - W_2}{W_2} \times 100$$

3.15.3 Consumptive use of water :

The field consumptive use of water for different treatments was computed by the formulae.

$$Cu = 0.8 \sum_{j=1}^n E_o + \sum_{j=1}^k v_j$$

$$K = 1, j = 1.$$

Where,

Cu = seasonal consumptive use of water in mm

E_o = evaporation from u.s. weather burea class.I pan evaporimeter for the period between sampling intervals.

n = number of time intervals

v_j = water use in j th interval

$$v_j = \sum_{i=1}^n = 1 \frac{M_{1i} - M_{2i}}{100} \times Asi \times DI + GWC + ERF$$

n = number of soil samples

M_{1i} = soil moisture percentage on oven dry basis at first sampling of i th soil layer.

M_{2i} = soil moisture percentage on oven dry weight basis at second sampling from i th soil layer.

A_{si} = bulk density (g/cc)

D_i = soil depth

G.W.C. = ground water contribution

ERF = effective rainfall

3.15.4 Consumptive water use efficiency (WUE)

Consumptive water use efficiency i.e. cost of economic yield per mm of water per hectare in each treatment was worked out by the formulae

$$WUE = \frac{Y}{C_u}$$

Where,

WUE = consumptive water use efficiency. Rupees of economic produce/ha per mm of water used.

Y = cost of produce/ha

C_u = total seasonal consumptive use of water (mm)

3.16 Spectrum of price analysis :

The economic analysis of the yield data was carried out. Various prices of the yield of base crop and intercrop were assumed and the economics of various treatments were worked out by spectrum of price analysis. This analysis serves as a guide line for the cultivators under fluctuation price situations.

3.17 Castor grain equivalents :

The monetary return from the respective intercrop in the respective treatment is converted into castor grain equivalent by taking the castor price as standard.

3.18 Land equivalent ratio (LER) :

The land equivalent ratio is the relative land area under the sole crops that is required to produce the yield or yields obtained in intercropping. This permits direct comparison of crops with different yield levels and can be used either for individual crops or for the total of all crops. The LER was computed by the following formulae.

$$\text{LER(Castor)} = \frac{\text{Castor yield in the intercropping treatment}}{\text{Castor yield of sole crop treatment}}$$

$$\text{LER(Intercrop)} = \frac{\text{Intercrop yield in the intercropping treatment}}{\text{Intercrop yield in sole crop treatment}}$$

$$\text{LER(Combined)} = \underline{\text{LER(castor) + LER(Intercrop)}}$$

LER of sole crops is taken as a unit

3.19 Chemical studies :

3.19.1 Soil and plant analysis :

Soil samples taken before sowing were analysed for total nitrogen, available phosphorus, total potassium and organic carbon.

3.19.2 Plant analysis :

The plant samples at harvest were analysed for N,P,K from stem including leaves and kernels. Nitrogen from plant and soil were estimated by Modified Kjeldhal's method (A.O.A.C. 1955). The total phosphorus from the plant was estimated by Vando Molybdo phosphoric yellow colour method in nitric acid system (Jackson, 1959).

The available phosphorus from the soil was determined by Olsen's method as described by Jackson (1958). The total potassium was determined in ammonia acetate (Volk and Troug, 1934) and was determined by using Perkin Elmer Flame Photometer. The soil reaction was determined by Beckman glass electrode pH meter (Wright, 1934).

3.19.3 Kernel analysis :

3.19.3.1 Oil percentage of kernel(castor) :

Oil content of kernel (castor) treatmentwise was estimated by ether extraction method as described by Shankaran (1958) Soxhlet's ether extraction apparatus was used for extraction of oil from kernel and seed.

3.19.3.2 Preparation of sample :

Kernels of castor were crushed weighed for chemical analysis, care was taken to avoid sampling error in grinding.

EXPERIMENTAL FINDINGS

IV

EXPERIMENTAL FINDINGS

The experimental data, statistical parameters and results of the investigation are presented in this chapter.

CASTOR :4.1 Emergence and final stand :

Mean number of plants emerged and available at harvest per net plot during both the years are presented in Table 9.

Data presented in Table 9 indicate that seedling emergence and the plant stand at harvest were not influenced significantly during both the years by various treatments and their interactions.

4.2 Bio-metric observations :

4.2.1 Plant height :

Data on mean plant height of castor variety J-1 in cm at different stages of crop growth during 1980-81 and 1981-82 are presented in Table 10(a) and (b) respectively.

Data indicate that height of plant increased gradually at every stage till 120 days after sowing and thereafter it was more or less constant during both the years. The increase was slow in initial stages upto 30 days after sowing, very fast during 30 to 90 days after sowing and relatively very slow thereafter in both the years. Significant differences

Table 9: Mean number of castor plants variety J-1 per net plot at emergence and at harvest

Treatments	1980-81		1981-82	
	At emer- gence	At har- vest	At emer- gence	At har- vest
D ₁	25.00	25.00	25.00	25.00
D ₂	25.00	25.00	25.00	25.00
D ₃	24.95	24.90	24.95	24.90
S.E. $\pm$	0.03	0.04	0.03	0.04
C.D. at 5%	N.S.	N.S.	N.S.	N.S.
T ₁	25.00	25.00	25.00	25.00
T ₂	25.00	25.00	25.00	25.00
T ₃	25.00	25.00	25.00	25.00
T ₄	25.00	25.00	25.00	25.00
T ₅	25.00	25.00	25.00	25.00
T ₆	25.00	24.89	25.00	24.89
T ₇	24.89	24.89	24.89	24.89
S.E. $\pm$	0.04	0.06	0.04	0.06
C.D. at 5%	N.S.	N.S.	N.S.	N.S.
(T x D) S.E. $\pm$	0.13	0.10	0.13	0.10
C.D. at 5%	N.S.	N.S.	N.S.	N.S.
General mean	24.98	24.97	24.98	24.97

Table 10(a): Mean height of castor plant Variety J-1 in cm
at different growth stages during 1980-81

Treat- ments	Days after sowing				
	30	60	90	120	135
D ₁	15.07	40.70	78.00	86.70	86.64
D ₂	13.00	33.29	65.66	72.93	72.77
D ₃	7.79	33.21	60.32	63.13	62.99
S.E. $\pm$	0.05	0.05	0.08	0.19	0.07
C.D. at 5%	0.15	0.15	0.24	0.55	0.23
T ₁	11.06	43.27	94.27	102.92	102.73
T ₂	10.94	40.10	89.60	97.50	97.40
T ₃	11.11	33.77	76.67	86.87	87.70
T ₄	12.98	38.00	74.33	80.01	79.79
T ₅	12.88	33.43	55.26	58.66	58.56
T ₆	12.92	34.93	48.82	53.68	53.62
T ₇	11.80	26.63	32.02	40.17	40.14
S.E. $\pm$	0.08	0.08	0.13	0.30	0.35
C.D. at 5%	0.23	0.23	0.36	0.84	0.99
S.E. $\pm$ (T x D)	0.14	0.14	0.22	0.51	0.60
C.D. at 5%	0.39	0.39	0.62	1.46	1.73
General Mean	11.95	39.73	67.99	74.45	74.13

Table 10(b): Mean height of castor plant variety J-1 in cm
at different growth stages during 1981-82

Treatments	Days after sowing				
	30	60	90	120	135
D ₁	10.82	39.77	82.30	92.65	92.29
D ₂	8.66	32.67	71.37	78.21	78.11
D ₃	7.47	27.79	56.82	62.20	62.10
S.E. $\pm$	0.05	0.13	0.36	0.29	0.30
C.D. at 5%	0.15	0.36	1.02	0.84	0.87
T ₁	10.13	42.30	97.67	108.34	108.20
T ₂	8.80	40.27	94.47	104.47	104.03
T ₃	9.80	31.17	76.63	84.89	84.38
T ₄	7.71	35.20	68.17	75.44	75.27
T ₅	9.67	26.80	58.80	64.24	64.10
T ₆	9.34	31.47	54.92	61.79	61.64
T ₇	7.17	26.67	40.50	44.92	44.87
S.E. $\pm$	0.08	0.19	0.55	0.45	0.47
C.D. at 5%	0.22	0.55	1.56	1.28	1.33
S.E. $\pm$ (D x T)	0.13	0.34	0.95	0.78	0.81
C.D. at 5%	0.38	0.96	2.70	2.22	3.41
General Mean	8.98	33.41	70.16	77.69	77.50

were observed in height due to dates of sowing, treatments and their interactions at all stages during both the years.

Maximum plant height was observed due to sowing on 29th Met. week and was significantly superior over rest of the sowing dates. This was closely followed by 31st Met. week sowing and which in turn was significantly superior over sowing on 33rd Met. week. The above trend was maintained at all stages during both the years except at 60 days after sowing during the second year. At this stage, sowing on 29th Met. week was significantly superior over sowing on 31st Met. week and which in turn was on par with sowing on 33rd Met. week.

Among the treatments sole crop of castor recorded maximum plant height and was significantly superior over rest of the treatments. This was closely followed by the treatment castor + coriander one row crop combination which in turn was significantly superior over rest of the treatments. The above trend was maintained at all stages except at 30 days after sowing during both the years. The above two treatments in succession were closely followed by the treatment castor + coriander two rows intercrop combination which recorded significantly increased plant height over rest of the treatments at all stages except at 30 and 60 days after sowing during both the years.

Interaction effects between D x T were observed significant at 30 days after sowing (Table 11).

Table 11: Mean height of castor(cm) as influenced by interaction D x T at 30 days after sowing.

Treatments	Dates of sowing					
	1980-81			1981-82		
	D ₁	D ₂	D ₃	D ₁	D ₂	D ₃
T ₁	16.30	11.39	5.50	12.00	9.50	8.90
T ₂	16.00	8.07	8.70	9.80	8.10	8.50
T ₃	14.50	10.32	8.52	11.60	9.60	8.20
T ₄	13.70	17.13	8.11	8.62	7.60	7.00
T ₅	16.00	15.30	7.33	10.80	12.00	6.33
T ₆	15.20	14.33	9.24	12.92	6.70	8.40
T ₇	13.80	14.48	7.12	10.00	6.50	5.00
S.E. $\pm$	0.137			0.134		
C.D. at 5%	0.390			0.383		

However, there was no consistency in the trend of treatments during both the years.

At 60 days stage the treatment combination of sowing on 29th Met.week with the sole crop of castor attained significantly increased plant height over rest of the intercropping treatment combinations (Table 12). This treatment combinations was followed by castor + coriander one row crop combination. These two treatment combinations maintained their trend over sowing on 31st Met.week but it was inconsistent over sowing on 33rd Met.week during the the 1st year, but during the second year the earlier trend was maintained over rest of the sowing dates.

Table 12: Mean height of castor(cm) as influenced by interaction D x T at 60 days after sowing.

Treatments	Dates of sowing					
	1980-81			1981-82		
	D ₁	D ₂	D ₃	D ₁	D ₂	D ₃
T ₁	51.60	42.40	35.80	48.40	42.00	36.50
T ₂	45.70	39.20	35.40	47.40	40.60	32.80
T ₃	40.50	33.50	27.20	39.10	30.40	24.00
T ₄	42.10	35.00	35.90	39.99	34.80	30.80
T ₅	37.30	28.00	35.00	34.20	36.60	19.60
T ₆	39.40	29.00	36.40	38.60	29.50	26.30
T ₇	28.30	24.80	26.80	30.70	24.80	24.50
S.E. +	0.135			0.335		
C.D. at 5%	0.393			0.957		

At 90 days after sowing (Table 13) the treatment combination of sowing on 29th Met.week with sole cropping of castor gave significantly higher plant height over rest of the intercropping treatment combinations. This was followed by the treatment of castor + coriander one row crop combination. These two treatments maintained their trend over rest of the sowing dates during both the years. This was followed by the treatment combination of sowing on 31st Met.week with Castor + Coriander two row crop combination which maintained its trend over sowing on 33rd Met.week during the 1st year, while the treatment combination of sowing on 29th Met.week with castor + coriander two rows maintained its trend over rest of sowing dates also during the second year.

Table 13: Mean height of castor(cm) as influenced by interaction D x T at 90 days after sowing.

Treatments	Dates of sowing					
	1980-81			1981-82		
	D ₁	D ₂	D ₃	D ₁	D ₂	D ₃
T ₁	106.80	93.00	83.00	114.50	98.50	80.00
T ₂	98.80	88.00	82.00	109.40	96.50	77.50
T ₃	83.80	77.40	68.80	86.50	79.20	64.20
T ₄	84.20	68.20	70.60	81.50	72.00	51.00
T ₅	67.40	53.80	54.56	73.20	56.60	46.60
T ₆	62.60	44.40	39.46	65.70	52.40	46.66
T ₇	42.40	34.80	33.86	45.30	44.40	31.80
S.E. +	0.217			0.945		
C.D. at 5%	0.622			2.700		

At 120 days after sowing (Table 14) the treatment combination of sowing on 29th Met. week with the sole cropping of castor, castor + coriander one row and castor + coriander two rows crop combinations maintained the significantly superior trend over rest of the treatments and maintained the same trend over rest of the sowing dates during both the years as at 90 days after sowing during the second year.

Table 14: Mean height of castor(cm) as influenced by interaction D x T at 120 days after sowing.

Treatments	Dates of sowing					
	1980-81			1981-82		
	D ₁	D ₂	D ₃	D ₁	D ₂	D ₃
T ₁	118.86	102.40	87.50	129.70	109.40	85.93
T ₂	110.46	96.26	85.76	124.98	105.76	82.66
T ₃	93.86	94.46	72.26	98.26	87.23	68.26
T ₄	92.26	74.23	73.53	92.00	79.46	54.86
T ₅	74.26	55.80	45.90	81.26	62.20	49.26
T ₆	70.00	49.16	41.80	72.13	57.30	55.93
T ₇	47.10	38.23	35.16	50.20	46.13	38.43
S.E. $\pm$	0.511			0.777		
C.D. at 5%	1.460			2.220		

At 135 days after sowing (Table 15) also the same treatment combination of sowing on 29th Met.week with sole

Table 15: Mean height of castor(cm) as influenced by interaction D x T at 135 days (at harvest) after sowing.

Treatments	Dates of sowing					
	1980-81			1981-82		
	D ₁	D ₂	D ₃	D ₁	D ₂	D ₃
T ₁	118.80	102.20	87.20	129.50	109.20	85.90
T ₂	110.40	96.10	85.70	123.80	105.70	82.60
T ₃	93.80	94.30	72.00	97.90	87.10	68.15
T ₄	92.20	73.80	73.33	91.80	79.40	54.60
T ₅	74.20	55.70	45.77	81.00	62.10	49.20
T ₆	70.00	49.10	41.87	72.00	57.10	55.83
T ₇	47.10	38.20	35.13	50.00	46.20	38.40
S.E. $\pm$	0.602			0.807		
C.D. at 5%	1.730			3.406		

cropping of castor, castor + coriander one row and castor + coriander two rows crop combinations maintained the same trend over rest of the sowing dates during both the years as at 120 days after sowing.

4.2.2 Number of leaves :

Data on mean number of leaves per plant collected at various stages of growth during 1980-81 and 1981-82 are presented in Table 16(a) and (b) respectively.

Data revealed that leaf production increased gradually upto 60 days, increased very fast between 60 to 90 days, slowed down till 120 days after sowing and declined thereafter till harvest during both the years.

Significant differences were observed in the number of leaves per plant due to dates of sowing, treatments and their interactions at all stages during both the years.

Maximum number of leaves per plant were produced due to sowing on 29th Met.week and it was significantly superior over rest of the sowing dates. This was closely followed by sowing on 31st Met.week and which in turn was significantly superior over sowing on 33rd Met.week. The above trend was maintained at all stages during both the years except at 30 days after sowing during the second year. At this stage 31st Met.week sowing and 33rd Met.week sowings were at par with each other.

Table 16(a): Mean number of leaves per plant of castor variety J-1 at different growth stages during 1980-81

Treatments	Days after sowing				
	30	60	90	120	135
D ₁	7.31	14.87	35.91	40.13	33.08
D ₂	6.77	13.14	24.39	28.63	23.50
D ₃	5.40	10.40	19.40	20.26	15.97
S.E. $\pm$	0.009	0.031	0.046	0.053	0.134
C.D. at 5%	0.026	0.087	0.132	0.161	0.384
T ₁	6.37	16.13	38.07	45.23	39.87
T ₂	6.20	15.43	37.86	41.87	35.52
T ₃	6.50	14.03	31.07	34.63	28.80
T ₄	6.53	12.83	24.70	27.10	20.10
T ₅	6.73	10.07	18.93	20.73	14.97
T ₆	6.60	12.87	21.47	23.13	19.17
T ₇	6.53	8.27	13.80	14.80	11.07
S.E. $\pm$	0.014	0.047	0.071	0.081	0.205
C.D. at 5%	0.041	0.133	0.202	0.231	0.588
S.E. $\pm$ (D x T)	0.025	0.081	0.122	0.140	0.356
C.D. at 5%	0.070	0.231	0.349	0.401	1.016
General Mean	6.49	12.80	26.57	29.67	24.18

Table 16(b): Mean number of leaves per plant of castor variety J-1 at different growth stages during 1981-82

Treatments	Days after sowing				
	30	60	90	120	135
D ₁	6.91	14.56	34.36	38.37	31.34
D ₂	5.60	12.51	26.51	29.96	23.56
D ₃	5.70	10.17	20.95	21.74	16.16
S.E. $\pm$	0.034	0.018	0.046	0.034	0.023
C.D. at 5%	0.097	0.038	0.132	0.098	0.066
T ₁	6.07	15.67	40.20	44.53	37.30
T ₂	6.27	15.33	37.78	41.43	33.90
T ₃	6.33	13.47	31.10	34.17	28.37
T ₄	6.37	12.47	25.07	27.83	21.13
T ₅	5.73	9.65	20.07	22.23	15.13
T ₆	6.20	12.18	21.60	23.53	18.47
T ₇	5.53	8.13	15.17	16.43	11.50
S.E. $\pm$	0.052	0.020	0.071	0.006	0.035
C.D. at 5%	0.148	0.058	0.202	0.015	0.101
S.E. $\pm$ (D x T)	0.090	0.035	0.122	0.091	0.061
C.D. at 5%	0.267	0.100	0.349	0.260	0.174
General Mean	6.07	12.41	27.28	30.02	23.69

Sole crop of castor produced maximum number of leaves per plant and was significantly superior over rest of the treatments at all stages except at 30th days. This was followed by the treatment castor + coriander one row crop combination which was significantly superior over rest of the treatments except the above treatment i.e. sole crop of castor at all stages except at 30th day. This was again followed by the treatment castor + coriander two rows which was significantly superior over rest of the treatments excepting the above two. This trend between the above three treatments, was maintained at all stages except at 30th days after sowing during both the years.

Interaction effects between D x T were observed significant at 30 days after sowing. However, there was no consistency in the trend of treatments during both the years.

Table 17: Mean number of functional leaves/plant as influenced by interaction D x T at 30 days after sowing.

Treatments	Dates of sowing					
	1980-81			1981-82		
	D ₁	D ₂	D ₃	D ₁	D ₂	D ₃
T ₁	7.70	6.80	4.60	6.80	6.00	5.40
T ₂	7.40	5.60	5.60	6.60	5.60	6.60
T ₃	7.30	6.50	5.60	7.40	6.20	5.40
T ₄	6.80	7.40	5.40	6.20	6.40	6.50
T ₅	7.60	7.40	5.20	7.20	5.80	4.20
T ₆	6.80	7.20	5.80	7.40	4.80	6.40
T ₇	7.60	6.40	5.60	6.80	4.40	5.40
S.E. $\pm$	0.025			0.089		
C.D. at 5%	0.070			0.257		

At 60 days after sowing the treatment combination (Table 18) of sowing on 29th Met.week with sole cropping of castor followed by castor + coriander one row and castor + coriander two rows attained the maximum number of leaves per plant and this trend was maintained significantly in the same order of sequences over rest of the sowing dates during the 1st year. While only the 1st two treatment combination maintained the same order of sequence as above, and the same trend was seen over rest of the sowing dates during the second year.

Table 18: Mean number of functional leaves/plant as influenced by interaction D x T at 60 days after sowing.

Treatments	Dates of sowing					
	1980-81			1981-82		
	D ₁	D ₂	D ₃	D ₁	D ₂	D ₃
T ₁	18.60	16.80	13.00	18.40	15.80	12.80
T ₂	18.40	15.80	12.40	17.80	15.60	12.60
T ₃	15.90	15.20	11.60	13.40	14.80	12.20
T ₄	14.30	14.60	9.60	14.40	13.20	9.80
T ₅	11.40	10.40	8.40	11.00	9.75	8.20
T ₆	15.40	11.40	10.80	16.60	10.72	9.20
T ₇	10.00	7.80	7.00	10.30	7.70	6.40
S.E. $\pm$	0.081			0.035		
C.D. at 5%	0.231			0.100		

The order of sequence between these three above treatments as in the 1st year existed over sowing on 31st Met.week and was maintained over 33rd Met.week during the second year.

At 90 days after sowing (Table 19) the treatment combinations of sowing on 29th Met.week with sole cropping of castor was significantly superior over rest of the treatments.

Table 19: Mean number of functional leaves/plant as influenced by interaction D x T at 90 days after sowing.

Treatments	Dates of sowing					
	1980-81			1981-82		
	D ₁	D ₂	D ₃	D ₁	D ₂	D ₃
T ₁	52.80	32.60	29.40	52.00	40.60	28.00
T ₂	50.00	35.80	28.00	48.60	38.00	26.75
T ₃	39.40	32.00	21.80	36.20	34.90	22.50
T ₄	34.80	22.90	16.40	32.60	21.80	20.80
T ₅	26.00	16.80	14.00	23.30	17.70	19.20
T ₆	30.00	18.80	15.60	27.80	19.60	17.40
T ₇	18.40	12.40	10.60	22.00	13.50	12.00
S.E. $\pm$	0.122			0.122		
C.D. at 5%	0.349			0.349		

This was closely followed by the treatment castor + coriander one row which again was significantly superior over rest of the treatments and this was again followed by the treatment combinations of castor + coriander two rows. These three treatments maintained their trend over sowing on 33rd Met.week during the 1st year and over rest of the dates during the 2nd year. At 31st Met.week during 1st year the place of castor + coriander one row was significantly elevated over rest of the treatments and this was followed by the treatment of castor + pigeonpea one row and was at par with sole crop of castor and significantly superior over rest of the treatment combinations.

At 120 days and 135 days after sowing the treatment combinations of sowing on 29th Met. week with sole crop of castor gave (Table 20 and 21) significantly more number of leaves per plant over rest of the treatment and this was followed by the treatment combination of castor + coriander one row and castor + coriander 2 rows which were independently significantly superior over rest of the treatments. This trend was maintained over rest of the sowing dates during both the years.

Table 20: Mean number of functional leaves/plant as influenced by interaction D x T at 120 days after sowing.

Treatments	Dates of sowing					
	1980-81			1981-82		
	D ₁	D ₂	D ₃	D ₁	D ₂	D ₃
T ₁	60.60	44.70	31.00	58.10	46.10	29.40
T ₂	56.00	40.90	28.70	53.80	42.60	27.90
T ₃	45.15	36.60	22.80	40.50	38.60	23.40
T ₄	38.40	25.70	17.20	36.60	25.30	21.60
T ₅	28.80	18.20	15.20	26.60	20.40	19.70
T ₆	32.70	20.70	16.00	30.80	21.90	17.90
T ₇	19.90	13.60	10.90	22.35	14.80	12.30
S.E. $\pm$	0.140			0.091		
C.D. at 5%	0.401			0.260		

Table 21: Mean number of functional leaves/plant as influenced by interaction D x T at 135 days after sowing.

T ₁	53.40	39.60	26.60	50.60	38.60	22.70
T ₂	48.70	35.10	24.20	46.40	35.00	20.30
T ₃	37.40	32.80	16.20	33.80	32.50	18.80
T ₄	30.10	17.70	12.50	28.50	17.60	17.30
T ₅	20.80	13.40	10.70	18.60	13.90	12.90
T ₆	27.30	15.70	13.30	24.60	17.70	13.10
T ₇	15.10	9.90	8.20	16.80	9.60	8.60
S.E. $\pm$	0.356			0.061		
C.D. at 5%	1.016			0.174		

4.2.3 Leaf area :

Data on leaf area per plant in square decimeters at various growth stages during 1980-81 and 1981-82 are presented in Tables 22 (a) and (b) respectively.

Data indicate that the leaf area per plant increased progressively upto 90 days after sowing and declined thereafter during both the years.

Statistical analysis of the data have shown significant differences in leaf area per plant due to dates of sowing, treatments and their interaction-s at all stages during both the the years.

Maximum leaf area was attained when sowing was done on 29th Met.week. Which was significantly superior over rest of the sowing dates. Sowing on 31st Met.week followed the above treatment and was significantly superior over sowing on 33rd Met.week. This trend was repeated at all stages except at 30 days after sowing during both the years.

Among the treatments sole crop of castor attained the maximum leaf area and was significantly superior over rest of the treatments. The sequence among the treatments in attainment of significantly higher leaf area was, sole castor crop followed by castor + coriander one row followed by castor + coriander two row followed by castor + pigeonpea one row followed by

Table 22(a) : Mean leaf area in square decimeters per plant of castor variety J-1 at various growth stages during 1980-81

Treatments	Days after sowing				
	30	60	90	120	135
D ₁	5.26	54.30	64.05	37.49	32.44
D ₂	4.84	41.30	39.14	23.74	20.58
D ₃	6.63	27.56	31.84	21.23	18.58
S.E. $\pm$	0.008	0.096	0.072	0.049	0.232
C.D. at 5%	0.022	0.274	0.206	0.139	0.662
T ₁	5.25	62.97	76.29	53.97	48.61
T ₂	5.56	59.00	70.36	48.99	44.09
T ₃	5.37	45.79	51.91	35.55	32.33
T ₄	5.73	39.93	40.08	20.73	14.62
T ₅	5.65	27.57	26.26	10.03	6.57
T ₆	5.88	33.47	31.91	16.42	14.73
T ₇	5.60	19.65	18.23	6.73	6.00
S.E. $\pm$	0.012	0.147	0.110	0.074	0.354
C.D. at 5%	0.033	0.419	0.315	0.213	1.011
S.E. $\pm$ (D x T)	0.020	0.254	0.191	0.129	0.613
C.D. at 5%	0.062	0.726	0.545	0.368	1.752
General Mean	5.58	41.05	45.01	27.49	23.87

Table 22(b): Mean leaf area in square decimeters per plant of castor variety J-1 at various growth stages during 1981-82

Treatments	Days after sowing				
	30	60	90	120	135
D ₁	4.82	50.70	67.37	38.98	33.63
D ₂	4.07	44.63	41.03	25.32	22.18
D ₃	7.67	29.03	34.79	33.95	20.02
S.E. $\pm$	0.036	0.280	0.078	0.026	0.029
C.D. at 5%	0.103	0.801	0.223	0.074	0.082
T ₁	6.52	62.83	85.03	59.01	52.66
T ₂	5.61	58.47	71.20	50.42	45.09
T ₃	6.14	46.56	55.02	38.17	33.56
T ₄	5.72	40.15	40.48	21.66	15.96
T ₅	4.41	30.68	27.76	10.61	6.30
T ₆	5.09	30.82	32.66	17.22	15.60
T ₇	5.13	20.68	21.93	8.83	7.75
S.E. $\pm$	0.055	0.428	0.119	0.040	0.044
C.D. at 5%	0.157	1.224	0.340	0.113	0.125
S.E. $\pm$ (D x T)	0.095	0.742	0.206	0.068	0.076
C.D. at 5%	0.272	2.120	0.589	0.196	0.216
General Mean	5.52	41.45	47.73	29.42	25.28

castor + pigeonpea two rows, castor + sesamum one row and castor + sesamum two rows and this trend was maintained at all stages except at early stage i.e. 30 days after sowing during both the years.

Interaction effects between D x T were observed significant at 30 days after sowing (Table 23). However, there was no consistency in the trend of treatments during both the years.

Table 23: Mean leaf area (dm)² as influenced by interaction D x T at 30 days after sowing.

Treatments	Dates of sowing					
	1980-81			1981-82		
	D ₁	D ₂	D ₃	D ₁	D ₂	D ₃
T ₁	5.90	4.76	5.09	4.93	4.11	10.51
T ₂	5.18	3.70	7.80	4.88	4.26	7.69
T ₃	4.98	4.50	6.62	5.51	4.13	8.78
T ₄	4.92	5.39	6.87	4.11	4.93	8.11
T ₅	5.59	5.50	5.85	4.48	3.99	4.75
T ₆	4.60	5.30	7.73	5.40	3.64	6.23
T ₇	5.65	4.72	6.42	4.40	3.37	7.62
S.E. ±	0.020			0.095		
C.D. at 5%	0.057			0.272		

At 60 days after sowing (Table 24) the treatment combination of sowing on 29th Met. week with sole cropping of castor attained significantly higher leaf area per plant over rest of the treatments. This was followed by the treatment

combination castor + coriander one row crop combination castor + coriander two row crop combination. These two treatment combinations were independently significant over rest of the treatment. This trend was seen over sowing on 33rd Met. week. Whereas, only the first two treatment combinations viz., sole cropping of castor and castor + coriander one row crop combination maintained their trend over 31st Met. week during the 1st year. While all the above three treatment combinations maintained the trend over rest of the sowing dates during the second year.

Atable 24: Mean leaf (dm^2) as influenced by interaction D x T at 60 days after sowing.

Treatments	Dates of sowing					
	1980-81			1981-82		
	D ₁	D ₂	D ₃	D ₁	D ₂	D ₃
T ₁	80.57	66.44	41.89	80.35	67.76	40.37
T ₂	78.93	57.57	40.49	76.85	64.53	34.03
T ₃	60.77	42.50	34.10	55.35	54.39	29.95
T ₄	50.16	44.94	21.70	46.33	45.87	28.23
T ₅	37.11	28.83	16.77	35.98	31.65	24.42
T ₆	43.89	32.64	23.87	35.39	32.14	24.92
T ₇	28.70	16.18	14.08	24.70	16.04	21.29
S.E. $\pm$	0.254			0.742		
C.D. at 5%	0.726			2.120		

At 90 days, 120 days and 135 days after sowing the treatment combination of sowing on 29th Met. weeks (Tables 25, 26 and 27) with the treatment of sole crop of castor attained

significantly higher leaf area over rest of the treatments, thus was followed by the treatment combination of castor + coriander one row and castor + coriander two row crop combinations. The later two treatment combinations were independently significantly superior over rest of the treatments. This trend was maintained over rest of the sowing dates during both the years.

Table: 25: Mean leaf (dm²) as influenced by interaction D x T at 90 days after sowing.

Treatments	Dates of sowing					
	1980-81			1981-82		
	D ₁	D ₂	D ₃	D ₁	D ₂	D ₃
T ₁	112.09	68.40	48.39	133.68	72.70	48.71
T ₂	103.11	61.58	46.40	106.04	65.97	41.60
T ₃	68.44	48.40	39.91	70.23	54.84	39.98
T ₄	57.88	36.91	25.45	54.44	32.81	34.21
T ₅	39.51	19.62	19.65	36.80	19.60	26.86
T ₆	43.71	24.07	27.95	43.10	26.24	28.63
T ₇	23.59	15.00	16.11	27.28	15.00	23.50
S.E. $\pm$	0.191			0.206		
C.D. at 5%	0.545			0.589		

Table 26: Mean leaf(dm²) as influenced by interaction
D x T at 120 days after sowing.

Treatments	Dates of sowing					
	1980-81			1981-82		
	D ₁	D ₂	D ₃	D ₁	D ₂	D ₃
T ₁	75.60	47.28	39.03	86.64	50.09	40.29
T ₂	68.23	42.69	36.04	73.75	44.51	32.99
T ₃	44.41	33.01	29.22	47.66	38.09	28.75
T ₄	28.60	18.04	15.53	24.83	16.43	23.71
T ₅	14.99	7.78	7.31	12.60	7.42	11.80
T ₆	21.70	11.89	15.67	17.43	14.15	20.08
T ₇	8.86	5.52	5.81	9.91	6.057	10.00
S.E. $\pm$	0.129			0.068		
C.D. at 5%	0.368			0.196		

Table 27: Mean leaf(dm²) as influenced by interaction
D x T at 135 days after sowing.

T ₁	68.04	42.54	35.24	76.59	45.03	36.36
T ₂	61.48	38.47	32.31	66.44	40.00	28.82
T ₃	40.80	30.01	26.17	42.91	34.29	23.46
T ₄	20.07	12.27	11.52	17.28	11.99	18.61
T ₅	9.22	5.00	5.49	7.44	5.23	6.22
T ₆	19.51	10.63	14.03	15.72	12.68	18.39
T ₇	7.93	5.10	5.27	9.02	6.00	8.24
S.E. $\pm$	0.613			0.076		
C.D. at 5%	1.752			0.216		

4.2.4 Number of branches :

Data on mean number of branches per plant at various growth stages during 1980-81 and 1981-82 are presented in Table 28 (a) and (b) respectively.

Statistical analysis of the data on mean number of branches per plant indicated significant differences between dates of sowing, treatments and their interactions at all stages during both the years.

Sowing on 29th Met.week recorded maximum number of branches per plant and was significantly superior over rest of the sowing dates. This was followed by sowing on 31st Met.week which was significantly superior over sowing on 33rd Met.week. This trend between the dates of sowing was maintained at all stages i.e. 60, 90, 120 and 135 days after sowing during both the years.

Sole crop of castor had put forth maximum number of branches and were significantly superior over rest of the treatments at all stages during both the years except at 60 days after sowing during the second year. The sequence among the treatments in attainment of significantly more number of branches was, sole crop of castor, castor + coriander one row, castor + coriander two rows, castor + pigeonpea one row, castor + pigeonpea two rows, castor + sesamum one row, castor + sesamum two rows. This trend was maintained over 90, 120 and

Table 28(a): Mean number of branches per plant of castor variety J-1 at different growth stages as influenced by various treatments during 1980-81

Treatments	Days after sowing			
	60	90	120	135
D ₁	2.06	5.36	5.79	5.79
D ₂	1.83	4.43	4.69	4.69
D ₃	0.77	2.47	2.71	2.68
S.E. $\pm$	0.021	0.031	0.036	0.048
C.D. at 5%	0.061	0.087	0.103	0.105
T ₁	2.43	5.87	6.33	6.38
T ₂	1.90	5.47	5.90	5.88
T ₃	1.60	4.70	5.00	4.98
T ₄	1.60	4.20	4.43	4.42
T ₅	1.33	3.27	3.50	3.50
T ₆	1.20	2.97	3.27	3.27
T ₇	0.80	2.13	2.33	2.29
S.E. $\pm$	0.032	0.047	0.055	0.056
C.D. at 5%	0.093	0.133	0.157	0.161
S.E. $\pm$ (D x T)	0.065	0.009	0.095	0.097
C.D. at 5%	0.160	0.023	0.272	0.278
General Mean	1.55	4.09	4.39	4.39

Table 28(b): Mean number of branches per plant of castor variety J-1 at different growth stages as influenced by various treatments during 1981-82

Treatments	Days after sowing			
	60	90	120	135
D ₁	2.07	4.86	5.88	5.89
D ₂	1.53	4.07	4.52	4.40
D ₃	1.09	2.90	3.23	3.24
S.E. $\pm$	0.024	0.034	0.029	0.040
C.D. at 5%	0.069	0.096	0.083	0.082
T ₁	2.20	6.03	7.13	7.23
T ₂	2.13	5.43	6.17	6.17
T ₃	1.60	4.53	5.17	5.17
T ₄	1.47	3.60	4.10	4.10
T ₅	1.47	2.83	3.20	3.13
T ₆	1.30	3.27	3.75	3.75
T ₇	0.83	1.90	2.26	2.27
S.E. $\pm$	0.037	0.051	0.044	0.044
C.D. at 5%	0.106	0.147	0.127	0.125
S.E. $\pm$ (D x T)	0.064	0.089	0.077	0.076
C.D. at 5%	0.184	0.254	0.220	2.216
General Mean	1.56	3.94	4.54	4.54

135 days after sowing during both the years. The trend at 60 days after sowing differed slightly during both the years.

At 60 days after sowing the treatment combination of sowing on 29th Met.week with the treatment of sole cropping of castor registered significantly more number of branches per plant over rest of the treatment combinations (Table 29).

Table 29: Mean number of branches per plant as influenced by interaction D x T at 60 days after sowing.

Treatments	Dates of sowing					
	1980-81			1981-82		
	D ₁	D ₂	D ₃	D ₁	D ₂	D ₃
T ₁	3.00	2.80	1.50	2.50	2.60	1.50
T ₂	2.20	2.50	1.00	3.00	2.00	1.40
T ₃	2.00	2.00	0.80	2.00	1.50	1.30
T ₄	2.20	2.00	0.60	2.00	1.39	1.00
T ₅	2.00	1.50	0.50	2.00	1.40	0.80
T ₆	2.00	1.00	0.60	2.00	1.00	0.90
T ₇	1.00	1.00	0.40	1.00	0.80	0.70
S.E. $\pm$	0.056			0.064		
C.D. at 5%	0.160			0.184		

This was followed by the treatment combinations castor + coriander one row and this was again followed by the treatment combination castor + coriander two row crop combinations. These later two treatment combinations were independently significantly superior over rest of the treatments. This trend was maintained

over rest of the sowing dates during the 1st year, but during the second year, the above trend was observed on 31st Met.week and was maintained over sowing on 33rd Met.week without differing significantly, at 29th Met.week Castor + coriander one row replaced the position of sole crop of castor.

At 90 days after sowing the above trend as at 60 days after sowing (Table 30) during 1st year was maintained over rest of the sowing dates during both the years.

Table 30: Mean number of branches per plant as influenced by interaction D x T at 90 days after sowing.

Treatments	Dates of sowing					
	1980-81			1981-82		
	D ₁	D ₂	D ₃	D ₁	D ₂	D ₃
T ₁	7.60	5.80	4.20	7.50	6.20	4.40
T ₂	7.40	5.60	3.40	7.20	5.50	3.60
T ₃	6.40	5.20	2.50	5.60	5.00	3.00
T ₄	5.80	4.60	2.20	4.50	3.50	2.80
T ₅	4.10	4.00	1.70	3.20	3.00	2.30
T ₆	3.80	3.20	1.90	4.00	3.30	2.50
T ₇	2.40	2.60	1.40	2.00	2.00	1.70
S.E. $\pm$	0.009			0.089		
G.D. at 5%	0.023			0.254		

At 120 days after sowing (Table 31) the treatment combination of sowing on 29th Met.week with the treatment of sole cropping of castor recorded maximum number of branches per plant and was at par with the treatment combination

castor + coriander one row and was significantly superior over rest of the treatments. This was again followed by the treatment combination castor + coriander two row crop combinations. This trend was maintained over 31st Met.week during 1st year but at 33rd Met.week of the same year sole crop of castor produced significantly more branches over rest of the treatments and this was followed by the treatment of castor + coriander one row which again was significantly superior over rest of the treatments and was followed by the treatment of castor + coriander two rows. During 1981-82 the same trend as at 33rd Met.week of 1st year was seen over all dates.

Table 31: Mean number of branches per plant as influenced by interaction D x T at 120 days after sowing.

Treatments	Dates of sowing					
	1980-81			1981-82		
	D ₁	D ₂	D ₃	D ₁	D ₂	D ₃
T ₁	8.20	6.20	4.62	9.50	6.90	5.00
T ₂	8.00	6.00	3.70	8.30	6.10	4.10
T ₃	6.80	5.50	2.70	6.60	5.53	3.40
T ₄	6.20	4.62	2.40	5.40	3.90	3.00
T ₅	4.40	4.20	1.90	4.00	3.20	2.40
T ₆	4.30	3.40	2.10	4.75	3.70	2.80
T ₇	2.60	2.84	1.60	2.60	2.30	1.90
S.E. $\pm$	0.095			0.077		
C.D. at 5%	0.272			0.220		

At 135 days after sowing (Table 32) the treatment combination of sowing on 29th Met.week with sole crop of castor, castor + coriander one row and castor + coriander two

row crop combinations recorded significantly more number of branches in the above order over rest of the treatments and maintained the same trend over rest of the dates of sowing during both the years.

Table 32: Mean number of branches per plant as influenced by interaction D x T at 135 days after sowing.

Treatments	Dates of sowing					
	1980-81			1981-82		
	D ₁	D ₂	D ₃	D ₁	D ₂	D ₃
T ₁	8.30	6.27	4.57	9.60	7.00	5.10
T ₂	7.97	6.00	3.67	8.30	6.10	4.10
T ₃	6.80	5.47	2.67	6.60	5.50	3.40
T ₄	6.20	4.70	2.37	5.40	3.90	3.00
T ₅	4.40	4.20	1.90	4.00	3.00	2.40
T ₆	4.30	3.40	2.10	4.75	3.70	2.80
T ₇	2.57	2.80	1.50	2.60	2.30	1.90
S.E. $\pm$	0.097			0.076		
C.D. at 5%	0.278			0.216		

4.2.5 Number of internodes :

Data on mean number of internodes per plant at various growth stages during 1980-81 and 1981-82 are presented in Table 33(a) and (b) respectively.

Data indicated significant differences between dates of sowing, treatments and their interactions at all stages during both the years.

Table 33(a): Mean number of internodes per plant of castor variety J-1 at different growth stages as influenced by various treatments during 1980-81

Treatments	Days after sowing				
	30	60	90	120	135
D ₁	5.03	11.12	18.37	19.90	19.98
D ₂	4.99	10.83	18.62	18.73	18.90
D ₃	3.83	10.51	16.17	17.29	17.50
S.E. $\pm$	0.073	0.075	0.072	0.058	0.030
C.D. at 5%	0.208	0.216	0.206	0.165	0.090
T ₁	4.27	12.70	19.23	22.30	22.36
T ₂	4.53	12.30	19.30	21.79	21.95
T ₃	4.43	11.76	18.37	20.33	20.33
T ₄	4.57	11.23	17.73	18.33	18.37
T ₅	4.74	9.80	16.20	16.97	17.33
T ₆	4.83	9.77	15.53	16.63	17.07
T ₇	4.89	8.20	13.17	14.03	14.13
S.E. $\pm$	0.111	0.115	0.110	0.088	0.050
C.D. at 5%	0.318	0.329	0.314	0.262	0.130
S.E. $\pm$ (D x T)	0.193	0.200	0.190	0.153	0.080
C.D. at 5%	0.551	0.570	0.544	0.436	0.230
General Mean	4.61	10.84	17.08	18.64	18.79

Table 33(b): Mean number of internodes per plant of castor variety J-1 at different growth stages as influenced by various treatments during 1981-82

Treatments	Days after sowing				
	30	60	90	120	135
D ₁	4.99	11.49	18.20	20.19	20.33
D ₂	4.61	11.03	17.12	19.04	19.14
D ₃	3.97	10.10	17.09	17.33	17.42
S.E. $\pm$	0.020	0.032	0.040	0.080	0.120
C.D. at 5%	0.057	0.091	0.115	0.230	0.340
T ₁	4.67	12.53	19.87	22.57	22.67
T ₂	4.33	12.40	19.55	21.93	22.00
T ₃	4.60	11.20	18.88	20.47	20.63
T ₄	4.23	11.53	18.07	18.64	18.71
T ₅	4.70	10.07	15.43	16.53	16.60
T ₆	4.13	10.27	17.17	17.23	17.33
T ₇	5.00	8.10	13.33	14.60	14.79
S.E. $\pm$	0.030	0.049	0.061	0.120	0.180
C.D. at 5%	0.087	0.140	0.175	0.350	0.520
S.E. $\pm$ (D x T)	0.053	0.085	0.106	0.210	0.316
C.D. at 5%	0.150	0.242	0.303	0.610	0.902
General Mean	4.43	10.87	17.47	18.85	18.96

Significantly higher number of internodes were recorded due to sowing on 29th Met.week over rest of the sowing dates at all stages during both the years except at 30 days after sowing during first year. This was closely followed by the sowing on 31st met.week which in turn was significantly superior over sowing on 33rd Met.week at all stages during both the years except at 90 days after sowing during the second year where at it was on par with sowing on 33rd Met.week.

Significantly higher number of internodes over rest of the treatments were registered by the treatment of sole cropping of castor at 60, 120 and 135 days after sowing during the 1st year and at 90, 120 and 125 days after sowing during the second year. It was on par with the treatment castor + coriander one row at 90 days after sowing during the 1st year and at 60 days after sowing during the second year. Although there were significant differences among treatments at 30 days after sowing during both the years the trend was not continued till next stage. Treatment castor + coriander one row crop combination followed by the treatment of sole cropping of castor and was significantly superior over rest of the treatments at all stages except at 30 days after sowing during both the years. This treatment was again followed by the treatment castor + coriander two row crop combination at all stages except at 30 days after sowing during both the years and at 60 days after sowing during the second year. Castor + pigeonpea one row crop combination replaced the above treatment i.e.

castor + coriander two row crop combination at 60 days after sowing during the second year and was significantly superior over rest of the treatments.

Interaction effects between D x T were observed significant at 30 days after sowing (Table 34). However, there was no consistency in the trend of treatments during both the years.

Table 34: Mean number of internodes per plant as influenced by interaction D x T at 30 days after sowing.

