A STUDY OF INTERCROPPING IN CABBAGE
(Brassica oleracea var. capitata L.)

BY

VENKAT BHUJANGRAO GORKHE

Dissertation

Submitted To The Marathwada Agricultural University

In Partial Fulfilment Of The Requirement

For The Degree of

MASTER OF SCIENCE

(Agriculture)

IN

HORTICULTURE

DEPARTMENT OF HORTICULTURE

MARATHWADA AGRICULTURAL UNIVERSITY

PARBHANI [Maharashtra] INDIA

1989

CANDIDATE'S DECLARATION

I hereby declare that the dissertation or part thereof has not been previously submitted by me for a degree of any University.

PARBHANI

DATED : 9-8-1989

Gorkhe

(V.B. GORKHE)

CERTIFICATE - I

Shri Venkat Bhujangrao Gorkhe has satisfactorily prosecuted his course of research for a period of not less than four semesters and that the dissertation entitled " A STUDY OF INTERCROPPING IN CABBAGE (Brassica oleracea var. capitata L.) " submitted by him is the result of original work and is of sufficiently high standard to warrant its presentation to the examination. I also certify that the dissertation or part thereof has not been previously submitted by him for a degree of any University.

PARBHANI

DATED 9-8-1989

(S.N. Gunjkar)
Guide

CERTIFICATE - II

This is to certify that the dissertation entitled " A STUDY OF INTERCROPPING IN CABBAGE (Brassica oleracea var. capitata L. " submitted by Shri Venkat Bhujangrao Gorkhe to the Marathwada Agricultural University in partial fulfilment of the requirement for the degree of MASTER OF SCIENCE (Agriculture) in the subject of Horticulture has been approved by the student's advisory committee after oral examination in collaboration with external examiner.

External Examiner.

(Prof. S.N. Gunjkar)
Guide

Advisor

1. (Dr. V.R. Chakrawar)
2. (Prof. S.G. Rajput)
3. (Prof. S.P. Jinturkar)

Associate Dean & Principal,
College of Agriculture,
Parbhani.

ACKNOWLEDGEMENT

I have immense pleasure in expressing my whole hearted sense of gratitude and indebtdness towards Prof. S.N. Gunjkar, Associate Professor, Department of Horticulture, Marathwada Agricultural University, Parbhani for suggested the research project, valuable guidance and constructive criticism throughout the course of investigation and final preparing the manuscript.

With profound respect, I acknowledge indebtdness to Dr. V.R. Chakrawar, Head, Department of Horticulture, Marathwada Agricultural University, Parbhani, Prof. S.G. Rajput, Prof. S.P. Jinturkar, the members of the advisory committee for their valuable suggestions.

My sincere thanks are due to Dr. V.K. Patil, Director of Instruction and Dean, Faculty of Agriculture and Dr. C.P. Ghonsikar, Associate Dean & Principal, College of Agriculture, Parbhani, for providing the facilities for conducting this experiment.

I also acknowledge the help given by Dr. K.W. Anserwadekar, Professor of Horticulture, Dr. N.N. Shinde, Dr. M.B. Sontakke, Senior Research Officers, Prof. R.M. Kulkarni, Dr. B.A. Kadam, Assistant Professors.

My special thanks are due to Dr. V.B. Shelke, Professor of Agronomy, Dr. M.V. Dhoble, Agronomist, Dryland Research Station, Marathwada Agricultural University, Parbhani, Dr. V.S. Hudge, Reader, Department of Plant Physiology for their support.

I express my deep heartly sense of gratefulness to my friends Mr. Chaudhari, Deshmukh, Dhole, Sayad, Patil, Mundhe, Katte, Gutte for their generous help and full co-operation during the period of study.

I whole heartedly appreciate the inspiration given by my wives Sow. Vimal and Suman Venkatrao Gorkhe.

No words are enough to express my heartiest gratitude to my parents and my relatives who have taken much pains for providing me opportunity to build up my academic career.

I am very much thankful to Marathwada Agricultural University, Parbhani, for providing me opportunity to complete M.Sc. (Agri.) degree programme on deputation.

PARBHANI:

DATED : 9-8-1989

V Gorkhe

(V.B. GORKHE)

CONTENT

INTRODUCTION

CHAPTER - I

INTRODUCTION

Vegetables are the protective food and forms an essential part of humen diet. Vegetables are rich source of proteins, carbohydrates, minerals, salts and vitamins. They are energetic, having appetizing value because of their organic acid content. Vegetables also prevent constipation. Taking into consideration of this dietory importance of vegetables, they are essential part of balanced diet. However, in India per capita consumption of vegetable is reported to be less than 45 gms which is supposed to be 400 gm (Premanath et al. 1987).