Treatments	Dates of sowing					
	1980-81			1981-82		
	D ₁	D ₂	D ₃	D ₁	D ₂	D ₃
T ₁	4.20	5.30	3.30	5.40	4.80	3.80
T ₂	5.60	5.20	2.80	5.20	4.40	3.40
T ₃	5.30	4.80	2.20	5.80	4.60	3.40
T ₄	5.10	5.00	3.60	5.70	3.40	3.60
T ₅	4.53	4.60	5.00	3.40	5.50	5.20
T ₆	5.67	4.40	4.40	4.60	4.20	3.60
T ₇	4.60	5.60	4.47	4.80	5.40	4.80
S.E. $\pm$	0.193			0.053		
C.D. at 5%	0.551			0.150		

At 60 days after sowing treatment combination of sowing on 29th Met. week with the treatments sole cropping of castor, castor + coriander one row and castor + coriander two rows registered maximum number of internodes and were at par

with each other and significantly superior over rest of the treatments (Table 35). During the 1st year and only the first two treatment combinations maintained their trend during the second year. The treatment combination of sowing on 31st Met. week with sole crop of castor and castor + coriander one row maintained their superiority over rest of the treatments and this trend was seen over 33rd Met. week during both the years.

Table 35: Mean number of internodes per plant as influenced by interaction D x T at 60 days after sowing.

Treatments	Dates of sowing					
	1980-81			1981-82		
	D ₁	D ₂	D ₃	D ₁	D ₂	D ₃
T ₁	13.20	12.60	12.30	13.60	12.20	11.80
T ₂	12.67	12.20	12.00	13.60	12.00	11.60
T ₃	12.70	11.10	11.47	13.20	10.40	10.00
T ₄	12.00	10.80	10.90	12.60	11.40	10.60
T ₅	10.30	9.70	9.40	10.60	10.60	9.00
T ₆	9.20	10.40	9.70	9.00	11.80	10.00
T ₇	7.80	9.00	7.80	7.80	8.80	7.70
S.E. +	0.200			0.085		
C.D. at 5%	0.570			0.242		

At 90 days, 120 days and 135 days after sowing (Table 36, 37 and 38) the treatment combinations of sowing on 29th Met. week with sole crop of castor, castor + coriander one row and castor + coriander two rows registered maximum number of internodes as compared to rest of the treatment in the above order and maintained the same sequence over rest of the sowing

dates during both the years.

Table 36: Mean number of internodes per plant as influenced by interaction D x T at 90 days after sowing.

Treatments	Dates of sowing					
	1980-81			1981-82		
	D ₁	D ₂	D ₃	D ₁	D ₂	D ₃
T ₁	20.40	18.80	18.50	20.60	19.60	19.40
T ₂	20.53	19.20	18.20	20.20	19.25	19.20
T ₃	19.60	18.47	17.00	19.80	18.60	18.25
T ₄	18.80	17.10	17.30	18.59	17.20	18.40
T ₅	17.20	14.90	16.50	16.00	15.52	14.80
T ₆	17.20	15.50	13.90	17.50	16.70	17.20
T ₇	14.90	12.80	11.80	14.60	13.00	12.40
S.E. $\pm$	0.190			0.106		
C.D. at 5%	0.544			0.303		

Table 37: Mean number of internodes per plant as influenced by interaction D x T at 120 days after sowing.

T ₁	24.30	23.20	19.40	24.80	23.00	19.90
T ₂	23.36	22.80	19.20	24.20	22.00	19.60
T ₃	21.20	21.00	18.80	22.70	20.40	18.30
T ₄	19.00	18.00	18.00	18.70	18.00	19.23
T ₅	18.00	15.80	17.10	17.00	17.30	15.30
T ₆	17.70	16.40	15.80	18.10	17.60	12.67
T ₇	15.50	13.90	12.70	15.80	15.60	13.00
S.E. $\pm$	0.153			0.210		
C.D. at 5%	0.436			0.610		

Table 38: Mean number of internodes per plant as influenced by interaction D x T at 135 days after sowing.

Treatments	Dates of sowing					
	1980-81			1981-82		
	D ₁	D ₂	D ₃	D ₁	D ₂	D ₃
T ₁	24.44	23.20	19.45	24.90	23.10	20.00
T ₂	23.80	22.80	19.25	24.30	22.00	19.70
T ₃	21.20	21.00	18.80	22.80	20.50	18.60
T ₄	19.00	18.00	18.10	18.80	18.10	19.23
T ₅	18.00	16.80	17.20	17.10	17.40	15.30
T ₆	17.80	16.50	16.90	18.20	17.70	16.10
T ₇	15.60	14.00	12.80	16.23	15.16	13.00
S.E. $\pm$	0.080			0.316		
C.D. at 5%	0.230			0.902		

4.2.6 Length of petiole :

Data on mean petiole length of castor at various growth stages during 1980-81 and 1981-82 are presented in Table 39 (a) and (b) respectively.

Data revealed significant differences between dates of sowing, treatments and their interactions at all stages during both the years.

Sowing on 29th Met.week recorded significantly higher petiole length over rest of the sowing dates and this was followed by sowing on 33rd Met.week and it was followed by 31st Met.week sowing at 30 days after sowing during both the

Table 39(a): Length of petiole of castor variety J-1 in cm at different growth stages as influenced by various treatments during 1980-81

Treatments	Days after sowing				
	30	60	90	120	135
D ₁	5.79	8.23	9.40	10.00	9.83
D ₂	4.71	6.71	7.49	7.94	7.77
D ₃	4.79	6.40	6.84	7.37	7.21
S.E. $\pm$	0.022	0.023	0.023	0.020	0.020
C.D. at 5%	0.063	0.066	0.066	0.060	0.060
T ₁	5.27	8.60	9.80	10.53	10.33
T ₂	4.90	7.70	8.67	9.40	9.17
T ₃	4.93	7.23	7.87	8.40	8.23
T ₄	5.27	7.17	7.70	8.50	8.33
T ₅	5.00	6.40	7.63	7.80	7.50
T ₆	5.10	6.60	7.27	7.70	7.60
T ₇	5.20	6.10	7.50	6.73	6.53
S.E. $\pm$	0.034	0.035	0.035	0.034	0.030
C.D. at 5%	0.096	0.101	0.101	0.100	0.090
S.E. $\pm$ (D x T)	0.058	0.061	0.061	0.058	0.068
C.D. at 5%	0.167	0.175	0.175	0.167	0.164
General Mean	5.10	7.11	7.96	8.44	8.27

Table 39(b): Length of petiole of castor variety J-1 in cm
at different growth stages as influenced by
various treatments during 1981-82

Treatments	Days after sowing				
	30	60	90	120	135
D ₁	5.41	7.87	8.60	8.85	8.60
D ₂	4.84	6.99	7.57	7.97	7.81
D ₃	5.33	6.64	7.14	7.31	7.16
S.E. $\pm$	0.022	0.022	0.034	0.020	0.022
C.D. at 5%	0.063	0.052	0.098	0.058	0.062
T ₁	5.97	9.16	9.98	10.50	10.07
T ₂	5.80	8.40	9.13	9.50	9.30
T ₃	5.20	6.33	6.90	7.20	7.07
T ₄	4.93	7.27	7.93	8.18	8.07
T ₅	5.03	6.37	6.77	6.87	6.65
T ₆	5.80	6.87	7.47	7.77	7.67
T ₇	4.63	5.80	6.13	6.30	6.20
S.E. $\pm$	0.034	0.033	0.052	0.031	0.049
C.D. at 5%	0.097	0.095	0.149	0.089	0.094
S.E. $\pm$ (D x T)	0.059	0.057	0.090	0.054	0.057
C.D. at 5%	0.168	0.164	0.258	0.155	0.163
General Mean	5.19	7.17	7.10	8.05	7.86

years. At rest of the stages sowing on 29th Met.week was followed by 31st Met.week during both the years.

Among the treatments sole cropping of castor gave significantly higher petiole length as compared to the rest of the treatments and this was followed by the treatment castor + coriander one row crop combination and was significantly superior over the rest of the treatments over all stages, except at 30 days after sowing during both the years and also at 90 days after sowing during second year. This treatment was closely followed by castor + coriander two rows crop combination at 60 and 90 days during the first year, while castor + pigeonpea one row crop combination replaced it at 120 and 135 days after sowing during 1st year and at 60, 90 , 120 and 135 days after sowing during the second year. There was no consistency in treatments at 30 days after sowing during both the years.

Interaction effects between D x T were observed significant at 30 days after sowing (Table 40). However, there was no consistency in the trend of treatments during both the years.

At 60 days and 90 days after sowing the treatment combination of sowing on 29th Met.week with sole cropping of castor recorded significantly higher petiole length over rest of the treatments and was followed by the treatment combination (Table 41 and 42) castor + coriander one row crop combination and was significantly superior over rest of the treatments.

Table 40: Mean length of petiole (cm) as influenced by interaction D x T at 30 days after sowing.

Treatments	Dates of sowing					
	1980-81			1981- 82		
	D ₁	D ₂	D ₃	D ₁	D ₂	D ₃
T ₁	6.70	4.20	4.90	6.80	4.80	6.30
T ₂	6.60	3.80	4.30	6.20	4.50	6.70
T ₃	5.20	4.00	5.60	4.50	3.90	4.20
T ₄	6.40	4.60	4.80	4.20	4.10	6.50
T ₅	4.80	5.50	4.70	4.80	5.60	4.70
T ₆	5.60	5.30	4.80	6.20	6.50	4.70
T ₇	5.60	5.60	4.40	5.20	4.50	4.20
S.E. $\pm$	0.058			0.059		
C.D. at 5%	0.167			0.168		

Table 41: Mean length of petiole(cm) as influenced by interaction D x T at 60 days after sowing.

T ₁	10.40	7.60	7.80	10.47	7.90	9.10
T ₂	9.80	6.80	6.50	9.20	8.80	7.20
T ₃	8.00	6.30	7.40	7.20	5.90	5.90
T ₄	9.00	6.30	6.20	6.80	8.20	6.80
T ₅	6.80	6.70	5.70	6.70	5.80	6.60
T ₆	7.10	6.70	6.00	7.80	6.00	6.80
T ₇	6.47	6.60	5.20	7.00	5.10	5.30
S.E. $\pm$	0.061			0.057		
C.D. at 5%	0.175			0.164		

Table: 42: Mean length of petiole(cm) as influenced by interaction D x T at 90 days after sowing.

Treatments	Dates of sowing					
	1980-81			1981-82		
	D ₁	D ₂	D ₃	D ₁	D ₂	D ₃
T ₁	7.80	8.80	8.80	11.60	9.63	8.70
T ₂	10.90	7.80	7.30	10.10	9.50	7.80
T ₃	8.90	7.10	7.60	7.90	6.40	6.40
T ₄	9.90	7.20	6.00	7.60	8.90	7.30
T ₅	9.50	7.20	6.20	7.20	6.20	6.90
T ₆	7.20	7.30	6.60	8.50	6.60	7.30
T ₇	5.90	7.00	5.40	7.30	5.50	5.60
S.E. $\pm$	0.061			0.090		
C.D. at 5%	0.175			0.258		

This trend was maintained over sowing on 31st Met.week at 60 days during first year, over rest of the sowing dates during the second year. While at 90 days the above trend was maintained over 31st Met.week during the 1st year and over 33rd Met.week during the second year.

At 120 days and 135 days after sowing the treatment combination of sowing on 29th Met.week with sole crop of castor recorded significantly higher petiole length as compared to the rest of the treatment combinations (Table 43 and 44). This was followed by the treatment castor + coriander one row crop combination which in turn recorded significantly higher petiole

Table 43: Mean length of petiole(cm) as influenced by interaction D x T at 120 days after sowing.

Treatments	Dates of sowing					
	1980-81			1981-82		
	D ₁	D ₂	D ₃	D ₁	D ₂	D ₃
T ₁	12.70	9.50	9.40	12.10	10.40	9.00
T ₂	11.70	8.60	7.90	10.50	10.00	8.00
T ₃	9.60	7.70	7.90	8.20	6.80	6.60
T ₄	10.50	7.70	7.30	7.80	9.30	7.45
T ₅	9.80	7.20	6.40	7.25	6.40	6.95
T ₆	8.50	7.70	6.90	8.70	7.10	7.50
T ₇	7.20	7.20	5.80	7.40	5.80	5.70
S.E. $\pm$	0.058			0.054		
C.D. at 5%	0.167			0.155		

Table 44: Mean length of petiole(cm) as influenced by interaction at 135 days after sowing.

T ₁	12.50	9.30	9.20	11.20	10.20	8.80
T ₂	11.50	8.30	7.70	10.30	9.80	7.80
T ₃	9.40	7.60	7.70	8.10	6.60	6.50
T ₄	10.30	7.50	7.20	7.70	9.20	7.30
T ₅	9.60	7.00	6.20	7.00	6.20	6.75
T ₆	8.40	7.60	6.80	8.60	7.00	7.40
T ₇	7.10	7.10	5.70	7.30	5.70	5.60
S.E. $\pm$	0.068			0.057		
C.D. at 5%	0.164			0.163		

length as compared to the rest of the treatment combinations and the same trend of these two treatments was also seen over rest of the sowing dates during both the years.

4.2.7 Number of spikes per plant :

Data on mean number of spikes per plant of castor variety J-1 at various growth stages during 1980-81 and 1981-82 are presented in Table 45.

It is evident from the table that the mean number of spikes borne per plant increased upto 120 days and thereafter it was more or less constant.

Significant differences were observed between dates of sowing, treatments and their interactions at all the stages i.e. 75, 90, 105, 120 and 135 days after sowing during both the years.

Sowing on 29th Met.week recorded significantly more number of spikes per plant as compared to the rest of the sowing dates. This was followed by 31st Met.week sowing which was again significantly superior over 33rd Met.week sowing. This trend was observed at all the stages during both the years.

Maximum number of spikes were recorded by the treatment of sole crop of castor, castor + coriander one row, castor + coriander two row crop combinations at 75 and 90 days after sowing during both the years. At later stages i.e. at 105, 120

Table 45: Mean number of spikes per plant of castor variety J-1 at different growth stages as influenced by various treatments during 1980-81 and 1981-82

Treat- ments.	Days after sowing									
	1980-81					1981-82				
	75	90	105	120	135	75	90	105	120	135
D ₁	0.73	1.36	3.37	4.83	4.84	0.74	1.23	2.99	4.34	4.37
D ₂	0.53	0.99	2.34	3.80	3.82	0.51	0.94	2.27	3.14	3.17
D ₃	0.41	0.73	1.40	2.73	2.79	0.41	0.69	1.59	2.60	2.63
S.E. + C.D. at 5%	0.009 0.026	0.031 0.088	0.029 0.083	0.026 0.075	0.041 0.117	0.013 0.038	0.026 0.041	0.023 0.066	0.028 0.080	0.022 0.065
T ₁	0.73	1.50	3.53	5.33	5.43	0.73	1.47	3.33	5.03	5.20
T ₂	0.72	1.58	3.20	4.67	4.68	0.73	1.43	2.98	4.53	4.53
T ₃	0.73	1.23	2.87	4.20	4.20	0.70	1.23	2.67	3.80	3.80
T ₄	0.50	1.03	2.53	4.10	4.10	0.54	0.80	2.33	3.42	3.47
T ₅	0.43	0.63	1.73	3.23	3.23	0.40	0.63	1.73	2.73	2.73
T ₆	0.40	0.73	1.70	3.43	3.54	0.40	0.60	1.90	2.47	2.47
T ₇	0.37	0.47	1.03	1.53	1.53	0.37	0.50	1.03	1.50	1.53
S.E. + C.D. at 5%	0.014 0.039	0.047 0.135	0.044 0.137	0.040 0.115	0.062 0.178	0.020 0.058	0.022 0.063	0.035 0.100	0.043 0.122	0.035 0.099
S.E. + (D x T)	0.024	0.082	0.076	0.070	0.108	0.035	0.038	0.061	0.074	0.060
C.D. at 5%	0.068	0.233	0.219	0.199	0.308	0.063	0.039	0.064	0.074	0.060
General Mean	0.56	1.01	2.37	3.79	3.82	0.56	0.95	2.28	3.36	3.39

and 135 days after sowing sole crop of castor recorded significantly more number of spike over rest of the treatments and this was followed by castor + coriander one row and castor + coriander two rows which were also independently significant over rest of the treatments during both the years.

At 75 days after sowing the treatment combination of sowing on 29th Met.week with sole cropping of castor, followed by castor + coriander one row and followed by castor + coriander two row crop combinations (Table 46) recorded maximum number of spikes per plant. They were on par with each other and maintained their superiority over rest of the treatments and this trend was seen over rest of the sowing dates during both the years.

Table 46: Mean number of spikes per plant as influenced by interaction D xT at 75 days after sowing.

Treatments	Dates of sowing					
	1980-81			1981-82		
	D ₁	D ₂	D ₃	D ₁	D ₂	D ₃
T ₁	1.00	0.70	0.50	1.00	0.70	0.50
T ₂	0.95	0.70	0.50	1.00	0.70	0.50
T ₃	1.00	0.70	0.50	1.00	0.60	0.50
T ₄	0.60	0.50	0.40	0.67	0.50	0.45
T ₅	0.50	0.40	0.40	0.50	0.40	0.30
T ₆	0.50	0.40	0.30	0.50	0.40	0.30
T ₇	0.50	0.30	0.30	0.50	0.30	0.30
S.E. $\pm$	0.024			0.035		
C.D. at 5%	0.068			0.101		

At 90 and 105 days (Table 47 and 48) after sowing the same treatment combinations as at 75 days dominated the other treatment combination and maintained their trend over rest of the dates of sowing during both the years.

Table:47: Mean number of spikes per plant as influenced by interaction of D x T at 90 days after sowing.

Treatments	Dates of sowing					
	1980-81			1981-82		
	D ₁	D ₂	D ₃	D ₁	D ₂	D ₃
T ₁	2.00	1.50	1.00	2.00	1.50	0.90
T ₂	2.00	1.40	1.33	2.00	1.40	0.90
T ₃	1.70	1.20	0.80	1.70	1.20	0.80
T ₄	1.50	0.90	0.70	0.90	0.80	0.70
T ₅	0.80	0.70	0.40	0.70	0.60	0.60
T ₆	0.90	0.80	0.50	0.70	0.60	0.50
T ₇	0.60	0.40	0.40	0.60	0.50	0.40
S.E. ±	0.082			0.038		
C.D. at 5%	0.233			0.110		

Table 48: Mean number of spikes per plant as influenced by interaction D x T at 105 days after sowing.

T ₁	4.80	3.60	2.20	4.50	3.50	2.00
T ₂	4.40	3.20	2.00	4.00	3.00	1.95
T ₃	4.00	2.90	1.70	3.60	2.60	1.80
T ₄	3.60	2.60	1.40	3.00	2.21	1.80
T ₅	3.00	1.40	0.80	1.80	1.90	1.50
T ₆	2.30	1.80	1.00	2.60	1.70	1.40
T ₇	1.50	0.90	0.70	1.40	0.99	0.70
S.E. ±	0.076			0.061		
C.D. at 5%	0.219			0.174		

At 120 and 135 days (Table 49 and 50) the interaction effects between D x T indicated that the same treatment combinations with the trend that sowing on 29th Met. week with sole cropping of castor recorded significantly more number of spikes per plant over rest of the treatments and this was followed by the treatment combination castor + coriander one row crop combination which again recorded significantly more number of spikes per plant over rest of the treatments and this again followed by the treatment combination castor * coriander two rows crop combination which was also significantly superior over rest of the treatment. This trend was clearly seen over rest of the sowing dates during both the years.

Table 49: Mean number of spikes per plant as influenced by interaction D x T at 120 days after sowing.

Treatments	Dates of sowing					
	1980-81			1981-82		
	D ₁	D ₂	D ₃	D ₁	D ₂	D ₃
T ₁	6.50	5.50	4.00	6.00	5.20	3.90
T ₂	6.00	4.50	3.50	5.40	4.60	3.60
T ₃	5.60	4.00	3.00	5.00	3.40	3.00
T ₄	5.00	4.30	3.00	4.40	3.00	3.00
T ₅	4.30	3.30	2.00	4.00	2.20	2.00
T ₆	4.40	3.40	2.50	3.56	2.00	2.80
T ₇	2.00	2.60	1.00	2.00	1.60	0.90
S.E. $\pm$	0.070			0.074		
C.D. at 5%	0.199			0.211		

Table 50: Mean number of spikes per plant as influenced by interaction D x T at 135 days after sowing.

Treatments	Dates of sowing					
	1980-81			1981-82		
	D ₁	D ₂	D ₃	D ₁	D ₂	D ₃
T ₁	6.60	5.60	4.10	6.20	5.40	4.00
T ₂	6.00	4.57	3.50	5.40	4.60	3.60
T ₃	5.60	4.00	3.00	5.00	3.40	3.00
T ₄	5.00	4.30	3.00	4.40	3.00	3.00
T ₅	4.30	3.30	2.10	4.00	2.20	2.00
T ₆	4.40	3.40	2.83	3.60	2.00	1.80
T ₇	2.00	1.60	1.00	2.00	1.60	1.00
S.E. $\pm$	0.108			0.060		
C.D. at 5%	0.308			0.171		

4.2.8 Mean length of the spikes :

Data pertaining to the mean length of spikes in cm at different growth stages during 1980-81 and 1981-82 are presented in Table 51.

It is evident from the table that the mean length of spikes increased gradually and reached to the maximum at 120 days after sowing.

Significant differences were observed due to the sowing dates, treatments and their interactions at all stages during both the years.

At all the stages and during both the years sowing of 29th Met. week recorded significantly more length of spikes

Table 51: Mean length of spike of castor variety J-1(cm) at different growth stages as influenced by various treatments during 1980-81 and 1981-82

Treatments	Days after sowing											
	1980-81						1981-82					
	75	90	105	120	135		75	90	105	120	135	
D ₁	3.37	7.54	13.34	16.39	16.13		4.11	8.98	13.80	16.33	16.31	
D ₂	2.85	7.17	11.30	14.30	14.16		2.73	7.17	10.75	14.10	13.91	
D ₃	2.03	4.64	7.77	10.84	10.66		2.00	5.06	7.93	10.26	10.13	
S.E.+	0.025	0.032	0.029	0.081	0.022		0.022	0.027	0.038	0.031	0.024	
C.D. at 5%	0.073	0.091	0.084	0.231	0.063		0.063	0.077	0.110	0.088	0.068	
T ₁	3.80	10.23	16.43	20.88	20.57		3.73	10.03	16.37	20.33	20.17	
T ₂	3.37	8.60	14.53	18.57	18.40		3.57	8.90	14.00	17.90	17.73	
T ₃	2.97	7.13	12.63	16.33	16.13		3.03	7.97	12.28	15.73	15.90	
T ₄	2.67	6.13	10.53	13.80	13.60		3.03	7.47	11.57	14.02	13.88	
T ₅	2.27	4.10	6.87	8.47	8.30		2.73	4.47	6.47	7.77	7.67	
T ₆	2.40	5.17	8.93	11.43	11.27		2.63	6.37	9.47	12.00	11.83	
T ₇	1.80	3.80	5.67	7.43	7.27		1.90	4.10	5.63	7.20	7.00	
S.E.+	0.039	0.049	0.045	0.123	0.034		0.034	0.041	0.059	0.058	0.036	
C.D. at 5%	0.111	0.139	0.128	0.352	0.096		0.096	0.118	0.168	0.134	0.104	
S.E.+(D x T)	0.067	0.084	0.077	0.214	0.058		0.058	0.071	0.102	0.081	0.063	
C.D. at 5%	0.192	0.241	0.221	0.611	0.167		0.167	0.204	0.291	0.232	0.180	
General Mean	2.74	6.45	10.80	13.83	13.65		2.90	7.06	10.83	13.57	13.45	

as compared to the rest of the sowing dates. This was followed by 31st Met.week sowing which also was significantly superior over 33rd Met.week sowing.

Among the treatments sole cropping of castor recorded significantly more length of spike as compared to rest of the treatments. This was followed by castor + coriander one row crop combinations, which was significantly superior over rest of the treatments except the above. This was again followed by the treatment castor + coriander two row crop combination which was also significantly superior over rest of the treatment except the above two. This trend was repeated over all the stages during both the years.

Tables 52,53,54,55 and 56 indicated one type of interaction effects due to D x T at 75, 90, 105, 120 and 135 days after sowing during both the years. The treatment combination of sowing on 29th Met.week with sole cropping of castor recorded significantly more length of spike as compared to rest of the treatment combinations. This was followed by the treatment combination castor + coriander one row crop combination and recorded significantly more length of spike as compared to the rest of the treatment combinations. This was again followed by the treatment combination of castor + coriander two row crop combination. This trend was seen over rest of the sowing dates.

Table 52: Mean length of spike(cm) as influenced by interaction D x T at 75 days after sowing.

Treatments	Dates of sowing					
	1980-81			1981-82		
	D ₁	D ₂	D ₃	D ₁	D ₂	D ₃
T ₁	4.60	4.00	2.80	4.50	3.90	2.80
T ₂	4.20	3.40	2.50	4.60	3.50	2.60
T ₃	3.70	3.00	2.20	3.80	3.00	2.30
T ₄	3.00	3.00	2.00	4.40	2.70	2.00
T ₅	2.60	2.50	1.70	4.20	2.30	1.70
T ₆	3.60	2.40	1.80	4.30	2.00	1.60
T ₇	2.50	1.70	1.20	3.00	2.70	1.00
S.E. $\pm$	0.067			0.058		
C.D. at 5%	0.192			0.167		

Table 53: Mean length of spike (cm) as influenced by interaction D x T at 90 days after sowing.

T ₁	12.80	10.50	7.40	12.70	10.40	7.00
T ₂	10.30	9.10	6.40	10.60	9.50	6.60
T ₃	8.10	7.90	5.40	9.50	8.40	6.00
T ₄	6.90	7.70	3.80	9.50	7.40	5.50
T ₅	4.20	5.10	3.00	5.80	4.30	3.30
T ₆	6.00	5.90	3.60	9.60	6.20	3.90
T ₇	4.50	4.00	2.90	5.50	4.00	2.80
S.E. $\pm$	0.084			0.071		
C.D. at 5%	0.241			0.204		

Table 54: Mean length of spike(cm) as influenced by interaction D x T at 105 days after sowing.

Treatments	Dates of sowing					
	1980-81			1981-82		
	D ₁	D ₂	D ₃	D ₁	D ₂	D ₃
T ₁	20.20	16.60	12.50	20.30	16.50	12.30
T ₂	18.50	14.80	10.30	17.80	13.80	10.40
T ₃	16.40	12.30	9.20	15.80	11.45	9.60
T ₄	12.80	11.60	7.20	14.70	11.20	8.80
T ₅	7.30	8.00	5.30	8.20	6.30	4.90
T ₆	10.15	10.20	6.10	12.20	10.20	6.00
T ₇	7.73	5.49	3.80	7.60	5.80	3.50
S.E. $\pm$	0.077			0.102		
C.D. at 5%	0.221			0.291		

Table 55: Mean length of spike(cm) as influenced by interaction D x T at 120 days after sowing.

T ₁	25.33	20.50	16.80	24.00	20.40	16.60
T ₂	22.90	18.50	14.30	22.00	18.40	13.30
T ₃	20.20	16.40	12.40	19.00	16.70	11.50
T ₄	16.60	14.40	10.40	17.50	14.50	10.07
T ₅	8.40	9.80	7.20	9.00	8.00	6.30
T ₆	12.50	13.00	8.80	14.30	13.50	8.20
T ₇	8.80	7.50	6.00	8.50	7.20	5.90
S.E. $\pm$	0.214			0.081		
C.D. at 5%	0.611			0.232		

Table 56: Mean length of spike(cm) as influenced by interaction D x T at 135 days after sowing.

Treatments	Dates of sowing					
	1980-81			1981-82		
	D ₁	D ₂	D ₃	D ₁	D ₂	D ₃
T ₁	24.80	20.30	16.50	23.90	20.20	16.40
T ₂	22.60	18.40	14.20	21.80	18.20	13.20
T ₃	20.00	16.20	12.20	19.80	16.50	11.40
T ₄	16.40	14.20	10.20	17.30	14.30	10.03
T ₅	8.20	9.70	7.00	8.90	7.90	6.20
T ₆	12.30	12.90	8.60	14.20	13.30	8.00
T ₇	8.60	7.40	5.80	8.30	7.00	5.70
S.E. $\pm$	0.058			0.063		
C.D. at 5%	0.167			0.180		

4.2.9 Number of capsules per plant :

Data on mean number of capsules of castor variety J-1 per plant at different growth stages during 1980-81 and 1981-82 are presented in Table 57.

It is clear from the table that the number of capsules per plant increased gradually upto 120 days and thereafter it increased progressively upto 135 days.

Significant differences were observed due to sowing dates, treatments and their interactions at all stages during both the years.

Table 57: Mean number of capsules per plant of castor variety J-1 at different growth stages as influenced by various treatments during 1980-81 and 1981-82

Treat- ments	Days after sowing											
	1980-81						1981-82					
	75	90	105	120	135	150	75	90	105	120	135	150
D ₁	19.84	39.29	54.96	62.57	65.69	68.70	21.86	43.11	61.77	72.03	82.57	
D ₂	13.89	30.50	41.64	53.17	59.32	65.69	18.44	36.27	50.57	61.07	66.73	
D ₃	10.71	18.17	25.74	33.70	37.59	41.64	12.53	20.87	33.81	42.20	45.69	
S.E.+ C.D. at 5%	0.024 0.067	0.035 0.099	0.078 0.223	0.507 1.450	0.392 1.121	0.392 1.121	0.021 0.059	0.023 0.066	0.022 0.063	0.022 0.065	0.021 0.060	
T ₁	23.27	47.90	66.03	78.87	83.28	87.80	29.07	55.70	78.37	94.20	101.77	
T ₂	22.47	41.63	57.83	70.20	75.63	80.15	26.80	50.70	71.40	85.33	94.37	
T ₃	18.33	35.53	49.34	61.60	67.00	71.60	23.20	45.73	63.50	72.57	79.23	
T ₄	14.97	30.97	43.50	53.30	59.63	65.69	16.37	32.12	45.10	61.83	71.73	
T ₅	7.13	16.14	21.33	27.60	31.88	36.15	8.93	16.03	25.97	33.00	37.63	
T ₆	11.43	22.40	31.80	39.53	43.08	47.80	12.20	22.67	34.17	43.37	48.77	
T ₇	6.07	10.67	15.63	17.53	18.90	20.15	6.73	10.97	16.53	19.73	21.57	
S.E.+ C.D. at 5%	0.036 0.103	0.053 0.151	0.119 0.340	0.775 2.295	0.599 1.712	0.599 1.712	0.032 0.090	0.035 0.100	0.034 0.097	0.034 0.096	0.032 0.092	
S.E.+ (D x T)	0.062	0.091	0.206	1.342	1.038	1.038	0.054	0.061	0.059	0.058	0.056	
C.D. at 5%	0.178	0.261	0.590	3.837	2.966	2.966	0.156	0.173	0.168	0.166	0.160	
General Mean	14.81	29.32	40.77	50.05	54.20	58.43	17.61	33.42	48.72	58.43	65.00	

Sowing on 29th Met. week produced significantly more number of capsules per plant as compared to rest of the sowing dates. This was followed by sowing on 31st Met. week which also produced significantly more number of capsules over sowing on 33rd Met. week. This uniform trend was maintained at all stages during both the years.

Significant differences were also observed between treatments. Sole cropping of castor produced significantly more number of capsules per plant over rest of the treatments. Castor + coriander one row crop combination followed the above treatment and was significantly superior over rest of the treatments. This was again followed by the treatment castor + coriander two row crop combination which also recorded significantly more number of capsules over the remaining treatments. This uniform trend in the above three treatments was observed at all stages during both the years.

At 75 days after sowing (Table 58) the treatment combination of sowing on 29th Met. week recorded significantly more number of capsules per plant. Castor + coriander one row crop combination followed the above treatment and recorded significantly more number of capsules per plant as compared to the remaining treatment combinations. This was again followed by the treatment of castor + coriander two row crop combination and which again was significantly superior over the remaining treatment combinations.

Table 58: Mean number of capsules per plant as influenced by interaction D x T at 75 days after sowing.

Treatments	Dates of sowing					
	1980-81			1981-82		
	D ₁	D ₂	D ₃	D ₁	D ₂	D ₃
T ₁	27.70	23.30	18.80	35.70	30.50	31.00
T ₂	31.00	20.20	16.20	33.40	28.60	18.40
T ₃	25.00	17.30	12.70	28.60	25.00	16.00
T ₄	21.50	13.23	10.20	20.50	16.50	12.00
T ₅	10.40	6.20	4.80	10.80	9.00	7.00
T ₆	15.80	10.50	8.00	15.20	12.60	8.80
T ₇	7.50	6.53	4.00	8.80	6.80	4.60
S.E. $\pm$	0.062			0.054		
C.D. at 5%	0.178			0.156		

This trend was seen on rest of the sowing dates during both the years.

At 90, 105, 120 and 135 days after sowing the same trend as at 75 days after sowing was observed during both the years (Tables 59, 60, 61 and 62 respectively).

Table 59: Mean number of capsules per plant as influenced by interaction D x T at 90 days after sowing.

Treatments	Dates of sowing					
	1980-81			1981-82		
	D ₁	D ₂	D ₃	D ₁	D ₂	D ₃
T ₁	59.60	52.40	31.60	68.80	62.30	36.00
T ₂	56.80	45.30	22.80	66.40	56.00	29.70
T ₃	51.20	35.00	20.40	60.80	51.60	24.80
T ₄	41.40	31.60	19.90	42.56	33.20	26.60
T ₅	22.53	16.60	9.30	20.20	16.30	11.60
T ₆	31.40	20.80	15.00	28.80	23.30	15.90
T ₇	12.00	11.80	8.20	14.20	11.20	7.50
S.E. $\pm$	0.091			0.061		
C.D. at 5%	0.261			0.173		

Table 60: Mean number of capsules per plant as influenced by interaction D x T at 105 days after sowing.

T ₁	87.60	71.60	38.90	95.60	85.50	54.00
T ₂	70.70	62.40	31.40	90.40	75.20	48.60
T ₃	69.23	50.50	28.30	80.20	70.30	40.00
T ₄	56.50	42.30	31.70	68.00	50.30	35.00
T ₅	28.30	20.90	14.80	32.70	26.40	18.80
T ₆	43.20	27.80	23.70	43.70	31.00	27.80
T ₇	19.50	16.00	11.40	21.80	15.30	12.50
S.E. $\pm$	0.206			0.059		
C.D. at 5%	0.590			0.168		

Table 61: Mean number of capsules per plant as influenced by interaction D x T at 120 days after sowing.

Treatments	Dates of sowing					
	1980-81			1981-82		
	D ₁	D ₂	D ₃	D ₁	D ₂	D ₃
T ₁	99.20	86.10	51.30	112.60	101.50	68.50
T ₂	86.70	79.00	44.90	106.90	91.30	57.80
T ₃	77.20	69.90	37.70	91.20	79.70	46.80
T ₄	65.50	53.90	40.60	74.60	64.60	46.30
T ₅	33.50	30.10	19.20	38.60	32.80	24.60
T ₆	53.60	35.50	29.50	54.50	38.90	36.70
T ₇	22.30	17.70	12.60	25.80	18.70	14.70
S.E. $\pm$	1.342			0.058		
C.D. at 5%	3.837			0.166		

Table 62: Mean number of capsules per plant as influenced by interaction D x T at 135 days after sowing.

T ₁	102.60	91.53	55.70	125.80	110.50	59.01
T ₂	90.70	86.20	50.00	120.00	97.30	65.80
T ₃	81.00	76.50	43.50	105.00	82.70	50.00
T ₄	68.00	66.50	44.40	87.70	75.00	62.50
T ₅	36.00	36.50	23.15	48.00	36.90	28.00
T ₆	57.13	39.60	32.50	63.00	44.30	39.00
T ₇	24.40	18.40	13.90	28.50	20.40	15.50
S.E. $\pm$	1.038			0.056		
C.D. at 5%	2.966			0.160		

4.3 Dry matter accumulation :

Data on mean dry matter per plant and its parts viz., stem, leaf, petiole and spike recorded in g at various growth stages during 1980-81 and 1981-82 are presented in Tables 63 (a) and (b) and graphically represented in Fig.3 (a) and (b) respectively.

4.3.1 Dry weight of stem :

It is clear from Tables 63(a) and (b) that mean dry weight of stem increased progressively upto 120 days after sowing.

Significant differences were observed in mean dry weight due to dates of sowing, treatments and their interactions at all stages during both the years.

Sowing on 29th Met.week produced significantly more dry weight of stem as compared to rest of the sowing dates. This was followed by sowing on 31st Met.week; it produced significantly more dry weight of stem over 33rd Met.week sowing. This uniform order of trend of sowing dates was observed at all stages during both the years.

Among the treatments sole cropping of castor produced significantly more dry weight of stem as compared to rest of the treatments. This was followed by the treatment castor + coriander one row crop combination which also produced

Table 63(a): Dry matter accumulation of castor variety J-1(g/plant) at different growth stages as influenced by various treatments during 1980-81

Treat- ments	Days after sowing								
	30				60				
	Stem	Leaves	Petiole	Total	Stem	Leaves	Petiole	Spike	Total
D ₁	1.58	1.50	0.36	3.44	8.68	10.32	3.09	2.26	24.36
D ₂	1.26	0.87	0.40	2.53	8.84	9.82	2.65	2.11	22.33
D ₃	0.94	0.76	0.51	2.21	6.32	7.51	2.54	1.54	17.91
S.E.+	0.011	0.006	0.003	0.013	0.029	0.032	0.022	0.006	0.055
C.D. at 5%	0.031	0.016	0.009	0.038	0.084	0.092	0.063	0.018	0.158
T ₁	1.60	1.19	0.63	3.42	9.29	11.02	2.99	2.03	25.34
T ₂	1.31	0.84	0.58	2.73	8.49	10.42	2.95	1.92	23.78
T ₃	1.28	1.20	0.38	2.86	7.82	9.91	2.72	2.03	22.47
T ₄	1.06	0.84	0.35	2.25	7.93	9.22	2.87	1.98	22.01
T ₅	1.17	1.34	0.30	2.81	7.10	8.02	2.73	1.98	19.83
T ₆	1.10	1.05	0.43	2.58	7.58	8.37	2.60	2.03	20.57
T ₇	1.32	0.82	0.28	2.42	5.80	6.63	2.45	1.83	16.72
S.E.+	0.016	0.008	0.005	0.020	0.045	0.047	0.034	0.007	0.084
C.D. at 5%	0.048	0.025	0.014	0.057	0.128	0.140	0.097	0.028	0.241
S.E.(D x T)	0.029	0.015	0.009	0.035	0.078	0.085	0.059	0.017	0.146
C.D. at 5%	0.083	0.044	0.025	0.100	0.221	0.244	0.168	0.048	0.417
General Mean	1.26	1.04	0.42	2.73	7.71	9.08	2.76	1.97	21.53

Contd...

Table 63(a)(Contd.)

Treat- ments	Days after sowing									
	90					120				
	Stem	Leaves	Petiole	Spike	Total	Stem	Leaves	Petiole	Spike	Total
D ₁	20.68	23.46	7.14	27.49	78.76	26.39	26.23	9.15	71.74	133.50
D ₂	16.69	19.56	4.99	17.61	58.87	20.22	22.18	6.73	57.42	106.58
D ₃	13.64	15.72	3.97	14.14	47.49	15.97	17.36	5.13	43.17	81.62
S.E.+	0.028	0.054	0.030	0.007	0.064	0.029	0.023	0.032	0.018	0.054
C.D. at 5%	0.070	0.151	0.085	0.021	0.183	0.082	0.064	0.090	0.052	0.155
T ₁	23.53	27.17	7.27	36.17	94.10	29.42	29.77	9.03	86.00	152.22
T ₂	20.67	24.12	6.68	28.33	79.97	26.20	27.00	8.43	80.18	141.82
T ₃	18.57	22.25	5.80	21.70	68.32	24.42	24.45	7.92	68.23	125.01
T ₄	17.47	19.55	5.42	17.50	59.93	19.17	22.43	7.75	58.40	107.75
T ₅	13.55	14.87	4.25	12.35	45.02	15.78	17.13	5.80	40.43	79.15
T ₆	14.70	16.97	4.75	14.22	50.62	18.52	19.17	5.82	45.82	89.33
T ₇	10.33	12.15	3.42	8.02	33.98	12.58	13.50	4.26	23.03	53.38
S.E.+	0.037	0.081	0.045	0.011	0.098	0.044	0.034	0.048	0.028	0.083
C.D. at 5%	0.107	0.230	0.130	0.032	0.279	0.126	0.098	0.128	0.080	0.237
S.E.+(D x T)	0.065	0.140	0.077	0.019	0.170	0.076	0.060	0.084	0.048	0.144
C.D. at 5%	0.186	0.399	0.226	0.055	0.484	0.218	0.170	0.239	0.138	0.411
General Mean	17.00	19.58	5.37	19.75	61.71	20.86	21.92	7.01	57.44	107.23

Contd....

Table 63(a) Contd.

Treatments	135 Days after sowing			
	Stem	Leaves	Petiole	Spike
D ₁	23.43	24.35	8.21	76.93
D ₂	18.10	11.16	6.04	65.35
D ₃	14.87	16.17	4.39	47.15
S.E. +	0.025	0.020	0.028	0.480
C.D. at 5%	0.071	0.058	0.080	1.380
T ₁	27.32	28.05	8.13	92.16
T ₂	23.65	24.99	7.66	85.91
T ₃	20.00	22.37	6.99	75.37
T ₄	18.89	21.04	6.92	64.41
T ₅	14.33	15.80	5.11	46.43
T ₆	16.70	17.56	5.13	52.73
T ₇	10.72	12.21	3.59	25.03
S.E. +	0.038	0.031	0.043	0.740
C.D. at 5%	0.109	0.089	0.122	2.110
S.E. (D x T)	0.077	0.054	0.074	1.279
C.D. at 5%	0.188	0.153	0.212	3.656
General Mean	18.80	17.22	6.21	63.15
				108.42

1980-81

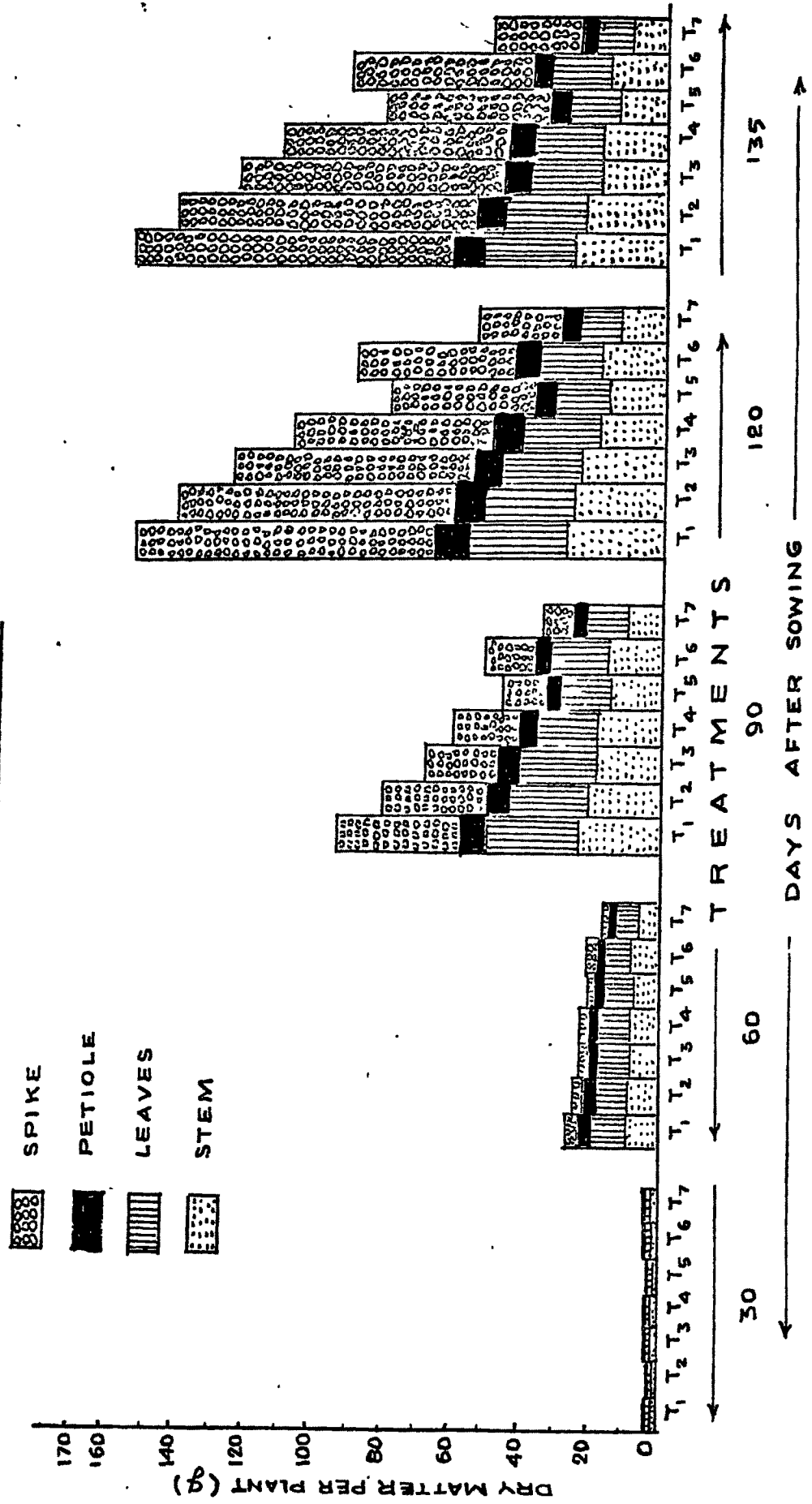


FIG.3(a). DRY MATTER ACCUMULATION IN VARIOUS PLANT PARTS

1981-82

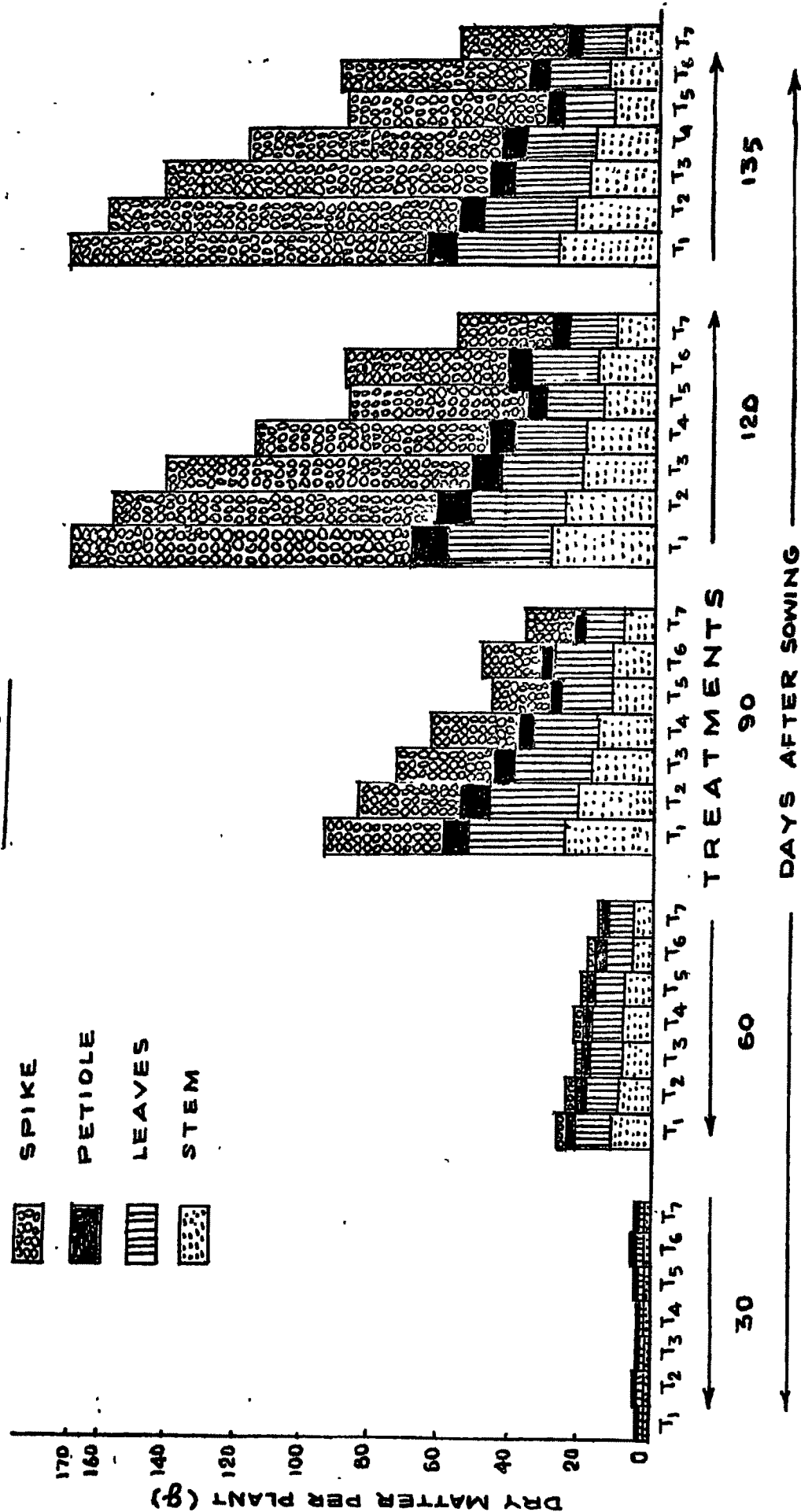


FIG. 3(b). DRY MATTER ACCUMULATION IN VARIOUS PLANT PARTS

Table 63(b) : Dry matter accumulation of castor variety J-1(g/plant) at different growth stages as influenced by various treatments during 1981-82

Treat- ments	135 Days after sowing								
	30								
	60								
	Stem	Leaves	Petiole	Total	Stem	Leaves	Petiole	Spike	Total
D ₁	2.07	2.58	0.63	5.23	10.94	10.86	3.13	1.63	26.55
D ₂	1.78	2.43	0.46	4.67	8.33	9.17	2.76	1.22	21.48
D ₃	1.16	1.74	0.43	3.32	5.82	8.04	2.31	0.72	16.89
S.E.+	0.017	0.015	0.003	0.024	0.018	0.018	0.020	0.014	0.044
C.D. at 5%	0.049	0.044	0.009	0.068	0.052	0.052	0.050	0.041	0.125
T ₁	1.82	1.92	0.61	4.34	12.65	11.16	2.78	0.91	27.57
T ₂	1.75	2.52	0.64	4.91	9.83	10.77	3.10	0.97	24.67
T ₃	1.68	1.86	0.52	4.06	8.35	10.07	2.74	1.10	22.17
T ₄	1.52	2.11	0.53	4.17	8.54	9.71	2.73	1.37	22.34
T ₅	1.63	2.28	0.45	4.36	7.97	8.53	2.79	1.27	20.56
T ₆	1.63	2.66	0.41	4.70	6.00	8.35	2.71	1.23	18.29
T ₇	1.65	2.25	0.39	4.29	5.18	6.93	2.28	1.48	15.88
S.E. +	0.026	0.023	0.005	0.036	0.028	0.027	0.030	0.022	0.067
C.D. at 5%	0.074	0.067	0.014	0.103	0.079	0.078	0.086	0.063	0.191
S.E.+(D x T)	0.045	0.040	0.008	0.063	0.048	0.047	0.052	0.038	0.116
C.D. at 5%	0.128	0.115	0.024	0.179	0.136	0.135	0.149	0.110	0.330
General Mean	1.67	2.23	0.51	4.41	8.36	9.36	2.73	1.19	21.64

Contd....

Table 63(b) Contd.

Treat- ments	Days after sowing									
	90					120				
	Stem	Leaves	Petiole	Spike	Total	Stem	Leaves	Petiole	Spike	Total
D ₁	21.98	24.34	7.25	32.09	85.66	26.55	27.18	8.71	86.49	148.94
D ₂	16.17	20.79	5.76	21.35	64.06	19.98	23.12	7.21	68.49	118.70
D ₃	12.44	15.80	4.08	14.16	46.47	16.32	18.45	5.83	49.60	90.04
S.E.+	0.022	0.050	0.026	0.013	0.052	0.026	0.085	0.026	0.030	0.051
C.D. at 5%	0.063	0.143	0.076	0.038	0.149	0.073	0.244	0.074	0.085	0.145
T ₁	25.64	27.99	7.86	34.90	96.38	30.84	31.47	9.92	100.53	172.77
T ₂	21.91	26.04	7.58	31.07	86.60	26.90	28.95	9.34	94.95	160.13
T ₃	18.68	23.07	6.68	26.19	74.62	22.67	25.43	8.61	87.06	143.78
T ₄	16.79	19.44	5.57	22.58	64.38	21.06	22.32	7.19	67.52	118.09
T ₅	12.70	15.45	3.85	16.13	48.13	15.78	17.75	5.54	51.60	90.28
T ₆	12.73	17.36	4.88	15.57	50.54	17.19	19.79	5.77	48.12	90.88
T ₇	9.60	12.81	3.46	11.27	37.14	12.21	14.69	4.37	27.58	58.87
S.E.+	0.034	0.077	0.040	0.020	0.079	0.039	0.130	0.039	0.046	0.077
C.D. at 5%	0.096	0.220	0.115	0.068	0.227	0.113	0.373	0.113	0.130	0.221
S.E.+(D x T)	0.058	0.133	0.070	0.035	0.138	0.068	0.226	0.068	0.079	0.134
C.D. at 5%	0.167	0.380	0.200	0.100	0.393	0.195	0.646	0.195	0.226	0.383
General Mean	16.86	20.31	5.70	22.53	65.40	20.94	22.92	7.25	68.19	119.23

Contd....

Table 63(b) Contd.

Treatments	135 Days after sowing			
	Stem	Leaves	Petiole	Spike
				Total
D ₁	24.70	25.49	7.57	91.84
D ₂	18.25	21.16	6.48	75.05
D ₃	14.09	16.57	5.05	55.63
S.E. +	0.011	0.042	0.026	0.370
C.D. at 5%	0.032	0.121	0.073	1.060
T ₁	29.04	29.69	8.73	105.60
T ₂	24.95	27.10	8.12	101.42
T ₃	20.52	23.34	7.53	93.51
T ₄	19.01	20.57	6.40	74.07
T ₅	19.86	15.65	4.87	58.11
T ₆	15.21	17.95	5.23	54.82
T ₇	10.43	13.23	3.66	32.14
S.E. +	0.018	0.065	0.039	0.570
C.D. at 5%	0.049	0.185	0.112	1.620
S.E. + (D x T)	0.030	0.112	0.068	0.983
C.D. at 5%	0.084	0.321	0.194	2.809
General Mean	19.01	21.07	6.37	74.17
				120.68

significantly more dry weight of stem as compared to the remaining treatments. This was again followed by the treatment of castor + coriander two row crop combination which in turn produced significantly more dry weight of stem as compared to the remaining treatments. This sequence in order was observed at all stages except at 30 and 60 days after sowing during both the years. At 60 days after sowing the treatment castor + coriander two row crop combination was replaced by castor + pigeonpea one row crop combination which was on par with the said treatment but both were significantly superior over the remaining treatments during both the years. At 30 days after sowing only the 1st treatment maintained its trend during both the years.

At 30 days after sowing (Table 64) the treatment combination of sowing on 29th Met.week with sole crop of castor produced significantly more dry weight of stem as compared to the rest of the treatments. This trend was seen over rest

Table 64: Dry weight of stem(g/plant) as influenced by interaction D x T at 30 days after sowing.

Treatments	Dates of sowing					
	1980-81			1981-82		
	D ₁	D ₂	D ₃	D ₁	D ₂	D ₃
T ₁	1.90	1.75	1.15	2.23	1.95	1.27
T ₂	1.53	1.45	0.95	2.10	2.05	1.10
T ₃	1.43	1.45	0.95	2.27	1.78	1.00
T ₄	1.50	0.87	0.80	2.37	1.20	1.00
T ₅	1.65	0.95	0.90	1.60	1.90	1.40
T ₆	1.56	0.82	0.92	2.00	1.73	1.17
T ₇	1.60	1.55	0.90	1.95	1.85	1.15
S.E.+	0.029			0.045		
C.D. at 5%	0.083			0.128		

of the sowing dates during the 1st year. While during the 2nd year although significant interaction effect was observed between various treatment combinations, but there was no definite trend.

At 60 days after sowing the treatment combination of sowing on 29th Met.week (Table 65) with sole cropping of castor produced significantly more dry weight of stem as compared to rest of the treatment combination. This trend was maintained over rest of the sowing dates during both the years. This treatment combination was followed by castor + coriander one row crop combination during the second year, which produced significantly more dry weight of stem over rest of the treatments and this trend was maintained over rest of the sowing dates.

Table 65: Dry weight of stem(g/plant) as influenced by interaction D x T at 60 days after sowing.

Treatments	Dates of sowing					
	1980-81			1981-82		
	D ₁	D ₂	D ₃	D ₁	D ₂	D ₃
T ₁	10.50	9.80	7.58	14.00	13.48	10.46
T ₂	9.02	9.10	7.35	13.20	9.13	7.14
T ₃	8.30	8.15	7.00	10.45	8.20	6.40
T ₄	8.50	9.15	6.15	12.30	8.18	5.15
T ₅	7.82	7.40	6.08	10.71	8.75	4.45
T ₆	9.35	7.30	6.08	8.90	5.40	3.70
T ₇	7.30	6.11	4.00	6.99	5.95	3.40
S.E. ±	0.078			0.048		
C.D. at 5%	0.221			0.136		

At 90 days after sowing (Table 66) the treatment combination of sowing on 29th Met. week with sole crop of castor produced significantly more dry weight of stem as compared to rest of the treatment combinations. This was followed by the treatment combination castor + coriander one row crop combination which in turn was significantly superior over rest of the treatment combinations. This trend was maintained over 31st Met. week during 1st year and over rest of the sowing dates during the second year.

Table 66: Dry weight of stem (g/plant) as influenced by interaction D x T at 90 days after sowing.

Treatments	Dates of sowing					
	1980-81			1981-82		
	D ₁	D ₂	D ₃	D ₁	D ₂	D ₃
T ₁	30.40	23.50	16.75	32.65	25.10	19.17
T ₂	28.00	20.00	14.50	30.40	20.17	15.17
T ₃	25.70	17.75	12.25	26.80	17.10	12.14
T ₄	18.10	17.80	16.50	21.66	16.20	12.51
T ₅	14.75	12.80	13.10	16.00	13.10	9.00
T ₆	16.30	15.50	12.25	15.56	12.34	10.30
T ₇	11.50	9.40	10.10	10.80	9.20	8.80
S.E. $\pm$	0.065			0.058		
C.D. at 5%	0.186			0.167		

At 120 days after sowing (Table 67) the trend of the 1st two treatment combinations as observed at 90 days after sowing during the second year was observed only during the second year and was also followed by the treatment combination castor + coriander two rows. During the 1st year this trend existed on 31st Met.week and was observed over 33rd Met.week.

Table 67: Dry weight of stem(g/plant) as influenced by interaction D x T at 120 days after sowing.

Treatments	Dates of sowing					
	1980-81			1981-82		
	D ₁	D ₂	D ₃	D ₁	D ₂	D ₃
T ₁	37.75	29.30	21.22	38.11	30.12	24.30
T ₂	34.00	24.90	19.70	35.51	25.00	20.20
T ₃	36.60	20.70	15.95	31.05	21.00	15.95
T ₄	23.70	20.90	12.90	26.27	20.12	16.80
T ₅	17.40	15.10	14.85	20.17	15.17	12.00
T ₆	21.30	19.20	15.05	21.27	16.30	14.00
T ₇	13.95	11.70	12.10	13.60	12.16	10.97
S.E. $\pm$	0.076			0.068		
C.D. at 5%	0.218			0.195		

At 135 days after sowing (Table 68) the above three treatment combinations viz., sole cropping of castor, castor + coriander one row and castor + coriander two rows crop combinations sown on 29th Met.week maintained their independent superiority over the remaining treatment combinations during both the years.

Table 68: Dry weight of stem(g/plant) as influenced by interaction D x T at 135 days after sowing)

Treatments	Dates of sowing					
	1980-81			1981-82		
	D ₁	D ₂	D ₃	D ₁	D ₂	D ₃
T ₁	35.51	27.40	19.06	36.19	28.20	22.64
T ₂	31.50	22.46	17.00	33.15	23.68	18.10
T ₃	28.90	18.02	13.10	29.44	19.08	13.02
T ₄	21.35	18.13	17.20	24.52	18.48	14.02
T ₅	15.63	13.79	13.50	18.10	13.48	10.00
T ₆	19.09	17.70	13.32	19.58	14.07	12.28
T ₇	12.00	9.24	10.92	11.94	10.69	8.67
S.E. ±	0.077			0.030		
C.D. at 5%	0.188			0.084		

This trend was observed over 31st Met.week also. While only sole crop of coriander was significantly superior over rest of the treatment on 33rd Met.week sowing while the other treatments differed in their superiority during 1st year and only the first two treatments were significantly superior over rest of the treatment combination during the second year.

4.3.2 Dry weight of leaves :

Tables 63(a) and (b) indicated that mean dry weight of leaves increased progressively and reached the maximum at 120 days and thereafter declined towards maturity.

Significant differences were observed in mean dry weight

of leaves due to dates of sowing, treatments and their interactions at all stages during both the years.

29th Met.week sowing produced significantly more dry weight of leaves as compared to the rest of sowing dates. This was followed by 31st Met.week producing significantly more dry weight over 33rd Met.week. The above trend was observed at all stages during both the years.

Sole cropping of castor produced significantly more dry weight of leaves over rest of the treatments. This was followed by the treatment of castor + coriander one row crop combination producing significantly more dry weight of leaves over the remaining treatments. This was again followed by the treatment of castor + coriander two row crop combination producing significantly more dry weight of leaves over remaining treatments. This trend was observed at all stages except at 30 days after sowing during both the years.

Interaction effects between D x T were observed significant at 30 days after sowing (Table 69). However, there was no consistency in the trend of treatments during both the years.

Table 69: Dry weight of leaves(g/plant) as influenced by interaction D x T at 30 days after sowing.

Treatments	Dates of sowing					
	1980-81			1981-82		
	D ₁	D ₂	D ₃	D ₁	D ₂	D ₃
T ₁	1.95	0.83	0.80	1.99	1.81	1.95
T ₂	0.98	0.80	0.75	3.00	2.67	1.90
T ₃	1.80	0.82	0.99	2.00	2.57	0.90
T ₄	0.95	0.77	0.80	2.76	2.38	1.19
T ₅	2.00	1.30	0.73	2.00	2.69	2.15
T ₆	1.85	0.75	0.55	3.17	2.91	1.90
T ₇	0.95	0.80	0.73	2.70	1.90	2.16
S.E. $\pm$	0.013			0.040		
C.D. at 5%	0.044			0.115		

At 60, 90, 120 and 135 days after sowing (Tables 70, 71, 72 and 73) the treatment combination of sowing on 29th Met. week with sole cropping of castor produced significantly more dry weight of leaves as compared to the rest of the treatments. This was followed by the treatment combination castor + coriander one row crop combination producing significantly more dry weight of leaves over the remaining treatment combinations. This was again followed by the treatment combination castor + coriander two row crop combination which again produced significantly more dry weight of leaves over the remaining treatment combinations.

Table: 70: Dry weight of leaves(g/plant) as influenced by interaction D x T at 60 days after sowing.

Treatments	Dates of sowing					
	1980-81			1981-82		
	D ₁	D ₂	D ₃	D ₁	D ₂	D ₃
T ₁	12.91	11.65	8.50	12.40	11.40	9.70
T ₂	12.00	11.11	8.15	12.20	11.00	9.10
T ₃	10.74	10.36	8.65	11.70	10.10	8.40
T ₄	11.20	9.35	7.10	12.17	9.05	7.90
T ₅	9.80	8.20	6.05	10.10	7.90	7.60
T ₆	8.50	8.50	8.10	9.44	8.10	7.50
T ₇	7.10	6.80	6.00	8.00	6.70	6.10
S.E. $\pm$	0.085			0.047		
C.D. at 5%	0.244			0.135		

Table 71: Dry weight of leaves(g/plant) as influenced by interaction D x T at 90 days after sowing.

T ₁	34.00	28.35	19.15	35.16	29.30	19.51
T ₂	30.85	24.20	17.30	32.17	27.34	18.61
T ₃	28.50	21.75	16.50	28.10	24.90	16.20
T ₄	23.00	19.10	16.55	23.05	20.00	15.28
T ₅	16.75	14.50	13.35	18.61	14.60	13.15
T ₆	18.60	17.70	15.20	19.20	17.75	15.12
T ₇	13.10	11.36	12.00	14.12	11.60	12.70
S.E. $\pm$	0.140			0.133		
C.D. at 5%	0.399			0.380		

Table 72: Dry weight of leaves(g/plant) as influenced by interaction D x T at 120 days after sowing.

Treatments	Dates of sowing					
	1980-81			1981-82		
	D ₁	D ₂	D ₃	D ₁	D ₂	D ₃
T ₁	37.90	31.20	20.21	39.17	33.10	22.15
T ₂	33.95	27.75	19.31	35.00	30.60	21.24
T ₃	30.85	24.10	18.38	31.17	26.36	18.77
T ₄	26.45	22.60	18.23	26.05	22.80	18.11
T ₅	19.20	17.30	14.90	20.27	16.00	16.98
T ₆	31.10	19.15	17.27	22.25	19.15	17.97
T ₇	14.15	13.15	13.21	16.27	13.80	13.95
S.E. $\pm$	0.060			0.226		
C.D. at 5%	0.170			0.646		

Table 73: Dry weight of leaves(g/plant) as influenced by interaction D x T at 135 days after sowing.

T ₁	36.00	29.42	18.75	37.14	31.18	20.76
T ₂	31.00	25.12	17.86	33.34	28.97	18.99
T ₃	28.06	22.13	16.93	29.00	24.02	17.00
T ₄	25.28	21.12	16.74	24.15	20.63	16.91
T ₅	18.00	15.33	14.08	18.66	14.09	14.19
T ₆	19.35	17.24	16.08	20.57	17.22	16.07
T ₇	12.73	11.16	12.73	15.57	12.05	12.07
S.E. $\pm$	0.054			0.112		
C.D. at 5%	0.153			0.321		

This above trend was also observed over rest of the sowing dates during 1st year while it differed over sowing on 33rd Met. week

during the second year at all the above stages. The third treatment combination i.e. castor + coriander two row crop combination was on par with the succeeding treatment combination i.e. castor + pigeonpea one row at 90, 120 and 135 days during the second year over 33rd Met.week.

4.3.3 Dry weight of petiole :

Tables 63(a) and (b) indicated that mean dry weight of petiole increased progressively and reached maximum at 120 days after sowing and thereafter declined towards maturity.

Significant differences were observed in mean dry weight of petiole due to dates of sowing, treatments and their interaction at all stages during both the years.

Sowing on 29th Met.week produced significantly more dry weight of petiole as compared to rest of sowing dates. This was followed by sowing on 31st Met.week it produced significantly more dry weight of petiole over 33rd Met.week sowings. This trend was observed at all stages during both the years except at 30 days after sowing during the first year.

Though significant differences were observed between treatments at 30 and 60 days after sowing, the treatments differences were inconsistent during both the years. At 90, 120 and 135 days after sowing, sole cropping of castor produced significantly more dry weight of petiole over rest of the treatments. This was followed by the treatment castor + coriander one row crop combination which produced significantly more dry

weight of petiole over the remaining treatments and this treatment was followed by the treatment of castor + coriander two row crop combination, which again produced significantly more dry weight of petiole over the remaining treatments. This trend was observed during both the years with the exception that at 135 days during the second year the treatment castor + coriander two crop combination was on par with the succeeding treatment combination castor + pigeonpea one row crop combination.

Interaction effects between D x T were observed significant at 30 days and 60 days after sowing (Tables 74 and 75). However, there was no consistency in the trend of treatment during both the years.

Table 74: Mean weight of petiole as influenced by interaction D x T at 30 days after sowing.

Treatments	Dates of sowing					
	1980-81			1981-82		
	D ₁	D ₂	D ₃	D ₁	D ₂	D ₃
T ₁	0.60	0.70	0.60	0.77	0.70	0.35
T ₂	0.45	0.71	0.58	0.70	0.60	0.60
T ₃	0.48	0.13	0.55	0.72	0.33	0.50
T ₄	0.25	0.15	0.65	0.60	0.45	0.55
T ₅	0.15	0.30	0.45	0.65	0.30	0.40
T ₆	0.35	0.45	0.50	0.48	0.45	0.30
T ₇	0.24	0.35	0.25	0.52	0.35	0.30
S.E. $\pm$	0.009			0.008		
C.D. at 5%	0.025			0.024		

Table 75: Mean weight of petiole as influenced by interaction D x T at 60 days after sowing.

Treatments	Dates of sowing					
	1980-81			1981-82		
	D ₁	D ₂	D ₃	D ₁	D ₂	D ₃
T ₁	3.37	3.00	2.60	3.35	2.84	2.16
T ₂	3.25	3.10	2.50	3.55	2.54	3.15
T ₃	2.85	2.30	3.00	3.60	2.58	2.05
T ₄	2.90	3.17	2.55	3.27	2.77	2.15
T ₅	3.15	2.70	2.35	3.10	2.96	2.30
T ₆	3.00	1.94	2.80	2.67	3.27	2.20
T ₇	3.10	2.30	1.95	2.40	2.30	2.15
S.E. ±	0.059			0.052		
C.D. at 5%	0.168			0.149		

At 90 days (Table 76) the treatment combination of sowing on 29th Met.week with sole cropping of castor produced significantly more dry weight of petiole as compared to rest of the treatment combination. This was followed by the treatment combination castor + coriander one row crop combination which produced significantly more dry weight of petiole as compared to the remaining treatment combination. This was again followed by the treatment combination castor + coriander two row crop combination which again produced significantly more dry weight of petiole over remaining treatments. This trend was also observed over rest of the dates during the first year. During the second year the above trend was repeated over sowing on 33rd Met.week. At 31st Met.week sowing castor + coriander one

row crop combination replaced the significant position of sole crop of castor and vice-versa.

Table 76: Mean weight of petiole as influenced by interaction D x T at 90 days after sowing.

Treatments	Dates of sowing					
	1980-81			1981-82		
	D ₁	D ₂	D ₃	D ₁	D ₂	D ₃
T ₁	9.70	6.75	5.35	10.90	7.70	4.97
T ₂	9.10	6.25	4.70	10.40	7.85	4.50
T ₃	8.00	5.05	4.35	9.15	6.75	4.15
T ₄	7.20	5.10	3.95	6.40	5.95	4.35
T ₅	5.52	3.80	3.45	4.15	3.60	3.80
T ₆	6.10	4.80	3.35	5.95	5.20	3.50
T ₇	4.40	3.20	2.65	3.80	3.30	3.27
S.E. $\pm$	0.077			0.070		
C.D. at 5%	0.226			0.200		

At 120 and 135 days after sowing (Tables 77 and 78) the treatment combination of sowing on 29th Met. week with sole cropping of castor produced significantly more dry weight of petiole as compared to the rest of the treatment combinations. This was followed by the treatment combination castor + coriander one row crop combination, which produced significantly more dry weight of petiole as compared to the remaining treatment combinations. The above trend was also observed over rest of the sowing dates during both the years.

Table 77: Mean weight of petiole as influenced by interaction D x T at 120 days after sowing.

Treatments	Dates of sowing					
	1980-81			1981-82		
	D ₁	D ₂	D ₃	D ₁	D ₂	D ₃
T ₁	11.90	8.60	6.60	12.60	9.75	7.40
T ₂	11.15	8.15	6.00	11.87	9.15	7.00
T ₃	10.85	7.60	5.30	10.96	8.58	6.30
T ₄	9.93	7.71	5.60	8.14	7.17	6.27
T ₅	7.75	5.10	4.55	6.10	5.57	4.95
T ₆	7.20	5.45	4.30	6.50	5.05	4.77
T ₇	5.25	4.01	3.53	4.71	4.20	4.15
S.E. $\pm$	0.084			0.068		
C.D. at 5%	0.239			0.195		

Table 78: Mean weight of petiole as influenced by interaction D x T at 135 days after sowing.

T ₁	11.00	8.00	5.40	11.15	8.65	6.40
T ₂	10.20	7.72	5.05	10.35	8.20	6.00
T ₃	9.20	7.06	4.70	9.10	8.05	5.43
T ₄	9.10	7.00	4.65	7.13	6.43	5.65
T ₅	7.05	4.22	4.05	5.20	5.07	4.15
T ₆	6.50	5.05	3.85	6.00	5.70	4.00
T ₇	4.45	3.26	3.05	4.04	3.25	3.70
S.E. $\pm$	0.074			0.068		
C.D. at 5%	0.212			0.194		

4.3.4 Dry weight of spike :

Table 63(a) and (b) indicated that mean dry weight of spike including capsule weight increased gradually upto 120 days and progressively thereafter.

Significant differences were observed in mean dry weight of spike due to dates of sowing, treatments and their interactions at all stages during both the years.

Sowing on 29th Met.week produced significantly more dry weight of spike over rest of the sowing dates. This date was followed by 31st Met.week, it produced significantly more dry weight of spike over 33rd Met.week sowing. This trend was observed at all stages i.e. 60, 90, 120 and 135 days after sowing during both the years.

Though significant differences between treatments were observed at 30 days after sowing during both the year their trend was not observed at the succeeding stages. At rest of the stages sole cropping of castor produced significantly more dry weight of spike as compared to the rest of the treatments. This was followed by the treatment of castor + coriander one row crop combination, which produced significantly more dry weight of spike as compared to the rest of the treatments. This trend was observed during both the years.

Interaction effects between D x T were observed significant at 60 days after sowing (Table 79). However, there

Table 79: Dry weight of spike (g/plant) as influenced by interaction D x T at 60 days after sowing.

Treatments	Dates of sowing					
	1980-81			1981-82		
	D ₁	D ₂	D ₃	D ₁	D ₂	D ₃
T ₁	1.95	2.65	1.50	0.99	0.75	1.00
T ₂	2.00	2.00	1.75	1.35	0.95	0.60
T ₃	2.10	2.00	2.00	1.90	1.00	0.40
T ₄	2.20	1.85	1.90	1.75	1.80	0.55
T ₅	1.85	2.10	2.00	2.00	1.10	0.70
T ₆	3.10	1.98	1.00	1.10	1.75	0.85
T ₇	2.65	2.20	0.65	2.30	1.20	0.95
S.E. $\pm$	0.017			0.038		
C.D. at 5%	0.048			0.110		

there was no consistency in the trend of treatments during both the years.

At rest of the stages i.e. 90, 120 and 135 days after sowing (Tables 80, 81 and 82) the treatment combination of 29th Met.week with sole cropping of castor produced significantly more dry weight of spike over rest of the treatment combination. This was followed by the treatment combination of castor + coriander one row which produced significantly more dry weight of spike over the remaining treatment combinations. This was again followed by the treatment combination castor + coriander two row crop combination. This again produced significantly

more dry weight over the remaining treatment combinations.

Table 80: Dry weight of spike(g/plant) as influenced by interaction D x T at 90 days after sowing.

Treatments	Dates of sowing					
	1980-81			1981-82		
	D ₁	D ₂	D ₃	D ₁	D ₂	D ₃
T ₁	49.95	32.90	25.50	45.50	35.10	24.10
T ₂	33.50	28.00	23.50	42.20	29.30	21.70
T ₃	27.15	20.80	17.15	37.40	24.17	17.00
T ₄	25.70	15.30	11.50	33.20	20.85	31.70
T ₅	20.00	8.95	8.10	23.99	15.20	9.19
T ₆	22.45	11.90	8.90	23.40	14.55	8.75
T ₇	13.65	6.05	4.35	18.92	10.25	4.65
S.E. $\pm$	0.019			0.035		
C.D. at 5%	0.055			0.100		

Table 81: Dry weight of spike (g/plant) as influenced by interaction D x T at 120 days after sowing.

T ₁	105.85	85.85	66.30	122.90	105.70	73.00
T ₂	100.70	79.20	60.65	117.90	100.20	66.75
T ₃	87.30	67.90	49.84	110.89	89.30	61.00
T ₄	71.50	71.35	42.35	86.90	53.60	52.05
T ₅	51.60	38.60	31.10	66.70	48.30	39.80
T ₆	55.55	45.20	36.70	63.97	45.50	34.90
T ₇	29.70	23.80	15.60	36.20	26.85	19.70
S.E. $\pm$	0.048			0.079		
C.D. at 5%	0.138			0.226		

Table 82: Dry weight of spike(g/plant) as influenced by interaction D x T at 135 days after harve sowing.

Treatments	Dates of sowing					
	1980-81			1981-82		
	D ₁	D ₂	D ₃	D ₁	D ₂	D ₃
T ₁	109.92	93.47	73.20	128.40	109.00	79.40
T ₂	104.00	88.48	65.25	123.13	107.73	73.40
T ₃	93.08	81.90	51.10	143.72	98.67	67.15
T ₄	79.10	69.07	45.05	96.82	69.37	56.05
T ₅	55.93	45.25	88.10	73.20	55.60	45.53
T ₆	63.68	54.10	40.40	67.80	55.10	41.56
T ₇	32.82	25.20	17.08	38.87	30.60	26.95
S.E. $\pm$	1.279			0.983		
C.D. at 5%	3.656			2.809		

This trend was observed rest of the sowing dates during both the years except at 31st Met. week sowing date at 135 days after sowing during the second year, where the 1st two treatment combinations as mentioned above were on par and rest of the effects were similar.

4.3.5 Total dry matter accumulation :

Data presented in Table 63(a) and (b) revealed that total dry matter per plant of castor variety J-1 increased at every stage except at last stage. The increase was comparatively more between 60 and 120 days after sowing.

Significant differences were observed in total dry matter per plant due to sowing dates, treatments and their interactions at all stages during both the years.

Significantly more total dry matter per plant was produced due to sowing on 29th Met.week as compared to rest of the sowing dates. This was followed by sowing on 31st Met. week which produced significantly more total dry matter per plant over sowing on 33rd Met.week. This uniform trend was observed at all stages during both the years.

The treatment of sole cropping of castor produced significantly more dry matter per plant as compared to rest of the treatments. This was followed by the treatment castor + coriander one row crop combination which produced significantly more dry matter per plant as compared to the remaining treatments. This was again followed by the treatment castor + coriander two row crop combination which produced significantly more dry matter per plant as compared to the still remaining treatments. This trend was maintained at all stages except at 30 days after sowing during both the years. Further, at 60 days, after sowing during the second year the treatment of castor + pigeonpea one row crop combination produced more dry matter over the treatment of castor + coriander two row crop combination, but these two treatments were on par with each other.

At 30 days after sowing (Table 83) although interaction effects were significant during both the years only one treatment combination namely sowing on 29th Met.week with sole crop of castor produced significantly more dry matter per plant over rest of the treatment combinations. This trend was seen on rest of the sowing dates during the first year. During the second year treatment combinations differed over dates in their performance.

Table 83: Dry matter accumulation per plant(g/plant) of castor variety J-1 as influenced by interaction D x T at 30 days after sowing.

Treatments	Dates of sowing					
	1980-81			1981-82		
	D ₁	D ₂	D ₃	D ₁	D ₂	D ₃
T ₁	4.45	3.28	2.55	4.99	4.46	3.57
T ₂	2.96	2.96	2.28	5.79	5.32	3.60
T ₃	3.71	2.40	2.49	4.99	4.78	2.40
T ₄	2.70	1.79	2.25	5.73	4.03	2.74
T ₅	3.80	2.55	2.08	4.26	4.89	3.95
T ₆	3.76	2.02	1.97	5.65	5.09	3.37
T ₇	2.69	2.70	1.88	5.15	4.10	3.61
S.E. $\pm$	0.035			0.063		
C.D. at 5%	0.100			0.179		

At 60 days after sowing (Table 84) the treatment combination of sowing on 29th Met.week with sole crop of castor produced significantly more dry matter per plant over rest of the

treatment combinations. This was followed by the treatment combination of castor + coriander one row crop combination which produced significantly more dry matter per plant as compared to the rest of the treatment combination. This trend was observed over 31st Met.week during the first year and over rest of the sowing dates during the second year.

Table 84: Dry matter accumulation per plant(g/plant) of castor variety J-1 as influenced by interaction D x T at 60 days after sowing.

Treatments	Dates of sowing					
	1980-81			1981-82		
	D ₁	D ₂	D ₃	D ₁	D ₂	D ₃
T ₁	28.73	27.10	20.18	30.74	28.65	23.32
T ₂	26.27	25.31	19.75	30.30	23.67	20.12
T ₃	23.99	22.77	20.65	27.65	21.88	16.98
T ₄	24.80	23.52	17.70	29.49	21.78	15.75
T ₅	23.62	20.40	16.48	25.91	20.71	15.06
T ₆	23.95	19.77	17.98	22.14	18.52	14.25
T ₇	20.15	17.41	12.61	19.72	15.35	12.60
S.E. $\pm$	0.146			0.116		
C.D. at 5%	0.417			0.330		

At 90, 120 and 135 days after sowing (Tables 85, 86 and 87) another treatment combination of castor + coriander two row crop combination followed the first two treatment combinations as at 60 days and produced significantly more dry matter per plant and this trend was seen over rest of the sowing dates during both the years.

Table 85: Dry matter accumulation per plant(g/plant) of castor variety J-1 as influenced by interaction D x T at 90 days after sowing.

Treatments	Dates of sowing					
	1980-81			1981-82		
	D ₁	D ₂	D ₃	D ₁	D ₂	D ₃
T ₁	124.05	91.50	66.87	124.20	97.20	67.75
T ₂	101.45	78.45	60.00	115.17	84.66	59.98
T ₃	89.35	65.35	50.25	101.47	72.92	49.49
T ₄	74.00	57.30	48.50	84.31	63.00	45.84
T ₅	57.00	40.05	38.00	62.75	46.48	35.14
T ₆	62.85	49.30	39.70	64.11	49.85	37.70
T ₇	42.65	30.20	29.10	47.64	34.35	29.42
S.E. $\pm$	0.170			0.138		
C.D. at 5%	0.484			0.393		

Table 86: Dry matter accumulation per plant(g/plant) of castor variety J-1 as influenced by interaction D x t at 120 days after sowing.

T ₁	193.40	154.95	114.33	212.78	178.67	136.85
T ₂	179.80	140.00	105.66	200.26	164.95	115.19
T ₃	165.60	120.30	89.12	184.07	145.24	102.02
T ₄	131.60	112.56	79.08	147.36	133.69	93.23
T ₅	95.95	76.10	65.40	113.22	85.04	72.58
T ₆	105.15	89.51	73.32	113.97	87.00	71.64
T ₇	63.05	52.86	44.44	70.92	57.00	48.77
S.E. $\pm$	0.144			0.134		
C.D. at 5%	0.411			0.383		

Table 87: Dry matter accumulation per plant(g/plant) of castor variety J-1 as influenced by interaction D x T at 135 days after sowing.

Treatments	Dates of sowing					
	1980-81			1981-82		
	D ₁	D ₂	D ₃	D ₁	D ₂	D ₃
T ₁	193.09	158.21	116.31	212.82	176.98	128.46
T ₂	176.82	144.86	105.17	200.00	168.63	116.50
T ₃	159.27	129.20	85.90	182.31	150.06	102.63
T ₄	133.83	115.38	83.70	152.59	115.19	92.64
T ₅	96.56	77.58	69.75	115.30	88.39	74.01
T ₆	108.62	94.15	73.72	113.97	91.33	73.87
T ₇	84.96	48.93	43.85	70.48	56.73	51.50
S.E. $\pm$	0.135			0.088		
C.D. at 5%	0.386			0.252		

4.4 Growth analysis :

4.4.1 Absolute growth rate (AGR)(Plant height):

Mean values of absolute growth rate (AGR) of castor variety J-1 for plant height in cm per day obtained at various growth stages during 1980-81 and 1981-82 are presented in Table 88(a) and (b) respectively.

Data revealed that AGR of plant height was slow during initial stages and was maximum between 60 to 90 days after sowing and slowed down between 90 to 120 days after sowing and practically ceased thereafter. Marked differences of AGR were observed between treatments and dates of sowing. 29th Met.week

Table 88: Mean absolute growth rate(plant height) of castor variety J-1(cm/day)

Treat- ments	Days after sowing				
	0-30	31-60	61-90	91-120	121-135
<u>1980-81</u>					
D ₁	0.5023	0.8543	1.2433	0.2900	- 0.0040
D ₂	0.4333	0.6763	1.0790	0.2423	- 0.0107
D ₃	0.2597	0.8473	0.9037	0.0937	- 0.0093
T ₁	0.3687	1.0737	1.7000	0.2883	- 0.0127
T ₂	0.3640	0.9727	1.6500	0.2633	- 0.0067
T ₃	0.3703	0.7553	1.4300	0.3400	- 0.0113
T ₄	0.4327	0.8340	1.2110	0.1893	- 0.0153
T ₅	0.4293	0.6850	0.7277	0.1133	- 0.0067
T ₆	0.4307	0.7337	0.4630	0.1620	- 0.0040
T ₇	0.3933	0.4943	0.3463	0.1050	- 0.0020
Mean	0.3984	0.7927	1.0753	0.2087	- 0.0080

<u>1981-82</u>					
D ₁	0.3607	0.9650	1.4177	0.3450	- 0.0240
D ₂	0.2867	0.8023	1.2900	0.2280	- 0.0067
D ₃	0.2490	0.6773	0.9677	0.1793	- 0.0067
T ₁	0.3377	1.0723	1.8457	0.3557	- 0.0093
T ₂	0.2933	1.0490	1.8067	0.3333	- 0.0293
T ₃	0.3267	0.7123	1.5153	0.2753	- 0.0340
T ₄	0.2570	0.9163	1.0990	0.2423	- 0.0113
T ₅	0.3223	0.5710	1.0667	0.1813	- 0.0093
T ₆	0.3113	0.7377	0.7817	0.2290	- 0.0100
T ₇	0.2390	0.6500	0.4610	0.1473	- 0.0033
Mean	0.2988	0.8149	1.2251	0.2508	- 0.0124

sowing recorded maximum AGR over 31st Met.week sowing and 31st Met.week recorded maximum AGR over 33rd Met.week sowing at all the stages wherever there was increase in the AGR during both the years. Similarly, treatment of sole cropping of castor recorded maximum AGR over rest of the treatments. This was followed by the treatments of castor + coriander one row, followed by castor + coriander two row crop combination.

4.4.2 Absolute growth rate (Dry matter) :

Mean values of absolute growth rate (AGR) of dry matter per plant of castor variety J-1 in g/day obtained at various growth stages during 1980-81 and 1981-82 are presented in Table 89(a) and (b) respectively.

Data revealed that AGR of dry matter was slow during initial stages and fast between 60 to 120 days, and slow thereafter. Marked differences were observed in AGR due to dates of sowing and treatments. Sowing on 29th Met.week in general produced more AGR as compared to rest of the sowing dates at all stages. This was followed by sowing on 31st Met. week.

Sole cropping of castor produced more AGR over rest of the treatment, this was followed by the treatment of castor + coriander one and castor + coriander two rows crop combination at all stages.

Table 89(a): Mean absolute growth rate (AGR) for dry matter of castor variety J-1(g/plant/day) as influenced by various treatments

Treatments	Days after sowing				
	0-30	31-60	61-90	91-120	121-135
			<u>1980-81</u>		
D ₁	0.1147	0.6973	1.8133	1.8247	- 0.0410
D ₂	0.0843	0.6600	1.2180	1.5903	0.2120
D ₃	0.0737	0.5233	0.9860	1.1377	0.0670
T ₁	0.1140	0.7307	2.2920	2.0040	0.1100
T ₂	0.0910	0.7017	1.8730	2.0617	0.0307
T ₃	0.0953	0.6537	1.5283	1.8897	- 0.0146
T ₄	0.0833	0.6587	1.2640	1.5940	0.2147
T ₅	0.0937	0.5673	0.8397	1.1377	0.1900
T ₆	0.0860	0.5997	1.0017	1.2903	0.1900
T ₇	0.0807	0.4767	0.5753	0.6467	- 0.1200
Mean	0.0909	0.6269	1.3391	1.5176	0.0793

Table 89(b)		<u>1981-82</u>			
D ₁	0.1743	0.7107	1.9783	2.1090	0.0470
D ₂	0.1557	0.5603	1.4197	1.8243	0.1490
D ₃	0.1107	0.4523	0.9860	1.4523	0.0890
T ₁	0.1447	0.7743	2.2937	2.5463	- 0.0010
T ₂	0.1637	0.6593	2.0637	2.4510	0.1050
T ₃	0.1353	0.6037	1.7483	2.3053	0.0810
T ₄	0.1390	0.6057	1.4013	1.7903	0.1370
T ₅	0.1453	0.5400	0.9190	1.4050	0.1530
T ₆	0.1567	0.4530	1.0750	1.3443	0.1450
T ₇	0.1430	0.3863	0.7087	0.7250	0.0450
Mean	0.1469	0.5744	1.4587	1.7953	0.0950

4.4.3 Relative growth rate (RGR) :

Mean values of RGR computed in g/g/day from total dry matter accumulation obtained at various growth stages during 1980-81 and 1981-82 are presented in Table 90(a) and (b) respectively.

Data revealed that RGR in g/g/day was maximum between 30 to 60 days after sowing and decreased gradually till harvest. In general, not much differences were observed in RGR due to dates of sowing. Sole crop of castor produced more RGR as compared to rest of the treatments between 60 to 90 days. This was followed by castor + coriander one row and castor + coriander two row crop combinations. The least RGR was produced by the treatment castor + sesamum two row crop combinations at all stages.

4.4.4 Leaf area index (LAI) :

Mean values of leaf area index of castor variety J-1 was computed from the data on leaf area in sq.cm per plant and ground area in sq.cm per plant at various growth stages and presented in Table 91(a) and (b) respectively.

Data revealed that the leaf area index increased continuously from early stages till active growth period (90 days) and thereafter there was a gradual decrease towards harvest.

Increased leaf area index was noticed due to sowing on 29th Met.week as compared to the rest of the sowing dates.