In our country, vegetable crops occupy about 1.2 per cent of the total cultivated area. It is very difficult to account the vegetable production but however it is estimated that, the production of vegetable is about 16 million tonnes per year which is extremly low, to meet the demand of vegetarian and as well as non vegetarian people.

During last two to three decades there is rapid increase in the population which increased the heavy demand for vegetable production because of greater application of the food value of vegetables and of the place of vegetable in the Nation's food requirement. The findings of research workers and their wider application in the field to increase

the vegetable production have inhanced this interest to a great extent among growers and consumers.

There are many ways to increase the vegetable production like adoption of F_1 hybrid varieties, improved varieties, timely sowing, adopting proper spacing and plant population per hectare, giving optimum doses of fertilizer, use of plant growth regulators and adopting proper plant protection measures. As regards package of practices of vegetables many olericulturist, research workers and scientists working in this field have contributed significant achievement. But as regards intercropping in vegetable very few workers have carried systematic effort towards this approach such as Liao and Montas (1978) and Patil (1988).

Intercropping means taking two or more crops on the same piece of land. It helps in economic use of land, saving of tillage operation, complete utilisation of surplus labour and as such there is increase in vegetable production of the nation. Beside this intercropping is advantages from the point of view of (1) economy in the space (2) saving of tillage operation (3) complete utilization of surplus nutrients (4) better utilisation of soil moisture and as such increased gross returns from per unit land area, Thompson and Kelly (1959).

In the vegetables, cole crops like cabbage, cauliflower are well known and very popularly grown in different parts of India at the spacing of 45 to 60 cm in rows and 45 to 60 cm in plants. The duration of these crops is approximately 100 to 120 days. Therefore, the interspace of such wider spaced crops can be betterly utilised by taking the intercrops of either short duration or having the straight growth.

In Maharashtra and other states of India intercropping of short duration vegetables and cereals in long duration and widely spaced vegetables is practised by so many cultivars since long time. However, these practices needs evaluation and standardization from research point of view for further recommendation.

Keeping the above object in view an experiment on intercropping of palak (Beta vulgaris L.), methi (Trigonella foenumgraecum L.), radish (Raphanus sativus L.), coriander (Coriandrum sativum L.) and onion (Allium cepa L.) in widely spaced plants of cruciferous i.e. cabbage (Brassica oleracea Var. capitata L.) group, is conducted in the Department of Horticulture, College of Agriculture, Marathwada Agricultural University, Parbhani, during the rabi season of 1988-89.

REVIEW OF LITERATURE

CHAPTER - II

REVIEW OF LITERATURE

Vegetables constitute an important item of human diet. In the contest of alleviating protein, malnutrition in India, afforts are under way to in rich cereles. To supplement them vegetables can be used in a very effective manner most of the vegetables, being short duration crops (from 135 to 140 days), can be produce in succession on the same plot or as an intercrop in widely pest plant and all the family labour of the vegetable grower can be useful employed throughout the year.

In India intercropping is generally followed in Agronomical crops, but it is realy practice in a vegetables but sparace work has been done on intercropping in vegetables, the available literature on the intercropping system vegetables and other crops is revewed under the appropriate headings.

I) Intercropping as an important agricultural practice :

An intercropping is advantageous because of economy of space (which is important with high price land) saving of tillage (same ploughing and fitting of the land serve for two or more crops) complete utilisation of the nutrients as well as any surplus applied to one crop being available for another and increased gross returns from the area under cultivation (Thompson and Kelly, 1959).

Mehrotra and Ali (1970) revealed that mixed cropping is an ancient agricultural practice in India, to meet the vagaries of weather as insurance against total failure of crops, better utilisation of space, manures, water and labour as well as it is advantagrous to small and fragmented holdings to grow different varieties of crops for home consumption and for a balanced diet.

Intercropping of legumineous crops like pea and bean crops were found most suitable combiner as intercrop with Kalazira because they fix the atmospheric nitrogen in the soil and improves the soil fertility, both these crops do not exhaust the available nutrient from soil but add more of humus and atmosphoric nitrogen in available form and less number of irrigations are needed in their life span as water requirement is less with no effect on Kalazira was reported by Kaith (1980).

At Central Tuber Crops Research Institute, Trivendrum, Prabhakar and Pillai (1984) recorded the advantages of multiple cropping system with tuber crops as it increased net returns, suppressed weed growth, minimised soil loss and an inclusion of grain legume and vegetables provide calorie-protein and calorie-mineral-vitamin in diet.

II) Effect of intercropping on growth on main crop :

Thompson and Kelly (1959) stated that snap bean, early cabbage, lettuce or any other small growing crop may be planted between the rows of asparagus. Tall growing or long season crops should not be grown with asparagus on account of shading and competition for mo$sture and nutrients.

They further mentioned that radish and lettuck are often planted as intercrops with cabbage or other similar crops. Cabbage and tomatoes may be grown together, the cabbage plants being set earl y in the season and tomatoes set between the rows. The early cabbage will ready to harvest before the tomato plants need the space.