Table 90(a): Relative growth rate (RGR) in g/g/day of castor variety J-1 as influenced by various treatments

Treatments	1980-81			
	Days after sowing			
	30-60	60-90	90-120	120-135
D ₁	0.0652	0.0391	0.0176	- 0.0003
D ₂	0.0726	0.0323	0.0198	0.0020
D ₃	0.0697	0.0325	0.0181	0.0008
T ₁	0.0667	0.0437	0.0165	0.0007
T ₂	0.0721	0.0404	0.0191	0.0002
T ₃	0.0687	0.0371	0.0201	- 0.0001
T ₄	0.0760	0.0369	0.0196	0.0020
T ₅	0.0651	0.0273	0.0188	0.0024
T ₆	0.0692	0.0300	0.0189	0.0021
T ₇	0.0640	0.0236	0.0151	- 0.0023
Mean	0.0692	0.0346	0.0185	0.0008

Table 90(b)		1981-82		
D ₁	0.0542	0.0390	0.0184	0.0003
D ₂	0.0509	0.0364	0.0206	0.0012
D ₃	0.0542	0.0337	0.0220	0.0010
T ₁	0.0616	0.0417	0.0195	- 0.000007
T ₂	0.0538	0.0418	0.0205	0.0007
T ₃	0.0566	0.0405	0.0219	0.0006
T ₄	0.0559	0.0353	0.0202	0.0011
T ₅	0.0604	0.0284	0.0210	0.0017
T ₆	0.0453	0.0339	0.0196	0.0016
T ₇	0.0436	0.0283	0.0154	0.0008
Mean	0.0531	0.0364	0.02040	0.0008

Table 91(a): Mean leaf area index of castor variety J-1 at various growth stages as influenced by various treatments

Treatments	Days after sowing				
	30	60	90	120	135
<u>1980-81</u>					
D ₁	0.0649	0.6704	0.7911	0.4628	0.4004
D ₂	0.0597	0.5099	0.4827	0.2996	0.2543
D ₃	0.0818	0.3402	0.3921	0.2621	0.2294
T ₁	0.0658	0.8774	0.9383	0.6662	0.6000
T ₂	0.0687	0.7283	0.8701	0.6199	0.5449
T ₃	0.0663	0.5653	0.6397	0.4389	0.3991
T ₄	0.0707	0.4807	0.4949	0.2559	0.1805
T ₅	0.0697	0.3404	0.3243	0.1237	0.0811
T ₆	0.0726	0.4132	0.2949	0.2027	0.1818
T ₇	0.0691	0.2426	0.2259	0.0830	0.0753
Mean	0.0689	0.5068	0.5553	0.3415	0.2947

Table 91(b)

<u>1981-82</u>					
D ₁	0.0600	0.6319	0.8317	0.4813	0.4145
D ₂	0.0502	0.5509	0.5060	0.3126	0.2738
D ₃	0.0947	0.3584	0.4136	0.2968	0.2471
T ₁	0.0804	0.7756	1.0500	0.7285	0.6502
T ₂	0.0692	0.7219	0.8790	0.6250	0.5566
T ₃	0.0758	0.5748	0.6779	0.5137	0.4143
T ₄	0.0706	0.5094	0.4999	0.2674	0.1860
T ₅	0.0544	0.3788	0.3058	0.1310	0.0777
T ₆	0.0628	0.3803	0.4032	0.2126	0.1926
T ₇	0.06446	0.2553	0.2708	0.1092	0.0942
Mean	0.0683	0.5137	0.5838	0.3636	0.3118

Similarly, sowing on 31st Met.week recorded increased LAI as compared to 33rd Met.week sowing.

Sole cropping of castor recorded increased LAI as compared to the rest of the treatments. This was followed by treatment of castor + coriander one row and castor + coriander two row crop combination. The lowest LAI was observed in castor + sesamum two row crop combination.

4.5 Post harvest studies :

Data on number of capsules, weight of capsules, grains, stalk of plant(g), test weight (g), one litre volume grain weight (g) and hulling percentage of castor variety J-1 are presented in Table 92.

4.5.1 Number of capsules, weight of capsules, grain and stalks per plant :

Data presented in Table 92 indicated significant differences between dates of sowing, treatments and their interactions for number of capsules, weight of capsules, grain and stalks in g/plant.

Sowing on 29th Met.week produced significantly more number of capsules, weight of capsules, grains and stalks weight per plant over rest of the sowing dates. This was followed by sowing on 31st Met.week which was significantly superior over sowing on 33rd Met.week during both the years.

Sole crop of castor produced significantly more number of capsules, weight of capsules, grain and stalk over rest of

Table 92: Mean number of capsules, weight of capsules, grains, stalk per plant, 1000 grain weight, one litre grain weight, and hulling percentage of castor variety J-1

Treat- ments	No. of cap- sules/plant		Wt. of cap- sules/plant (g)		Wt. of grains / plant (g)		Wt. of stalk / plant (g)		1000 grain weight (g)		1 litre grain wt (g)		Hulling percen- tage	
	1980- 81	1981- 82	1980- 81	1981- 82	1980- 81	1981- 82	1980- 81	1981- 82	1980- 81	1981- 82	1980- 81	1981- 82	1980- 81	1981- 82
D 1	65.69	82.57	55.52	70.55	36.97	40.76	44.96	46.00	181.55	186.99	641.43	645.48	76.95	58.9
D 2	59.32	66.73	47.64	56.56	30.65	33.40	35.81	36.84	179.46	179.35	830.95	835.71	64.27	58.0
D 3	37.59	45.69	32.97	39.88	18.58	28.05	29.10	29.89	156.79	170.40	623.57	632.86	57.12	67.8
S.E.+	0.392	0.021	0.476	0.370	0.292	0.038	0.034	0.034	0.007	0.570	1.215	1.610	0.043	0.0
C.D. at 1.21	0.060		1.359	1.056	0.834	0.076	0.097	0.096	0.034	1.613	3.472	4.602	0.124	0.0
T 1	83.28	101.77	64.00	76.83	43.84	51.00	55.71	57.64	184.12	193.17	640.00	648.89	68.18	67.0
T 2	75.63	94.37	59.78	73.89	35.56	43.78	49.79	52.49	183.02	190.20	640.00	647.78	58.94	60.7
T 3	67.00	79.23	53.44	69.44	31.09	40.00	41.93	44.58	172.66	184.41	635.00	643.33	57.98	59.5
T 4	59.63	71.73	45.67	56.78	28.83	34.78	37.64	36.31	175.60	180.13	631.67	638.89	62.44	59.5
T 5	31.88	37.63	36.56	47.44	23.30	26.00	24.20	24.56	168.59	174.77	630.00	635.00	62.62	55.2
T 6	43.08	48.77	39.21	40.22	27.43	21.78	30.22	29.90	165.62	167.43	625.56	628.89	68.16	55.1
T 7	18.90	21.47	19.00	25.02	11.07	18.56	16.88	17.65	157.59	162.26	621.67	623.33	58.57	73.5
S.E.+	0.599	0.032	0.726	0.565	0.446	0.405	0.052	0.051	1.087	0.871	1.256	2.460	0.066	0.0
C.D. at 5%	1.712	0.092	2.076	1.614	1.274	1.168	0.149	0.146	3.107	2.464	5.304	7.030	0.189	0.0
S.E.+ (D x T)	1.038	0.056	1.258	0.978	0.772	0.702	0.090	0.089	1.883	1.509	3.214	4.250	0.115	0.0
C.D. at 5%	2.966	0.160	3.596	2.795	2.207	2.006	0.258	0.253	N.S.	4.268	N.S.	N.S.	0.429	0.15
Mean	54.20	65.00	45.38	55.66	28.73	34.07	36.62	37.58	172.60	178.91	631.98	638.02	66.11	61.6

At other dates of sowing it was significantly superior over rest of the treatments during both the years. This was followed by the treatment combination of castor + coriander one row crop combination and was significantly superior over rest of the treatments. This trend was seen during both the years at all dates of sowing. This was again followed by the treatment of castor + coriander two row crop combination and was significantly superior over rest of the treatments.

Table 93: Mean number of capsules per plant as influenced by interaction D.x.T. at harvest.

Treatments	Dates of sowing					
	1980-81			1981-82		
	D ₁	D ₂	D ₃	D ₁	D ₂	D ₃
T ₁	102.60	91.53	55.70	125.80	110.50	59.01
T ₂	90.70	86.20	50.00	120.00	97.30	65.80
T ₃	81.00	76.50	43.50	105.00	82.70	50.00
T ₄	68.00	66.50	44.40	87.70	75.00	62.50
T ₅	36.00	36.50	23.15	48.00	36.90	28.00
T ₆	57.13	39.60	32.50	63.00	44.30	39.00
T ₇	24.40	18.40	13.90	28.50	20.40	15.50
S.E. $\pm$	1.038			0.056		
C.D. at 5%	2.966			0.160		

the treatments, this was followed by the treatment castor + coriander one row crop combination, this was also significantly superior over the remaining treatments. This was followed by the treatment castor + coriander two row crop combination which also indicated significant superiority over remaining treatments.

Treatment combination of sowing on 29th Met.week with sole crop of castor produced significantly more number of capsules, weight of grain and stalk over rest of the treatment combinations, this was followed by the treatment combination of castor + coriander two row crop combination which also showed significant interaction effect over rest of the treatment combination. These trends were seen over rest of the sowing dates. This trend of effects was similar for number of capsules (Table 93), grain weight (Table 94) and stalk weight in g/plant (Table 95) during both the years except that the treatment combination of castor + coriander two row crop combination was replaced by castor + pigeonpea over 33rd Met.week sowing during the 1st year for stalk weight in g/plant. But in case of weight of capsules (Table 96) sowing on 29th Met.week with sole crop of castor produced capsule weight at par with castor + coriander one row crop combination and was significantly superior over rest of the treatments during first year. This trend was seen at 31st Met.week of the same year as well as the second year.

Table 94: Weight of grain per plant as influenced by interaction D x T at harvest

Treatments	Dates of sowing					
	1980-81			1981-82		
	D ₁	D ₂	D ₃	D ₁	D ₂	D ₃
T ₁	53.53	45.60	32.40	58.00	50.00	45.00
T ₂	48.07	37.87	20.73	51.00	44.33	36.00
T ₃	41.67	32.67	18.93	47.67	38.00	34.33
T ₄	38.00	29.87	18.63	44.67	31.33	28.33
T ₅	28.53	25.53	15.83	32.00	44.67	21.33
T ₆	34.33	32.33	15.63	28.00	20.67	16.67
T ₇	14.67	10.67	7.87	24.00	17.00	14.67
S.E. $\pm$	0.772			0.702		
C.D. at 5%	2.207			2.006		

Table 95: Weight of stalk per plant as influenced by interaction D x T at harvest.

T ₁	69.76	55.20	42.16	69.59	56.58	46.74
T ₂	62.50	48.61	38.25	65.95	51.07	40.40
T ₃	57.00	39.92	28.87	58.50	42.08	33.17
T ₄	44.45	37.20	31.28	43.67	37.18	28.07
T ₅	28.29	23.03	31.27	30.30	35.08	18.30
T ₆	33.44	31.80	25.42	34.38	49.17	26.17
T ₇	19.27	14.94	16.44	19.63	16.69	16.32
S.E. $\pm$	0.903			0.089		
C.D. at 5%	2.571			0.253		

Table 96: Dry weight of capsules as influenced by interaction D x T at harvest.

Treatments	Dates of sowing					
	1980-81			1981-82		
	D ₁	D ₂	D ₃	D ₁	D ₂	D ₃
T ₁	76.33	65.56	50.00	95.00	80.67	54.67
T ₂	73.00	62.33	44.00	90.33	80.33	51.00
T ₃	65.00	60.00	35.33	85.67	75.67	47.00
T ₄	56.00	50.00	31.00	77.67	50.67	42.00
T ₅	43.33	36.00	30.33	61.00	44.00	37.33
T ₆	49.33	40.00	28.30	53.00	40.00	27.67
T ₇	25.67	19.50	11.83	31.17	24.60	19.30
S.E. ±	1.258			0.978		
C.D. at 5%	3.596			2.794		

4.5.2 One thousand grain weight :

Data presented in Table 92 indicates significant differences due to dates of sowing, treatments and their interactions.

Sowing on 29th Met.week produced significantly more test weight as compared to rest of the sowing dates. This was followed by sowing on 31st Met.week which also produced significantly more test weight as compared to sowing on 33rd Met.week.

Sole crop of castor produced significantly more test weight over all the treatments except castor + coriander one row crop combination both these treatments were on par with each other

but were significantly superior over rest of the treatments. These two treatments were followed by castor + coriander two row crop combination which was again on par with castor + pigeonpea one row crop combination and both were significantly superior over rest of the treatments.

The interaction effect due to D x T treatment was found to be absent during the first year. But during the 2nd year, treatment combination of sowing on 29th Met. week with (Table 97) sole crop of castor produced significantly more test weight as compared to the rest of the treatment combinations, this was followed by the treatment combination of castor + coriander one row and this was closely followed by the treatment combination castor + coriander two crop combination. These two later treatments was at par with each other and significantly superior over rest of the treatments. The treatment combination of sowing on 31st Met. week with sole crop of castor and castor + coriander one row was on par with each other and were significantly superior over rest of the treatments. This later trend was observed over sowing on 33rd Met. week.

Table 97: Mean test weight (thousand grain weight in g) as influenced by interaction D x T at harvest during 1981-82.

Treatments	Dates of sowing		
	D ₁	D ₂	D ₃
T ₁	204.23	192.40	182.86
T ₂	195.83	191.67	183.10
T ₃	193.50	186.43	173.30
T ₄	185.13	183.00	172.27
T ₅	118.00	175.57	168.73
T ₆	178.20	165.03	159.06
T ₇	172.0	161.33	153.43
S.E. $\pm$	1.509		
C.D. at 5%	4.270		

4.5.3 One litre volume grain weight :

Data presented in Table 92 indicated significant differences between dates of sowing, treatments and their interactions.

Significantly more one litre volume grain weight was recorded due to sowing on 29th Met.week as compared to the rest of the sowing dates. This was followed by the sowing on 31st Met.week which produced significantly more one litre volume grain weight over sowing on 33rd Met.week during the first year, but the late two treatments were on par with each other during the second year.

Sole crop of castor, castor + coriander one row and castor + coriander two row crop combinations were on par with each other but were significantly superior over rest of the treatments.

One litre volume grain weight was not influenced by any interaction during both the years.

4.5.4 Hulling percentage :

Significant differences were observed due to dates of sowing (Table 92) treatments and their interactions.

During the 1st year 29th Met.week recorded significantly more hulling percentage over rest of the sowing dates. Sowing on 31st Met.week followed the above date. This trend was not seen during the second year, 33rd Met.week replaced the 29th Met. week and was significantly superior over the rest.

Sole crop of castor recorded significantly higher hulling percentage over rest of the treatments during the first year but treatments differed over the second year, castor + two rows of sesamum recorded significantly more hulling percentage over rest of the treatments.

Interaction effects between D x T were observed significant, however, there was no consistency in the trend of treatments during both the years (Table 98).

Table 98: Hulling percentage as influenced by interaction
D x T at harvest

Treatments	Dates of sowing					
	1980-81			1981-82		
	D ₁	D ₂	D ₃	D ₁	D ₂	D ₃
T ₁	70.04	69.52	64.97	61.05	62.03	77.93
T ₂	65.97	60.95	50.00	56.52	55.10	70.60
T ₃	64.83	55.50	53.60	55.58	50.20	73.00
T ₄	67.77	59.60	59.97	57.60	61.88	60.23
T ₅	65.70	70.03	52.13	52.45	56.05	57.10
T ₆	69.50	79.77	55.20	52.83	52.40	60.20
T ₇	57.10	54.60	64.00	76.90	68.90	75.90
S.E. $\pm$	0.115			0.053		
C.D. at 5%	0.429			0.151		

On an average the hulling percentage was 66.11 per cent during the first year and 61.64 per cent during the second year.

4.6 Yield :

4.6.1 Grain yield :

Data on grain yield of castor grain variety J-1 during 1980-81 and 1981-82 along with their means subjected to pooled analysis because of heterogenous error variance and significant interaction effects and are presented in Table 99.

The data in Table 99 indicated significant differences due to date of sowing, treatments and their interactions during both the years as well as in the pooled analysis.

Table 99: Grain yield of castor variety J-1 during 1980-81 and 1981-82 and its pooled mean (kg/ha)

Treatments	1980-81	1981-82	Pooled mean
D ₁	298.69	396.77	347.73
D ₂	192.04	298.69	245.37
D ₃	165.98	237.99	201.99
S.E. $\pm$	4.458	1.612	8.500
C.D. at 5%	12.690	4.630	51.720
T ₁	357.68	508.22	432.95
T ₂	302.46	442.72	372.59
T ₃	245.19	409.80	327.50
T ₄	213.99	302.81	258.40
T ₅	176.95	205.07	191.01
T ₆	176.61	178.32	177.47
T ₇	58.98	131.00	94.99
S.E. $\pm$	6.859	0.274	31.384
C.D. at 5%	19.55	0.709	108.573
S.E. $\pm$ (T x D)	11.659	4.287	32.442
C.D. at 5%	31.550	12.280	N.S.
General Mean	218.90	311.15	265.03

Sowing on 29th Met.week produced significantly more grain yield over rest of the sowing dates. This was followed by sowing on 31st Met.week and was significantly superior over sowing on 33rd Met.week during both the years and also in the pooled analysis.

Sole cropping of castor produced significantly more grain yield over rest of the treatments during both the years while it was at par with the treatment of castor + coriander one row and castor + coriander two row crop combination and significantly superior over rest of the treatments in the pooled analysis. This was followed by the treatments of castor + coriander one row crop combination and significantly superior over rest of the treatments. This was again followed by the treatment of castor + coriander two row crop combination and which was significantly superior over rest of the treatments during both the years.

Significant interaction effects were also noticed due to D x T interaction during both the years as well as for pooled analysis (Tables 100 and 101). Table 100 would indicate that the treatment combination of sowing on 29th Met.week with the sole crop of castor produced significantly more grain yield of castor over rest of the treatments. This was followed by the treatment castor + coriander one row and which was significantly superior over rest of the treatments. This was again followed by the treatment castor + coriander two crop combination.

Table 100: Grain yield (kg/ha) of castor variety J-1 as influenced by interaction D x T at harvest.

Treatments	Dates of sowing					
	1980-81			1981-82		
	D ₁	D ₂	D ₃	D ₁	D ₂	D ₃
T ₁	533.24	324.41	244.17	598.98	513.25	413.23
T ₂	441.69	226.33	239.71	545.26	433.23	350.36
T ₃	356.65	148.83	230.11	523.54	377.22	328.64
T ₄	349.10	172.49	123.11	380.65	286.35	224.05
T ₅	250.34	175.92	104.59	280.63	181.75	153.14
T ₆	148.49	230.79	150.20	256.05	162.89	116.02
T ₇	39.44	64.13	73.04	193.18	119.45	81.16
S.E. + —	11.659			4.296		
C.D. at 5%	31.550			12.280		

Table 101: Grain yield of castor variety J-1 in (kg/ha) as influenced by interaction D x T at harvest.

T ₁	551.77	418.72	328.70
T ₂	493.48	329.73	294.92
T ₃	439.98	263.03	279.32
T ₄	364.88	273.99	172.15
T ₅	265.43	178.84	128.77
T ₆	202.16	196.84	133.06
T ₇	116.25	91.73	76.99
S.E. + —	14.29		
C.D. at 5%	39.60		

This trend was observed over 31st Met.week during both the years as well as in the pooled analysis and was continued on 33rd Met.week during the second year only. While the treatment combination of sowing on 33rd Met.week with sole crop of castor produced grain yield at par with castor + coriander one row and castor + coriander two row crop combination and was significantly superior over rest of the treatments during the first year and also in the pooled analysis.

4.6.2 Grain yield at different pickings, capsule yield, stalk yield and grain to stalk ratio :

Data on grain yield at different pickings along with total yield, capsule and stalks yield in kg/ha and grain to stalk ratio are presented in Table 102.

4.6.2.1 Grain yield at different pickings :

It is clear from the Table 102 that sowing on 29th Met. week gave numerically maximum grain yield over rest of the sowing dates in all the pickings during both the years. This was followed by sowing on 31st Met.week in case of first picking only.

Sole crop of castor produced numerically more grain yield over rest of the treatments in all the pickings during both the years. This was followed by the treatment of castor + coriander one row and castor + coriander two row crop combination.

Table 102: Yield of grain, capsules, stalk(kg/ha) and grain to stalk ratio of castor variety J-1

Treatments	Grain yield during 1980-81			kg/ha	Grain yield during 1981-82			kg/ha
	Number of pickings				Number of pickings			
	I	II	III		I	II	III	
D ₁	162.55	100.48	35.67	298.69	206.08	137.63	53.06	396.77
D ₂	110.77	64.36	16.92	192.04	175.35	90.03	33.31	298.69
D ₃	93.28	72.70	-	155.98	142.81	95.18	-	237.90
S.E. $\pm$	-	-	-	4.458	-	-	-	1.612
C.D. at 5%	-	-	-	12.69	-	-	-	4.630
T ₁	185.05	138.12	34.53	357.68	265.58	190.06	52.58	508.22
T ₂	152.60	122.81	27.24	302.46	232.81	163.77	46.18	442.72
T ₃	137.36	91.14	16.80	245.19	217.57	153.09	39.14	409.80
T ₄	118.69	76.02	19.43	213.99	175.28	96.59	30.94	302.81
T ₅	102.69	58.30	16.04	176.95	130.81	63.06	11.20	205.07
T ₆	120.18	47.82	8.65	176.61	113.93	51.05	13.34	178.32
T ₇	38.52	20.46	-	58.98	87.26	35.63	8.11	131.00
S.E. $\pm$	-	-	-	6.859	-	-	-	0.274
C.D. at 5%	-	-	-	19.550	-	-	-	0.709
S.E. $\pm$ (D x T)	-	-	-	11.659	-	-	-	4.287
C.D. at 5%	-	-	-	31.550	-	-	-	12.280

Contd....

Table 102(Contd.)

Treatments	Capsule yield in kg/ha		Stalk yield in kg/ha		Grain/stalk ratio	
	1980	1981	1980	1981	1980	1981
D ₁	445.66	688.51	660.48	910.89	0.42	0.45
D ₂	293.65	519.47	530.86	869.33	0.35	0.33
D ₃	298.02	345.23	309.32	665.28	0.52	0.34
S.E. +	6.820	2.657	6.677	4.791	0.008	0.003
C.D. at 5%	19.490	7.594	19.090	13.690	0.024	0.009
T ₁	521.10	779.63	644.02	1315.31	0.570	0.39
T ₂	507.00	749.07	605.96	1145.77	0.54	0.39
T ₃	416.05	714.51	493.48	990.38	0.52	0.41
T ₄	335.31	498.51	503.08	802.11	0.42	0.37
T ₅	277.89	375.85	472.56	620.36	0.38	0.33
T ₆	260.28	329.44	445.81	462.20	0.41	0.38
T ₇	102.80	177.14	337.10	370.36	0.19	0.35
S.E. +	10.427	4.058	10.200	7.319	0.013	0.005
C.D. at 5%	29.770	11.600	29.150	20.920	0.037	0.014
S.E.+ (D x T)	18.043	7.029	17.670	12.676	0.022	0.008
C.D. at 5%	51.57	20.09	50.49	36.23	0.065	0.024

4.6.2.2 Capsule yield :

Data presented in Table 102 indicates significant differences in capsule yield due to dates of sowing, treatments and their interactions.

The trend of effects due to dates of sowing was similar for grain yield and capsule yield during both the years. During 1980-81, sole crop of castor produced capsule yield at par with castor + coriander one row crop combination and was significantly superior over rest of the treatments. During 1981-82 sole cropping of castor produced significantly more capsule yield as compared to rest of the treatments. This was followed by castor + one row coriander and was significantly superior over the remaining treatments during both the years.

The treatment combination of sowing on 29th Met. week with sole crop of castor produced capsule yield at par with castor + coriander one row crop combination during both the years (Table 103).

Table 103: Capsule yield(kg/ha) of castor variety J-1 as influenced by interaction D x T at harvest.

Treatments	Dates of sowing					
	1980-81			1981-82		
	D ₁	D ₂	D ₃	D ₁	D ₂	D ₃
T ₁	720.50	466.96	375.85	981.12	827.60	530.17
T ₂	669.74	371.85	479.42	964.66	786.22	496.33
T ₃	550.06	268.63	429.46	942.03	751.36	450.15
T ₄	515.42	289.55	201.07	660.83	462.73	371.96
T ₅	381.11	251.37	201.19	534.97	324.30	268.29
T ₆	213.87	289.43	277.54	484.67	310.81	192.84
T ₇	69.04	117.74	121.63	251.25	173.29	106.88
S.E.+ ₇	18.043			7.029		
C.D. at 5%	51.570			20.090		

While the treatment combination of sowing on 31st Met.week with sole crop of castor gave significantly more capsule yield as compared to rest of the treatments during both the years. During first year at 33rd Met.week, sowing with castor + coriander one row produced capsule yield at par with castor + coriander two row crop combination and was significantly superior over rest of the treatments including sole crop of castor. During the second year the trend at 33rd Met.week was as at 31st Met.week.

4.6.2.3 Stalk yield :

Data in Table 102 indicated significant differences in stalk yield due to dates of sowing, treatments and their interactions.

The trend of effects due to dates of sowing and treatments was similar to grain yield during both the years.

The treatment combination (Table 104) of sowing on 29th Met.week with sole crop of castor produced stalk yield at par with the treatment of castor + coriander one row and significantly superior over rest of the treatments. This trend was observed over 31st Met.week during the first year. The same year the treatment combination of sowing on 33rd Met.week with sole crop of castor produced significantly more stalk yield over rest of the treatments. This was followed by the treatment combination of castor + coriander 1 row crop combination.

Table 104: Castor stalk yield (kg/ha) as influenced by interaction D x T at harvest.

Treatments	Dates of sowing					
	1980-81			1981-82		
	D ₁	D ₂	D ₃	D ₁	D ₂	D ₃
T ₁	823.03	720.15	387.51	1546.61	1316.85	1083.66
T ₂	812.74	675.57	332.64	1323.71	1186.54	929.34
T ₃	696.15	456.10	325.78	1080.23	1087.09	802.46
T ₄	720.10	486.96	301.78	905.34	857.33	606.99
T ₅	709.87	452.67	257.20	644.71	703.01	514.40
T ₆	452.67	582.98	301.78	497.27	493.82	397.80
T ₇	411.52	342.93	257.20	377.22	408.09	322.35
S.E.+	17.670			12.677		
C.D. at 5%	50.480			36.230		

During the second year, the treatment combination of sowing on 29th Met.week with sole crop of castor produced significantly more stalk yield over rest of the treatments. This was followed by the treatment of castor + coriander one row crop combination and was significantly superior over rest of the treatments. This was again followed by the treatment of castor + coriander two row crop combination which also produced significantly more stalk weight over the remaining treatments. This trend was seen over rest of the sowing dates during the second year.

4.6.2.4 Grain to stalk ratio :

Data in Table 102 indicated significant differences in grain to stalk ratios due to dates of sowing, treatments and their interactions.

During 1980-81 sowing on 33rd Met.week gave significantly more grain to stalk ratio as compared to rest of the sowing dates. This was closely followed by sowing on 29th Met.week and produced significantly more grain to stalk ratio over sowing on 31st Met.week. During 1981-82 sowing on 29th Met.week produced significantly more grain to stalk ratio as compared to rest of the sowing dates. This was followed by sowing on 33rd Met.week and was significantly superior over 31st Met.week.

During 1980-81 sole crop of castor produced grain to stalk ratio at par with the treatment of castor + coriander one row crop combination and was significantly superior over rest of the treatments. While during 1981-82 the treatment of castor + coriander two row crop combination gave significantly more grain to stalk ratio over rest of the treatments and this was followed by the treatment of sole crop of castor which gave grain to stalk ratio at par with castor + coriander one row crop combination and was significantly superior over rest of the treatments.

During 1980-81 the treatment combination of sowing on 29th Met. week (Table 105) with sole cropping of castor gave significantly more grain to stalk ratio over rest of the treatment combination. The same trend was observed over 31st Met.week while the treatment combination of sowing on 33rd Met.week with castor + coriander one row gave grain to stalk ratio at par with castor + coriander two row crop combination and was significantly superior over rest of the treatment.

During 1981-82, the treatment combination of sowing on 29th Met.week with castor + sesamum one row gave grain to stalk ratio at par with the treatment castor + sesamum two row crop combination and was significantly superior over rest of the treatment combination. The treatment combination of sowing on 31st Met.week with sole crop of castor gave grain to stalk ratio at par with the treatments castor + coriander one row and castor + coriander two row crop combination and was significantly superior over rest of the treatment combinations. While the treatment combination of sowing on 33rd Met.week with castor + coriander two row intercrop combination gave grain to stalk ratio at par with castor + coriander one row intercrop combination and sole cropping of castor and was significantly superior over rest of the treatment combinations.

Table 105: Grain to stalk ratio as influenced by interaction D x T at harvest.

Treatments	Dates of sowing					
	1980-81			1981-82		
	D ₁	D ₂	D ₃	D ₂	D ₃	D ₃
T ₁	0.614	0.452	0.633	0.388	0.390	0.381
T ₂	0.544	0.339	0.724	0.412	0.365	0.378
T ₃	0.512	0.327	0.708	0.485	0.348	0.402
T ₄	0.485	0.356	0.413	0.421	0.321	0.369
T ₅	0.353	0.389	0.409	0.436	0.259	0.298
T ₆	0.329	0.398	0.502	0.517	0.331	0.293
T ₇	0.097	0.188	0.284	0.513	0.292	0.251
S.E. $\pm$	0.026			0.009		
C.D. at 5%	0.055			0.025		

4.6.3. Correlation and regression studies :

Simple correlation coefficients(r) and regression coefficients (b) computed between weight of castor seed per plant (Y) and morphological characters(X) for 1980-81 and 1981-82 are presented in Table 106 (a) and (b) with intercept (a) values and depicted in Fig. 4(a) and (b).

The ' r ' values presented revealed that castor grain yield per plant was positively and significantly correlated with plant height, number of leaves, number of branches, number of internodes, petiole length, leaf area, number of spikes, mean length of spike, number of capsules, 1000 grain weight, dry matter and one litre volume grain weight over all dates during both the years except with number of capsules and petiole length at 29th Met.week during 1st and 2nd year respectively and with number of internodes at 33rd Met.week during the 2nd year.

Positive but not significant correlation were obtained between castor grain yield and the above exceptions.

The simple regression analysis presented in Table 106 (a) and (b) revealed that significant regression coefficient were found between castor grain yield per plant and all the above morphological characters which were correlated positively and significantly at respective dates of sowing and respective years.

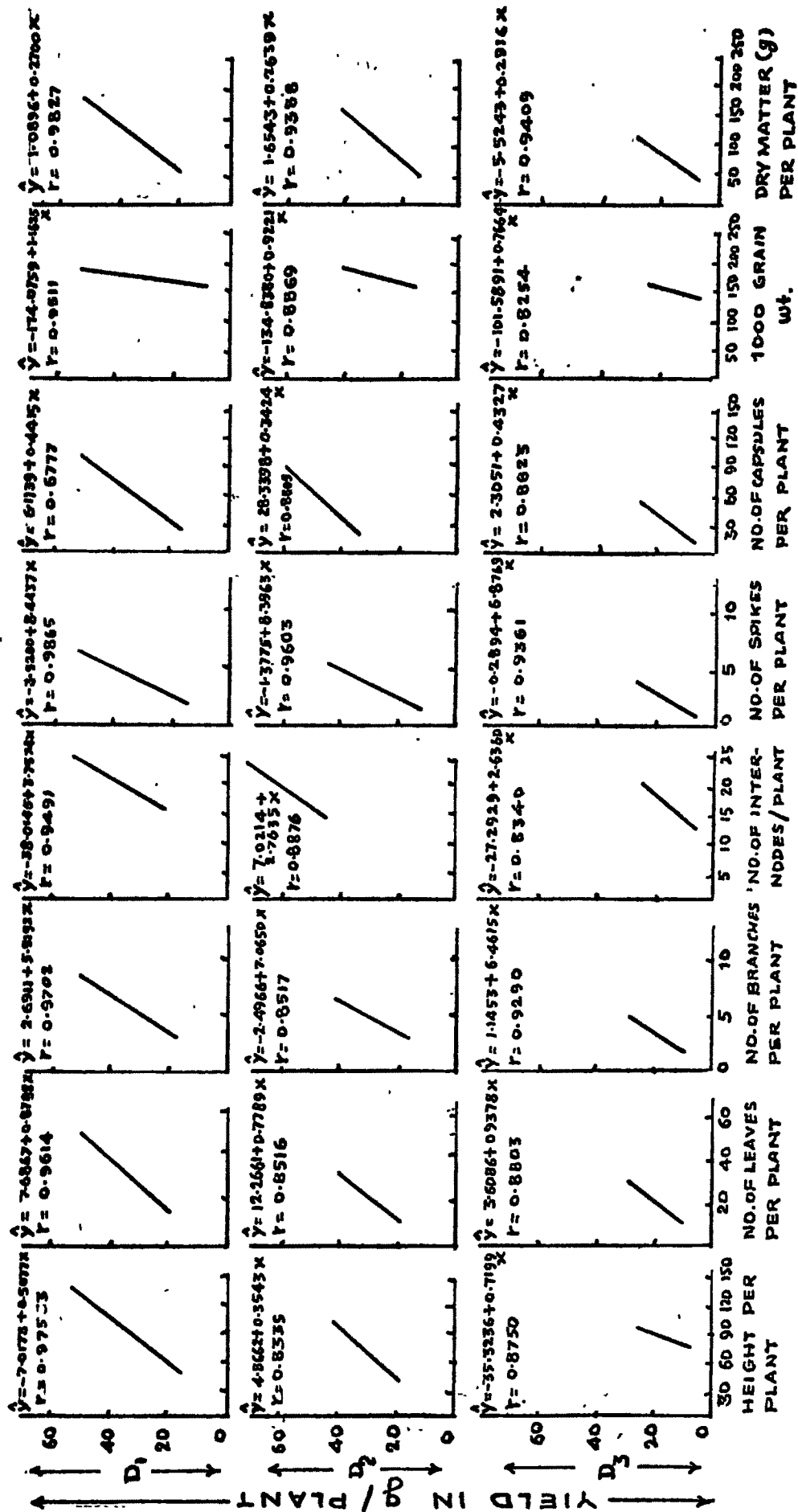


FIG. 4 (a). RELATIONSHIP BETWEEN YIELD PER PLANT AND YIELD ATTRIBUTES (1980-81)

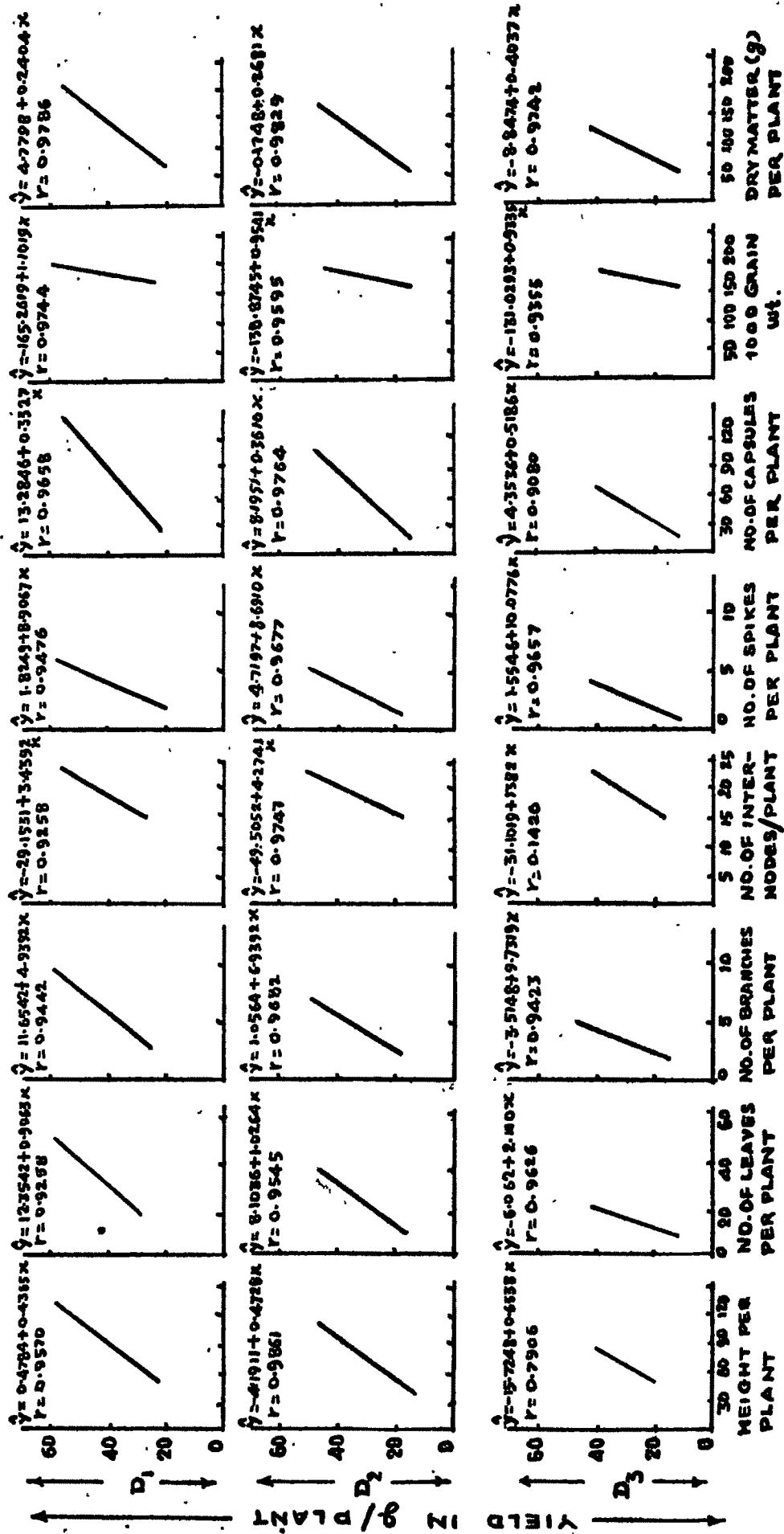


FIG. 4 (b). RELATIONSHIP BETWEEN YIELD PER PLANT AND YIELD ATTRIBUTES (1981-82)

Table 106(a): Simple correlation coefficients (r) and regression coefficients(b) during 1980-81

Plant characters (x)	D ₁			D ₂				
	'r'values	'b'values	't'values	'a'values	'r'values	'b'values	't'values	'a'values
Plant height(cm)	0.9753**	0.5077	10.5500**	- 7.0173	0.8335*	0.3543	3.3735*	4.8662
No.of leaves	0.9614**	0.8798	7.8115**	7.6867	0.8516*	0.7789	3.6333*	12.2661
No.of branches	0.9702**	5.9192	8.9543**	2.6911	0.8517*	7.0650	3.6343*	-2.4966
No.of internodes	0.9491**	3.7574	6.7383**	- 38.0145	0.8876**	2.7635	4.3092**	7.0214
Petiole length	0.9084**	6.4310	4.8580**	- 26.2357	0.8411*	11.4938	3.4770*	-58.6746
Leaf area	0.9007**	0.0047	4.6495**	21.6822	0.8183*	0.0055	3.1836*	19.2369
No.of spikes	0.9865**	8.4437	13.4800**	- 3.9200	0.9603**	8.3963	7.6978**	-1.3775
Mean length of spikes	0.9296**	1.7978	5.6410**	7.9753	0.9409**	2.2224	6.2140**	-0.8138
No.of capsules	0.6777	0.4415	1.2455	6.1139	0.8809**	0.3424	4.1608**	28.3398
1000 grain weight	0.9511**	1.1625	6.8880**	-174.0739	0.8869**	0.9221	4.2923**	-134.8380
Dry matter	0.9827**	0.2700	11.8507**	1.0896	0.9388	0.2639	6.0952**	1.6843
One litre grain weight	0.9274**	1.5974	5.5433**	-987.6767	0.7962*	1.0757	2.9428*	-648.0513

Contd....

Table 106(a) Contd.

Plant characters (x)	D ₃			
	'r' values	'b' values	't' values	'a' values
Plant height(cm)	0.8750**	0.7194	4.0416**	- 35.3236
No.of leaves	0.8803**	0.9378	4.1492**	3.6086
No.of branches	0.9290**	6.4615	5.6120**	1.1453
No.of internodes	0.8340*	2.6360	3.3779*	- 27.2929
Petiole length	0.9617**	6.1833	7.8462**	- 26.0349
Leaf area	0.9181**	0.0048	3.1806*	9.6220
No.of spikes	0.9361**	6.8769	5.9488**	- 0.2894
Mean length of spike	0.9153**	1.7288	5.0849**	- 140.1486
No.of capsules	0.8823**	0.4327	4.1906**	2.3051
1000 grain weight	0.8254**	0.7664	3.3360**	-101.5891
Dry matter	0.9409**	0.2916	6.2153**	- 5.5234
One litre grain weight	0.8744*	1.1603	4.0316**	-704.9379

* Significant at P = 0.05

** Significant at P = 0.01

D₁ = 29th Met.weekD₂ = 31st Met.weekD₃ = 33rd Met.week.

Table 106(b): Simple correlation coefficients (r) and regression coefficients(b) during 1981-82

Plant characters (x)	D ₁				D ₂			
	'r'values	'b'values	't'values	'a'values	'r'values	'b'values	't'values	'a'values
Plant height(cm)	0.9570**	0.4365	7.3781**	0.4784	0.9861**	0.4728	13.3187**	- 4.1911
No.of leaves	0.9258**	0.9063	5.4744**	12.3542	0.9545**	1.0264	7.1618**	8.1036
No.of brähces	0.9442**	4.9392	6.4127**	11.6542	0.9682**	6.9392	8.6608**	1.0564
No.of internodes	0.9258**	3.4392	7.8901**	-29.1531	0.9747**	4.2741	9.7510**	-49.5052
Petiole length	0.7501	6.0880	2.5366*	-12.8141	0.7551*	9.1793	2.5756*	-33.4670
Leaf area	0.8884**	0.0040	4.3267**	27.3884	0.9400**	0.0069	6.1596**	17.0860
No.of spikes	0.9476**	8.9067	6.6355**	1.8249	0.9677**	8.6910	14.1297**	4.7197
Mean length of spike	0.9380**	1.9654	6.0502**	8.6958	0.9078**	2.2544	4.8395	0.9139
No.of capsules	0.9658**	0.3327	8.3276**	13.2846	0.9764**	0.3610	9.9015	8.1951
1000 grain weight	0.9744**	1.1019	9.6973**	-165.2619	0.9595**	0.9544	7.6160	-138.8744
Dry matter	0.9786**	0.2404	10.6364**	4.7798	0.9829**	0.2681	11.9642	- 9.1748
One litre grain weight	0.9387**	1.1803	6.0757**	-7.2109	0.9907**	1.1317	16.3661	-687.1396

Contd....

Table 106(b) contd.

Plant characters (x_0)	D_3			
	'r' values	'b' values	't' values	'a' values
Plant height(cm)	0.7906*	0.6338	2.8877*	-13.7248
No.of leaves	0.9626**	2.1110	7.9485**	- 6.0629
No.of branches	0.9423**	9.7319	6.2941**	- 3.5148
No.of internodes	0.1420	3.1382	2.3487	-31.1019
Petiole length	0.7836*	4.6907	2.8204*	- 8.6103
Leaf area	0.8891**	0.0092	4.3424**	9.5660
No.of spikes	0.9657**	10.0776	8.3204**	1.5546
Mean length of spike	0.9608**	2.7631	7.7447**	0.0578
No.of capsules	0.9080**	0.5186	4.8466**	4.3536
1000 grain weight	0.9355**	0.9335	5.9780**	-131.0293
Dry matter	0.9742**	0.4037	9.6532**	- 8.8474
One litre grain weight	0.8583*	0.9393	3.7409*	-566.7071

* Significant at $P = 0.05$

** Significant at $P = 0.01$

D_1 = 29th Met. week

D_2 = 31st Met. week

D_3 = 33rd Met. week.

Considering significant regression coefficient, the regression equation was setup and the response of the castor grain yield per plant (Y) to (X) variables was predicted.

Regression equation $Y = a + bx$

Where,

a = intercept

b = regression coefficient

x = variable

Y = predicted yield.

On solving the regression equation, the predicted values of "Y" for varieties of 'X' variables were computed to obtain regression line which are graphically shown in Fig. 4(a) and (b).

4.6.4. Chemical analysis :

Data on estimated percentage of nitrogen, phosphorous and potassium in whole plant at various growth stages, during 1980-81 and 1981-82 are presented in Table 107 (a) and (b) respectively.

4.6.4.1 Percentage of nitrogen in castor plant :

Nitrogen content in all the treatments was maximum in early stages i.e. at 30 days age of the crop growth. The highest concentration of nitrogen was observed in 29th Met. week sown crop during this period and it continued the same trend throughout the crop growth period.

Table 107(a) Percentage of N P K in castor plant variety J-1 at different stages as influenced by different treatments during 1980-81

Treat ments	Days after sowing														
	30					60					90				
	N	P	K	N	P	K	N	P	K	N	P	K	N	P	K
D ₁	2.030	0.209	2.158	1.908	0.177	1.717	1.750	0.141	1.278	0.625	0.094	1.043	1.490	0.065	1.040
D ₂	2.020	0.209	2.130	1.900	0.173	1.648	1.742	0.138	1.194	1.610	0.092	1.019	1.476	0.064	1.005
D ₃	1.996	0.209	2.075	1.882	0.172	1.580	1.726	0.134	1.011	1.567	0.090	0.948	1.471	0.062	0.908
T ₁	2.020	0.210	2.148	1.922	0.182	1.891	1.764	0.146	1.571	1.634	0.098	1.156	1.512	0.069	1.115
T ₂	2.020	0.208	2.148	1.912	0.176	1.731	1.754	1.140	1.378	1.606	0.095	1.083	1.488	0.066	1.063
T ₃	2.010	0.208	2.180	1.898	0.172	1.602	1.736	0.138	1.175	1.586	0.085	1.009	1.460	0.059	1.007
T ₄	2.002	0.209	2.116	1.904	0.171	1.667	1.740	0.138	1.314	1.610	0.096	0.990	1.516	0.067	0.975
T ₅	2.030	0.208	2.084	1.894	0.169	1.571	1.736	0.129	1.083	1.600	0.079	0.934	1.502	0.050	0.932
T ₆	2.030	0.208	2.116	1.890	0.176	1.602	1.732	0.140	1.101	1.596	0.098	0.972	1.446	0.069	0.950
T ₇	2.002	0.207	2.052	1.876	0.173	1.474	1.712	0.137	1.083	1.572	0.094	0.879	1.428	0.064	0.848

Table 107(b): Percentage of N P K in castor plant variety J-1 at different stages as influenced by different treatments during 1981-82

Treatments	Days after sowing														
	30					60					90				
	N	P	K	N	P	K	N	P	K	N	P	K	N	P	K
D ₁	2.034	0.211	1.911	1.868	0.180	1.780	1.800	0.156	1.250	1.705	0.100	1.080	1.505	0.085	1.06
D ₂	2.020	0.210	1.885	1.800	0.175	1.700	1.730	0.143	1.200	1.670	0.090	1.071	1.433	0.070	1.03
D ₃	2.000	0.208	1.867	1.775	0.170	1.680	1.715	0.136	1.070	1.610	0.087	0.995	1.350	0.062	0.93
T ₁	2.023	0.212	1.930	1.900	0.188	1.860	1.840	0.166	1.378	1.785	0.100	1.225	1.520	0.080	1.15
T ₂	2.022	0.211	1.905	1.880	0.180	1.778	1.749	0.150	1.270	1.695	0.094	1.098	1.500	0.072	1.07
T ₃	2.015	0.209	1.886	1.840	0.174	1.720	1.742	0.147	1.203	1.680	0.093	1.093	1.420	0.074	1.07
T ₄	2.012	0.208	1.880	1.850	0.170	1.680	1.735	0.146	1.120	1.643	0.093	1.025	1.410	0.070	0.98
T ₅	2.020	0.208	1.877	1.850	0.169	1.610	1.720	0.145	1.120	1.620	0.089	1.000	1.385	0.072	0.97
T ₆	2.020	0.208	1.870	1.780	0.173	1.664	1.733	0.144	1.080	1.609	0.091	0.962	1.400	0.072	0.95
T ₇	2.014	0.208	1.865	1.600	0.171	1.528	1.717	0.138	1.040	1.600	0.086	0.940	1.370	0.070	0.90

Among the treatments there was not much variation in the nitrogen concentration during this period but at 60th day sole crop combination of castor followed by castor + coriander one row crop combination recorded maximum concentration of nitrogen over rest of the treatments. This trend was maintained at all the stages during both the years.

4.6.4.2 Percentage of phosphorus in castor plant :

The data in Table 107 (a) and (b) indicated that the phosphorus content in shoot was maximum at early stages of the crop in all the treatments and dates of sowing and the concentration declined with the advance in the age of the crop. In general, the phosphorus content was maximum in the 29th Met. week sown crop at all stages. Among the treatments it was maximum in sole crop of castor followed by castor + one row and two row coriander intercrop combinations at all stages of the crop growth during both the years.

4.6.4.3 Percentage of potassium in castor plant :

The data in Table 107(a) and (b) indicated that the potassium content in shoot in all the treatments and dates of sowing was maximum at early stages of the crop and the concentration declined with the advance in age of the crop. In general sowing on 29th Met. week recorded maximum content of potassium followed by 31st Met. week. Among the treatments sole crop of castor followed by castor + coriander one row and 2 rows intercrop coriander recorded maximum content of potassium.

4.6.4.4 Kernel analysis :

The data in Table 108 indicated that the oil content in the kernels of castor was numerically maximum due to sowing 29th Met.week over sowing on rest of the dates. This was followed by sowing on 31st Met.week.

Table 108: Oil content in the kernels of castor as influenced by different treatments for the year 1980-81 and 1981-82.

Treatments	1980	1981
D ₁	49.48	49.39
D ₂	49.41	49.37
D ₃	49.31	49.34
T ₁	49.47	49.45
T ₂	49.44	49.42
T ₃	49.41	49.35
T ₄	49.40	49.33
T ₅	49.30	49.28
T ₆	49.42	49.40
T ₇	49.37	49.33
Mean	49.40	49.37

Numerically maximum oil content was recorded with sole crop of castor and this was followed by the treatment castor + coriander one row crop combination. This was again followed by the treatment castor + coriander two row crop

combination. Numerically least oil content was recorded in the kernels of castor intercropped with sesamum two rows.

4.7 Intercrops :

4.7.1 Coriander :

4.7.1.1 Biometric observation :

Data on mean plant height, number of leaves and number of branches per plant of coriander at various growth stages are presented in Tables 109, 110 and 111 respectively.

The data revealed that the rate of increase of plant height and number of leaves was slow at 45 days after sowing very fast. Between 45 and 75 days after sowing and relatively slow thereafter.

Significant differences were observed in plant height, number of leaves and number of branches at harvest due to dates of sowing, treatment and their interactions during both the years.

Significantly more height, more number of leaves and more number of branches were observed at harvest due to sowing on 29th Met.week. This was followed by 31st Met.week sowing and was significantly superior over sowing on 33rd Met.week.

At harvest significantly more height was recorded in treatment of castor + coriander two row crop combination as compared to rest of the treatments followed by castor + coriander one row crop combination. While, number of leaves and number of

Table 109: Mean height of coriander (cm) at different growth stages

Treatments	Days after sowing				
	30	45	60	75	90
<u>1980-81</u>					
D ₁	3.80	20.77	30.47	30.52	30.70
D ₂	4.43	16.41	26.27	26.60	26.74
D ₃	6.03	15.64	22.24	22.28	22.38
S.E. + C.D. at 5%					0.120 0.370
T ₂	4.93	17.57	26.27	26.36	26.55
T ₃	4.10	19.18	28.50	28.50	28.66
T ₈	5.23	16.07	24.20	24.53	24.61
S.E. + C.D. at 5%					0.120 0.370
S.E. + (D x T) C.D. at 5%					0.210 0.630
Mean	4.76	17.60	26.32	26.47	26.58
<u>1981-82</u>					
D ₁	3.37	18.93	27.87	28.00	28.10
D ₂	2.87	15.40	24.97	25.23	25.34
D ₃	4.97	12.43	18.32	18.76	18.87
S.E. + C.D. at 5%					0.050 0.140
T ₂	3.67	15.23	23.79	23.84	23.89
T ₃	3.74	17.07	25.13	25.19	25.24
T ₈	3.80	14.47	22.23	22.97	23.18
S.E. + C.D. at 5%					0.050 0.140
S.E. + (D x T) C.D. at 5%					0.080 0.240
Mean	3.74	15.59	23.72	24.00	24.10

Table 110: Mean number of leaves per plant of coriander at different growth stages

Treatments	Days after sowing				
	30	45	60	75	90
<u>1980-81</u>					
D ₁	8.00	18.83	23.92	25.03	25.09
D ₂	8.40	15.12	20.12	21.35	21.29
D ₃	7.13	10.95	16.27	16.93	16.96
S.E. + C.D. at 5%					0.060 0.180
T ₂	8.33	15.33	19.35	20.13	20.15
T ₃	7.07	11.67	15.19	15.48	15.50
T ₈	8.13	17.90	25.77	27.70	27.69
S.E. + C.D. at 5%					0.060 0.180
S.E.+(D x T) C.D. at 5%					0.100 0.310
Mean	7.84	14.97	20.10	21.10	21.11
<u>1981-82</u>					
D ₁	7.20	18.93	23.53	22.33	20.71
D ₂	6.87	14.87	16.73	18.60	18.61
D ₃	6.60	9.87	12.70	13.23	13.28
S.E. + C.D. at 5%					0.020 0.070
T ₂	6.80	15.67	18.40	19.20	17.57
T ₃	7.27	10.60	12.20	12.83	12.90
T ₈	6.60	17.40	22.37	22.13	22.13
S.E. + C.D. at 5%					0.020 0.070
S.E. +(D x T) C.D. at 5%					0.040 0.130
Mean	6.89	14.56	17.66	18.60	17.55

Table 111: Mean number of branches per plant of coriander at various growth stages

Treatments	45	60	75	90
	Days after sowing			
	<u>1980-81</u>			
D ₁	3.50	3.72	3.87	4.06
D ₂	2.83	3.13	3.33	3.39
D ₃	1.80	2.30	2.90	2.94
S.E. +				0.020
C.D. at 5%				0.050
T ₂	2.63	2.91	3.20	3.36
T ₃	2.15	2.61	2.83	2.91
T ₈	3.35	3.64	4.07	4.12
S.E. +				0.020
C.D. at 5%				0.050
S.E. + (D x T)				0.030
C.D. at 5%				0.090
Mean	2.71	3.05	3.37	3.46
	<u>1981-82</u>			
D ₁	2.67	3.13	3.18	3.19
D ₂	2.33	2.87	2.93	2.96
D ₃	1.93	2.27	2.40	2.44
S.E. +				0.030
C.D. at 5%				0.090
T ₂	2.40	2.87	3.00	3.01
T ₃	1.83	2.13	2.22	2.25
T ₈	2.70	3.27	3.30	3.32
S.E. +				0.030
C.D. at 5%				0.090
S.E. + (D x T)				0.050
C.D. at 5%				0.150
Mean	2.31	2.76	2.84	2.86

branches were significantly more in sole cropping of coriander as compared to coriander intercropped with castor in one and two row crop combinations. This was followed by coriander intercropped with castor in one row crop combination.

Significant interaction effects were observed due to D x T in plant height, number of leaves and number of branches at harvest (Table 112, 113 and 114). Significantly more height was recorded due to the treatment combination of sowing on 29th Met. week with castor + coriander two row crop combination. This was followed by castor + coriander one row crop combination. This trend was observed totally over 31st Met. week sowing dates and with narrow differences over 33rd Met. week. (Table 112).

Table 112: Mean height of coriander(cm) as influenced by interaction D x T at harvest.

Treatments	Dates of sowing					
	1980-81			1981-82		
	D ₁	D ₂	D ₃	D ₁	D ₂	D ₃
T ₂	30.61	26.43	22.60	28.56	24.80	18.30
T ₃	33.16	29.80	23.03	29.19	26.63	19.90
T ₈	28.33	24.60	21.50	26.54	24.60	18.40
S.E. $\pm$	0.21			0.08		
C.D. at 5%	0.63			0.24		

The treatment combination of sowing on 29th Met. week with sole crop of coriander, followed by castor+ coriander one

row crop combination produced significantly more number of leaves and branches (Table 113 and 114). This trend was observed over rest of the sowing dates during both the years.

Table 113 : Mean number of functional leaves per plant as influenced by interaction D x T at harvest.

Treatments	Dates of sowing					
	1980-81			1981-82		
	D ₁	D ₂	D ₃	D ₁	D ₂	D ₃
T ₂	23.20	19.80	17.43	20.45	19.42	12.85
T ₃	19.85	13.73	12.91	17.50	12.20	9.00
T ₈	32.21	30.33	20.53	24.19	24.19	18.00
S.E. $\pm$	0.100			0.040		
C.D. at 5%	0.310			0.130		

Table 114: Mean number of branches per plant as influenced by interaction D x T at harvest.

T ₂	3.80	3.32	2.95	3.48	3.22	2.33
T ₃	3.59	2.85	2.30	2.48	2.27	2.03
T ₈	4.78	4.01	3.58	3.62	3.39	2.95
S.E. $\pm$	0.030			0.050		
C.D. at 5%	0.090			0.150		

4.7.1.2 Dry matter :

Data on total dry matter per plant of coriander and its parts viz., stem, leaves and pods recorded in g at various growth

stages in both the years are presented in Table 115(a) and (b) respectively.

The data revealed that the total dry matter per plant increased gradually at every stage. The increase was comparatively more between 45 to 75 days after sowing.

At harvest significant differences were observed due to dates of sowing treatments and their interactions during both the years.

In general, sowing on 29th Met.week tended to produce more dry matter as compared to rest of the sowing dates at all stages and at harvest the same trend was reflected significantly in the same order and sequence i.e. 29th Met.week followed by 31st Met.week followed by 33rd Met.week.

Sole cropping of coriander produced more dry matter per plant as compared to castor + coriander intercrop combinations at all stages and the same effect was reflected significantly at harvest.

At harvest the treatment combination of sowing on 29th Met.week (Table 116) with sole crop of coriander produced significantly more dry matter as compared to castor + coriander intercrop combination. This trend was reflected at rest of the sowing dates also during both the years.

Treatments	Days after sowing																													
	30						45						60						75						90					
	Stem and leaf	Total	Stem	Lea ves	Pods	Total	Stem	Leaves	Pods	Total	Stem	Lea ves	Pods	Total	Stem	Lea ves	Pods	Total	Stem	Lea ves	Pods	Total								
D ₁	0.57	0.57	1.30	0.98	0.34	2.62	2.41	1.46	0.50	4.37	2.06	1.13	0.65	3.84	1.81	0.16	1.13	3.14												
D ₂	0.45	0.45	1.00	0.58	0.27	1.85	2.01	0.83	0.43	3.27	1.61	0.56	0.56	2.73	1.22	0.13	0.74	2.09												
D ₃	0.40	0.40	0.77	0.36	0.19	1.32	1.02	0.44	0.30	1.76	0.87	0.30	0.43	1.60	0.69	0.09	0.56	1.33												
S.E.+ C.D. at 5%																			0.01 0.04											
T ₂	0.47	0.47	0.94	0.63	0.25	1.82	1.82	0.83	0.39	3.04	1.50	0.57	0.51	2.58	1.30	0.14	0.69	2.11												
T ₃	0.41	0.41	0.79	0.41	0.11	1.31	1.29	0.66	0.21	2.16	1.04	0.41	0.36	1.81	0.82	0.09	0.54	1.45												
T ₈	0.54	0.54	1.33	0.88	0.44	2.65	2.34	1.24	0.64	4.22	2.01	1.00	0.78	3.79	1.60	0.16	1.19	3.01												
S.E.+ C.D. at 5%																			0.01 0.04											
S.E.+(D x T) C.D. at 5%																			0.02 0.06											
Mean	0.47	0.47	1.02	0.64	0.27	1.93	1.82	0.91	0.41	3.13	1.51	0.66	0.55	2.72	1.24	0.08	0.80	2.12												

Table 115(b): Dry matter accumulation(g/plant) of coriander at different growth stages as influenced by various treatments during 1981-82

Treatments	Days after sowing																													
	30						45						60						75						90					
	Stem and leaf	Total	Stem	Leaf	Pods	ves	Total	Stem	Leaf	Pods	ves	Total	Stem	Leaf	Pods	ves	Total	Stem	Leaf	Pods	ves	Total	Stem	Leaf	Pods	ves	Total			
D ₁	0.35	0.35	0.87	0.59	0.19	1.65	1.42	1.09	0.32	2.83	1.17	0.89	0.45	2.51	1.07	0.16	0.62	1.79												
D ₂	0.30	0.30	0.77	0.47	0.15	1.39	1.13	0.72	0.23	2.08	0.94	0.51	0.40	1.85	0.76	0.13	0.47	1.29												
D ₃	0.22	0.22	0.67	0.32	0.11	1.10	0.81	0.55	0.18	1.54	0.59	0.36	0.35	1.30	0.51	0.09	0.34	0.90												
S.E.+																														
C.D. at 5%																														
T ₂	0.27	0.27	0.78	0.42	0.14	1.34	1.11	0.67	0.22	2.00	0.94	0.50	0.35	1.79	0.87	0.14	0.43	1.37												
T ₃	0.25	0.25	0.55	0.28	0.06	0.89	0.70	0.54	0.11	0.35	0.46	0.40	0.30	1.16	0.37	0.09	0.34	0.76												
T ₈	0.35	0.35	0.98	0.68	0.26	1.92	1.56	1.16	0.40	3.12	1.31	0.86	0.55	2.72	1.11	0.16	0.65	1.85												
S.E.+																														
C.D. at 5%																														
S.E.+ (D x T)																														
C.D. at 5%																														
Mean	0.29	0.29	0.77	0.46	0.15	1.38	1.12	0.79	0.24	2.15	0.90	0.59	0.40	1.89	0.78	0.13	0.47	1.38												

Table 116: Dry matter accumulation per plant(g/plant) as influenced by interaction D x T at harvest.

Treatments	Dates of sowing					
	1980-81			1981-82		
	D ₁	D ₂	D ₃	D ₁	D ₂	D ₃
T ₂	3.12	1.89	1.31	1.87	1.32	0.92
T ₃	2.09	1.34	0.91	1.07	0.72	0.49
T ₈	4.22	3.05	1.77	2.42	1.84	1.29
S.E. ±	0.020			0.010		
C.D. at 5%	0.060			0.040		

4.7.1.3 Post harvest studies :

Data pertaining to post harvest studies of coriander i.e. number of umbels, number of grains and test weight recorded during 1980-81 and 1981-82 are presented in Table 117.

The data indicated significant differences due to dates of sowing, treatments and their interaction during both the years for all the above characters.

Sowing on 29th Met.week produced significantly more number of umbels, number of pods and test weight as compared to rest of the sowing dates. This was followed by sowing on 31st Met.week and was significantly superior over sowing on 33rd Met. week.

Sole crop of coriander produced significantly more number of umbels number of pods (grain) and test weight as compared to castor + coriander intercrop combinations. This was followed by castor + coriander one row crop combination.

Table 117: Mean number of umbels, number of grains per plant and test weight of coriander as influenced by different treatments during 1980-81 and 1981-82

Treatments	No. of umbels/plant 1980-81	No. of umbels/plant 1981-82	No. of grains/plant 1980-81	No. of grains/plant 1981-82	1,000 grain weight(g) 1980-81	1,000 grain weight(g) 1981-82
D ₁	5.00	3.78	76.32	50.84	11.96	12.33
D ₂	3.93	3.01	58.06	38.53	11.60	11.84
D ₃	3.25	2.57	43.66	29.53	10.75	11.27
S.E. +	0.01	0.02	0.01	0.17	0.01	0.04
C.D. at 5%	0.03	0.06	0.03	0.51	0.02	0.12
T ₂	4.02	3.15	56.67	36.10	11.43	11.67
T ₃	3.16	2.52	46.99	29.06	11.12	11.36
T ₈	5.05	3.96	76.38	54.14	11.76	12.51
S.E. +	0.01	0.02	0.01	0.17	0.01	0.04
C.D. at 5%	0.03	0.06	0.03	0.51	0.02	0.12
S.E. + (D x T)	0.02	0.04	0.01	0.29	0.02	0.07
C.D. at 5%	0.05	0.11	0.02	0.88	N.S.	0.21
Mean	4.06	3.12	59.35	39.63	11.44	11.81

The treatment combination (Table 118, 119 and 120) of sowing on 29th Met. week with sole crop of coriander produced significantly more number of umbels, number of pods (grain) and test weight as compared to castor + coriander intercrop combination during both the years except during the first year for test weight where there were no significant interactions.

Table 118: Mean number of umbels per plant as influenced by interaction D x T at harvest.

Treatments	Dates of sowing					
	1980-81			1981-82		
	D ₁	D ₂	D ₃	D ₁	D ₂	D ₃
T ₂	4.98	4.00	3.09	3.84	3.05	2.57
T ₃	4.00	2.99	2.49	3.06	2.47	2.03
T ₈	6.02	4.98	4.16	4.45	3.50	3.12
S.E. $\pm$	0.020			0.040		
C.D. at 5%	0.050			0.110		

Table 119: Mean number of grains per plants as influenced by interaction D x T at harvest.

T ₂	75.00	54.00	41.00	49.87	33.00	25.43
T ₃	64.99	44.99	30.99	36.90	28.90	21.40
T ₈	94.98	75.18	53.98	65.77	54.99	41.77
S.E. $\pm$	0.010			0.290		
C.D. at 5%	0.020			0.880		

Table 120: Test weight(1000 grain weight in g) as influenced by interaction D x T at harvest (1981)

Treatments	Dates of sowing		
	D ₁	D ₂	D ₃
T ₂	12.15	11.76	11.08
T ₃	12.10	11.11	10.57
T ₈	12.73	12.64	12.16
S.E. $\pm$	0.070		
C.D. at 5%	0.210		

4.7.1.4 Yield :

Data on grain and straw yield kg/ha of coriander during 1980-81 and 1981-82 are presented in Table 121.

The data indicated significant differences due to dates of sowing, treatments and their interaction during both the years.

Sowing on 29th Met.week produced significantly more grain and straw yield kg/ha as compared to rest of the sowing dates. This was followed by sowing on 31st Met.week and produced significantly more grain and straw yield as compared to sowing on 33rd Met.week.

Sole crop of coriander produced significantly more grain and straw weight as compared to the treatments castor + coriander one and two row crop combinations. This was followed by the treatment castor + coriander two row crop combination and was significantly superior over the treatment castor + coriander one row crop combination.

Table 121: Yield of grain and straw of coriander in kg/ha during 1980-81 and 1981-82

Treatments	Grain yield kg/ha		Straw yield kg/ha	
	1980-81	1981-82	1980-81	1981-82
D ₁	354.59	190.52	288.06	320.82
D ₂	267.14	148.03	257.20	211.28
D ₃	169.41	116.98	205.76	188.42
S.E. $\pm$	17.69	1.93	11.40	3.39
C.D. at 5%	53.02	5.78	34.25	10.15
T ₂	141.97	71.06	142.13	145.36
T ₃	242.11	119.45	254.53	210.71
T ₈	407.40	265.01	354.36	364.45
S.E. $\pm$	17.69	1.93	11.40	3.39
C.D. at 5%	53.02	5.78	34.25	10.15
S.E. $\pm$ (D x T)	30.63	3.34	19.75	5.87
C.D. at 5%	91.83	10.00	59.21	17.59
Mean	263.71	151.84	250.34	240.13

Sowing on 29th Met. week with sole crop of coriander produced significantly more grain and straw yield as compared to rest of the treatment combination. This was followed by the treatment combination of castor + coriander two row crop combination and was significantly superior over the treatment castor + coriander one row crop combination. The above trend was also seen over rest of the sowing dates. (Table 122 and 123).

Table 122 : Grain yield (kg/ha) of coriander as influenced by D x T interaction at harvest.

Treatments	Dates of sowing					
	1980-81			1981-82		
	D ₁	D ₂	D ₃	D ₁	D ₂	D ₃
T ₂	172.61	156.60	97.16	86.88	70.30	56.01
T ₃	331.50	251.48	142.89	158.89	113.74	85.73
T ₈	560.12	393.23	268.63	325.78	260.06	209.19
S.E. $\pm$	36.630			3.340		
C.D. at 5%	91.830			10.000		

Table 123: Coriander straw yield(kg/ha) as influenced by D x T interaction at harvest.

T ₂	144.03	149.75	132.60	181.18	138.32	116.60
T ₃	274.34	274.06	217.19	226.91	208.62	196.61
T ₈	445.81	349.79	267.49	554.40	286.92	252.05
S.E. $\pm$	19.750			5.870		
C.D. at 5%	59.210			17.590		

4.7.2 Pigeonpea :

4.7.2.1 Biometric observations :

Data on mean plant height, number of leaves, leaf area, and number of branches per plant of pigeonpea variety T-21 at various growth stages during 1980-81 and 1981-82 are presented in Tables 124, 125, 126 and 127.

The data revealed that the rate of increase of plant height was very slow upto 45 days after sowing very fast between 45 to 90 days after sowing and relatively slow thereafter.

The number of leaves and leaf area was slow upto 45 days after sowing and very fast between 45 to 90 days after sowing. The number of leaves increased slowly between 90 to 105 days but adding no additional leaf area due to older leaves dropping and number of fresh leaves sprouting. The number of leaves were decreased and consequently the leaf area from 120 days was reduced till harvest.

The number of branches increased very fast between 45 to 90 days after sowing but relatively slow between 90 to 105 days after sowing and remained constant from 120 days till harvest. The number of pods increased from 90 to 120 days after sowing and remained more or less constant till harvest.

Statistical analysis for the data at harvest indicated significant differences due to dates of sowing, treatments and their interactions for the above characters.

Table 124: Mean height of pigeonpea variety T-21(cm) at different growth stages

Treatments	Days after sowing							
	30	45	60	75	90	105	120	135
<u>1980-81</u>								
D ₁	21.90	37.07	60.40	77.40	84.47	87.90	88.57	88.84
D ₂	21.13	31.13	54.17	63.90	72.63	66.07	77.37	77.66
D ₃	10.27	15.43	34.47	44.28	48.03	50.38	50.87	50.99
S.E.+								0.08
C.D. at 5%								0.25
T ₄	18.57	27.83	48.77	60.42	64.97	67.27	67.90	66.43
T ₅	17.40	26.03	52.37	64.20	68.33	71.02	72.00	70.69
T ₉	17.33	29.77	47.90	62.97	71.83	76.07	76.90	77.02
S.E.+								0.08
C.D. at 5%								0.25
S.E.+(D x T)								0.14
C.D. at 5%								0.43
<u>1981-82</u>								
D ₁	20.93	30.77	55.23	73.20	79.33	82.03	83.70	83.90
D ₂	19.47	26.60	47.90	60.10	67.20	70.90	73.33	73.51
D ₃	10.40	15.10	32.97	42.10	46.43	50.17	50.53	50.61
S.E. +								0.06
C.D. at 5%								0.17
T ₄	16.80	23.77	44.37	56.07	59.87	62.67	63.83	62.20
T ₅	17.83	25.67	48.80	61.17	65.83	68.30	70.07	71.02
T ₉	16.17	23.03	42.93	58.17	67.27	72.13	73.67	74.80
S.E.+								0.06
C.D. at 5%								0.17
S.E.+(D x T)								0.10
C.D. at 5%								0.29

Table 125: Mean number of leaves per plant of pigeonpea variety T-21 at different growth stages

[illegible]

Table 126: Mean leaf area (cm^2) per plant of pigeonpea variety T-21 at various growth stages

Treat- ments	Days after sowing							
	30	45	60	75	90	105	120	135
<u>1980-81</u>								
D ₁	153.13	255.05	341.19	435.02	622.52	571.17	390.36	248.97
D ₂	129.36	189.68	225.74	322.64	336.92	351.70	218.09	93.62
D ₃	71.44	107.64	141.00	175.01	206.57	196.74	115.15	38.02
S.E.+								0.12
C.D. at 5%								0.37
T ₄	118.36	205.31	262.79	324.85	398.27	376.69	265.71	145.00
T ₅	116.67	141.12	149.57	169.84	117.01	228.49	143.82	66.60
T ₉	118.90	205.93	295.57	437.99	150.73	514.34	314.06	168.01
S.E.+								0.12
C.D. at 5%								0.37
S.E.+(D x T)								0.21
C.D. at 5%								0.64
<u>1981-82</u>								
D ₁	173.95	260.44	354.66	427.67	576.51	552.13	390.39	251.82
D ₂	149.94	188.87	229.51	275.46	305.91	307.30	199.50	90.64
D ₃	96.14	105.94	130.32	181.98	192.20	188.70	115.17	47.09
S.E.+								0.13
C.D. at 5%								0.40
T ₄	134.75	192.72	232.06	287.81	356.67	345.89	265.95	150.36
T ₅	145.68	160.99	143.08	156.09	202.86	207.88	134.25	62.69
T ₉	139.60	202.43	339.34	141.22	515.09	494.36	302.87	173.50
S.E.+								0.13
C.D. at 5%								0.40
S.E.+(D x T)								0.23
C.D. at 5%								0.69

Table 127: Mean number of branches per plant of pigeonpea variety T-21 at different growth stages

Treat- ments	1980-81						
	Days after sowing						
	45	60	75	90	105	120	135
D ₁	3.50	4.27	6.23	7.37	7.60	7.60	7.59
D ₂	3.10	3.32	3.60	3.87	4.30	4.27	4.22
D ₃	2.50	2.67	3.04	3.35	3.83	3.73	3.69
S.E.+ C.D. at 5%							0.02 0.05
T ₄	3.72	3.32	4.15	5.17	5.70	5.70	5.65
T ₅	2.80	2.88	3.37	3.27	3.57	3.53	3.53
T ₉	3.25	4.05	5.36	6.14	6.47	6.37	6.31
S.E. + C.D. at 5%							0.02 0.05
S.E.+(D x T) C.D. at 5%							0.03 0.09
<u>1981-82</u>							
D ₁	3.45	4.26	5.43	6.77	7.33	7.40	7.40
D ₂	2.17	2.90	3.36	3.77	4.33	4.43	4.33
D ₃	2.33	2.62	2.92	3.21	3.74	3.48	3.75
S.E.+ C.D. at 5%							0.02 0.05
T ₄	2.82	3.30	4.02	5.08	5.63	5.55	5.50
T ₅	2.47	2.59	2.82	3.05	3.55	3.42	3.66
T ₉	2.67	3.89	4.88	5.61	6.22	6.35	6.33
S.E. + C.D. at 5%							0.02 0.05
S.E.+(D x T) C.D. at 5%							0.03 0.08

Sowing on 29th Met.week produced significantly more height, number of leaves, leaf area and number of branches over rest of the sowing dates. This was followed by sowing on 31st Met.week and was significantly superior over sowing on 33rd Met.week.

Sole crop of pigeonpea registered significantly more height, as compared to castor + pigeonpea intercrop combination. This was followed by castor + pigeonpea two row crop combination.

The treatment combination (Table 128) sowing on 29th Met.week with sole crop of pigeonpea produced significantly more height over rest of the intercrop combination with pigeonpea.

Table 128: Mean height of pigeonpea(cm) as influenced by D x T interaction at harvest.

Treatments	Dates of sowing					
	1980-81			1981-82		
	D ₁	D ₂	D ₃	D ₁	D ₂	D ₃
T ₄	81.40	72.03	45.88	78.33	62.67	45.60
T ₅	83.51	77.17	51.40	85.33	76.67	51.07
T ₉	91.60	83.77	55.70	88.03	81.20	55.17
S.E. $\pm$	0.140			0.100		
C.D. at 5%	0.430			0.290		

This was followed by castor + pigeonpea two row crop combination. This trend was observed over rest of the sowing dates during both the years.

Sole crop of pigeonpea also produced significantly more number of leaves, leaf area and number of branches over rest of the intercrop combination viz., castor + pigeonpea one row and two row crop combination. This was followed by castor + pigeonpea one row crop combination.

The treatment combination of sowing on 29th Met.week (Table 129, 130 and 131) with sole crop of pigeonpea produced significantly more number of leaves, leaf area and number of branches over rest of the treatment combination i.e. castor + pigeonpea one row crop combination.

Table 129: Mean number of functional leaves per plant as influenced by D x T interaction at harvest.

Treatments	Dates of sowing					
	1980-81			1981-82		
	D ₁	D ₂	D ₃	D ₁	D ₂	D ₃
T ₄	40.50	21.43	14.35	43.23	20.76	20.56
T ₅	21.78	15.84	10.12	20.22	14.25	9.98
T ₉	52.08	40.50	24.86	51.51	40.29	30.10
S.E. + $\frac{1}{2}$	0.060			0.040		
C.D. at 5%	0.180			0.130		

Table 130: Mean leaf area (cm²) as influenced by interaction D x T at harvest.

T ₄	303.58	94.52	36.90	315.68	91.54	52.87
T ₅	128.12	52.38	22.31	118.91	47.14	22.01
T ₉	315.21	133.97	54.86	320.88	133.25	66.37
S.E. + $\frac{1}{2}$	0.210			0.230		
C.D. at 5%	0.640			0.690		

Table 131 : Mean number of branches per plant as influenced by D x T interaction at harvest

Treatments	Dates of sowing					
	1980-81			1981-82		
	D ₁	D ₂	D ₃	D ₁	D ₂	D ₃
T ₄	8.60	4.42	3.92	8.45	4.36	3.70
T ₅	4.29	3.28	3.01	4.29	3.05	3.64
T ₉	9.88	4.95	4.11	9.46	5.59	3.93
S.E. $\pm$	0.030			0.030		
C.D. at 5%	0.090			0.090		

This was followed by the treatment combination of castor + pigeonpea one intercrop combination. This trend was observed over the rest of the sowing dates during both the years for all the characters mentioned above.

4.7.2.2 Dry matter :

Data on total dry matter per plant of pigeonpea and its parts viz., stem, leaves and pods recorded in g at various growth stages during 1980-81 and 1981-82 are presented in Table 132 (a) and (b) respectively.

The data revealed that the total dry matter increased at every stage and the increase was more between 60 to 120 days after sowing and thereafter the increase was very slow.

Table 132(A): Dry matter accumulation (g/plant) of pigeonpea variety T-21 at different growth stages as influenced by various treatments during 1980-81

Treatments	Days after sowing														
	30			45			60			75			90		
	Stem	Lea-	Total	Stem	Lea-	Total	Stem	Lea-	Total	Stem	Lea-	Total	Stem	Lea-	Total
	ves	ves		ves	ves		ves	ves		ves	ves		ves	ves	
D ₁	1.87	2.47	1.43	3.90	5.93	2.28	8.21	9.26	3.25	12.51	17.07	5.58	2.62	25.27	
D ₂	1.24	1.90	0.96	2.86	3.53	1.45	4.98	6.50	2.52	9.02	10.83	4.43	1.67	16.93	
D ₃	0.87	1.72	0.50	2.22	2.52	0.88	3.40	3.59	1.92	5.51	5.67	2.55	1.06	9.28	
S.E.+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
C.D. at 5%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
T ₄	1.35	2.07	0.79	2.86	3.90	1.36	5.26	5.42	2.50	7.92	10.40	4.16	1.63	16.19	
T ₅	1.31	1.83	0.84	2.67	3.24	0.96	4.20	4.93	1.68	6.61	6.17	2.42	1.01	9.60	
T ₉	1.32	2.18	1.26	3.44	4.85	2.29	7.14	9.00	3.51	12.51	17.00	5.98	2.72	25.70	
S.E. +	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
C.D. at 5%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
S.E.+(D x T)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
C.D. at 5%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	

Contd....

Table 132(A) Contd.

[illegible]

Table 132(B): Dry matter accumulation(g/plant) of pigeonpea variety T-21 at different growth stages as influenced by various treatments during 1981-82.

Treat- ments	Days after sowing											
	30			45			60			75		
	Stem	Lea-	Total	Stem	Lea-	Total	Stem	Lea-	Total	Stem	Lea-	Total
	ves	ves		ves	ves		ves	ves		ves	ves	
D ₁	2.30	3.34	1.18	4.52	6.67	2.14	8.81	9.62	3.37	12.99	14.44	5.28
D ₂	1.77	2.18	0.94	3.12	4.32	1.05	5.37	7.00	1.42	8.42	9.93	3.64
D ₃	1.32	1.78	0.53	2.31	2.88	0.81	3.69	3.86	1.78	5.64	4.08	2.05
S.E.+	-	-	-	-	-	-	-	-	-	-	-	-
C.D. at 5%	-	-	-	-	-	-	-	-	-	-	-	-
T ₄	1.73	2.44	0.87	3.31	4.80	1.24	6.04	6.45	2.17	8.62	8.30	3.71
T ₅	1.83	2.32	0.77	3.09	2.89	0.89	3.78	3.93	1.33	5.26	4.60	2.32
T ₉	1.82	2.54	1.01	3.55	6.18	1.86	8.04	10.08	3.07	13.15	15.55	4.95
S.E. +	-	-	-	-	-	-	-	-	-	-	-	-
C.D. at 5%	-	-	-	-	-	-	-	-	-	-	-	-
S.E.+(D×T)	-	-	-	-	-	-	-	-	-	-	-	-
C.D. at 5%	-	-	-	-	-	-	-	-	-	-	-	-

Contd....

Table 132(B) Contd.

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Treatments	Days after sowing											
	105				120				135			
	Stem	Lea- ves	Pods	Total	Stem	Lea- ves	Pods	Total	Stem	Lea- ves	Pods	Total
D ₁	16.50	5.95	4.57	27.02	15.81	4.91	7.62	28.34	14.86	4.67	7.67	27.20
D ₂	13.50	4.82	3.66	21.98	11.90	3.99	5.54	21.43	11.65	3.68	5.66	22.99
D ₃	6.48	2.94	2.46	11.88	5.55	2.57	3.67	11.79	5.47	2.30	3.83	11.60
S.E. _t									0.02	0.01	0.02	0.03
C.D. at 5%									0.05	0.02	0.06	0.09
T ₄	11.03	4.68	3.47	19.18	10.06	3.99	5.33	19.38	9.81	3.74	5.41	18.96
T ₅	6.72	3.05	2.18	11.95	5.91	2.26	4.16	12.33	5.63	2.00	4.28	11.91
T ₉	18.73	5.97	5.05	29.75	17.28	5.22	7.34	29.84	16.54	4.92	7.46	28.92
S.E. _t									0.02	0.01	0.02	0.03
C.D. at 5%									0.05	0.02	0.06	0.09
S.E. _t (D x T)									0.03	0.01	0.03	0.04
C.D. at 5%									0.08	0.03	0.10	0.13

The data on total dry matter at harvest was subjected to statistical analysis and it indicated significant differences due to dates of sowing, treatments and their interactions during both the years.

Sowing on 29th Met.week produced more dry matter at all stages and at harvest it was significantly superior over rest of the sowing dates. This was followed by sowing on 31st Met.week at all stages and at harvest produced significantly more dry matter over 33rd Met.week.

Sole crop of pigeonpea produced more dry matter at all stages and at harvest it was significantly superior over rest of the intercrop combination, with pigeonpea. This was followed by castor + pigeonpea one row crop combination and at harvest it produced significantly more dry matter over castor + pigeonpea two row crop combination.

The interaction effects due to D x T were also significant (Table 133). The treatment combination of sowing on 29th Met.week with sole crop of pigeonpea produced significantly more dry matter as compared to castor + pigeonpea one row and two row crop combination. This was followed by castor + pigeonpea one row crop combination. This trend was seen over rest of the sowing dates during both the years.

Table 133: Dry matter accumulation per plant of pigeonpea(g/plant) as influenced by D x T interaction at harvest.

Treatments	Dates of sowing					
	1980-81			1981-82		
	D ₁	D ₂	D ₃	D ₁	D ₂	D ₃
T ₄	27.82	19.15	10.85	26.05	19.85	10.99
T ₅	18.33	11.53	9.55	15.16	11.85	8.72
T ₉	42.48	31.50	16.93	40.40	31.27	15.08
S.E. $\pm$	0.030			0.040		
C.D. at 5%	0.100			0.130		

4.7.2.3 Post harvest :

Data pertaining to number of pods per plant, weight of grain per plant and test weight of pigeonpea recorded during 1980-81 and 1981-82 are presented in Table 134.

The data indicated significant differences due to dates of sowing, treatments and their interactions for the above characters during both the years.

Sowing on 29th Met.week produced significantly more number of pods, weight of grains and test weight over rest of the sowing dates. This was followed by sowing on 31st Met.week and was significantly superior over sowing on 33rd Met.week.

Sole crop of pigeonpea produced significantly more number of pods, weight of grain and test weight as compared to rest of the treatments i.e. castor + pigeonpea one and two row

Table 134: Number of pods, weight of grains(g) per plant and test weight(g) of pigeonpea variety T-21 as influenced by different treatments during 1980-81 and 1981-82

Treat- ments.	No. of pods per plant		Weight of grains per plant(g)		1000 grain weight(g)	
	1980- 81	1981- 82	1980- 81	1981- 82	1980- 81	1981- 82
D ₁	24.97	21.93	5.47	5.03	71.47	70.60
D ₂	17.57	13.52	3.78	3.49	69.16	68.87
D ₃	12.54	8.89	2.79	2.41	66.68	66.03
S.E.+	0.06	0.02	0.07	0.05	0.31	0.19
C.D. at 5%	0.17	0.06	0.20	0.16	0.93	0.58
T ₄	17.73	13.49	3.89	3.42	66.70	64.50
T ₅	12.98	9.89	2.75	2.63	68.82	68.54
T ₉	24.35	20.96	5.39	4.88	71.79	72.46
S.E.+	0.06	0.02	0.07	0.05	0.31	0.19
C.D. at 5%	0.17	0.06	0.20	0.16	0.93	0.58
S.E.+ (D x T)	0.10	0.03	0.11	0.09	0.54	0.33
C.D. at 5%	0.30	0.10	0.34	0.27	N.S.	1.00

crop combinations. This was followed by castor + pigeonpea one row crop combination for number of pods and weight of grains. While castor + pigeonpea two row crop combination followed the sole crop of pigeonpea in respect of test weight.

Sowing on 29th Met. week with sole crop of pigeonpea (Table 135, 136 and 137) produced significantly more number of pods, weight of grain during both the years and test weight only during 2nd year as compared to pigeonpea intercropped with castor in one or two rows crop combinations.

Table 135: Mean number of pods per plant as influenced by D x T interaction at harvest.

Treatments	Dates of sowing					
	1980-81			1981-82		
	D ₁	D ₂	D ₃	D ₁	D ₂	D ₃
T ₄	24.50	15.53	13.17	19.27	12.64	8.57
T ₅	17.22	12.13	9.60	14.55	9.46	5.64
T ₉	33.18	25.03	14.84	32.00	18.46	12.43
S.E. $\pm$	0.100			0.030		
C.D. at 5%	0.300			0.100		

Table 136 : Weight of grain (g/plant) of pigeonpea as influenced by D x T interaction at harvest.

T ₄	5.57	3.20	2.92	4.74	3.20	2.33
T ₅	3.63	2.63	1.99	3.53	2.72	1.65
T ₉	7.20	5.51	3.47	6.82	4.57	3.25
S.E. $\pm$	0.110			0.090		
C.D. at 5%	0.340			0.270		

Table 137 : Test weight (1000 grain weight in g) as influenced by D x T interaction at harvest during 1981-82

Treatments	Dates of sowing		
	D ₁	D ₂	D ₃
T ₄	65.23	64.86	53.36
T ₅	70.94	68.48	56.20
T ₉	75.57	73.27	68.54
S.E. $\pm$	0.330		
C.D. at 5%	1.000		

This was followed by castor + pigeonpea one row crop combination for number of pods and weight of grain. While for test weight during the second year castor + pigeonpea two row crop combination followed the sole crop of pigeonpea. This trend was seen over rest of the sowing dates during both the years for number of pods and weight of grain and during second year for test weight.

4.7.2.4 Yield :

Data on grain and straw yield (kg/ha) of pigeonpea during 1980-81 and 1981-82 are presented in Table 138.

The data indicated significantly differences due to dates of sowing, treatments and their interactions during both the years.

Sowing on 29th Met.week produced significantly more grain and straw yield as compared to rest of the sowing dates. This was followed by sowing on 31st Met.week and produced significantly more grain and straw yield over sowing on 33rd Met.week.

Table 138: Grain and straw yield of pigeonpea variety T-21
(kg/ha) and their ratios

Treat- ments	Grain yield kg/ha		Straw yield kg/ha		Grain/straw ratio	
	1980- 81	1981- 82	1980- 81	1981- 82	1980- 81	1981- 82
D ₁	273.58	255.29	793.31	1400.30	0.340	0.176
D ₂	206.33	183.85	760.54	1182.16	0.270	0.151
D ₃	155.08	131.27	569.64	821.32	0.280	0.156
S.E.+ _u	11.23	4.91	15.71	11.88	0.010	0.003
C.D.at5%	33.65	14.72	42.11	35.62	0.040	0.009
T ₄	134.89	111.83	472.29	823.41	0.290	0.138
T ₅	174.13	168.42	727.39	1134.15	0.250	0.147
T ₉	325.97	290.16	922.10	1446.21	0.370	0.198
S.E.+ _u	11.23	4.91	15.71	11.88	0.010	0.003
C.D.at 5%	33.65	14.72	42.11	35.62	0.040	0.009
S.E.+ _u (DxT)	19.45	8.50	27.22	20.58	0.020	0.005
C.D.at5%	58.29	25.49	81.60	61.70	0.060	0.016

Sole crop of pigeonpea produced significantly more grain and straw yield as compared to the treatments castor + one row pigeonpea and castor + two row of pigeonpea. The above treatment was followed by the treatment castor + two row pigeonpea and was significantly superior over the treatment castor + one row pigeonpea.

The interaction effect of sowing on 29th Met. week with sole crop of pigeonpea produced significantly more grain and straw yields over the rest of the treatment combinations with pigeonpea. This was followed by the treatment combination of castor + two rows of pigeonpea and was significantly superior over castor + one row of pigeonpea (Table 139 and 140).

Table 139: Grain yield(kg/ha) of pigeonpea as influenced by D x T interaction at harvest.

Treatments	Dates of sowing					
	1980-81			1981-82		
	D ₁	D ₂	D ₃	D ₁	D ₂	D ₃
T ₄	185.18	108.59	110.88	160.03	106.88	68.59
T ₅	240.05	154.32	128.03	212.62	184.04	108.59
T ₉	395.51	356.08	226.30	392.54	260.63	216.62
S.E. $\pm$	19.450			8.500		
C.D. at 5%	58.290			25.490		

Table 140: Pigeonpea straw yield (kg/ha) as influenced by D x T interaction at harvest.

Treatments	Dates of sowing					
	1980-81			1981-82		
	D ₁	D ₂	D ₃	D ₁	D ₂	D ₃
T ₄	552.12	364.08	500.68	1149.96	868.76	851.52
T ₅	661.85	891.62	628.70	1344.29	1271.70	786.45
T ₉	1063.08	1025.93	579.55	1706.65	1406.01	1225.97
S.E. +	27.220			20.580		
C.D. at 5%	81.600			61.700		

This trend was also seen over rest of the sowing dates.

4.7.3 Sesamum :

4.7.3.1 Biometric observation :

Data on mean plant height, number of leaves and number of branches per plant sesamum variety N-85 at different growth stages during 1980-81 and 1981-82 are presented in Tables 141, 142 and 143.