While working on intercropping in sugarcane Kar et al. (1972) reported that sugarcan e germination was not affected by intercropping onions. But it needs additional dose of nitrogen and irrigation.

Mendal et al. (1973) reported that intercropping in casava with cowpea, groundnut, black gram, green gram sunnhemp etc. have been found successful at normal spacing (1 m x 1 m) of cassava without affecting the growth and yield of main crop.

Randhava and Sharma (1973) reported that when the banana plants are small at least two fields crops like

radish, moong (Phaseolus aureus) can safely be taken as intercrop without affecting the growth of the main crop by the additional dose of fertilizers.

No adverse effect on growth of maize crop was observed due to growing of bhendi, cowpea, radish, clusterbean, lablab,beatroot, knol-khol and carrot as intercrops by Meenakshi et al. (1974).

Improved growth and production of coconut palm was noted by taking an intercrops of sweet potato, maize, groundnut and ginger (Gallash, 1975).

Nagre (1979) indicated that though intercropping of mung, cowpea, tur, sesamum and sunflower in cotton was advantageous, but sunflower and sesamum suppressed the growth of cotton.

At Arizons University, Itulya (1980) observed that root and shoot dry weight of french bean, mung beans or pinto beans were significantly reduced by the intercropping with summer squash, but in summer squash foot and shoot dry weight as well as leaf area was not significantly affected.

III) Effect of intercropping on yield of main crop :

Indicing the importance of intercrops in cassava Mendal et al. (1973) stated that short duration crops

like cowpea, groundnut, black gram, sunnhemp, soyabean and vegetables like bhindi, coleus, etc. can be grown successfully. These crops can increase the yield per unit area.

Experiment conducted at the Crops Research Center, Pantnagar, Singh and Singh (1973) observed that sugarcane intercropped with potato gaves slightly higher cane yield than pure autum crop.

In Maharashtra, Zende and Patil (1973) reported that, growing of onion, berceem, sweat clover, methi and peas showed slight depressing effect on cane yield. The effect was particularly marked in case of onion. Growing of radish as intercrop had an adverse effect on cane yield.

At Arizone University, Summer squash yield was significantly reduced by, within row intercropping than adjecent row intercropping (Itulya, 1980). Further, he stated that, food production per unit area space was increased by as much as 76 per cent by intercropping summer squash with pinto beans, whereas, intercropping summer squash with mung bean increased food production by 63 per cent.

Sharma et al. (1983) reported that intercropping of wheat, potatoes, onions and sunflower in sugarcane increased the net return and productivity per unit land

area. They observed that potatoes were the most remunerative intercrop and gave additional yield without much reduction in sugarcane yield followed by onions.

Studies on coconut based multistory cropping, Margete and Magat (1983) observed that planting of piper nigrum + cocoa + pineapply markedly improved nut and copra production per palm. This cropping patern gave an additional net profit during the full productive stage of the intercrop compared with their monoculture.

In a study carried out at Turmeric Research Station, Digraj, Umrani et al. (1984) revealed that maize and french bean adversely affected the yield of turmeric particularly when maize was grown for grain.

Observations on beans as an associated crop with coffee and cassava, Bengazo (1985) reported beans as one of the best crop for growing in young coffee plantation, using 4-5 beans rows in the first year, 3-4 rows in the second year and 3 rows in the third year. He also stated that when beans were grown with cassava, the highest yield was obtained when one row of beans was grown between cassava rows.

IV) Effect of intercrops :

Singh and Singh (1973) observed that when early variety of potato was grown a s intercrop in sugarcane

production about half the potato yield (84.19 q) as compared to pure crop of potato (176.19 q).

Liao and Montas (1978) showed that the best intercropping system for tomato was planting tomato on the eastern side of the ridge and cabbage on the other side of the same ridge. This gives 53.32 tonns tomato per hectare and 11.04 tonns cabbage per hectar.

Intercropping of corn with cowpea and soyabean planting legumes either in the rows with corn or alternate to the corn row. Monoculture yield ranged from 46 to 90 per cent. They stated that seed yield of intercropped cowpea ranged from 42 to 56 per cent of monoculture and intercropped soyabean yield ranged from 48 to 60 per cent of monoculture (Allen and Obura, 1983).

At the Central Tuber Crops Research Institute, Trivendrum, Prabhakar and Pillai (1984) reported the yield of intercrops grown with cassava sas follows :

1) Intercropping grain legumes in cassava yielded 800 kg per hectare of cowpea grains and 700 kg per hectare of pigeonpea grain.

2) Intercropping oilseeds in cassava like groundnut yielded 1200 kg dry pods from one hectare.

3) Among various vegetables crops grown as intercrop with cassava, french bean was found to be the most economical with a yield of 1,500 kg per hectare, and

4) Growing of maize with cassava yielded 1,200 kg of grain from one hectare.

V) Economics of intercropping :

In the intercropping experiment Koregave (1964) found that radish, methi, clusterbean, groundnut and lucern can profitably be taken as mixed crop in suran.

Kar et al. (1972) obtained a net profit of Rs. 1,659 per hectare, which was Rs. 216 more than that obtained from pure spring planted cane.

An additional income of Rs. 2,865 per hectare was obtained, which was 55.25 per cent more than that of the income obtained by growing cassava alone (Mandal et al. 1973). It was also found that bhendi and coleus also gave an additional income to the tune of 13.29 and 19.73 per cent respectively over the income obtained in case of cassava alone.

Studies conducted on intercropping, Meenakshi et al. (1974) reported that cultivation of bhendi along with maize gave an additional return of Rs. 934 per hectare during summer and Rs. 2,632 per hectare during

monsoon season. The intercropping of cowpea with maize gave an additional return of Rs. 700 per hectare in summer and Rs. 1,934 per hectare in the monsoon season.

Ramakrishnan Nayar (1976) reported that intercropping of ginger, turmeric and eleph ant foot (yam) in young Robusta coffee gave highest returns from a unit area per unit time. Further, he reported that, intercrops raising all the three crops was profitable but turmeric giving maximum return per rupee.

Jain (1978) observed that potato, barley is the most successful and profitable system of intercropping with an average additional net profit of Rs. 2,730.

In a trial of intercropping in tomato Singh and Srivastava (1981) reported that, although tomato yields were highest in monoculture (236.5 q per hectare), the net returns was highest when tomato was intercropped with palak with yields of 214.9 q per hectare and 220.4 q per hectare, respectively.

While working on intercropping in sugarcane Tiwari et al. (1983) reported that, economically the most viable co-mbination was sugarcane + okra followed by sugarcane + moong (Phaseolus aurecus) and sugarcane + black gram. They also observed that sugarcane + onion gave very poor returns due to the high cost of cultivation of onions.

Rajshekharan et al. (1983) noted that the maize intercropped with onion gave higher return followed by cowpea during kharif season, where in rabi season maize intercropped with black gram followed by cowpea gave higher returns.

Umrani et al. (1984) reported that turmeric + radish followed by turmeric + french bean yielded Rs. 7,487 and Rs. 5,691 per hectare respectively, which was 22.9 and 14 per cent increase over sole turmeric crop. They further stated that decrease due to inter-cropping of mai-ze for grain w i th turmeric.

Studies conducted at Indore and Akola, Maheshwari et al. (1985) reported that the net returns were highest when Rauvolfia serpentine was intercropped with soyabeans in kharif and onion and garlic in rabi, giving an extra income of Rs. 8,352 and Rs. 11,770 per hectare respectively.

The highest net income was obtained in the intercropping of cabbage with tomatoes, when grown on 5-10 hectare farm by Brown et al. (1985).

Patra and Chatterjee (1986) reported soyabean intercropped with maize 48 to 50 per cent m ore yield and Rs. 4,300 to Rs. 5,800 per hectare net returns over the sole cropping.

From a field study Singh and Singh (1986) reported that wild turnip intercropped in taramira and chickpea in paired rows (2:2) gave 11.1 per cent more total productivity than sole cropped taramira and 81.9 per cent more productivity than sole cropped chickpea.

Patil (1988) conducted intercropping study in vegetable at Department of Horticulture, Marathwada Agricultural University, Parbhani and concluded that intercropping of coriander in Brinjal gave highest net profit followed by radish in tomato and palak with chilli in the respective solanaceous vegetables.

MATERIALS AND METHODS

CHAPTER - III

MATERIAL AND METHODS

The present experiment entitled " A study of intercropping in cabbage (Brassica oleracea var. capitata L.) was laid out at Department of Horticulture, Marathwada Agricultural University, Parbhani, during rabi season of 1988-89.