The data revealed that the rate of increase of plant height was very slow upto 30 days after sowing, very fast between 30 to 60 days after sowing and relatively very slow thereafter. The number of leaves increased upto 60 days after sowing. The rate of increase in number of leaves was slow upto 30 days after sowing and very fast between 30 to 60 days after sowing, thereafter, there was a decline in number of leaves due to leaf drop.

Table 141: Mean height of sesamum variety N-85 (cm) at different growth stages

Treat- ments	Days after sowing						
	30	45	60	75	90	105	120
<u>1980-81</u>							
D ₁							
D ₁	10.80	54.70	80.10	80.27	80.60	80.60	80.57
D ₂	12.00	24.50	51.53	51.23	51.30	51.73	50.40
D ₃	6.73	16.50	42.56	43.13	43.14	43.14	43.17
S.E.+							0.06
C.D. _{at 5%}							0.19
T ₆	11.60	32.77	57.40	57.53	57.60	57.60	57.53
T ₇	8.98	35.23	62.03	61.43	61.57	62.20	61.50
T ₁₀	8.96	27.70	54.76	55.67	55.88	55.68	55.10
S.E.+							0.06
C.D. _{at 5%}							0.19
S.E.+(D x T)							0.11
C.D. _{at 5%}							0.32
<u>1981-82</u>							
D ₁	3.20	43.79	80.23	80.33	80.53	80.63	80.67
D ₂	2.60	23.40	53.73	53.93	54.50	54.60	54.53
D ₃	6.23	18.90	42.17	42.93	43.17	43.27	43.43
S.E.+							0.06
C.D. _{at 5%}							0.17
T ₆	4.07	29.19	57.27	57.50	57.67	57.73	57.67
T ₇	3.73	31.50	64.37	64.40	64.53	64.57	64.57
T ₁₀	4.23	25.40	54.50	55.30	56.00	56.20	56.30
S.E.+							0.06
C.D. _{at 5%}							0.17
S.E.+(D x T)							0.10
C.D. _{at 5%}							0.30

Table 142: Mean number of leaves per plant of sesamum variety N-85 at different growth stages

Treat- ments	Days after sowing						
	30	45	60	75	90	105	120
<u>1980-81</u>							
D ₁	10.57	28.40	49.47	38.73	34.47	31.93	30.36
D ₂	9.33	17.47	30.22	27.77	24.83	20.03	17.95
D ₃	7.33	14.80	19.48	15.07	13.27	12.17	10.58
S.E.+ C.D. at 5%							0.03 0.10
T ₆	8.97	21.49	35.48	28.20	25.53	22.57	20.26
T ₇	9.23	11.43	18.99	15.47	12.63	11.20	9.31
T ₁₀	9.03	27.83	44.70	37.90	34.40	32.37	29.32
S.E.+ C.D. at 5%							0.03 0.10
S.E.+(D x T) C.D. at 5%							0.06 0.18
<u>1980-81</u>							
D ₁	6.20	28.20	47.33	42.93	38.73	35.20	31.07
D ₂	5.67	16.27	29.50	26.40	21.33	17.60	14.81
D ₃	7.27	13.20	22.07	15.31	13.87	11.75	10.84
S.E.+ C.D. at 5%							0.03 0.10
T ₆	6.17	19.00	37.33	30.10	25.97	23.10	19.38
T ₇	5.43	12.53	18.83	16.23	13.30	11.78	10.45
T ₁₀	7.53	26.13	42.73	38.31	34.67	29.67	26.89
S.E.+ C.D. at 5%							0.03 0.10
S.E.+(D x T) C.D. at 5%							0.06 0.18

Table 143: Mean number of branches per plant of sesamum variety N-85 at different growth stages.

Treatments	Days after sowing					
	45	60	75	90	105	120
<u>1980-81</u>						
D ₁	1.70	2.07	2.71	2.87	2.87	2.90
D ₂	1.05	1.80	2.32	2.77	2.73	2.72
D ₃	0.37	2.00	2.20	2.30	2.27	2.28
S.E. +						0.03
C.D. at 5%						0.08
T ₆	1.15	2.13	2.41	2.73	2.72	2.71
T ₇	0.40	1.37	2.03	2.23	2.20	2.22
T ₈₀	1.57	2.37	2.78	2.97	2.95	2.97
S.E. +						0.03
C.D. at 5%						0.08
S.E.+(D x T)						0.04
C.D. at 5%						0.13
<u>1981-82</u>						
D ₁	3.87	4.07	2.07	2.93	3.03	3.03
D ₂	1.07	1.87	2.63	2.43	2.43	2.47
D ₃	0.20	1.80	1.80	1.83	1.83	1.86
S.E. +						0.03
C.D. at 5%						0.08
T ₆	1.40	2.27	2.10	2.43	2.43	2.45
T ₇	2.60	3.13	1.80	2.00	2.10	2.12
T ₁₀	1.13	2.33	2.60	2.77	2.77	2.79
S.E. +						0.03
C.D. at 5%						0.08
S.E.+(D x T)						0.05
C.D. at 5%						0.15

The number of branches increased very fast between 45 to 95 days after sowing thereafter the increase was rather very slow upto 90 days after sowing and thereafter it remained more or less constant till harvest.

In general, the sowing on 29th Met.week recorded more height more number of leaves and more number of branches at all stages and significantly more at harvest as compared to rest of the sowing dates. This was followed by sowing on 31st Met.week at harvest and was significantly superior over sowing on 33rd Met.week.

At harvest the treatment castor + sesamum two row crop combination recorded significantly more height as compared to sole cropping of sesamum and castor + sesamum one row crop combination. This was followed by castor + sesamum one row crop combination and was significantly superior over sole crop of sesamum at harvest.

While at harvest the number of leaves and number of branches were significantly more in the sole crop of sesamum as compared to castor + sesamum one and two row crop combination. This was followed by castor + sesamum one row crop combination, and was significantly superior over castor + two row of sesamum.

The interaction effect of sowing on 29th Met.week (Table 144) with castor + sesamum two row crop combination produced significantly more height over other treatment combinations at

harvest.. This was followed by castor + sesamum one row crop combination and was significantly superior over sole crop of sesamum.. This trend was seen over rest of the sowing dates also during both the years..

Table 144 : Mean height of sesamum (cm) as influenced by D x T interaction at harvest.

Treatments	Dates of sowing					
	1980-81			1981-82		
	D ₁	D ₂	D ₃	D ₁	D ₂	D ₃
T ₆	80.40	50.10	42.10	79.60	52.60	41.10
T ₇	85.30	54.10	45.10	85.90	60.40	47.70
T ₁₀	76.00	47.00	42.30	76.50	50.90	41.50
S.E. $\pm$	0.110			0.100		
C.D. at 5%	0.320			0.300		

While at harvest the treatment combination of sowing on 29th Met.week with sole crop of sesamum produced significantly more number of leaves (Table 145) and more number of branches (Table 146) over rest of the treatment combination viz., castor + sesamum one row crop and two row crop combination.

Table 145: Mean number of functional leaves per plant as influenced by D x T interaction at harvest.

Treatments	Dates of sowing					
	1980-81			1981-82		
	D ₁	D ₂	D ₃	D ₁	D ₂	D ₃
T ₆	32.23	17.90	10.65	30.20	16.63	11.30
T ₇	12.59	10.10	5.23	16.30	9.30	5.75
T ₁₀	46.26	25.85	15.85	46.70	18.50	15.47
S.E. $\pm$	0.060			0.060		
C.D. at 5%	0.180			0.180		

Table 146 : Mean number of branches per plant as influenced by D x T interaction at harvest.

Treatments	Dates of sowing					
	1980-81			1981-82		
	D ₁	D ₂	D ₃	D ₁	D ₂	D ₃
T ₆	3.00	2.79	2.35	3.00	2.49	1.85
T ₇	2.40	2.40	1.85	2.70	2.03	1.62
T ₁₀	3.30	2.99	2.63	3.40	2.88	2.10
S.E. $\pm$	0.040			0.050		
C.D. at 5%	0.130			0.150		

This was followed by the treatment combination of castor + sesamum one row intercrop combination and was significantly superior over castor + sesamum two row crop combination. This trend was seen over rest of the dates during both the year at harvest.

4.7.3.2 Dry matter :

Data on total dry matter per plant and its parts viz., stem, leaves and pods recorded in g at various growth stages during 1980-81 and 1981-82 are presented in Table 147 (a) and (b) respectively.

The data revealed that total dry matter increased upto 90 days after sowing the increase was more between 45 to 90 days after sowing.

At harvest, the data on total dry matter subjected to statistical analysis indicated significant differences due to

Table 147(a): Dry matter accumulation(g/plant) of sesamum variety N-85 at different growth stages as influenced by various treatments during 1980-81

Treatments	Days after sowing											
	30			45			60			75		
	Stem	Leaf	Total	Stem	Leaf	Total	Stem	Leaf	Total	Stem	Leaf	Total
D ₁	1.24	3.52	4.76	1.45	4.97	6.42	5.93	2.94	8.87	8.87	2.77	11.64
D ₂	0.78	2.58	3.36	1.34	3.92	5.26	4.21	2.42	6.63	4.02	2.24	6.26
D ₃	0.49	2.12	2.61	1.07	3.19	4.26	3.23	2.51	5.74	2.96	2.00	4.96
T ₆	0.83	2.65	3.48	1.69	4.34	6.03	4.21	2.72	6.93	3.78	2.50	6.28
T ₇	0.46	1.91	2.37	0.76	2.67	3.43	3.23	1.95	5.18	3.05	1.52	4.57
T ₁₀	1.22	3.66	4.88	1.42	5.08	6.50	5.87	3.20	9.07	5.68	2.99	8.67

Contd....

Table 147(a) contd.

Treatments	Days after sowing											
	90				105				120			
	Stem	Leaf	Pods	Total	Stem	Leaf	Pods	Total	Stem	Leaf	Pods	Total
D ₁	5.28	2.57	4.97	12.82	4.99	2.36	5.28	12.63	4.83	2.25	5.56	12.64
D ₂	3.80	2.03	3.97	9.80	3.58	1.88	3.12	8.58	3.47	1.79	4.90	10.15
D ₃	2.85	1.81	2.57	7.23	2.68	1.69	3.00	7.37	2.50	1.54	3.69	7.73
S.E.+	-	-	-	-	-	-	-	-	0.01	0.01	0.02	0.02
C.D. at 5%	-	-	-	-	-	-	-	-	0.04	0.04	0.06	0.06
T ₆	3.65	2.30	3.68	9.63	3.39	2.18	4.05	9.62	3.28	2.07	4.78	10.12
T ₇	2.76	1.36	2.69	6.81	2.55	1.19	3.05	6.79	2.39	1.07	3.24	6.69
T ₁₀	5.51	2.74	5.14	13.39	5.31	2.56	4.30	12.17	5.13	2.45	6.14	13.72
S.E.+	-	-	-	-	-	-	-	-	0.01	0.01	0.02	0.02
C.D. at 5%	-	-	-	-	-	-	-	-	0.04	0.04	0.06	0.06
S.E.+ (D x T)	-	-	-	-	-	-	-	-	0.02	0.02	0.03	0.03
C.D. at 5%	-	-	-	-	-	-	-	-	0.07	0.06	0.10	0.10

Table 147(b): Dry matter accumulation(g/plant) of sesamum variety N-85 at different growth stages as influenced by various treatments during 1981-82

Treatments	Days after sowing											
	30			45			60			75		
	Stem	Leaf	Total	Stem	Leaf	Total	Stem	Leaf	Total	Stem	Leaf	Total
D ₁	1.04	3.12	4.16	6.05	3.02	2.67	11.74	5.87	2.91	3.47	12.25	
D ₂	0.61	2.47	3.08	4.62	2.58	1.61	8.81	4.41	2.37	2.58	9.36	
D ₃	0.40	2.01	2.41	3.20	2.25	0.04	5.49	3.00	2.03	1.55	6.58	
T ₆	0.63	2.46	3.09	4.61	2.84	1.34	8.79	4.42	2.60	2.26	9.28	
T ₇	0.40	1.71	2.11	3.30	1.70	0.88	5.88	3.12	1.56	1.90	6.58	
T ₁₀	1.02	3.43	4.45	5.96	3.30	2.09	11.35	5.74	3.15	3.44	12.34	

Contd...

Table 147(b) Contd.

Treatments	Days after sowing											
	90			105			120					
	Stem	Leaf	Pods	Total	Stem	Leaf	Pods	Total	Stem	Leaf	Pods	Total
D ₁	5.68	2.72	4.76	13.16	5.51	2.59	4.87	12.97	5.41	2.38	5.31	13.10
D ₂	4.22	2.20	3.88	10.30	4.05	1.92	4.16	10.13	3.96	1.34	4.41	10.32
D ₃	2.86	1.89	2.37	7.12	2.71	1.71	2.77	7.19	2.62	1.63	3.45	7.70
S.E. +	-	-	-	-	-	-	-	-	0.01	0.01	0.03	0.02
C.D. at 5%	-	-	-	-	-	-	-	-	0.02	0.03	0.08	0.06
T ₆	4.27	2.48	3.61	10.36	4.11	2.33	4.00	10.44	4.03	2.18	4.43	10.63
T ₇	2.97	1.37	2.64	6.98	2.80	1.24	2.73	6.77	2.70	1.15	3.34	7.19
T ₁₀	5.52	2.94	4.76	13.23	5.36	2.65	5.07	13.08	5.26	2.62	5.40	13.29
S.E. +	-	-	-	-	-	-	-	-	0.01	0.01	0.03	0.02
C.D. at 5%	-	-	-	-	-	-	-	-	0.02	0.03	0.08	0.06
S.E.+(D x T)	-	-	-	-	-	-	-	-	0.01	0.02	0.05	0.03
C.D. at 5%	-	-	-	-	-	-	-	-	0.04	0.06	0.15	0.10

dates of sowing, treatments and their interactions during both the years.

Sowing on 29th Met.week produced significantly more dry matter as compared to rest of the sowing dates. This was followed by sowing on 31st Met.week and was significantly superior over sowing on 33rd Met.week.

Sole crop of sesamum produced significantly more dry matter at harvest as compared to rest of the treatments i.e. castor + sesamum one row and castor + sesamum two row crop combination. This was followed by castor + sesamum one row crop combination and was significantly superior over castor + sesamum two row crop combination.

The interaction effects due to D x T were also found significant at harvest (Table 148).

Table 148: Dry matter accumulation per plant(g/plant) as influenced by D x T interaction at harvest.

Treatments	Dates of sowing					
	1980-81			1981-82		
	D ₁	D ₂	D ₃	D ₁	D ₂	D ₃
T ₆	12.37	10.01	7.98	13.70	10.36	7.83
T ₇	8.29	6.45	5.34	8.83	7.00	5.76
T ₁₀	17.27	14.00	9.83	16.77	13.59	9.51
S.E. $\pm$	0.030			0.030		
C.D. at	0.100			0.100		

At harvest the treatment combination of sowing on 29th Met.week with sole crop of sesamum produced significantly more dry matter as compared to castor + sesamum intercrop combination. This was followed by castor + sesamum one row crop combination and was significantly superior over sowing on 33rd Met.week. This trend was observed over rest of the dates during both the years.

4.7.3.3 Post harvest studies :

Data pertaining to number of pods per plant, weight of grains per plant and test weight recorded during 1980-81 and 1981-82 are presented in Table 149.

The data indicated significant differences due to dates of sowing treatments and their interactions at harvest.

At harvest sowing on 29th Met.week produced significantly more number of pods, weight of grain and test weight over rest of the sowing dates. This was significantly followed by 31st Met.week sowing over sowing on 33rd Met.week.

Significantly more number of pods, weight of grain and test weight were produced by sole crop of sesamum at harvest as compared to sesamum one row and two rows intercrop combinations with castor. This was followed by sesamum one row intercrop combination with castor and was significantly superior over castor + sesamum two rows crop combinations.

Table 149: Mean number of pods, weight of grains(g) per plant and test weight(g) of sesamum variety N-85 as influenced by different treatments during 1980-81 and 1981-82

Treat- ments	Number of pods per plant		Weight of grains per plant(g)		1000 grain weight(g)	
	1980- 81	1981-8 82	1980- 81	1981- 82	1980- 81	1981 82
D ₁	22.69	16.60	2.06	1.46	3.29	2.43
D ₂	17.34	12.13	1.57	1.08	3.00	2.37
D ₃	10.36	10.06	0.92	0.88	2.72	2.32
S.E. +	0.07	0.11	0.03	0.02	0.02	0.03
C.D. at 5%	0.21	0.33	0.10	0.06	0.07	0.08
T ₆	16.20	12.32	1.45	1.09	3.01	2.35
T ₇	10.83	8.10	1.03	0.72	2.94	2.33
T ₁₀	23.36	19.36	2.07	1.61	3.06	2.44
S.E.+	0.07	0.11	0.03	0.02	0.02	0.03
C.D. at 5%	0.21	0.33	0.10	0.06	0.07	0.08
S.E.+ (D x T)	0.12	0.19	0.06	0.04	0.04	0.05
C.D. at 5%	0.37	0.58	0.18	0.11	N.S.	N.S.

At harvest sowing on 29th Met.week with sole crop of sesamum produced significantly more number of pods (Table 150) and weight of grains (Table 151) as compared to sesamum one row and two crop combination treatments with castor.

Table 150: Mean number of pods per plant as influenced by D x T interaction at harvest.

Treatments	Dates of sowing					
	1980-81			1981-82		
	D ₁	D ₂	D ₃	D ₁	D ₂	D ₃
T ₆	22.54	17.01	9.94	16.40	12.02	8.53
T ₇	16.53	10.00	6.96	13.04	6.15	5.12
T ₁₀	30.00	25.01	15.07	20.34	18.21	16.53
S.E. $\pm$	0.120			0.190		
C.D. at 5%	0.370			0.580		

Table 151: Weight of grain (g/plant) of sesamum as influenced by D x T interaction at harvest.

T ₆	2.02	1.50	0.83	1.45	1.09	0.74
T ₇	1.51	0.93	0.65	1.14	0.55	0.47
T ₁₀	2.65	2.28	1.29	1.79	1.59	1.43
S.E. $\pm$	0.060			0.040		
C.D. at 5%	0.180			0.110		

This was followed by the treatment combination of castor + sesamum one row crop combination and was significantly superior over castor + sesamum two row crop combination. This trend was observed over rest of the sowing dates during both the years.

There were no significant interaction effects due to D x T in respect of test weight during both the years.

4.7.3.4. Yield :

Data on grain and straw yield in kg/ha of sesamum variety N-85 during 1980-81 and 1981-82 are presented in Table 152.

The data indicated significant differences at harvest due to dates of sowing, treatments and their interactions during both the years.

At harvest sowing on 29th Met.week produced significantly more grain and straw yield as compared to rest of the sowing dates. This was followed by sowing on 31st Met.week and was significantly superior over 33rd Met.week.

At harvest sole crop of sesamum produced significantly more grain and straw yield over rest of the treatments where castor was intercropped with sesamum. This was followed by the treatment of two row of sesamum intercropped with castor and was significantly superior over the treatment of one row of sesamum intercropped with castor.

The interaction effects at harvest due to sowing on 29th Met.week with sole crop of sesamum produced significantly more grain and straw yield over rest of the treatments (Table 153 and 154), where castor was intercropped with one row and two row of sesamum. The above treatment was followed by the treatment of two rows of sesamum intercropped with castor and

Table 152: Grain and straw yield (kg/ha) of sesamum variety N-85 and their ratios during 1980-81 and 1981-82

Treat- ments	Grain yield kg/ha		Straw yield kg/ha		Grain/straw ratio	
	1980- 81	1981- 82	1980- 81	1981- 82	1980- 81	1981- 82
D ₁	253.04	177.37	1215.50	880.95	0.225	0.197
D ₂	215.25	145.97	683.95	691.58	0.356	0.209
D ₃	115.65	118.12	634.42	616.89	0.232	0.194
S.E.+	3.59	1.18	9.54	7.51	0.007	0.003
C.D. at 5%	10.77	3.56	28.61	22.52	0.020	0.009
T ₆	145.52	93.54	453.43	489.25	0.337	0.191
T ₇	203.70	124.79	944.96	627.94	0.230	0.202
T ₁₀	270.72	223.10	1135.48	1072.23	0.246	0.207
S.E. +	3.59	1.18	9.54	7.51	0.007	0.003
C.D. at 5%	10.77	3.54	28.61	22.52	0.020	0.009
S.E.+(D x T)	6.22	2.05	16.53	13.01	0.011	0.005
C.D. at 5%	18.66	6.14	49.55	39.00	0.034	0.015

was significantly superior over one row of sesamum intercropped with castor.

Table 153: Grain yield(kg/ha) of sesamum as influenced by D x T interaction at harvest.

Treatments	Dates of sowing					
	1980-81			1981-82		
	D ₁	D ₂	D ₃	D ₁	D ₂	D ₃
T ₆	196.16	164.95	75.44	124.03	93.73	66.30
T ₇	232.96	195.36	182.78	144.06	121.17	108.59
T ₁₀	330.01	285.43	196.73	266.91	222.90	223.10
S.E. $\pm$	6.220			2.050		
C.D. at 5%	18.660			6.140		

Table 154: Sesamum straw yield(kg/ha) as influenced by D x T interaction at harvest.

T ₆	645.85	320.07	394.37	634.42	477.24	356.08
T ₇	1388.87	754.45	691.58	808.17	567.55	508.11
T ₁₀	1611.77	977.35	817.32	1200.26	1029.93	986.50
S.E. $\pm$	16.530			13.010		
C.D. at 5%	49.550			39.000		

The above trend was maintained over rest of the sowing dates.

4.8 Evaluation of crop productivity :

Data on mean monetary returns, castor equivalents and land equivalent ratios(LER) for the intercropping of castor for 1980-81 and 1981-82 and their means subjected to pooled analysis

because of heterogenous error variance and significant interactions and are presented in Table 155.

4.8.1 Monetary returns (Rs/ha) :

Data in Table 155 indicated significant differences due to dates of sowing, treatments and their interactions.

Sowing on 29th Met.week gave significantly more monetary returns (Rs/ha) as compared to rest of the sowing dates. This was followed by sowing on 31st Met.week and was significantly superior over sowing on 38rd Met.week. This trend was observed during 1980-81, 1981-82 and in the pooled analysis also.

During 1980-81 sole cropping of coriander gave significantly more monetary returns over rest of the treatments. This was followed by the treatment castor + two row of coriander and was significantly superior over remaining treatments. This was again followed by the treatment of castor + one row of coriander and gave significantly more monetary returns over rest of the treatments. During 1981-82, the treatment of castor + coriander two row intercrop combinations gave significantly more monetary returns as compared to rest of the treatments. This was followed by the treatment of castor + coriander one row intercrop combination and it was significantly superior over rest of the treatments. This was followed by the sole cropping of coriander. In the pooled analysis the treatment of castor + two row of coriander gave monetary returns at par with sole cropping of coriander and castor + coriander one row intercrop

Table 155: Mean monetary returns (Rs/ha), castor seed equivalents (kg/ha), land equivalent ratios and their pooled means due to intercropping of castor variety J-1 for 1980-81 and 1981-82

Treatments	Monetary returns (Rs/ha)		Castor seed equivalents kg/ha		Land equivalent ratio (LER)	
	1980-81	1981-82	1980-81	1981-82	1980-81	1981-82
		Pooled mean		Pooled mean		Pooled mean
D 1	1914.05	1749.28	668.75	585.00	1.07	1.05
D 2	1443.16	1346.11	493.17	444.88	1.03	0.97
D 3	1051.75	1059.65	360.41	350.41	1.17	0.91
S.E.+	40.90	7.34	13.46	2.59	0.02	0.01
C.D. at 5%	113.36	20.35	38.47	7.33	0.07	0.02
T 1	1050.12	1529.84	357.68	508.45	-	-
T 2	1694.84	1773.32	612.82	597.96	1.21	1.12
T 3	2162.74	1962.32	773.31	670.54	1.29	1.24
T 4	1119.47	1345.43	374.82	430.26	0.99	0.95
T 5	1161.01	1292.08	384.42	406.03	1.02	0.99
T 6	1260.45	1023.83	424.89	338.93	1.06	0.76
T 7	1249.37	1047.08	406.71	343.50	0.96	0.82
T 8	2479.62	1625.87	888.87	578.18	-	-
T 9	1131.29	1095.47	388.54	345.90	-	-
T 10	1388.48	1154.91	461.93	381.22	-	-
S.E.+	74.68	13.41	24.58	4.73	0.03	0.01
C.D. at 5%	206.97	37.16	70.23	13.38	0.10	0.03
S.E.+(D x T)	129.35	23.23	42.558	8.162	0.057	0.016
C.D. at 5%	358.48	64.37	121.637	23.15	0.163	0.045
S.E.+(D x Y)	-	-	-	-	-	-
C.D. at 5%	-	-	-	-	-	-
S.E.+(T x Y)	-	-	-	-	-	-
C.D. at 5%	-	-	-	-	-	-
S.E.+(D x T x Y)	-	-	-	-	-	-
C.D. at 5%	-	-	-	-	-	-

combination and was significantly superior over rest of the treatments.

During 1980-81 the treatment combination (Table 156) of sowing on 29th Met. week with sole crop of coriander gave significantly more monetary returns over rest of the treatment combinations. This was followed by the treatment combination of castor + coriander two row intercrop combination and was significantly superior over rest of the treatment combination.

Table 156: Monetary returns (Rs/ha) due to intercropping of castor as influenced by D x T interaction.

Treatments	Dates of sowing					
	1980-81			1981-82		
	D ₁	D ₂	D ₃	D ₁	D ₂	D ₃
T ₁	1472.31	965.22	712.15	1801.53	1543.18	1244.83
T ₂	2136.45	1658.64	1289.42	2170.75	1745.51	1403.72
T ₃ ✓	2951.48	1991.28	1545.47	2521.68	1848.39	1516.89
T ₄	1681.50	908.76	768.16	1776.38	1313.42	946.49
T ₅	1585.48	1111.09	786.43	1668.93	1299.70	907.62
T ₆	1442.59	1500.88	837.89	1382.00	984.21	705.29
T ₇	1383.15	1205.97	1158.99	1328.28	994.50	818.46
T ₈ ✓	3405.58	2393.65	1636.92	2009.57	1588.91	1279.13
T ₉	1370.58	1247.12	776.16	1459.73	994.50	832.18
T ₁₀	1711.22	1448.31	1005.92	1374.00	1148.82	941.91
S.E. ±	129.349			23.225		
C.D. at 5%	358.480			64.366		

This was followed by the treatment combination of castor + coriander one row intercrop combination and was significantly superior over rest of the treatment combinations. The treatment

combination of sowing on 31st Met.week with sole crop of coriander followed the same trend as at 29th Met.week but the treatment combination of castor + two row coriander intercrop combination which was next to the above treatment gave monetary returns at par with the treatment combination of castor + coriander one row intercrop combination and was significantly superior over rest of the treatments. The treatment combination of sowing on 33rd Met.week with sole crop of coriander and castor + one row of coriander intercrop combination and was significantly superior over rest of the treatments. During 1981-82 the treatment combination of sowing on 29th Met.week with castor + two rows of coriander gave significantly more monetary returns as compared to rest of the treatment combination and this was followed by the treatment combination of castor + coriander one row intercrop combination and was significantly superior over rest of the treatments. This trend was seen over rest of the dates also.

The interaction effect due to D x T was not significant in the pooled analysis.

4.8.2 Castor equivalents (kg/ha) :

Data in Table 155 indicated significant differences due to dates of sowing, treatments and their interactions.

The trend of effects due to sowing dates was similar to monetary returns during both the years. Sowing on 29th Met.week gave castor equivalents at par with sowing on 31st Met.week and was significantly superior over sowing on 33rd Met.week.

During 1980-81, the treatment of sole cropping of coriander gave significantly more castor equivalents as compared to rest of the treatments. This was followed by the treatment castor + coriander two rows intercrop combination and was significantly superior over rest of the treatments. During 1981-82 the treatment of castor + coriander two row intercrop combination gave significantly more castor equivalents as compared to rest of the treatments. This was followed by the treatment castor + coriander one row inter crop combination and was significantly superior over rest of the treatments. While in the pooled analysis sole cropping of coriander gave castor equivalents at par with castor + coriander two row crop combination and was significantly superior over rest of the treatments. This was followed by castor + coriander two row crop combination and was significantly superior over rest of the treatments. This was followed by castor + coriander one row crop combination and was significantly superior over rest of the treatments.

During 1980-81, the treatment combination (Table 157) of sowing on 29th Met. week with sole crop of coriander gave significantly more castor equivalents as compared to rest of the treatment combinations. This was followed by the treatment combination of castor + coriander two row intercrop combination and was significantly superior over rest of the treatments. The same trend was observed over sowing on 31st Met. week.

Table 157: Castor equivalents (kg/ha) due to intercropping of castor J-1 as influenced by D x T interaction.

Treatments	Dates of sowing					
	1980-81			1981-82		
	D ₁	D ₂	D ₃	D ₁	D ₂	D ₃
T ₁	504.45	324.75	244.17	598.76	513.37	413.23
T ₂	818.57	568.24	451.64	734.90	586.41	482.56
T ₃	1079.89	697.86	541.83	870.36	625.50	515.77
T ₄	569.95	302.12	252.74	571.32	413.92	305.55
T ₅	536.34	359.73	257.20	534.28	401.23	282.57
T ₆	483.53	512.68	278.80	464.32	323.04	229.42
T ₇	437.24	397.80	385.11	440.32	326.47	263.71
T ₈	1222.20	858.01	586.41	710.89	567.21	456.44
T ₉	471.53	424.55	269.89	468.79	310.69	258.23
T ₁₀	563.78	486.62	335.73	456.10	381.00	306.58
S.E. ±	42.558			8.162		
C.D. at 5%	121.637			23.150		

The sowing on 33rd Met.week with sole crop of coriander gave castor equivalence at par with the treatment combination of castor + coriander two rows and castor + coriander one row treatment combination. During 1981-82 the treatment combination of sowing on 29th Met.week with castor + coriander two row intercrop combination gave significantly more castor equivalence as compared to rest of the treatment combinations. This was followed by the treatment combination of castor + coriander one row intercrop combination and was significantly superior over rest of the treatment combination. The treatment combination of

sowing on 31st Met.week with castor + coriander two rows intercrop combination maintained the same trend as at 29th Met.week and the same trend was also observed at 33rd Met.week. This was followed by the treatment combination of castor + coriander one row intercrop combination and gave castor equivalents at par with the sole cropping of coriander and was significantly superior over rest of the treatment combinations. This trend was also observed over 33rd Met.week.

In the pooled analysis (Table 158) interaction effects were noticed between D x T. The treatment combination of sowing on 29th Met.week with castor + coriander two rows intercrop combination gave castor equivalents at par with sole crop of coriander and was significantly superior over rest of the treatment combination. This was followed by sole crop of coriander and was significantly superior over rest of the treatments.

Table 158: Castor equivalents(kg/ha) as influenced by the D x T interaction (Pooled means)

Treatments	Dates of sowing		
	D ₁	D ₂	D ₃
T ₁	551.60	419.06	328.70
T ₂	776.74	577.32	462.10
T ₃	975.12	661.68	528.80
T ₄	570.64	358.02	279.15
T ₅	535.31	380.48	269.89
T ₆	473.93	417.86	254.11
T ₇	438.78	362.13	324.41
T ₈	966.55	712.61	521.43
T ₉	470.16	367.62	264.06
T ₁₀	509.94	433.81	321.15
S.E. +	21.986		
C.D. at 5%	65.316		

This was followed by castor + coriander one row crop combination and was significantly superior over rest of the treatments. This trend was observed over 33rd Met.week but the treatment combination of sowing on 31st Met.week with sole crop of coriander gave castor equivalents at par with castor + coriander two row intercrop combinations and was significantly superior over rest of the treatments. This was followed by the treatment castor + coriander two row crop combination and was significantly superior over rest of the treatments. This was followed by the treatment castor + coriander one row crop combination and was significantly superior over rest of the treatments.

4.8.3 Land equivalent ratios (LER) :

Data on land equivalent ratios based on sole crop means treated as a unit and deleted in the analysis for 1980-81 and 1981-82 and their means subjected to pooled analysis are presented in Table 155.

The data indicates significant differences due to dates of sowing, treatments and their interactions.

During 1980-81, sowing on 33rd Met.week gave significantly higher LER values over rest of the sowing dates. This was followed by sowing on 29th Met.week. During 1981-82 sowing on 29th Met.week gave significantly higher LER values over rest of the sowing dates. This was followed by 31st Met.week sowing. While no significant differences were observed in the pooled analysis due to different dates of sowing, however, sowing on 29th Met.week gave higher LER as compared to later dates of sowing.

During 1980-81 castor + coriander two row intercrop combination gave LER values at par with castor + coriander one row intercrop combination but significantly more over rest of the treatments. During 1981-82 castor + coriander two row intercrop combination gave significantly higher values of LER over rest of the treatments. This was followed by the treatment castor + coriander one row intercrop combination and was significantly superior over rest of the treatments during both the years. In the pooled analysis the treatment of castor + coriander two row intercrop combination gave LER at par with castor + coriander one row intercrop combination and was significantly superior over rest of the treatments.

During 1980-81, the treatment combination of sowing on (Table 159) 29th Met. week with castor + coriander two row intercrop combination gave LERs at par with castor + coriander one row intercrop combination and castor + pigeonpea one row intercrop combination and was significantly (Table 159) superior over rest of the treatment combinations. The treatment combination of sowing on 31st Met. week with castor + one row of sesamum gave significantly higher LER as compared to rest of the treatment combinations. This was followed by castor + coriander one row and castor + coriander two row intercrop combination and were at par with each other and significantly superior over castor + pigeonpea one row and castor + sesamum two row intercrop combination. While the treatment combination

of sowing on 33rd Met.week with castor + coriander two row intercrop combination gave LER at par with castor + coriander one row intercrop combination and was significantly superior over rest of the treatments.

During 1981-82, the treatment combination of sowing on 29th Met.week with castor + coriander two row intercrop combination gave significantly higher values of LER as compared to rest of the treatments (Table 159). This was followed by the treatment combination castor + coriander one row crop combination. This trend was also observed at 33rd Met.week. The treatment combination at 31st Met.week with castor + coriander two row intercrop combination gave LER values at par with castor + coriander one row intercrop combination and was significantly superior over rest of the treatment combination.

Table 159: Land equivalent ratios due to intercropping of castor J-1 as influenced by D x T interaction.

Treatments	Dates of sowing					
	1980-81			1981-82		
	D ₁	D ₂	D ₃	D ₁	D ₂	D ₃
T ₂	1.19	1.10	1.35	1.17	1.12	1.08
T ₃	1.30	1.10	1.47	1.36	1.17	1.20
T ₄	1.16	0.84	0.97	1.04	0.96	0.86
T ₅	1.10	0.97	0.99	1.00	1.08	0.88
T ₆	0.88	1.29	1.00	0.88	0.74	0.65
T ₇	0.78	0.88	1.23	0.87	0.77	0.80
S.E. $\pm$	0.057			0.016		
C.D. at 5%	0.163			0.045		

4.9 Stability parameters :

Data on stability parameters for gross returns (Rs/ha) total grain yields (kg/ha) and land equivalent ratios (LER) are presented in Table 160 and depicted in Fig.5 and the analysis of variance for these characters are presented in

In Eberhart and Russel Model b_i is considered as para-meter of response and S^2_{di} as the parameter of stability. For a given value of independent variable, the value of dependent variable may be estimated using the regression equation, provided S^2_{di} is not significantly different from zero. Assuming S^2_{di} equal to zero, a high value of b_i will mean more change in Y for a unit change in I_j . In other words the treatment is more responsive. Such treatment may therefore, be recommended for highly favourable environments. Relative lower value of b_i say around 1, will mean less responsive to environmental change and therefore, more adaptive.

The significance of MS_1 / MS_3 (App.V,VI,VII) for all the three characters viz., gross returns (Rs/ha), total grain yields (kg/ha) and land equivalent ratios (LER) indicated significant treatment differences. In respect of gross economic returns and total grain yield MS_2 / MS_3 was significant indicating the significant differences in regression coefficients calculated for various treatments, however, in respect of LER MS_2 / MS_3 was more significant indicating no differences in the b_i value for this character.

Table 160: Stability parameters on fitted regressions on gross economic returns(Rs/ha), total grain yield(kg/ha) and land equivalent ratios (LER) due to intercropping of castor variety J-1 during 1980-81 and 1981-82

Treatments	Gross economic returns (Rs/ha)			Total grain yield (kg/ha)			Land equivalent ratios (LER)		
	M	bi	S ² di	M	bi	S ² di	M	bi	S ² di
T ₁	1289.99	0.7398	103403.13**	432.09	1.1708	22.3590**	-	-	-
T ₂	1734.08	0.9989	-415.75	483.53	1.2490	6.1103**	1.17	1.0278	0.0003
T ₃	2062.53	1.5900*	-1127.32	504.11	1.5360	4.1837**	1.27	1.1774	0.0083**
T ₄	1232.45	1.0675	39877.72**	377.22	1.4269	4.0466**	0.97	0.5997	0.0125**
T ₅	1226.54	0.9492	-1047.08	363.51	1.2470	-0.4115	1.00	0.3193	0.0052**
T ₆	1142.14	0.8288	27870.25*	294.92	0.7203	11.8482**	0.91	1.3344	0.0440**
T ₇	1148.24	0.4855	7834.84	257.20	0.3879*	3.0178**	0.89	1.5517	0.0125**
T ₈	2052.25	1.8089*	212117.17**	336.07	0.9808	28.3860**	-	-	-
T ₉	1113.38	0.7673	-310.71	305.21	0.8274	3.8837**	-	-	-
T ₁₀	1271.70	0.7701	3348.43	246.91	0.5248	3.0006**	-	-	-
S.E. ±	100.40	0.2843	-	25.27	0.2801	-	0.04	0.6386	-
C.D. at 5%	278.27	0.5572	-	70.05	0.5490	-	0.12	1.2517	-
Mean	1427.33	1.0	-	360.08	1.0	-	1.04	1.00	-

* Significant at 5%

** Significant at 1%

4.9.1 Gross returns (Rs/ha):

The treatment T_3 (castor + 2 rows of coriander) the gross economic return was highest (Rs. 2062.53) with b_1 value significantly more than one and $S^2_{di} = 0$. These results indicate that T_3 (castor + 2 rows of coriander) treatment is responsive to environments and gross economic returns are likely to be increased under favourable conditions. The gross economic returns from T_2 (castor + 1 row of coriander) is also high and is coupled with $b_1 = 1$ and $S^2_{di} = 0$. This T_2 (castor + 1 row of coriander) treatment is expected to be stable under varying environmental conditions for gross economic returns. In respect of T_8 (sole crop of coriander), the mean value for gross economic returns is high but, S^2_{di} is also high making prediction difficult.

4.9.2 Total yield :

The total grain yield from T_2 (castor + 1 row of coriander) and T_3 (castor + 2 rows of coriander) treatment is high and at par with each other. However, prediction in respect of these two treatment is difficult due to significant S^2_{di} values.