3.01 Climate :

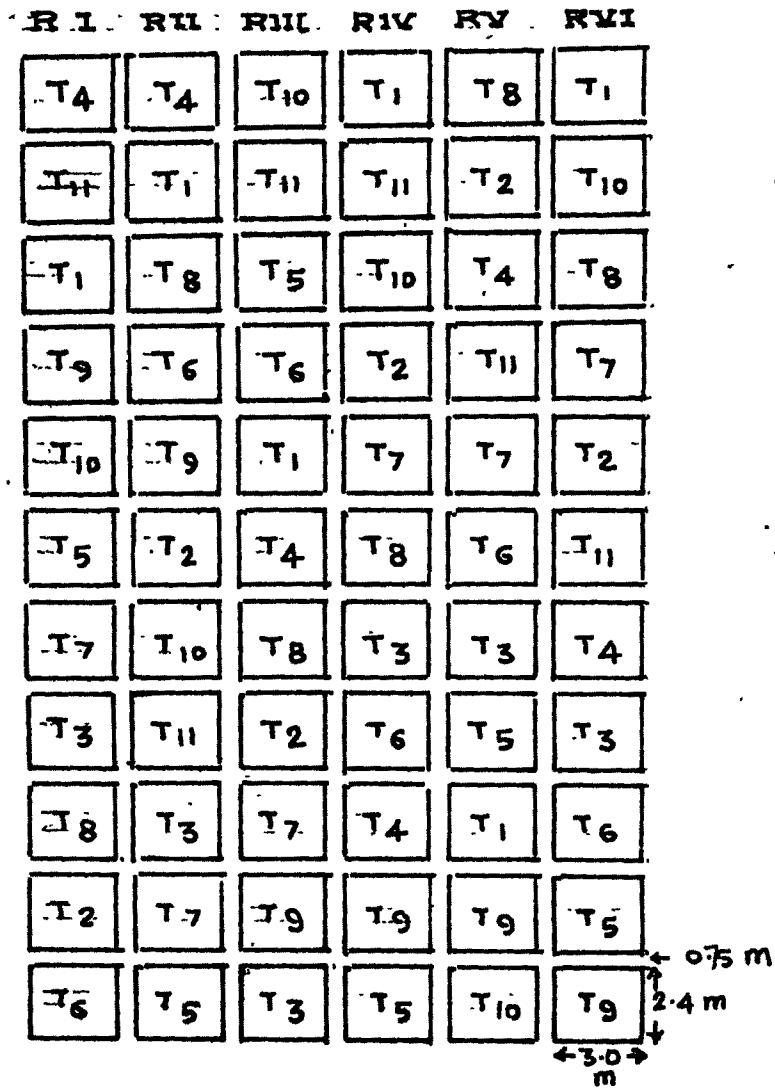
Parbhani is situated at 409 meters above mean sea level and falls on latitude 19.16° N and longitude 17.97° E and has a sub-tropical climate. The average maximum and minimum temperatures are 43° C and 6.5° C in the months of May and Decembers respectively. The average rainfall is 750 - 850 mm per year.

3.02 Soil type :

The soil type of experimental plot was well drained, medium black having depth 1.50 meters.

3.03 Experimental details :

1.	Design	: Randomised Block Design
2.	Number of replications	: Six
3.	Number of treatments	: Eleven
4.	Total plots	: 66



DESIGN : R. B. D.

REPLICATION : 6

TREATMENT : 11

GROSS PLOT SIZE : 4·2 x 3·6 m

NET PLOT SIZE : 3·0 x 2·4 m

DISTANCE BETWEEN TWO REPLICATIONS AND TWO PLOTS : 0·75 m

FIG. 1. PLAN OF LAYOUT

General View.

Cabbage + Radish

Cabbage + Palak

Cabbage + Methi

Cabbage Sole Crop

5. Spacing :

1. Main crop :

cabbage	:	60 cm x 60 cm
2. Intercrops :		
Palak, coriander, Radish, onion	:	10 cm apart
Methi	:	Line sowing
3. Sole crops :		
Palak, coriander, Radish, onion	:	15 cm x 10 cm
Methi	:	Line sowing 15 cm apart

6. Gross plot size : 4.2 m x 3.6 m = 15.12 m^2
   Net plot size : 3.0 m x 2.4 m = 7.20 m^2

7. Distance between two plots and two replications. : 0.75 m

8. Plant units :

1. Gross plot	:	35
2. Net plot	:	20

9. Total experimental area : 1363.54 sqm

10. Date of sowing/transplanting : 28th November, 1988.

3.0 4 Treatment details :

Treatments	Abbrivations
1. Cabbage + onion	T_1
2. Cabbage + radish	T_2
3. Cabbage + coriander	T_3
4. Cabbage + palak	T_4
5. Cabbage + methi	T_5
6. Cabbage sole crop	T_6
7. Onion sole crop	T_7
8. Coriander sole crop	T_8
9. Palak sole crop	T_9
10; Methi sole crop	T_{10}
11. Radish sole crop	T_{11}

3.05 Varieties planted :

1) Cabbage - Pride of India
2) Onion - N-53
3) Radish - Japanies white
4) Coriander - Local
5) Palak - Pusa all green
6) Methi - Local

3.06 Source of seed :

The seed materials of different crops under study were obtained from the different sources, which are given in Table 1.

Table 1 : Name of crop, variety and source used in experiment.

Sr. No.	Name of the crop	Variety	Source
1.	Cabbage	Pride of India	National Seed Corporation.
2.	Onion	N-53	Marathwada Agricultural University, Parbhani.
3.	Radish	Japanies white	Parbhani market.
4.	Coriander	Local	Marathwada Agricultural University, Parbhani.
5.	Palak	Pusa all green	Marathwada Agricultural University, Parbhani.
6.	Methi	Local	Parbhani market.

3.07 Preparation of seedlings :

The cabbage seeds were sown on 20th October, 1988 on raised beds in Horticulture Department. The onion seedlings were sown

on raised beds on 25th September, 1988. The seedlings were cared and watered regularly. Malathion was sprayed on the seedlings on 10th Novermber at the concentration of 0.05 per cent to protect from insect, pests, particularly aphids.

3.08 Land preparation :

Experimental plot was ploughed deeply in the month of October, harrowing was done four times and the soil was brought to fine tilth. Well rotten farm yard manure was applied at the rate of 20 tonnes per hectare to the experimental plot. This was broadcasted in the experimental plot before last harrowing. The plot was laid out as per the plan shown in Figure 1 on 15th November, 1988.

3.09 Transplanting of seedling:

Ridges and furrows of 60 cm x 60 cm distance were prepared on 27th November, 1988, which were subsequently watered during evening. Healthy and uniform sized cabbage seedlings were transplanted on the next day, by keeping 60 cm spacing in between two seedling. One seedling was planted at one hill on one side of the ridge. Sowing of intercrops was done on 28th Novermber, 1988 waon the other side sowong east side of the ridge.

The seeds requirement per hectare of various crops is given in the following Table 2.

Table 2 : Statement having the crop, number of seeds per hill, seed rate per hectare and seed rate for intercrop.

Sr. No.	Name of the crops	No. of seeds per hills	Seed rate per ha	Seed rate for inter crop
1.	Cabbage	One seedling	500 g	-
2.	Onion	One seedling	10 kg	3 kg
3.	Radish	4 to 5 seeds	8 kg	2.5 kg
4.	Coriander	8 to 10 seeds	30 kg	10 kg
5.	Palak	5 seeds	30 kg	10 kg
6.	Methi	Line sowing	50 kg	16.5 kg

3.10 Fertilizer application :

The redommended dose of fertilizers viz. nitrogen, phosphorus and potassium per hectare were applied to the crop through urea, single superphosphate and muriate of potash. The recommended doses for various crops are as under.

Table 3 : Fertilizer doses of various vegetable crops (kg per hectare)

Sr. No.	Name of the crop	N	P	K
1.	Cabbage	100	50	50
2.	Onion	100	50	50
3.	Radish	50	50	100
4.	Coriander	25	-	-
5.	Palak	100	50	50
6.	Methi	25	50	50

The entire dose of phosphorus and potash was applied at the time of transplanting and nitrogen was applied in two split doses. First after 10 days of transplanting and second 30 days after transplanting. Fertilizer was applied by ring method, and hand application to main cropped and intercrop respectively.

For the intercrops 1/3 extra dose of the respective vegetables was applied at the time of sowing in the cabbage plots.

3.11 Gap filling and thinning :

Gap filling was carried out after 20 days of transplanting on 16th December, 1988. Thinning of radish was done by keeping only one seedling at one hill, on 16th December, 1988.

3.12 Irrigation :

One irrigation was given before transplanting and it was followed immediately after transplanting. Later on irrigations to the experimental plot was given regularly till the harvest at an interval of 8 - 10 days.

3.13 Interculture operation :

In order to keep the field free from weeds, two weeding were carried out during the entire crop period. Earthing up was carried out after 30 days of transplanting to provide

support to the plants. Second earthing was done after the harvest of intercrops. Thinning of radish was done once at a time.

3.14 Plant protection :

Regular spray of malathion at 0.05 per cent concentration and copper oxychloride at the rate of 25 gm in one litre of water were given as protection measures, to protect the crop from the attack of pests like aphids, jassids and leaf eating caterpillers and to check disease attack till the 10th January, 1988.

3.155 Harvesting :

The intercrops was harvested at different ti-mes which is shown in the Table 4.

Table 4 : Days required for harvesting of various crops.

Sr. No.	Name of crop	Number of days required for harvesting
1.	Cabbage	90 - 110
2.	Onion	90 - 95
3.	Radish	35 - 45
4.	Coriander	35 - 40
5.	Palak	35 - 45
6.	Methi	35 - 40

Harvesting of cabbage was followed when the firm and compact head were observed. The harvesting of onion was done when the bulbs were formed but the leaves were still green. The harvesting of leafy vegetables like coriander, palak and methi was done before the flowering. Harvesting of radish was followed when it was developed but was not spongy and fibrus.

3.16 Observations :

Five plants were selected were randomly from each net plot. They were labled to record periodical observations in respect of growth and yield.