4.9.3 Land equivalent ratios (LER):

In respect of LER T_2 (castor + 1 row of coriander) and T_3 (castor + 2 rows of coriander) revealed high mean values,

- - - - - SOLE CASTOR (T₁) $bi = 0.7398$
 - - - - - CASTOR + 1 ROW CORIANDER (T₂) $bi = 0.9981$
 - - - - - CASTOR + 2 ROW CORIANDER (T₃) $bi = 1.5900$
 x - - - - - CASTOR + 1 ROW PIGEON PEA (T₄) $bi = 1.0675$
 - - - - - CASTOR + 2 ROW PIGEON PEA (T₅) $bi = 0.9492$
 o - - - - - CASTOR + 1 ROW SESAMUM (T₆) $bi = 0.8288$
 - - - - - CASTOR + 2 ROW SESAMUM (T₇) $bi = 0.4855$
 A - - - - - SOLE CORIANDER (T₈) $bi = 1.8089$
 - - - - - SOLE PIGEON PEA (T₉) $bi = 0.7673$
 - - - - - SOLE SESAMUM (T₁₀) $bi = 0.7701$

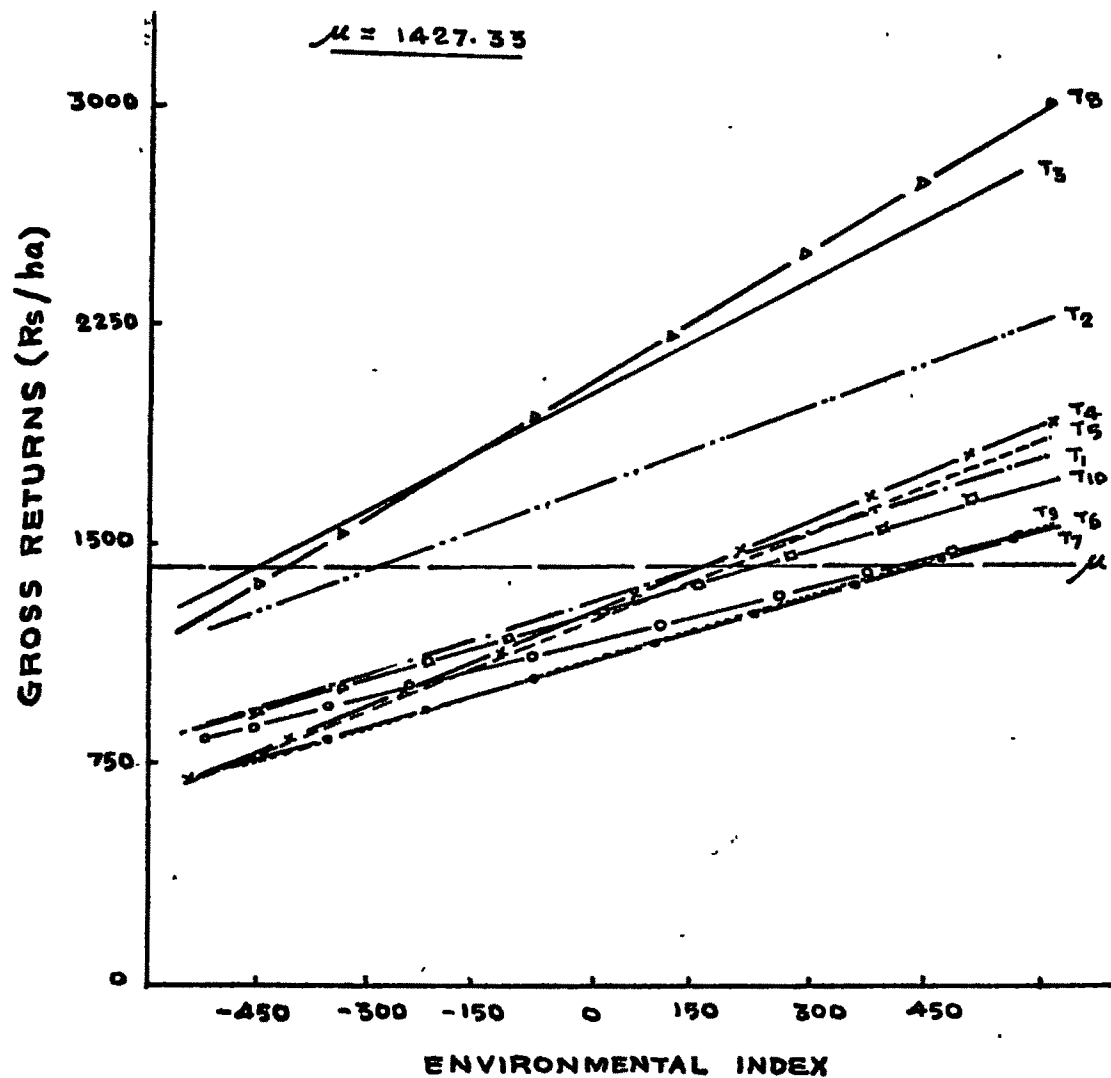


FIG. 5 (a). STABILITY PERFORMANCE OF INTERCROP SYSTEMS AND SOLE CROPS

- - - - - SOLE CASTOR (T_1) $bi = 1.1708$
 - · - · - CASTOR + 1 ROW CORIANDER (T_2) $bi = 1.2490$
 ——— CASTOR + 2 ROW CORIANDER (T_3) $bi = 1.536$
 x — x CASTOR + 1 ROW PIGEON PEA (T_4) $bi = 1.4269$
 - - - CASTOR + 2 ROW PIGEON PEA (T_5) $bi = 1.2470$
 o — o CASTOR + 1 ROW SESAMUM (T_6) $bi = 0.7203$
 · — · CASTOR + 2 ROW SESAMUM (T_7) $bi = 0.3879$
 Δ — Δ SOLE CORIANDER (T_8) $bi = 0.9808$
 - · - SOLE PIGEON PEA (T_9) $bi = 0.8274$
 □ — □ SOLE SESAMUM (T_{10}) $bi = 0.5248$

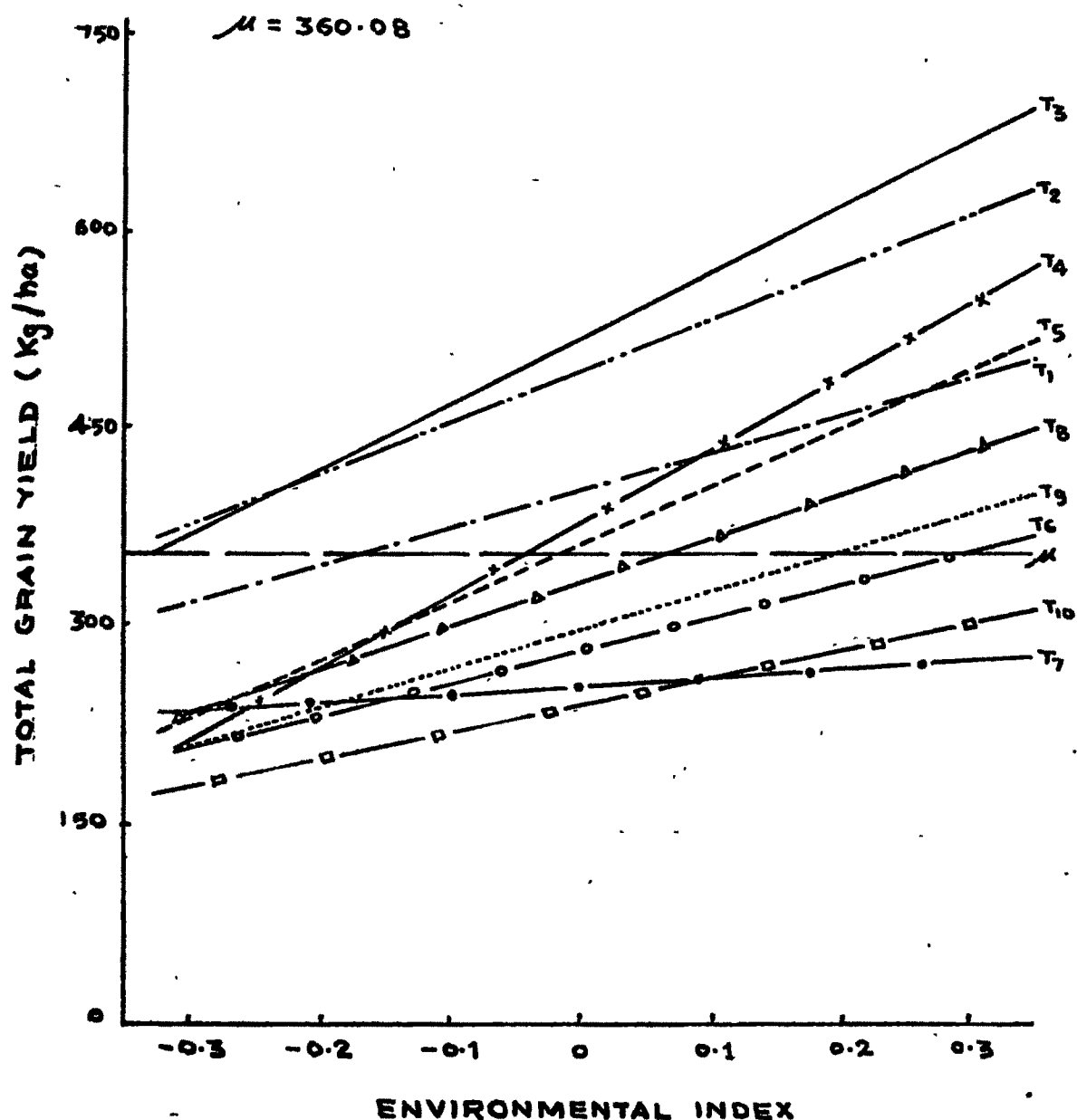


FIG.5 (b). STABILITY PERFORMANCE OF INTERCROP SYSTEMS AND SOLE CROPS

- CASTOR + 1 ROW CORIANDER (T_2) $bi = 1.0278$
- CASTOR + 2 ROW CORIANDER (T_3) $bi = 1.1774$
- x—x CASTOR + 1 ROW PIGEON PEA (T_4) $bi = 0.5997$
- CASTOR + 2 ROW PIGEON PEA (T_5) $bi = 0.3193$
- o—o CASTOR + 1 ROW SESAMUM (T_6) $bi = 1.3344$
- CASTOR + 2 ROW SESAMUM (T_7) $bi = 1.5517$

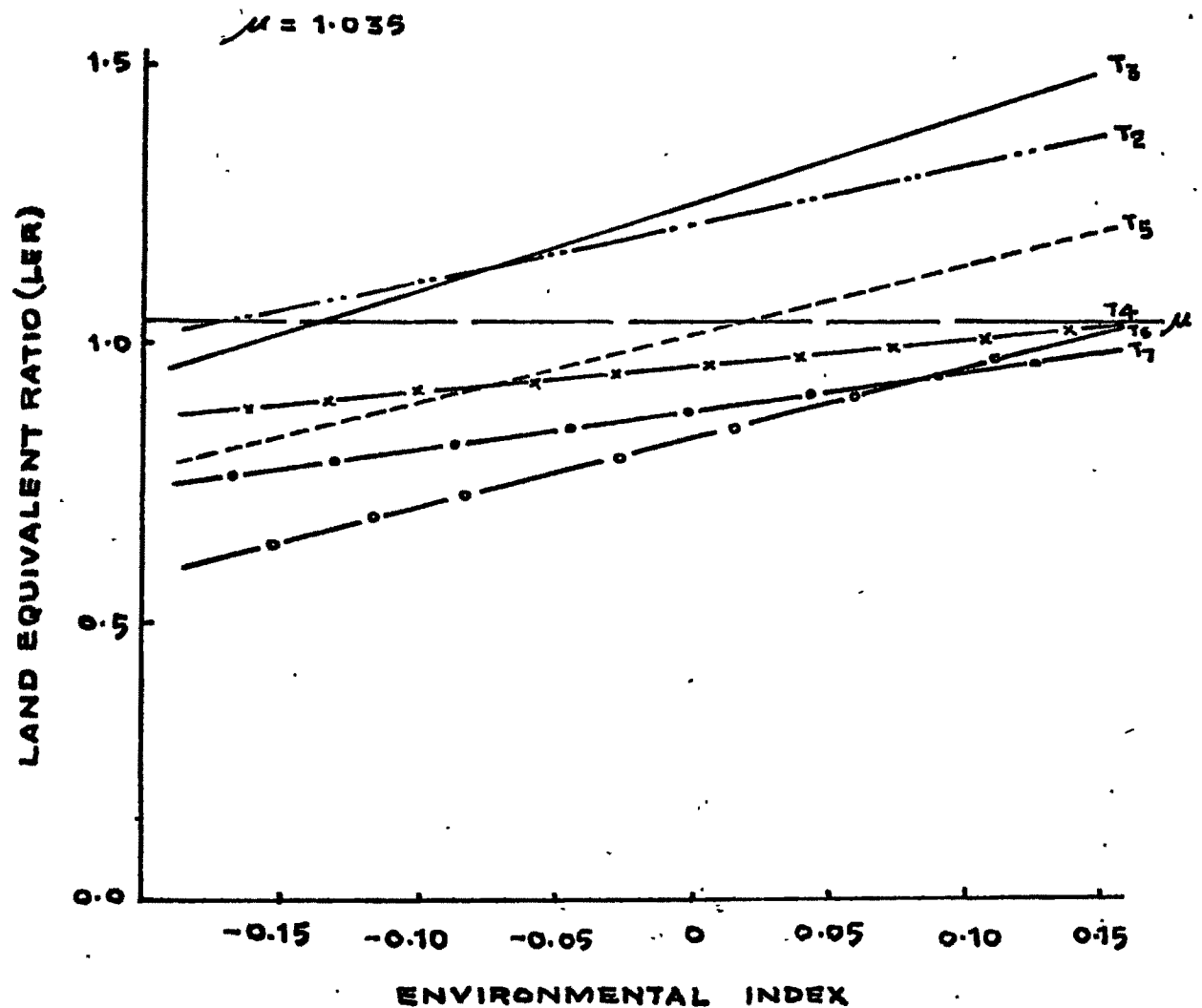


FIG. 5 (C). STABILITY PERFORMANCE OF INTERCROP SYSTEM AND SOLE CROPS

unit bi and low S^2_{di} . These two treatments for LER are likely to exhibit stable performance over varying environmental conditions.

In general T_2 (castor + 1 row of coriander) and T_3 (castor + 2 rows of coriander) treatments are expected to exhibit desirable performance under varying environmental conditions.

4.10 Mean monetary returns based on spectrum of marked price :

The mean gross economic returns (Rs/ha) from the grain of castor, coriander, pigeonpea and sesamum over averages of two years 1980-81 and 1981-82 at 0.75:0.75, 0.75:1.0, 0.75:1.25, 1:0.75, 1:1, 1:1.25, 1.25:0.75, 1.25:1 and 1.25:1.25 marked prices and computed per hectare as influenced by various treatments are presented in Table 161.

Sowing on 29th Met.week gave significantly higher gross returns as compared to rest of the sowing dates at all levels of price spectrum. This was followed by sowing on 31st Met.week and was significantly superior over sowing on 33rd Met.week.

Among the treatments sole crop of coriander gave significantly more gross returns as compared to rest of the treatments at price spectrum of 0.75:, 0.75:1.25, and 1:1.25. This was followed by the treatment castor + coriander 2 row intercrop combination and was significantly superior over rest of the treatments. Sole crop of coriander gave gross returns at par with the treatments castor + coriander two row crop

Table 161: Mean monetary returns (average of two years 1980-81 and 1981-82) (Rs/ha) due to intercropping of castor variety J-1 at price spectrum of castor, coriander, pigeonpea and sesamum.

Treatments	Price spectrum									
	0.75:0.75	0.75:1.0	0.75:1.25	1.0:0.75	1.0:1.0	1.0:1.25	1.25:0.75	1.25:1.0	1.25:1.25	1.25:1.25
D 1	1281.19	1541.93	1803.58	1457.68	1706.53	1967.85	1611.66	1873.31	2134.05	
D 2	967.29	1171.11	1376.06	1079.20	1282.56	1493.35	1202.66	1405.44	1611.43	
D 3	733.70	880.87	1011.76	831.99	978.26	1125.61	929.91	1076.11	1202.54	
S.E.+	15.89	19.80	25.72	16.71	21.554	25.087	19.12	22.84	28.39	
C.D. at 5%	44.95	56.00	72.75	47.26	60.96	70.96	54.08	64.61	80.30	
T 1	894.67	894.67	894.67	1192.63	1192.63	1192.63	1491.36	1491.36	1493.36	
T 2	1224.64	1378.20	1532.90	1515.37	1632.35	1784.95	1731.11	1886.50	2039.29	
T 3	1477.27	1747.80	2019.10	1697.88	1968.42	2240.10	1919.04	2189.41	2461.09	
T 4	829.13	927.82	1028.41	971.25	1084.80	1203.68	1180.44	1279.89	1379.72	
T 5	815.41	953.73	1077.94	947.63	1080.61	1221.59	1080.23	1215.50	1342.76	
T 6	789.88	922.34	1077.18	777.10	1050.74	1192.02	1032.74	1172.82	1301.99	
T 7	777.02	969.73	1117.57	842.46	1035.99	1229.59	908.00	1103.89	1251.31	
T 8	1513.85	2017.57	2521.68	1582.43	2017.57	2521.68	1513.85	2017.57	2521.68	
T 9	749.49	998.31	1248.65	749.49	998.31	1214.35	749.64	998.31	1218.16	
T 10	871.04	1161.01	1451.74	871.04	1161.01	1451.74	871.04	1161.01	1451.74	
S.E.+	29.02	36.15	46.96	30.27	39.35	45.80	34.91	41.71	51.83	
C.D. at 5%	82.07	102.25	122.53	86.28	111.30	129.55	98.75	117.97	146.61	
S.E.+(D x T)	50.26	62.62	81.33	52.84	68.16	79.33	60.47	72.24	89.78	
C.D. at 5%	142.15	177.11	230.05	149.45	192.78	224.39	171.03	204.32	253.94	

Note:- Prevailing market prices in Rs/ctl of the produce were taken as :

Castor seed	Rs. 275/ctl
Coriander seed	Rs. 600/ctl
Pigeonpea seed	Rs. 320/ctl
Sesamum seed	Rs. 470/ctl

Table 162: Mean monetary returns (average of 1980-81 and 1981-82) in Rs/ha due to intercropping of castor J-1 as influenced by D x T interaction at 0.75:0.75 price spectrum of castor, coriander, pigeonpea & sesamum.

Treatments	Dates of sowing		
	D ₁	D ₂	D ₃
T ₁	1139.67	866.36	679.00
T ₂	1526.04	1193.40	954.49
T ₃	1972.99	1366.00	1092.80
T ₄	1173.96	737.30	576.12
T ₅	1108.81	781.88	555.55
T ₆	978.49	864.18	526.97
T ₇	905.34	748.73	680.14
T ₈	1994.71	1471.17	1075.66
T ₉	960.20	747.59	540.69
T ₁₀	1051.65	897.33	664.14
S.E. + -	49.920		
C.D. at 5%	142.150		

Table 163: Mean monetary returns (average of 1980-81 and 1981-82) in Rs/ha due to intercropping of castor J-1 as influenced by D x T interaction at 0.75:1.00 price spectrum of castor, coriander, pigeonpea & sesamum.

T ₁	1139.67	865.33	679.00
T ₂	1703.22	1361.43	1069.94
T ₃	2339.93	1640.35	1263.13
T ₄	1312.28	823.03	648.14
T ₅	1291.70	919.05	650.42
T ₆	1163.68	1015.07	609.27
T ₇	1128.24	933.91	851.61
T ₈	2658.85	1960.42	1433.44
T ₉	1279.13	996.78	719.00
T ₁₀	1402.58	1195.68	884.76
S.E. + -	62.620		
C.D. at 5%	177.110		

Table 164: Mean monetary returns(average of 1980-81 and 1981-82) in Rs/ha due to intercropping of castor J-1 as influenced by D x T interaction at 0.75:1.25 price spectrum of castor, coriander, pigeonpea and sesamum.

Treatments	Dates of sowing		
	D ₁	D ₂	D ₃
T ₁	1139.67	865.33	679.00
T ₂	1881.54	1532.90	1184.25
T ₃	2709.15	1913.55	1434.59
T ₄	1454.02	911.05	720.15
T ₅	1475.74	1056.22	701.86
T ₆	1350.00	1168.25	713.29
T ₇	1350.00	1121.38	885.90
T ₈	3322.99	2449.66	1792.38
T ₉	1599.20	1247.12	899.62
T ₁₀	1753.52	1495.17	1106.52
S.E. $\pm$	81.330		
C.D. at 5%	230.050		

Table 165: Mean monetary returns(average of 1980-81 and 1981-82) in Rs/ha due to intercropping of castor J-1 as influenced by D x T interaction at 1.00:0.75 price spectrum of castor, coriander, pigeonpea and sesamum.

T ₁	1519.18	1153.39	905.33
T ₂	1968.42	1418.59	1159.10
T ₃	2262.19	1546.61	1284.84
T ₄	1423.16	865.33	693.86
T ₅	1293.99	904.19	644.71
T ₆	1146.81	941.91	617.27
T ₇	986.50	811.60	735.01
T ₈	1994.71	1471.16	1075.66
T ₉	960.20	747.59	540.69
T ₁₀	1051.65	897.33	664.14
S.E. $\pm$	52.840		
C.D. at 5%	149.450		

Table 166: Mean monetary returns (average of 1980-81 and 1981-82) in Rs/ha due to intercropping of castorJ-1 as influenced by D x T interaction at 1.25:1.25 price spectrum of castor, coriander, pigeonpea and sesamum.

Treatments	Dates of sowing		
	D ₁	D ₂	D ₃
T ₁	1898.69	1442.59	1132.81
T ₂	2539.97	1986.71	1591.20
T ₃	3287.56	2275.91	1819.81
T ₄	1954.70	1227.69	956.77
T ₅	1846.11	1301.99	880.19
T ₆	1627.77	1439.16	839.04
T ₇	1510.04	1248.27	995.64
T ₈	3322.99	2449.66	1792.38
T ₉	1599.20	1247.12	911.05
T ₁₀	1753.52	1495.17	1106.52
S.E. +	89.780		
C.D. at 5%	253.940		

Table 167: Mean monetary returns (average of 1980-81 and 1981-82) in Rs/ha due to intercropping of castorJ-1 as influenced by D x T interaction at 1.00:1.00 price spectrum of castor, coriander, pigeonpea and sesamum.

T ₁	1519.18	1153.39	905.34
T ₂	2033.57	1590.05	1273.41
T ₃	2630.27	1819.82	1455.17
T ₄	1563.76	924.77	765.88
T ₅	1466.60	1035.65	839.59
T ₆	1301.99	1149.96	700.72
T ₇	1209.40	99.07	905.34
T ₈	2662.28	1960.42	1433.45
T ₉	1279.13	996.78	719.01
T ₁₀	1402.58	1195.68	884.76
S.E. +	68.160		
C.D. at 5%	192.780		

Table 168: Mean monetary returns (average of 1980-81 and 1981-82) in Rs/ha due to intercropping of castorJ-1 as influenced by D x T interaction at 1.00:1.25 price spectrum of castor, coriander, pigeonpea and sesamum.

Treatments	Dates of sowing		
	D ₁	D ₂	D ₃
T ₁	1519.18	1153.39	905.34
T ₂	2210.76	1758.09	1387.72
T ₃	2998.35	2094.16	1627.78
T ₄	1497.46	1069.94	837.89
T ₅	1650.64	1178.54	835.61
T ₆	1488.32	1303.13	784.17
T ₇	1432.30	1184.25	1079.09
T ₈	3322.99	2449.66	1792.38
T ₉	1599.20	1247.12	865.33
T ₁₀	1753.52	1495.17	1106.52
S.E. +	79.330		
C.D. at 5%	224.390		

Table 169: Mean monetary returns (average of 1980-81 and 1981-82) in Rs/ha due to intercropping of castorJ-1 as influenced by D x T interaction at 1.25:0.75 price spectrum of castor, coriander, pigeonpea and sesamum.

T ₁	1898.69	1442.59	1132.81
T ₂	2184.46	1647.21	1361.43
T ₃	2551.40	1728.37	1476.89
T ₄	1674.64	1053.94	812.74
T ₅	1479.17	1027.65	733.87
T ₆	1256.27	1135.10	709.87
T ₇	1065.37	875.61	791.03
T ₈	1994.71	1471.17	1075.66
T ₉	960.20	747.59	540.69
T ₁₀	1051.65	897.33	458.38
S.E. +	60.470		
C.D. at 5%	171.030		

combination at 0.75:0.75, 1:1 and 1.25 : 1.25 price spectrum. Castor + coriander two row intercrop combination gave significantly higher monetary returns over rest of the treatments at 1: 0.75, 1.25 : 0.75 and 1.25: 1 price spectrum.

The interaction effects due to D x T reached to the level of significance at all levels of price spectrum.

The treatment combination of sowing on 29th Met.week with castor + two rows of coriander, followed by castor + one row of coriander gave significantly more monetary returns over rest of the intercrop treatment combinations and over sole crop of pigeonpea and sesamum at all levels of price spectrum (Table 162 to 170). This trend was seen due to sowing on 31st Met.week and 33rd Met.week also. Sowing on 29th Met. week with sole crop of coriander at 1.25 : 0.75 price level produced significantly less gross return over the treatment combination of castor + one row of coriander and castor + two rows of coriander and this trend was maintained uniformly over rest of the sowing dates also.

Table 170: Mean monetary returns (average of 1980-81 and 1981-82) in Rs/ha due to intercropping of castor J-1 as influenced by D x T interaction at 1.25:1.00 price spectrum of castor, coriander, pigeonpea and sesamum.

Treatments	Dates of sowing		
	D ₁	D ₂	D ₃
T ₁	1898.69	1442.59	1132.81
T ₂	2368.49	1816.39	1475.74
T ₃	2918.33	1932.98	1648.35
T ₄	1815.24	1139.67	884.76
T ₅	1663.21	1154.53	828.75
T ₆	1441.45	1285.99	791.03
T ₇	1288.27	1060.80	962.49
T ₈	2658.85	1960.42	1433.45
T ₉	1279.13	996.78	719.01
T ₁₀	1402.58	1195.68	884.76
S.E. $\pm$	72.240		
C.D. at 5%	204.320		

4.11 Moisture studies :

4.11.1 Moisture use and water use efficiency :

Data on mean moisture use in mm and water use efficiency in Rs/mm/ha are presented in Table 171.

Data revealed that moisture use was more in intercrops as compared to sole crops. Among sole crops, coriander recorded less moisture use.

Table 171: Mean moisture use(mm) from 0 to 90 cm depth of soil and water use efficiency(Rs/mm/ha) as influenced by various treatments

Treatments	Moisture use mm		Moisture use efficiency (M.U.E)Rs/mm/ha	
	1980	1981	1980	1981
D ₁	552.09	509.24	3.47	3.44
D ₂	537.04	541.49	2.69	2.49
D ₃	490.07	454.35	2.15	2.33
T ₁	522.33	529.13	2.01	2.89
T ₂	544.77	541.33	3.11	3.28
T ₃	528.73	536.27	4.09	3.66
T ₄	530.63	523.73	2.11	2.57
T ₅	531.50	534.07	2.18	2.42
T ₆	532.17	519.80	2.37	1.97
T ₇	539.47	534.17	2.32	1.96
T ₈	472.60	394.50	5.24	4.12
T ₉	529.90	508.83	2.13	2.15
T ₁₀	528.57	395.10	2.63	2.92

In general the water use and water use efficiency were more due to sowing on 29th Met.week followed by sowing on 31st Met.week.

Sole crop of coriander registered less moistured use coupled with high moisture use efficiency among all the treatments during both the years. This was followed by castor + coriander two row crop combination, which although

registered more moisture use yet the moisture use efficiency was next only to sole crop of coriander. This was again followed by castor + coriander one row crop combination.

4.11.2 Correlation and regression studies :

Data on simple correlation coefficients(r) and regression coefficients(b) computed between dry matter in g/m^2 (Biological yield)(Y) and moisture use (X_1) and average humidity (X_2) at various growth stages during 1980-81 and 1981-82 are presented in Table 172 (a) and (b) respectively.

The ' r ' values presented in Table 172 (a) and (b) indicated that the dry matter/ m^2 was positively and significantly correlated with moisture use at 30, 60 and 120 days after sowing during the second year and with humidity at 90 days after sowing during both the years and at 120 days after sowing during the second year. Positive but not significant correlations were obtained between dry matter/ m^2 and moisture use and humidity at the remaining stages during both the years.

The simple regression analysis revealed positive and significant regression coefficient between dry matter/ m^2 and moisture at 30, 60 and 120 days after sowing during the second year and with humidity at 90 days after sowing during both the years and also at 120 days after sowing during the second year.

Table 172(a): Simple correlation coefficients(r) and regression coefficients(b) between biological yield(Dry matter)(g/m^2) and moisture use(cm) and average humidity(%) due to intercropping of castor variety J-1, coriander, pigeonpea variety T-21 and sesamum variety N-85 and the sole crops.during 1980-81

Variables	Values for	Days after sowing			
		30	60	90	120
1. Moisture use in cm,0-90 cm soil depth by the cropping systems (x) and biological yield(dry matter) (g/m^2) (y)	'r'	0.2912	0.0864	0.1429	0.3097
	'b'	0.4704	3.9238	6.5446	14.6345
	't'	1.6111	0.4281	0.7156	1.7248
	'a'	10.8743	- 14.8603	- 65.7707	-549 .9300
2. Average humidity in percentage (x_1) and biological yield(dry matter)(g/m^2) (y)	'r'	0.1470	0.2533	0.4118*	0.3417
	'b'	1.1579	7.0674	17.7069	12.6383
	't'	0.7867	1.3854	2.3911*	1.9241
	'a'	-68.4663	-367.3168	-898.6179	-461.7561

* Significant at 5%

Table 172(b): Simple correlation coefficients(r) and regression coefficients(b) between
 b biological yield(dry matter)(g/m²) and moisture use(cm) and average humidity(%)
 due to intercropping of castor variety J-1, coriander, pigeonpea variety T-21
 and sesamum variety N-82 and the sole crops during 1981-82.

variables	Values for	Days after sowing				
		30	60	90	120	135
1. Moisture use in cm, 0-90 cm soil depth by the cropping systems (x) and biological yield (y) (dry matter) (g/m ²) (y)	'r'	0.3558*	0.3884*	0.1929	0.4218*	0.1292
	'b'	1.6992	9.8707	7.0683	9.7420	5.6577
	't'	2.0800*	2.2304*	1.0408	2.4616*	1.3327
	'a'	7.9028	-159.9443	-125.7363	-245.6381	-128.5944
2. Average humidity in percentage (x ₁) and biological yield (dry matter) (g/m ²) (y)	'r'	0.2087	0.2441	0.4010*	0.4433*	0.0745
	'b'	1.7080	32.8925	13.3104	13.7728	8.4623
	't'	1.1292	1.3317	2.3166*	2.6172*	0.3953
	'a'	-107.4566	-2326.9037	-917.8330	-762.7606	-304.9333

* Significant at 5%

DISCUSSION

V DISCUSSION

Results of the present investigation are discussed in this chapter.

A glance at Table 1 would reveal that the soil of the experimental area was clayey in texture, low in nitrogen, available phosphorus, but fairly rich in potassium and slightly alkaline in reaction. The data on meteorological parameters (Appendix I and II) indicated that during the cropping seasons of 1980-81 and 1981-82, a rainfall of 442.8 mm and 558.5 mm respectively was received as against the normal of 651.9 mm. Total precepitation of 893.2 mm and 779.8 mm was received during the respective years as against the normal annual of 937.1 mm. The data also indicated that during the cropping season 1980-81 the precepitation was spread over less number of rainy days and a dry spell of duration of more than 20 days was experienced during the month of September. While during the cropping season of 1981-82 the precepitation was spread over more number of rainy days and a dry spell of less than 15 days duration was also experienced during the 1st fortnight of October. The performance of the crop during 1980-81 was poor as compared to 1981-82 and this was reflected in the vegetative as well as reproductive characters of the crops. The data on decadal rainfall behaviour from 1950 to 1980 (Appendix III) indicated that in the event of the normal onset of monsoon during June

on an average one dry spell of an average duration of 10 days is common feature. During 1980-81 though the monsoon commenced 10 days earlier than normal a break in the monsoon activity for two to four weeks duration was observed, the normal activity started from middle of July. While during 1981-82, the monsoon was normal but sufficient rains for sowing were received only until third week of June, the activity was again below normal from 9.7.1981 to 27.7.1981. All these trends indicated aberrations in rainfall behaviour and the traditional crops and dates of sowing, and intercropping methods need to be adopted for attaining increased yields in dryland areas.

The new strategy developed for rainfed areas for obtaining increased and stabilised crop production per unit area per unit time envisages at selection of suitable crops, their varieties, advancing the traditional dates of sowing, intercropping etc. With the era of hybrids and high yielding varieties, the average grain yield obtained over many years of crop evaluation revealed that the oilseeds and pulses are also remunerative if managed properly, indicating the importance of the later under dryland areas. The present investigation was undertaken with castor variety J-1 as base crop and coriander local variety, pigeonpea variety T-21 and sesamum variety N-85 as intercrops. Earlier it was observed that castor and pigeonpea crops were ideal for dryland areas, Redja (1973) and Patil et al. (1981), castor + sesamum (Desai and Goyal 1980)

and Lai and Lawton (1962) and coriander and castor (Shinde, 1977).

From the rainfall behaviour it was made clear that in some years conditions to take up sowing were found to delay from late July to late August, Patil *et al.* (1980) and Anonymous (1979). The sowing time in the present investigation were fixed on 29th Met. week (16th to 22nd July), 31st Met. week (30th July to 5th August) and 33rd Met. week (13th August to 19th August). Contingency crop planning for dryland areas should aim at developing a cropping system that use available resources efficiently and yield well in a favourable environment but at the same time provide reasonable returns even under unfavourable situations. In the present investigation intensive cropping i.e. intercropping of castor with coriander, pigeonpea and sesamum with the above advanced dates of sowing was planned to develop a suitable cropping system for aberrant weather conditions of Marathwada tract.

The nature of growth of plants measured in terms of height, leaf number, leaf area, leaf area index, number of branches, number of internodes, total dry matter production at various growth stages, the yield contributing traits like number of spikes, number of capsules, weight of capsules, weight of grain, test weight, one litre volume weight etc and finally grain and straw yield were studied and ~~are~~ discussed below.

In general the season of 1981-82 was better than that of 1980-81 in terms of growth and yield. This may be due to favourable seasonal conditions such as rainfall, rainfall distribution, temperature humidity etc.

Castor : The dates of sowing and the intercropping combinations had no adverse effect on the emergence as well as final stand of the castor crop during both the year (Table-9).

In general, mean height and number of leaves per Castor plant increased progressively at every stage till 120 days. The rate of increase was slow during early stages, rapid between 60 to 90 days and slow thereafter till 120 days. Similar pattern of growth in terms of height was seen from growth analysis (Table 88). Similarly, the leaf area and leaf area index (LAI) (Table 22 (a) and (b) and (91) were maximum at 90 days after sowing and thereafter declined due to leaf drop. The number of branches increased from 60 days after sowing and the number of internodes from 30 days till 20 days. The rate of increase was rapid between 60 to 90 days.

In general, sowing in 29th Met. week produced significantly more height, number of leaves, leaf area, number of branches and internodes at most of the stages as compared to rest of the sowing dates during both the years. This was followed by 31st Met. week sowing and produced significantly more height, number of leaves, leaf area,

number of branches and internodes at most of the later stages as compared to sowing on 33rd Met.week during both the years. Significantly minimum height, number of leaves, leaf area, number of branches and internodes were recorded due to sowing on 33rd Met.week during both the years. These trends indicated the favourable seasonal conditions like rainfall, temperature, humidity etc and minimum stress of dry spells due to early vigour due to early sowing over later sowings. The dry spells more than 20 days during the September month during 1980-81 and a dry spell of 15 days during the early period of October 1981-82 had impact on these characters to a varying degree but since these crops were suitable for dryland areas, the stress was not felt as much as compared to traditional crops sown on traditional dates of sowing which failed totally to produce anything. Similar findings were reported by Spratt and Chowdhury (1978) and Sanghi (1982). ✓ Intercropping of castor with coriander, pigeonpea and sesamum significantly reduced the castor plant height, number of leaves, leaf area, number of branches and number of internodes at all stages except at earlier stages and in general two rows of the intercrop treatment reduced significantly more of the above characters of castor as compared to one row of the intercrop. The intercrops varied in their intensity of competition with castor in reducing the above characters. Sole cropping of castor recorded significantly more of the above characters as

compared to rest of the treatments where castor was intercropped. This treatment was followed by the treatment where castor was intercropped with one row of coriander and registered significantly more of all the above characters as compared to the rest of the treatments. This treatment was again followed by the treatment where castor was intercropped with two rows of coriander and registered significantly more of the above characters as compared to the rest of the intercropping treatments with castor. The above characters were significantly lowest in biometric observations in the treatment where castor was intercropped with two rows of sesamum. The reduction in the biometric observations of the above characters were rather intermediate in the treatments where castor was intercropped with pigeonpea. Effect of sowing dates on the above treatments (D x T) viz., sole crop of castor followed by castor + one row coriander followed by castor + two rows of coriander was also evident in improving the above characters over rest of the treatments at most of the stages during both the years. This may be due to the fact that coriander is a low growing crop in castor and at no stage interfered for light for castor, this may also be due to the fact that coriander is a short duration crop, its requirements for moisture and nutrients may be completed by 90 days and left no competition for the associated castor crop at later stages. It may also be due to the fact that the grand period of growth

of castor would have started just before coriander completed its harvest. The competition from one row of coriander was less because of wider space available for the better association of the intercrop as compared to thick population in two rows of coriander and consequently the competition in two rows of coriander was more for space, moisture and nutrients. Similar findings were reported by Shinde (1977). Sesamum is a fast growing medium duration and medium statured plant as compared to slow growing and long duration castor crop. Their grand periods of growth overlapped for most of the period. The early vigour of sesamum was fast and injurious to the slow growing castor crop. Sesamum shaded the castor at early stages and withered earlier due to short duration of the leaf persistence and thereby competition was vice-versa. Though there was not much competition for moisture and nutrients because of varying depths of root systems of sesamum and castor yet the competition for light was much reflected in both the crops in their vegetative characters. The competition was more severe in the treatment where castor was intercropped with two rows of sesamum as compared to one row of sesamum intercropped with castor because of more density of sesamum plant population. Similar types of findings were reported by Desai and Goyal (1980). On the other hand pigeonpea is of equal duration and height of castor, but both were hardy plants and competed at lower depths where moisture and nutrients were not limiting. The pigeonpea plant also did not compete for light because of trifoliate type of

leaf and its shade did not effect much to the castor plant as compared to sesamum. Because of nodulation of pigeonpea there was not much competition for nitrogen. These were some of the positive points and the negative points were over lapping of their grand period of growth, long duration and castor semi-looper meanace. Following the counteraction of these plus and negative points the competition offered by pigeonpea was rather intermediate as compared to coriander and sesamum.

The total dry matter of castor was continuous from initial stages to maturity (Table 63(a) and (b)). The increase was comparatively more between 60 to 120 days after sowing indicating active vegetative growth phase. This was also clear from the data on growth analysis i.e. AGR and RGR. During this period of 60 to 120 days the rate of increase of dry matter per plant was high because of rapid leaf and petiole, substantial stem weight production during 60 to 90 days and spike weight including capsules during 90 to 120 days. The dry matter production was comparatively more during the second year as compared to 1st year because of favourable seasonal conditions during the second year. In general sowing on 29th Met.week produced significantly more total dry matter per plant as compared to rest of the sowing dates at all stages. This may be due to luxuriant growth due to early sowing. This date was followed by sowing on 31st Met.week and produced significantly more dry matter per plant at all stages as compared to sowing on 33rd Met.week. These trends indicated that delayed

sowings may reduce the total dry matter significantly due to moisture stress at later stage of crop growth.

Intercropping of castor with coriander, pigeonpea and sesamum reduced the total dry matter of castor at all stages except at early stage. The intercrops varied in their competition in reducing the total dry matter per plant of castor. The competition was less when castor was intercropped with coriander as compared to rest of the intercrops, quite similar to vegetative characters as mentioned earlier. Effect of sowing dates (D x T) on these treatments i.e. sole crop of castor followed by castor + coriander combinations ^{was} evident in increasing the dry matter over rest of the treatments at most of the stages during both the years. At initial stages the leaf and petiole contributed more than stem for the total dry matter, while at peak period of growth stem and spike contributed relatively more and at maturity capsules contributed more for the total dry matter per plant.

Studies on post harvest characters such as number of capsules, grain weight, capsules weight and stalk weight per plant, test weight, one litre volume were also influenced by dates of sowing, treatments and their interactions (Table 92).

Sowing on 29th Met. week with sole cropping of castor produced significantly more number of capsules, weight of capsules, grains and stalks per plant, test weight and one litre volume ^{weight} over rest of the sowing dates. This was followed by sowing on 31st Met. week which again was significantly superior

over sowing on 33rd Met.week. Sole crop of castor produced significantly more number of capsules, weight of capsules, and stalk per plant over rest of the treatments. This was followed by the treatment castor + coriander one row which was significantly superior over rest of the treatments. This was again followed by castor + two rows of coriander and was significantly superior over rest of the treatments.

The interaction effects D x T were also significant for number of capsules, seed yield per plant and stalk weight per plant. Sowing on 29th Met.week with sole cropping of castor produced significantly more number of capsules, weight of seeds and stalks weight per plant over rest of the treatment combinations. This was followed by the treatment combination of castor + coriander one row and castor + coriander two rows crop combination and were significantly superior over rest of the treatments. This trend was also observed over rest of the sowing dates during both the years.

In case of weight of capsules, sowing on 29th Met.week the sole crop of castor was at par with castor + coriander one row^{and} was significantly superior over rest of the treatments during the 1st year and this trend was seen over 31st Met.week during the same year as well as during the second year. On rest of the sowing dates, the trend was similar as far number of capsules, weight of seeds and stalk weight. While test weight indicated no significant differences between sole crop of castor and the

treatment where castor was intercropped with one row of coriander and these two treatments were significantly superior over rest of the treatments in the same sequence. One litre volume seed weight also indicated no significant differences between sole crop of castor, castor + one row of coriander and castor + two rows of coriander intercrop combination, but were significantly superior over rest of the treatments with same sequence. For test weight the interaction effects were not significant during the first year. During the second year sowing on 29th Met.week with sole crop of castor produced significantly more test weight over rest of the treatments but it was at par with castor + coriander one row crop combination over sowing on 31st and 33rd Met.week and was significantly superior over rest of the treatments. This was followed by the treatment of castor + one row of coriander and was significantly superior over rest of the treatments. The interaction effects for one litre volume seed weight were not significant during both the years.

The castor seed yield in kg/ha which is a function of all the above yield contributing traits also indicated the same trend during individual years as well as in the pooled analysis (Table 99). Sowing on 29th Met.week produced significantly more seed yield over rest of the sowing dates during both the years as well as in the pooled analysis. This was followed by sowing on 31st Met.week which again produced significantly more seed yield over sowing on 33rd Met.week during both the years as well as in the pooled analysis.

This trend indicated that both vegetative as well as yield contributing traits put together boosted the yield for early sowing even after encountering the stress of dry spells but it varied from intercrop competition. The later sowings however faced stress to significant levels due to dry spells and produced reduced yields but did not result in total failure. Similar findings were reported by Balasubramanian (1959), Deokar et al. (1977), Patil et al. (1981) and Sanghi (1982). Sole crop of castor produced significantly more seed yield as compared to rest of the treatments during both the years as well as in the pooled analysis. This indicated competition free atmosphere for sole crop of castor as well as its drought resistant qualities. Similar findings were made by Weiss (1971). This was followed by the treatment of castor + one row of coriander which produced significantly more yield over rest of the treatments, during both the years as well as in the pooled analysis. This was again followed by the treatment of castor + coriander two rows which produced significantly more grain yield over rest of the treatments. These trends indicated that castor in association with coriander was ideal for intercropping as compared to rest of the intercrops. Similar findings were made by Guruswamy Raja (1968), Shinde (1977). It also indicated that one row of coriander offered less competition as compared to two rows of coriander because of high density of coriander intercrop in two rows. Effect of dates of sowing on these treatments i.e. sole crop of castor, followed by castor + one row

of coriander followed by castor + two rows of coriander was evident in increasing the seed yield over rest of the treatments during both the years. But in the pooled analysis these differences were not seen indicating that these treatments may perform equally well with other treatments and over other dates as well. Stalk yield in kg/ha also indicates the same trend during both the years.

Positive and significant correlation coefficients(r) and regression coefficients (b) were found between yield of castor g/plant and various characters viz., plant height, number of leaves, number of branches, number of internodes, petiole length, leaf area, number of spikes, mean length of spikes, number of capsules, 1000 grain weight, dry matter per plant and one litre volume grain weight over all the dates of sowing during both the years except with number of capsules at 29th Met.week during 1st year and with petiole length at 29th Met.week during the 2nd year (Table 106). These two later characters were correlated positively but not significantly with grain yield at the above mentioned dates and years. These studies indicate that the above characters are important in contributing towards yield.

The percentage of nitrogen in whole plant of castor was numerically high at early stages because of active absorptions and low at harvest because of high dry matter accumulation and subsequently substantial translocation to reproductive parts and

comparatively low availability of soil nitrogen at advanced stage (Table 107(a) and (b)). Numerically highest concentration of nitrogen was observed in whole plant of castor due to sowing on 29th Met.week as compared to rest of the sowing dates at all stages indicating active absorption because of sufficient moisture content in the soil. This treatment was followed by sowing on 31st Met.week which indicated higher concentration over 33rd Met. week. There was not much variation in the nitrogen concentration in the castor plant at earlier stages due to different treatmental effect, but at 60 days after sowing the nitrogen content in the castor plant intercropped with various intercrops was reduced slightly as compared to sole crop of castor. This indicated competition for nitrogen by the associated crops. The reduction in the treatment castor + coriander one row was comparatively less as compared to rest of the intercrop combinations.

The phosphorus and potassium content also indicated the same trend as nitrogen.

The oil content at harvest in the kernels of castor also indicated the same trend due to dates and treatments as for N,P,K (Table 108).

Coriander : The data (Table 109 and 110) indicated that coriander plant height and number of leaves increased very slow upto 45 days after sowing, very fast between 45 to 75 days after sowing and relatively very slow thereafter. Similarly, the number of branches (Table 111) increased from 45 to 75 days.

The total dry matter of coriander increased gradually at every stage (Table 115(a) and (b)). The increase was comparatively more between 45 to 75 days after sowing. These trends indicated that the grand growth period of coriander was between 45 to 75 days after sowing. Similar findings were observed by Shinde (1977).

Sowing on 29th Met.week produced significantly more height, number of leaves, branches, dry matter, number of umbels, grains, test weight etc at harvest. This was followed by sowing on 31st Met.week and which again was significantly superior over sowing on 33rd Met.week. These trends indicated suitability of early sowing but later sowing date also produced significantly more values over still late sowing of 33rd Met.week indicating the stress tolerance against dry spells of the crops even under aberrant weather conditions.

Sole crop of coriander registered significantly more number of leaves, number of branches, number of umbels, dry matter, number of grains, test weight etc at harvest over the treatments of castor + coriander one row and castor + coriander two rows. This was followed by the treatment of castor + coriander one row and was significantly superior over the treatment of castor + coriander two rows.

The interaction effects at harvest due to D x T (Tables 113, 114, 116, 118, 119 and 120) have also shown clear indications of benefit of sowing on 29th Met.week with sole crop of coriander for achieving significantly more number of leaves,

branches, umbels, dry matter, grains and test weight over rest of the treatment combinations. This was followed by the treatment combination of castor + coriander one row and was significantly superior over the treatment of castor + coriander two rows. The same trend was observed over rest of the sowing dates. These trends indicated competition free atmosphere for sole crop of coriander and greater degree of competition in castor + two rows of coriander than castor + one row of coriander due to the association of castor.

The grain and straw yield (Table 121) was also significantly more due to sowing on 29th Met. week as compared to rest of the sowing dates. This was followed by treatment of sowing on 31st Met. week which recorded significantly more grain and straw yield over sowing on 33rd Met. week. These trends indicated favourable weather conditions for early sowing and the degree of tolerance for drought by these crop combination was so ideal suited that even under delayed sowings due to weather aberrations, these could yield better than nothing.

Sole crop of coriander also registered significantly more grain and straw yield as compared to rest of the treatments viz., castor + coriander one row and castor + coriander two rows. This indicated competition free atmosphere for sole crop of coriander for better utilization of resources. This was followed by the treatment combination of castor + coriander two rows and produced significantly more grain and straw yield over castor +

coriander one row. Although the vegetative and yield contributing traits were less in castor + coriander two rows crop combination, but the total population of coriander plants in this treatment added to the total yield of grain and straw over castor + coriander one row crop combination

These trends indicated that, though the competition offered by castor in castor + coriander two rows was more yet the optimum population could make up the yield levels. The interaction effect due to D x T at harvest for grain and straw yield (Table 112 and 123) indicated that sowing on 29th Met. week with sole crop of coriander followed by castor + coriander two rows and castor + coriander one row crop combination maintained the same trend over rest of the sowing dates also. Similar findings were reported by Kumarnathsingh (1961), Guruswamy Raja (1962) and Shinde (1977).

Pigeonpea : The data indicated that the plant, height (Table 124) number of leaves (Table 125), leaf area (Table 126) and number of branches (Table 127) of pigeonpea variety T-21 increased very fast between 45 to 90 days after sowing. The total dry matter per plant (Table 132(a) and (b)) was maximum between 60 to 120 days.

Sowing on 29th Met. week registered significantly more plant height, number of leaves, leaf area, number of branches, dry matter, number of pods, number of grains and test weight at harvest over rest of the sowing dates. This indicated

suitability of early planting for utilization of resources. This was followed by sowing on 31st Met.week which produced significantly more of all the above characters over sowing on 33rd Met.week. These trends indicated that even when weather is not suitable for sowing till 29th Met.week, sowing can be delayed upto 31st Met.week which still produced significantly more of the above characters over sowing on 33rd Met.week, because of hardy nature of pigeonpea. Sole crop of pigeonpea produced significantly more number of leaves, branches, pods, grains, dry matter, and test weight as compared to castor + pigeonpea one row and castor + pigeonpea two row crop combinations. This was followed by the treatment of castor + pigeonpea one and was significantly superior over castor + pigeonpea two rows. These trends indicated competition free atmosphere for sole crop of pigeonpea as compared to pigeonpea intercropped with castor. The competition was more in castor + pigeonpea two rows than in castor + pigeonpea one row.

The interaction effects of dates of sowing on these treatments (Tables 129, 130, 131, 133, 135, 136 and 137) was evident in increasing the above characters. Sowing on 29th Met.week with sole crop of pigeonpea produced significantly more number of leaves, leaf area, branches, pods, grain weight, dry matter and test weight over rest of the treatments. This was followed by the treatment combination of castor + pigeonpea one row crop combination and was significantly superior over castor + two rows of pigeonpea. This trend was also seen at rest of the sowing dates during both the years.

These trends indicate competition free atmosphere for sole cropping of pigeonpea and greater degree of competition in intercropping treatments. The competition was more in castor + two rows of pigeonpea as compared to castor + one row of pigeonpea.

At harvest sowing on 29th Met.week gave significantly more grain and stalk yield as compared to rest of the sowing dates. This was followed by sowing on 31st Met.week and was significantly superior over 33rd Met.week. These trends indicate that pigeonpea being hardy plant could withstand the stress of aberrations even upto 33rd Met.week sowing.

Sole crop of pigeonpea produced significantly more grain and stalk yield as compared to castor + one row pigeonpea and castor + two rows of pigeonpea. This was followed by castor + two rows of pigeonpea which produced significantly more grain and stalk yield over castor + one row pigeonpea.