3.16.1 Growth observations :

The various growth observations of main crop in respect of height of plant, number of leaves per plant, circumfrence, leaf area, average plant spread was recorded at an interval of 15 days. The dry mat-ter observations of roots, shoots and leaves was recorded after the harvest of heads.

a) Average height of plant :

The height of the five observational plants was recorded in centimetre, from the ground level, where a point mark was made on the stem, to the tip of the terminal leaf crown and average was calculated.

b) Average number of leaves :

The leaves from each of the observational plants were counted and average number of leaves per plant were worked out.

c) Average circumference :

Circumference of stem at a marked point (3 cm above the ground level) was measured with the help of thread and average was worked out.

d) Average leaf area :

The length and breadth of all the leaves were noted after calculating the area of individual leaf it was summed up. For calculating average leaf area the summ was divided by number of leaves of that plants at an interval of 15 days.

e) Spread ofthe plant :

The spread of plants was measured in east-west and north-south direction i n centimetre. These noted observations of east-west and north-south directions were multiplied and converted into sq. cm.

f) Dry matter :

After harvesting of heads the observational plants were uprooted and cleaned by wash with water. The roots, shoots

and leaves were separated and weighed seperately. These were dried in hot oven at 100° C temperature. The dried samples were weighed seperately and averages were worked out.

3.16.2 Yield observations :

a) Weight of head :

The weight of heads from each treatment was recorded for observational plants and the average head weight per plant was calculated by dividing total head weight by total number of plants.

b) Yield of cabbage per plant and per hectare :

At the time of harvesting the mature head from net plots were harvested seperately. The total weight including the observational plants were totaled and treated as yield of cabbage per plot. The yield per hectare was calculated on this basis.

c) Yield of sole crops of various vegetables :

The produce from the net plot area was noted seperated and converted into per hectare.

d) Yield of intercrops :

Produce of intercrops from net plot was harvested weighed and it was calculated in hectare.

3.17 Economics :

The per hectare yield was multiplied by the average prices of various vegetables which are shown in Appendix-C. This was treated as gross profit.

Net profit per hectare was calculated by deducti-ng the cost of cultivation (Appendix-B) from the gross profit of indivvidual plots which was statist-ically analysed on hactare basis.

3.18 Statistical analysis :

The statistical analysis of the data was done by using analysis of variance technique as suggested by Panse and Sukhatme (1957). Critical difference was workedout at 5% level of significance.

RESULTS

CHAPTER - IV

RESULTS

The data recorded on various aspect of plant growth, development and yield of main crop and intercrop were subjected to statistical analysis and result of the same are presented here under the appropriate sub headings.

4.01 Growth observations

The various growth observation were recorded in respect of mean height of plant, number of leaves, circumference of stem, leaf area and average plants spread. They were recorded at an interval of 15 days after transplanting till the plant attained full growth and were ready to harvest after 90 to 110 days.

4.1.1 Height of plant

The periodically recorded data on the height of plant at an interval of 15 days of main crop was statistically analysed which result are presented in Table 5 and graphically depicted in Fig. 2.