The interaction effects due to D x T for grain and stalk yields indicated (Table 139 and 140) that sowing on 29th Met.week with sole crop of pigeonpea produced significantly more grain and stalk yields as compared to castor + one row of pigeonpea and castor + two rows of pigeonpea. This was followed by castor + two rows of pigeonpea which was significantly superior over castor + one row of pigeonpea. This trend was observed over rest of the sowing dates also. These trends indicated competition free atmosphere for sole cropping of pigeonpea and competition in treatments where pigeonpea was associated

with castor. The competition was more in castor + two rows of pigeonpea as compared to castor + one row of pigeonpea crop combination as a result of which the grain and stalk yield was more in two row crop combinations, because of optimum population of pigeonpea plants. Since both castor and pigeonpea are deep rooted and of uniform growth habits their grand periods of growth also overlapped totally and consequently resulted in competition to the extent of 50 per cent. Similar findings were observed by Rao and Willey (1979) when sorghum and pigeonpea were intercropped.

Sesamum : The data (Table 141) indicated that the rate of increase of plant height of sesamum variety N-85 was very slow upto 30 days after sowing, very fast between 30 to 60 days after sowing and relatively very slow thereafter. The number of leaves (Table 142) increased upto 60 days after sowing. The rate of increase in number of leaves was slow upto 30 days and very fast between 30 to 60 days after sowing. Thereafter, there was a decline in number of leaves due to leaf drop. The number of branches increased very fast between 45 to 75 days after sowing (Table 143). The dry matter production increased from 30 days to 90 days after sowing. The increase was more between 45 to 90 days after sowing. (Table 147 (a) and (b)). These trends indicated that the grand period of growth of sesamum variety N-85 was between 45 to 90 days which coincided partly with that of castor crop.

In general, sowing on 29th Met.week produced significantly more height, number of leaves, branches, number of pods, dry matter, weight of grain and test weight at harvest as compared to sowing on 31st Met.week which again produced significantly more of the above characters as compared to sowing on 33rd Met.week. These trends indicated that early sowing was better than late even for sesamum. Sesamum being short and fast growing plant could avoid the stress and could produce positive results.

Sole cropping of sesamum produced significantly more number of leaves, branches, pods, dry matter, test weight of grains at harvest as compared to one row and two rows of sesamum intercropped with castor. This was followed by treatment of castor + one row of sesamum and was significantly superior over castor + two rows of sesamum. These trends indicated competition free atmosphere in case of sole crop of sesamum and competition effects due to association with castor crop. The competition was more in castor + two rows of sesamum intercrop combination as compared to castor + one row of sesamum because of shading and over crowding of sesamum in association with castor.

D x T interaction effects in respect of number of leaves, branches, dry matter, number of pods and grain weight (Tables 145, 146, 148, 150 and 151) also indicated significant differences among treatment combinations. Sowing on 29th Met. week with sole crop of sesamum produced significantly more

number of leaves, branches, pods, dry matter and grain weight over rest of the treatments in association with castor crop. This was followed by the treatment of castor + one row of sesamum crop combination which produced significantly more of the above characters over castor + two rows of sesamum. All these tests confirm the superiority of the treatments of sole cropping of sesamum over rest of the treatments in association with castor followed by castor + one row of sesamum and castor + two rows of sesamum.

At harvest sowing on 29th Met.week produced significantly more grain and straw yield (Table 152) over rest of the sowing dates. This was followed by sowing on 31st Met. week which again produced significantly more grain and straw yield over sowing on 33rd Met.week.

These trends indicated the benefits of early sowing over later dates of sowing in avoiding stress periods of dry spells. However, the later dates of sowing also produced again grain and straw yields as an insurance against risks of weather aberrations.

Sole crop of sesamum produced significantly more grain and straw yield as compared to rest of the treatments in association with castor crop. This was followed by the treatment of castor + sesamum two rows and was significantly superior over castor + one row of sesamum.

D x T interaction effects in respect of grain and straw yield (Table 153 and 154) indicated that sowing on 29th Met.week with sole crop of sesamum produced significantly more grain and straw yield over rest of the treatments in association with sesamum and castor. This was followed by the treatment of castor + two rows of sesamum and was significantly superior over castor + one row of sesamum. and These trends indicated competition free atmosphere for sole crop of sesamum and competitive effects in intercrops with castor + sesamum one rows and two rows. The competition was more in two rows of sesamum and because of dencer population of sesamum the grain and straw yields were more as compared to castor + one row sesamum treatment. Sesamum is a fast growing and short duration crop in association with slow growing long duration castor crop. Their grand period of growth however over lapped for certain period and the competition resulted in decreased yield levels of sesamum. Similar findings were also observed by Lai and Lawton (1962).

✓ In order to bring out the real effect of intercropping system with different crops, indices such as monetary returns, LER, grain equivalents of main crop are utilized and based on these indices most productive and efficient intercropping system is evaluated. In the present investigation a comparative performance of pooled results of monetary returns, grain equivalent and LER has been made and the data (Table 155) indicated that sowing ✓ on 29th Met.week produced significantly more monetary returns over rest of the sowing dates. This was followed by

sowing on 31st Met.week which was significantly superior over 33rd Met.week sowing. These trends indicated that early sowing is better than late sowing. However, later sowing upto 33rd Met.week also provided some mance against total failure. Similar findings were also made by Ayyangar (1942), Ayayer(1949), Evans and Shreedharan (1962), Guruswamy Raja (1968), Weiss(1971), Raja (1973), Anonymous (1977), Spratt and Chowdhury (1978) and Sanghi (1982) Sowing on 29th Met.week and 31st Met.week produced castor seed equivalents at par with each other and significantly superior over 33rd Met.week sowing. This indicated that when we estimate the productivity in terms of base crop equivalents, delayed sowing upto 31st Met.week may not show any differences. However, further delayed sowing by 33rd Met.week may also provide some insurance than total failure. LERs on the other hand showed no significant differences due to sowing dates. This indicated that higher yields based on land equivalents treatments may be obtained even if sowings are delayed by 33rd Met.week. This trend indicated more suitability of these intercrop combinations for late sowing due to weather aberrations.

In the pooled analysis monetary returns from castor + two rows of coriander, sole crop of coriander and castor + one row of coriander were on par with each other and significantly superior over rest of the sole crops and intercrop combinations. This may be due to the fact that though the yields/ha of coriander is less its market price is more, so coriander crop may be choosen as one of the mid season correction crops as this is less susceptible crop for pests except the mildew

disease which can be controlled, as compared to castor crop which is highly susceptible to castor semi-looper which is very difficult to ~~control~~. Similar results were reported for coriander + castor intercrop (Shinde 1977), for castor + cowpea (Sanghi, 1982), for safflower + coriander (Anonymous, 1977), for castor + legume (Yadav and Amar Singh (1973), for castor + groundnut (Prabhakara Reddy et al., 1965), for castor + sorghum (Chinnapan and Palaniappan 1980). Castor grain equivalents from sole crop of coriander and castor + two rows of coriander were at par with each other and significantly more over rest of the sole crop of coriander and castor + two rows of coriander were at par with each other and significantly more over rest of the sole crops and intercrop combinations. This was followed by the treatments castor + one row of coriander and was significantly superior over rest of the treatments and sole crops. LER values from castor + two rows of coriander and castor + one row of coriander were at par with each other and were significantly superior over rest of the intercrop combinations.

Significant differences were also observed due to interaction effects of D x T for castor grain equivalents for individual years as well as for pooled analysis (Table 157 and 158). But the interaction effects for monetary returns and LER values were not significant in their pooled analysis, although there were significant differences during individual years. These trends indicated that castor + two rows of coriander is the productive and efficient intercropping system followed by

the treatment of castor + one row coriander intercropping system. These two intercropping systems exhibited their individual superiority over rest of the intercropping systems over all the dates of sowing as was reflected in the interaction effects due to D x T for castor seed equivalent. While the monetary returns and LER which showed significant interaction effects due to D x T during the individual years (Table 156 and 159) was extinguished in their pooled analysis. This indicated that all the intercropping system were at par with each other over dates of sowing. In other words all the systems were stable in their performance even if sowing were delayed upto 33rd Met.week.

The profitability of intercropping system was evaluated on the basis of spectrum of market prices. The data pertaining to the gross returns (Table 161) over spectrum of prices 25 per cent above market prices of both base crops and intercrop and 25 per cent below the market price of both base crop and intercrop indicated that significantly more gross returns could be obtained by sowing on 29th Met.week over rest of the sowing dates at all levels of price spectrum. This was followed by sowing on 31st Met.week which gave significantly more monetary returns over sowing on 33rd Met.week at all levels of price spectrum. These trends indicated that by advancing sowing dates upto 33rd Met.week and price levels falling below 25 per cent of market prices, the monetary returns were remunerative. Castor + two rows of coriander gave

significantly more monetary returns over rest of the intercropping systems and sole crops of pigeonpea and sesamum at all levels of price spectrum. It was at par with sole crop of coriander at most of the price spectrum except at 1.0: 0.75, 1.25: 0.75 and 1.25: 1.00 levels of market prices. Castor + one row of coriander followed the castor + two rows of coriander treatment and gave significantly more monetary returns over all the remaining intercropping treatments as well as sole crops of pigeonpea and sesamum at all levels of price spectrum.

The interaction effects due to D x T were also significant at all levels of market prices (Tables 162 to 170). These trends indicated that performance of the treatment castor + two rows of coriander and castor + one row of coriander was stable over different dates also, sole crop of coriander may give significantly less monetary returns over the above treatments if the market prices of main crop is increased by 25 per cent and the coriander price is reduced by 25 per cent. Under these circumstances it may be said that among the intercropping systems the above two treatments are more remunerative.

✓ For the small farmer under dryland agriculture, stability in cropping system is more essential. A stable system denotes similar performance in various environments as indicated by 'b' equal to zero, Eberhart and Russel (1963). In many respects, a system that shows the lack of fluctuations

over seasons is important for a small farmer. And further, part of the objective of any cropping system research programme should presumably be to develop systems that use available resources efficiently and yield well in favourable environment, but at the same time provide reasonable returns even under the unfavourable situations. The present investigation on stability parameters for three estimates of gross economic returns, total grain yield and LER have been worked and compared to show evidence for greater stability of the intercrop (Table 160). In Eberhart and Russel Model b_i is considered as parameter of response and S^2_{di} as the parameter of stability. The treatment castor + coriander two row crop combination gave highest gross economic returns with b_i values significantly more than one and $S^2_{di} = 0$. These results indicated that castor + coriander two row crop combination is stable to environments and gross economic returns are likely to be increased under favourable conditions. The gross economic returns from the treatment castor + coriander one row crop combination is also high and is coupled with $b_i = 1$ and $S^2_{di} = 0$. This treatment is expected to be stable under varying environmental conditions for gross economic returns. In respect of sole cropping of coriander the mean value for gross economic returns is high but S^2_{di} is also high making prediction difficult.

The total grain yield from castor + coriander one row crop combination and castor + coriander two row crop combination is high and at par with each other. However, the prediction

in respect of these two treatments is difficult due to significant S^2_{di} values.

In respect of LER values castor + coriander one row crop combination and castor + coriander two row crop combination revealed high mean values, unit 'bi' and low S^2_{di} . These two treatment for LER are likely to exhibit stable performance over varying environmental conditions. Similar observations with castor were made by Rao et al. (1979).

In general, castor + coriander one row and castor + coriander two row crop combination are expected to exhibit desirable performance under varying environmental conditions.

✓ Soil moisture which is a limiting factor in dryland areas was efficiently utilized by the treatment of sole crop of coriander followed by the treatment of castor + two rows of coriander and this was again followed by the treatment of castor + one row of coriander. These results indicated that the roots of intercrop of coriander and castor far from different soil layers in combination may exploit a greater total volume of soil moisture. Similar findings were reported by Willey (1979) and Snaydon and Harris (1979).

SUMMARY AND CONCLUSIONS

VI SUMMARY AND CONCLUSIONS

The present investigation was designed to study the effect of dates of sowing on growth, yield, quality and economics of intercropping of castor (Ricinus communis L.), with coriander (Coriandrum sativum L.), redgram (Cajanus cajan L.) and sesamum (Sesamum indicum L.sp.) as contingency planning for weather aberrations during 1980-81 and 1981-82 at the Dryland Agricultural Research Centre, Marathwada Agricultural University, Parbhani.

The experiment was laid out in factorial randomized blocks design with thirty treatments consisting of three dates of sowing, six intercropping treatments and four sole cropping treatments of one base crop and three intercrops replicated three times. The layout consisted of ninety plots during both the seasons. The gross plot size was 6.3 x 6.3 m.

The soil of experimental plot was clayey in texture, low in nitrogen and available phosphorus and fairly rich in available potassium during both the seasons. It was slightly alkaline in reaction. During 1980-81, though the monsoon commenced 10 days earlier than normal a break in the monsoon activity for two to four weeks duration was observed, the normal activity started from middle of July and the activity of monsoon receded early on 10th September. During 1981-82 the monsoon was normal but sufficient rains for sowing were received only until

third week of June, the activity was again below normal from 9.7.1981 to 27.7.1981. The weather conditions in general were normal during second year as compared to first year.

Observations on growth, yield and quality aspects were recorded periodically to evaluate treatment effect on castor as well as intercrops during both the years.

A. Castor :

1. The emergence count and final plant stand of castor variety J-1 were not influenced by either dates of sowing or treatments during both the years.
2. Growth characters viz., height, number of leaves, leaf area, number of nodes, petiole length were influenced significantly due to dates of sowing and treatments. Sowing on 29th Met.week(16th to 22nd July) produced significantly more of these characters as compared to rest of the sowing dates at most of the stages during both the years. This was followed by sowing on 31st Met.week(30th July to 5th August) which also produced significantly more of these characters at most of the stages over sowing on 33rd Met.week(13th to 19th August) during both the years.

Sole crop of castor produced significantly more of the above characters over rest of the treatments and at most of the stages during both the years. This was followed by the treatment of castor + one row of coriander and produced

significantly more of these characters at most of the stages during both the years. This was followed by the treatment of castor + two rows of coriander which again registered significantly more of the above characters at most of the stages over rest of the treatments during both the years. All these characters were drastically reduced in rest of the treatments viz., castor + pigeonpea one row and two rows, castor + sesamum one row and two rows of intercrop combination at most of the stages during both the years. Effect of sowing dates on sole crop of castor followed by castor + one row coriander, followed by castor + two rows of coriander was evident at most of the stages in significantly improving the above characters over rest of the treatments.

3. The active growth period was found to be between 60 to 120 days after sowing. During this period the dry matter accumulation was faster. In general sowing on 29th Met.week (16th to 22nd July) produced significantly more dry matter accumulation over rest of the sowing dates at most of the stages except at early stages during both the years. This was followed by sowing on 31st Met.week (30th July to 5th August) and produced significantly more dry matter accumulation over sowing on 33rd Met.week (13th to 19th August) at most of the stages during both the years. ✓ Sole crop of castor produced significantly more dry matter accumulation over rest of the treatments at most of the stages during both the years. And this was followed by the treatment of castor + two rows of coriander and was significantly

superior over rest of the treatments at most of the stages during both the years. This was followed by the treatment of castor + two rows of coriander and was significantly superior over rest of the treatments at most of the stages during both the years. Dry matter accumulation was drastically reduced in the treatments where pigeonpea and sesamum were intercropped with castor. Effect of sowing dates on the sole crop of castor followed by castor + one row of coriander followed by castor + two rows of coriander was evident at most of the stages in significantly increasing the dry matter accumulation over rest of the treatments during both the years.

4. Yield contributing characters viz., number of spikes and number of capsules per plant were also affected due to various dates of sowing and treatments. Sowing on 29th Met.week (16th to 22nd July) produced significantly more number of spikes and number of capsules over rest of the sowing dates at most of the stages during both the years. This was followed by sowing on 31st Met.week (30th July to 5th August) which was also significantly superior over sowing on 33rd Met.week (13th to 19th August) at most of the stages during both the years. Sole crop of castor produced significantly more number of spikes and number of capsules over rest of the treatments at most of the stages during both the years. This was followed by the treatment of castor + one row of coriander which again was significantly superior over rest of the treatments at most of the stages during both the years. This was followed by the

treatment of castor + two rows of coriander and was significantly superior over rest of the treatments at most of the stages during both the years. Effect of sowing dates on the sole crop of castor, followed by castor + one row of coriander followed by castor + two rows of coriander was evident at most of the stages in increasing the number of spikes and capsules significantly over rest of the treatments during both the years.

5. The weight of capsules, ~~seeds~~, stalk and test weight of castor variety J-1 were also influenced by dates of sowing and treatments. Sowing on 29th Met.week(16th to 22nd July) produced significantly more weight of capsules, seeds, stalks and test weight over rest of the sowing dates during both the years. This was followed by sowing on 31st Met.week(30th July to 5th August) which also produced significantly more weight of capsules, grains, stalk and test weight over sowing on 33rd Met. week(13th to 19th August) during both the years. Sole crop of castor produced significantly more of these characters except test weight over rest of the treatments while it was at par with the treatment castor + one row of coriander in respect of test weight and was significantly superior over rest of the treatments during both the years. This was followed by the treatment of castor + one row of coriander which produced significantly more of all the above characters over rest of the treatments during both the years. This was followed by the treatment of castor + two rows of coriander which also produced significantly more of

the above characters over rest of the treatments except test weight during both the years. In case of test weight the above treatment was at par with castor + pigeonpea one row and was significantly superior over rest of the treatments during both the years. Weight of capsules, seeds, stalk per plant and test weight were drastically reduced in case of the treatment of castor + sesamum during both the years. Effect of sowing dates on the sole crop of castor, followed by castor + one row of coriander followed by castor + two rows of coriander was evident in improving the above characters over rest of the treatments during both the years.

6. The capsule yield, seed yield and stalk yield of castor variety J-1 were also significantly influenced by dates of sowing and treatments.

Sowing on 29th Met.week(16th to 22nd July) produced significantly more capsule yield, ~~seed~~ and straw yield over rest of the sowing dates, during both the years and also in the pooled analysis for the grain yield. This was followed by sowing on 31st Met.week(30th July to 5th August) which again produced significantly more of the above characters over sowing on 33rd Met.week (15th to 19th August) during both the years and also in the pooled analysis for grain yield. Sole crop of castor produced significantly more of these characters over rest of the treatments during both the years and in the pooled analysis for grain yield.

This was followed by the treatment of castor + one row of coriander and was significantly superior over rest of the treatments during both the years and in the pooled analysis for grain yield. This was followed by the treatment of castor + two rows of coriander and was significantly more over rest of the treatments during both the years and in the pooled analysis for grain yield. Effect of sowing dates on the above treatments was also evident during individual years in increasing the capsule yield, seed yield, stalk yield over rest of the treatments. This was not reflected in the pooled analysis for seed yield.

7. Correlation coefficients and regression coefficients between castor plant characters viz., height, number of leaves, leaf area, number of branches, petiole length, number of nodes, number of spikes, length of spikes, number of capsules, 1000 grain weight, dry matter, one litre volume weight and grain yield per plant were positive during both the years at all dates of sowing.

8. The N, P, K content of the castor plant was also influenced by dates of sowing and treatments during both the years. Numerically high values of NPK were recorded due to sowing on 29th Met.week(16th to 22nd July) as compared to rest of the sowing dates during both the years. This was followed by sowing on 31st Met.week(30th July to 5th August) and was also higher in NPK content over sowing on 33rd Met.week(13th to 19th August) during both the years. Sole crop of castor recorded higher content of NPK as compared to rest of the treatments during both the years.

This was followed by the treatment of castor + one row and two rows of coriander during both the years. The NPK content was numerically high at earlier stages due to active absorption and low at later stages during both the years.

9. The oil content in the kernels of castor at harvest was more due to sowing on 29th Met.week(16th to 22nd July) as compared to rest of the sowing dates during both the years. This was followed by sowing on 31st Met.week(30th July to 5th August) and was more than in 33rd Met.week (15th to 19th August) sown crop. Sole crop of castor registered more oil content than intercropped castor. The oil content of castor was least effected due to intercropping with coriander as compared to rest of the treatments.

B. Intercrops :

10. Growth characters of intercrops viz., coriander, pigeonpea and sesamum were also significantly affected due to dates of sowing and treatments during both the years. Sowing on 29th Met.week (16th to 22nd July) produced significantly more height, number of leaves, leaf area in case of pigeonpea, number of branches, of these crops over rest of the sowing dates at harvest during both the years. This was followed by sowing on 31st Met.week (30th July to 5th August) which was significantly superior over sowing on 33rd Met.week(13th to 19th August) at harvest during both the years.

11. The yield contributing characters viz., number of umbels in case of coriander, number of pods in case of pigeonpea and sesamum and number of grains of these crops were also similarly effected due to dates of sowing and treatments at harvest during both the years. Sowing on 29th Met.week (16th to 22nd July) produced significantly more number of umbels in case of coriander, number of pods in case of pigeonpea and sesamum and number of grains over rest of the sowing dates at harvest during both the years. This was followed by sowing on 31st Met.week (30th July to 5th August) and was significantly superior over sowing on 33rd Met.week (13th to 19th August) at harvest during both the years.

Sole crop of these intercrops produced significantly more of these characters over intercropping treatments of the respective crops at harvest during both the years. This was followed by one row of intercrop combination and was significantly superior over two rows of intercrop combination at harvest during both the years. Effect of sowing dates on these treatments was also evident in improving these characters at harvest during both the years.

12 The weight of pods, grains, test weight of these intercrops were also significantly influenced by the dates of sowing and treatments during both the years at harvest. Sowing on 29th Met.week (16th to 22nd July) produced significantly more of the characters over rest of the sowing dates during both the years at harvest. This was followed by sowing on 31st Met.week (30th July to 5th August) and was significantly superior over

sowing on 33rd Met.week (13th to 19th August) during both the years at harvest. Sole crop of these intercroops produced significantly more of these characters over their respective intercrop treatments during both the years at harvest. This was followed by the respective intercrop of one row in association with castor crop during both the years at harvest. This was followed by the respective intercrop of one row in association with castor crop during both the years at harvest. This was again significantly superior over the respective intercrop of two rows in association with the castor during both the years at harvest. Effect of sowing dates on these treatments was also evident in increasing these characters at harvest during both the years.

13. Grain and straw yield of these intercroops were also significantly influenced by dates of sowing and treatments at harvest during both the years. At harvest sowing on 29th Met. week (16th to 22nd July) produced significantly more grain and straw yield for these crops over rest of the sowing dates during both the years. This was followed by sowing on 31st Met. week (30th July to 5th August) which again produced significantly more grain and straw yield over 33rd Met.week (13th to 19th August) during both the years.

At harvest sole crop of these intercroops produced significantly more grain and straw yields over respective intercropping treatments during both the years. This was followed by the respective intercropping treatment of two rows in association with castor and was significantly superior over the respective

intercropping treatment of two rows in association with castor and was significantly superior over the respective intercropping treatment of one row in association with castor during both the years. Effect of sowing dates on these treatments was also evident in increasing the grain and straw yields during both the years.

Evaluation of crop productivity :

14. Mean monetary returns, castor seed equivalents and LER of these intercropping system were also influenced by dates of sowing and treatments during the respective years as well as in the pooled analysis. Significantly more monetary returns were obtained due to sowing on 29th Met.week (16th to 22nd July) over rest of the sowing dates during both the years and in the pooled analysis. This was followed by sowing on 31st Met.week (30th July to 5th August) which also was significantly superior over sowing on 33rd Met.week (13th to 19th August) during both the years as well as in the pooled analysis. Sowing on 29th Met.week (16th to 22nd July) also produced significantly more castor seed equivalents over rest of the sowing dates during both the years but in the pooled analysis it was at par with sowing on 31st Met.week (30th July to 5th August) and was significantly superior over sowing on 33rd Met.week (13th to 19th August). This was followed by sowing on 31st Met.week (30th July to 5th August) during both the years and was significantly superior over sowing on 33rd Met.week (13th to 19th August). Sowing on 31st Met.week (30th July to 5th August)

was at par with sowing on 33rd Met.week(13th to 19th August) in the pooled analysis.

Why Sowing on 33rd Met.week (13th to 19th August) registered significantly higher values LER over rest of the sowing dates during 1st year. While during the second year sowing on 29th Met.week (16th to 22nd July) was significantly superior over rest of the sowing dates. In the pooled analysis no significant differences were observed between sowing dates for LER values, however sowing on 29th Met.week (16th to 22nd July) registered numerically higher LER values over rest of the sowing dates. Sowing on 29th Met.week(16th to 22nd July) followed 33rd Met.week (13th to 19th August) during first year and was at par with sowing on 31st Met.week(30th July to 5th August). While during the second year sowing on 31st Met. week (30th July to 5th August) was significantly superior over sowing on 33rd Met.week (13th to 19th August). In the pooled analysis sowing on 33rd Met.week (13th to 19th August) gave higher LER values over sowing on 31st Met.week (30 th July to 5th August).

During the first year sole crop of coriander produced monetary returns at par with castor + two rows of coriander and significantly superior over rest of the treatments. This was followed by castor + two rows of coriander which produced significantly more monetary returns over rest of the treatments. This was again followed by castor + one rows of coriander and was significantly superior over rest of the treatments. During the

second year castor + two rows of coriander produced significantly more monetary returns over rest of the treatments. This was followed by castor + one row of coriander which was significantly superior over rest of the treatments. In the pooled analysis castor + two rows of coriander produced monetary returns at par with sole crop of coriander and was significantly superior over rest of the treatments. This was followed by the treatment of sole crop of coriander and was significantly superior over rest of the treatments. This was again followed by castor + one row of coriander and was significantly superior over rest of the treatments. Monetary returns were reduced significantly in rest of the treatments during both the years and in the pooled analysis. Effect of sowing dates on these treatments was also evident in increasing the monetary returns during both the years but it was not reflected in the pooled analysis.

Castor grain equivalents also followed the same trend of monetary returns during individual years and also in the pooled analysis but the effect of sowing dates on these treatments was also evident in the pooled analysis in addition to the effects during individual years.

During first year castor + two rows of coriander gave LER values at par with castor + one row of coriander and was significantly superior over rest of the intercropping treatments. This was followed by castor + one row of coriander which again was

significantly superior over rest of the treatments. During second year castor + two rows of coriander registered significantly higher values of LER over rest of the treatments. This was followed by castor + one row of coriander and was significantly superior over rest of the treatments. In the pooled analysis castor + two rows of coriander registered LER values at par with castor + one row of coriander and was significantly superior over rest of the intercropping treatments. This was followed by castor + one row coriander and was at par with castor + two rows of pigeonpea and was significantly superior over rest of the intercropping treatments. Effect of sowing dates on these treatments was evident during both the years but was not evident in the pooled analysis.

15. The mean gross economic returns based on the spectrum of market prices were also influenced by dates of sowing and treatments. Sowing on 29th Met.week (16th to 22nd July) produced significantly more gross returns at all spectrum of prices over rest of the sowing dates. This was followed by sowing on 31st Met.week (30th July to 5th August) and was significantly superior over sowing on 33rd Met.week (13th to 19th August).

✓ Sole crop of coriander produced significantly more monetary returns over rest of the treatments at price spectrum of 0.25:1.00, 0.75: 1.25 and 1.0: 1.25 and it was at par with castor + two rows of coriander at 0.75: 0.75, 1:1 and 1.25: 1.25 price spectrum and was significantly superior over rest of the

treatments. It was only next to castor + two rows of coriander at price spectrum of 1.0:0.75, 1.25:1.00 and was significantly superior over rest of the treatments. It was significantly less than the treatment of castor + one row of coriander and at par with sole castor at 1.25:0.75 price spectrum and was significantly superior over rest of the treatments. Castor + two rows of coriander produced significantly more monetary returns over rest of the treatments at price spectrum of 1.0:0.75, 1.25:0.75 and 1.25: 1.0. It was at par with sole coriander at 0.75:0.75, 1:1 and 1.25: 1-25 price spectrum and was significantly superior over rest of the treatments. It was next only to sole crop of coriander and was significantly superior over rest of the treatments at price spectrum of 0.75:1.0, 0.75:1.25 and 1:1.25. This was followed by the treatment of castor + one row of coriander which was next only to castor + two rows of coriander and was significantly superior over rest of the treatments at 0.75:0.75, 0.75:1.0, 0.75:1.25, 1:1, 1:1.25, 1.25:0.75 and 1.25:1.25 price spectrum. Effects of dates of sowing for these treatments was evident at the respective price spectrum in increasing the monetary returns over rest of the treatment.

- ✓ 16. The stability parameters for gross economic returns, total grain yield and LER indicated that castor + coriander one row and castor + coriander two rows crop combination are expected to exhibit stability of production under varying environmental conditions.

17 Soil moisture in intercropping of castor + coriander was efficiently utilized as compared to rest of the intercrop treatment..

Conclusions :

1. Under aberrant weather conditions intercropping of castor with coriander crop on 29th Met.week(16th to 22nd July) was found to be better than sowing late. However, under more aberrant weather conditions sowings can be delayed further upto 31st Met.week (30th July to 5th August) for obtaining reasonable yields and remunerative economic returns.
- ✓2. Castor + two rows of coriander intercropping system was found to be ideal, productive efficient and stable because of high castor seed equivalents, gross economic returns and high LER values and stability in performance and as an insurance against fluctuations in market prices. This was followed by the treatment of castor + one row of coriander which also was found to be ideal, productive, efficient, and stable intercropping system next only to the above treatments.

Recommendations :

- ✓ From the results of two years of experimentation with intercropping of castor under late sowing conditions, it is recommended that castor sown at 90 cm x 90 cm spacing with two rows of coriander will be most economical and stable in production

under conditions of weather aberrations as a contingency plan of cropping. This can be conveniently sown by 30 cm seed drill by blocking the middle hole of seed bowl and sowing coriander in two open holes of the seed bowl and sowing of castor in the middle tyne by tying a seed tube behind the middle tyne or by dibbling of castor seed in the middle row by a yard-stick of 90 cm length.

Future line of research :

1. It would be desirable to test few more varieties which have different periods of demand and different depths of root system.
2. It is also essential to find out suitable fertilizer schedule for intercropping system so as to keep up the production levels without impairing soil fertility.

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* Original not seen

APPENDICES

APPENDIX- I

Weather data collected at Meteorological observatory, Parbhani during 1980-81 with normals (1947-1980)

Sr. Parameters No.	Normal Actual	Meteorological week numbers														41	42
		29	30	31	32	33	34	35	36	37	38	39	40				
1. Total Rain- fall(mm)	Normal 46.0 Actual 7.4	69.4	67.5	63.7	50.7	49.4	50.5	25.0	45.1	51.0	21.5	19.2	17.7				
2. No. of rainy days	Normal 3.6 Actual 1.0	3.4	3.0	3.2	3.7	2.0	1.0	1.0	2.0	1.0	1.0	1.0	1.0				
3. Temperature o _c (Max.)	Normal 33.0 Actual 34.3	32.9	32.1	32.1	32.0	32.0	32.0	31.5	32.3	33.0	33.2	33.7	34.1	33.4	34.8		
4. Temperature oc(Min.)	Normal 23.2 Actual 23.1	23.1	22.5	22.2	22.3	23.5	21.9	21.7	22.3	22.5	21.9	21.7	19.7	19.4	17.6		
5. Average temperature o _c	Normal 28.1 Actual 28.7	28.0	27.6	27.4	27.8	27.4	25.3	26.6	27.3	27.7	27.5	27.7	26.9	26.4	26.2		
6. Humidity(AM) %	Normal 87.0 Actual 79.0	90.0	91.0	90.0	80.0	89.0	89.0	92.0	89.0	88.0	91.0	86.0	82.0	82.0			
(PM)	Normal 62.0 Actual 51.0	62.0	68.0	64.0	63.0	64.0	63.0	66.0	59.0	57.0	57.0	47.0	42.0	39.0			
Average	Normal 75.0 Actual 65.0	76.0	80.0	77.0	76.0	87.0	83.0	79.0	72.0	73.0	74.0	62.0	62.0	60.0			
7. Evaporation (mm)	Normal 5.8 Actual 7.9	5.3	4.7	5.1	5.5	5.5	3.6	5.0	4.6	5.2	4.2	3.6	4.2	4.4	4.7		

Contd.....

Appendix- I Contd.

Sr. Parameters No.	Normal Actual	Meteorological week numbers												Grand Total
		43	44	45	46	47	48	49	50	51	52			
1. Total Rain-fall(mm)	Normal Actual	7.0 -	6.4 -	6.8 -	4.5 -	4.8 -	3.5 -	1.6 -	5.5 -	0.6 0.4	0.1 38.4	651.9 442.8		
2. No. of rainy days	Normal Actual	0.7 -	0.8 -	0.4 -	0.3 -	0.3 -	0.2 -	0.2 -	0.3 -	0.1 1.0	- 1.0	42.3 40.0		
3. Temperature °C (Max.)	Normal Actual	33.0 34.7	32.8 33.9	31.9 32.4	31.8 31.0	31.1 32.2	30.9 30.7	30.5 38.9	30.1 29.9	30.0 30.6	30.4 27.6	- -		
4. Temperature °C (min.)	Normal Actual	18.1 17.6	17.0 16.8	15.9 16.0	13.9 18.4	14.3 17.3	13.3 11.7	13.2 11.0	12.4 9.0	11.6 11.4	11.3 13.9	- -		
5. Average Temperature °C	Normal Actual	25.5 26.1	24.9 25.3	23.9 24.2	22.8 24.7	22.7 24.7	22.1 21.2	21.8 19.9	21.2 19.4	20.8 21.0	20.8 20.7	- -		
6. Humidity(AM) %	Normal Actual	77.1 61.0	77.0 63.0	76.6 63.0	75.0 73.0	73.0 57.0	73.0 60.0	73.0 74.0	79.0 53.0	77.0 63.0	76.0 85.0	- -		
(PM)	Normal Actual	39.0 28.0	35.0 27.0	36.0 34.0	33.0 49.0	36.0 30.0	33.0 17.0	34.0 74.0	34.0 17.0	32.0 28.0	32.0 49.0	- -		
Average	Normal Actual	58.0 45.0	56.0 45.0	56.0 49.0	54.0 61.0	57.0 44.0	55.0 39.0	56.0 49.0	56.0 35.0	54.1 46.0	54.0 67.0	- -		
7. Evaporation (mm)	Normal Actual	4.7 9.1	4.2 7.4	3.7 6.4	3.5 5.7	3.4 5.2	3.3 6.5	2.8 5.0	2.9 5.2	2.3 4.6	2.8 4.0	- -		

APPENDIX - II

Weather data collected at Meteorological Observatory, Parbhani during 1981-82

Sr. Parameters No.	Normal Actual	Meteorological week numbers															
		29	30	31	32	33	34	35	36	37	38	39	40	41	42		
1. Total rain- fall(mm)	Actual 1.4	110.6	44.1	34.2	11.6	38.9	1.2	49.9	20.6	74.5	100.8	20.6	-	-	-	-	-
2. Rainy days	Actual 2.0	4.0	6.0	3.0	4.0	4.0	1.0	5.0	2.0	5.0	5.0	4.0	-	-	-	-	-
3. Temperature °C (Max.)	Actual 34.7	31.7	30.0	29.3	31.3	32.6	33.7	29.2	29.2	29.9	31.1	32.8	32.9	33.6			
(Min.)	Actual 23.7	23.0	23.0	21.8	22.3	22.6	20.4	20.5	19.5	22.8	22.4	22.4	19.3	17.1			
Average	Actual 29.2	27.3	26.5	25.5	26.8	27.6	27.0	25.8	24.3	26.3	26.7	27.6	26.1	25.4			
4. Humidity (AM) %	Actual 77.4	88.0	87.0	90.0	90.0	87.0	81.0	96.0	91.0	97.0	91.0	94.0	86.0	77.0			
(PM)	Actual 40.0	56.0	68.0	71.0	58.0	50.0	55.0	72.0	63.0	74.0	70.0	65.0	56.0	30.0			
Average	Actual 59.0	72.0	78.0	81.0	74.0	69.0	68.0	84.0	77.0	86.0	80.0	72.0	71.0	53.0			
5. Evaporation (mm)	Actual 8.5	4.9	3.9	3.8	4.9	5.6	7.5	6.7	5.5	3.6	4.3	5.1	5.3	5.7			

Contd....

Appendix- II Contd.

Sr. Parameters No.	Normal Actual	Meteorological week numbers										Grand Total
		43	44	45	46	47	48	49	50	51	52	
1. Total rain-fall(mm)	Actual	4.7	3.5	-	-	-	-	-	-	41.9	-	558.5
2. Rainy days	Actual	3.0	3.0	-	-	-	-	-	-	2.0	-	53.0
3. Temperature o _c (Max.)	Actual	32.8	31.4	31.9	30.4	28.2	28.6	29.9	31.0	28.7	28.0	-
(Min.)	Actual	20.7	21.5	17.6	13.6	8.0	8.6	13.4	9.5	16.4	10.7	-
Average	Actual	26.7	26.4	24.7	22.0	18.1	18.6	21.6	20.2	22.5	19.3	-
4. Humidity(AM) %	Actual	80.0	91.0	76.0	77.0	66.0	63.0	68.0	63.0	88.0	82.0	-
(PM)	Actual	45.0	48.0	35.0	40.0	24.0	33.0	29.0	25.0	46.0	29.0	-
Average	Actual	62.0	70.0	56.0	59.0	45.0	48.0	49.0	44.0	67.0	55.0	-
5. Evaporation (mm)	Actual	6.0	5.7	6.9	5.9	6.4	5.8	5.9	5.4	3.9	4.8	-

APPENDIX - III

Decadal distribution of wet spells with rainfall (1951- 1980)

Spell length	June				July			
	1951-60		1961-70		1951-60		1961-70	
	I	II	I	II	I	II	I	II
1	24	225.8	20	175.0	22	375.8	19	164.7
2	15	313.3	12	162.3	12	260.4	11	296.6
3	4	163.7	7	366.0	8	261.9	10	364.4
4	3	206.0	4	187.6	6	342.2	3	180.9
5	-	-	1	40.1	5	402.2	4	297.8
6	1	85.6	2	188.2	2	203.2	1	138.8
7	-	-	1	71.8	2	270.4	-	-
8	1	72.46	-	-	1	176.2	-	-
9	-	-	-	-	1	103.6	2	418.8
10	1	333.2	1	121.1	-	-	-	-
11	-	-	-	-	-	-	3	594.5
12	-	-	-	-	-	-	-	-
13	-	-	-	-	-	-	-	-
14	-	-	-	-	-	-	-	-
Total	49	1400.0	48	1312.1	59	2395.5	53	2456.5
Average spell length with rainfall	2.08	13.72	2.39	11.4	2.74	14.78	2.94	15.74
							3.08	14.38

Contd..

Appendix III Contd.

Spell length	August				September			
	1951-60		1961-70		1951-60		1961-70	
	I	II	I	II	I	II	I	II
1	24	202.3	19	122.2	24	216.7	22	266.0
2	15	309.0	10	294.9	10	260.2	14	379.7
3	3	155.1	13	496.2	6	365.1	6	322.4
4	7	550.7	4	162.2	5	196.2	4	247.6
5	2	142.9	4	482.5	-	-	1	75.6
6	1	39.2	1	89.3	4	431.2	1	205.7
7	1	124.3	1	108.9	4	432.6	1	219.1
8	-	-	1	217.1	-	-	1	85.5
9	1	229.4	-	-	1	-	2	324.5
10	1	140.8	-	-	1	-	-	-
11	1	152.7	-	-	-	-	-	-
12	-	-	-	-	-	-	-	-
13	-	-	-	-	-	-	-	-
14	-	-	1	363.6	-	-	-	-
Total	56	2095.9	54	2336.1	56	1902.3	52	2126.1
Average spell length with rainfall	2.57	14.55	2.75	15.67	2.57	14.30	2.46	16.10
				3.18				2.61
								13.79

Note: I = Number of spells, II = Total rainfall(mm)

APPENDIX - IV

Decadal distribution of Dry Spells (1951-80)

Spell length	June			July			August			September		
	1	2	3	1	2	3	1	2	3	1	2	3
1	20	19	21	21	22	17	22	20	18	16	21	12
2	10	9	7	9	9	10	9	13	13	13	12	6
3	6	4	2	7	5	10	5	8	6	7	5	7
4	3	6	4	9	5	3	5	4	8	5	4	5
5	3	3	4	4	1	1	4	3	-	2	2	1
6	1	2	3	1	4	2	3	6	1	3	-	1
7	4	2	2	1	3	1	-	-	1	3	4	-
8	-	1	2	-	2	-	4	3	1	1	1	1
9	-	-	2	1	1	1	-	-	-	1	2	-
10	2	1	-	1	-	-	-	-	1	1	2	2
11	-	1	1	-	-	-	-	-	-	-	-	3
12	-	1	1	-	-	-	-	-	-	-	1	1
13	2	1	1	-	-	-	-	-	1	-	-	-
14	1	-	-	-	-	1	-	-	-	1	-	-
15	-	-	-	-	-	-	-	-	-	-	-	1
16	-	-	1	-	-	1	-	-	-	-	-	1
17	-	1	-	-	-	-	-	-	-	-	-	-
18	-	-	-	-	-	-	-	-	-	-	-	1
19	1	-	-	-	-	-	1	-	-	-	-	-
20	-	-	-	-	-	-	-	-	-	-	-	-
21	-	-	-	-	-	-	-	-	-	-	-	-
22	-	-	-	-	-	-	-	-	-	-	-	-
23	-	-	-	-	-	1	-	-	-	-	-	-

Total	53	51	51	54	52	48	53	57	50	52	54	42

Average Spell length above 7 days	10.7	10.6	10.0	8.6	7.6	13.8	6.6	8.0	9.5	8.8	9.5	12.2

Note: 1 = First decade (1951-60), 2 = Second decade (1961-70)
3 = Third decade (1971-80).

APPENDIX -V

Analysis of variance for stability of gross economic
returns (Rs/ha)

Source	d.f.	S.S.	M.S.S.	F Value
Total(ET-1)	59	16813000.00	-	-
Treatment(T-1)	9	7603873.10	844874.79(MS ₁)	16.76**
Envt +(Treatment x Env) T(E-1)	50	9209126.90	-	-
Environment(Linear) 1		6235913.30	-	-
Treatment x Environ- ment(Linear) (T-1)	9	956959.12	106328.79(MS ₂)	2.109*
Pooled deviation T(E-2)	40	2016254.30	50406.36(MS ₃)	-
Treatment T ₁ (E-2)	4	458617.68	114654.42	10.19**
T ₂ (E-2)	4	43342.20	10835.55	0.963
T ₃ (E-2)	4	40495.92	10123.98	0.8998
T ₄ (E-2)	4	204516.04	51129.01	4.544**
T ₅ (E-2)	4	40816.88	10204.22	0.9069
T ₆ (E-2)	4	156486.16	39121.54	3.477*
T ₇ (E-2)	4	76344.52	19086.13	1.696
T ₈ (E-2)	4	893473.84	223368.46	19.85**
T ₉ (E-2)	4	43762.36	10940.59	0.972
T ₁₀ (E-2)	4	58398.88	14599.72	1.2976
Pooled error (T x e(r-1)	120	-	11251.295	-

* Significant at 5%
** Significant at 2%

APPENDIX - VI

Analysis of variance for stability of total grain yield(kg/ha)

Source	d.f.	S.S.	M.S.S.	F Value
Total(ET-1)	59	3031.9127	-	-
Treatment(T-1)	9	1269.9727	141.1081(MS ₁)	14.96**
Env.+Tr.x Env. T(E-1)	50	1761.9400	-	-
Environment(Linear)	1	1202.3126	-	-
Treatment x Env. (Linear)(T-1)	9	182.3427	20.26030(MS ₂)	2.15*
Pooled deviation T(E-2)	40	377.2916	9.4323(MS ₃)	-
Treatment T ₁ (E-2)	4	92.5911	23.1478	29.35**
T ₂ (E-2)	4	27.6402	6.9100	8.76**
T ₃ (E-2)	4	19.8899	4.9725	6.30**
T ₄ (E-2)	4	19.3413	4.8353	6.13**
T ₅ (E-2)	4	1.5089	0.3772	0.4782
T ₆ (E-2)	4	50.5479	12.6370	16.02**
T ₇ (E-2)	4	15.2261	3.8065	4.83**
T ₈ (E-2)	4	116.6991	29.1748	36.99**
T ₉ (E-2)	4	18.6897	4.6724	5.92**
T ₁₀ (E-2)	4	15.1575	3.7894	4.80**
Pooled error T x E(r-1)	120	-	0.7887	

* Significant at 5%

** Significant at 1%

APPENDIX - VII

Analysis of variance for stability(Land equivalent ratios LER)

Source	d.f.	S.S.	M.S.S.	F Value
Total(ET-1)	35	1.325689	-	-
Treatment(T-1)	5	0.684433	0.13688(MS ₁)	8.82**
Env.+Tr.x Env. T(E-1)	30	0.641256	-	-
Environment(Linear)	1	0.2283084	-	-
Treatment x Env. (Linear)(T-1)	5	0.0404844	0.00809(MS ₂)	0.52 N.S.
Pooled deviation T(E-2)	24	0.3724632	0.01552(MS ₃)	-
Treatments T ₂ (E-2)	4	0.0080788	0.002019	0.1181
T ₃ (E-2)	4	0.0399828	0.009995	5.845**
T ₄ (E-2)	4	0.0568484	0.014213	8.311**
T ₅ (E-2)	4	0.0278136	0.006953	4.066**
T ₆ (E-2)	4	0.1829828	0.045745	26.75**
T ₇ (E-2)	4	0.0567568	0.014189	8.298**
Pooled error T x E(r-1)	72	-	0.00171	-

* Significant at 5%

** Significant at 1%