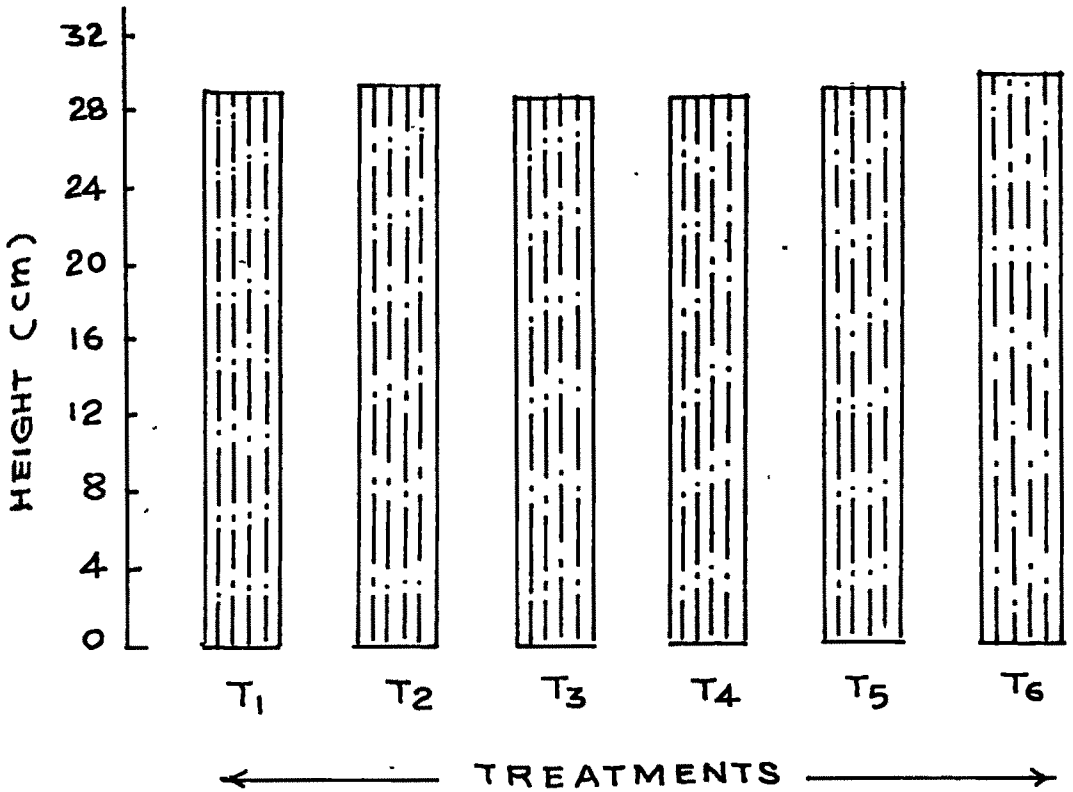


FIG. 2. MEAN HEIGHT IN cm OF CABBAGE PLANT

Table 5 : Mean height of cabbage plant (cm)

Treatment	Days after transplanting					
	15	30	45	60	75	90
T_1	7.40	12.15	16.30	26.10	28.36	28.56
T_2	6.88	12.36	16.11	26.16	28.28	28.70
T_3	7.06	12.50	16.31	26.50	28.26	28.53
T_4	7.05	12.40	16.16	26.31	28.40	28.53
T_5	6.81	12.70	16.31	26.35	28.23	28.58
T_6	7.26	12.61	16.35	26.71	28.40	28.70
SE ±	0.16	0.15	0.17	0.21	0.10	0.12
CD at 5%	0.49	-	-	-	-	-

It is evident from the data presented in Table 5 that, there were non significant differences in the height of the cabbage plant at all stages of growth except after 15 days, indicating that there was no effect of an intercrop on the main crop in the production of height of plant.

The height of the plant after 15 days of transplanting was significantly superior in T_1 (cabbage + onion), in T_1 over T_2 (cabbage + radish) and T_5 (cabbage + methi) and statistically similar with other treatments.

4.2 Number of leaves per plant

The observation in respect of number of leaves was recorded at an interval of 15 days and the recorded data were statistically analysed. The result of the same are given in Table 6.

Table 6 : Average number of leaves in cabbage

Treatment	Days after transplanting					
	15	30	45	60	75	90
T_1	8.50	9.83	16.83	23.33	22.66	24.00
T_2	8.83	11.00	18.33	23.16	21.33	23.83
T_3	8.33	10.83	18.50	23.16	22.33	24.00
T_4	8.00	10.16	18.00	23.83	22.66	24.33
T_5	7.83	11.00	18.16	21.66	22.83	23.33
T_6	7.83	10.50	18.50	22.50	22.66	23.33
SE ±	0.46	0.62	0.45	0.80	0.56	0.45
CD at 5%	-	-	1.33	-	-	-

A close perusal at the data presented in Table 6 clearly indicate that the differences in the number of leaves per plant were non significant at all the stages of growth except after 45 days after transplanting.

The observations after 45 days, the number of leaves per plant were significantly lesser in treatment T_1 (cabbage + onion) as compared to all other treatments, which were statistically not different from each other.

4.3 Circumference of stem

The periodical data of average circumference of cabbage plant was statistically analysed and the results of the same are depicted in Table 7.

Table 7 : Average circumference of stem of cabbage plant (cm)

Treatments	Days after transplanting					
	15	30	45	60	75	90
T_1	0.83	0.88	1.16	2.38	3.46	4.41
T_2	0.73	0.91	1.50	2.55	3.65	5.05
T_3	0.78	0.83	1.68	2.63	3.93	5.13
T_4	0.85	0.88	1.85	3.00	3.98	5.11
T_5	0.71	0.88	1.80	2.91	4.00	4.98
T_6	0.68	0.90	1.56	2.81	4.55	5.23
SE ±	0.04	0.05	0.09	0.17	0.11	0.15
CD at 5%	0.14	-	0.26	0.52	0.32	0.44

It can be seen from hthe Table 7 that there was significant effect of intercrops on the circumference of stem at all the stageof the growth except after 30 days.

At final stages (90 days) the circumference of the cabbage plant was more in treatment T_6 (cabbage sole crop) which was significantly superior to T_1 (cabbage + onion) and statistically similar with all the remaining treatments.

The observation after 75 days, the circumference of the stem of cabbage plant was significantly more in T_6 (cabbage sole crop) over all other treatments. Treatment T_5 (cabbage + methi) was next best which was statistically similar to T_4 (cabbage + palak), T_3 (cabbage + coriander) and significantly superior to remaining treatments. The treatment T_1 recorded minimum circumference of plant, which was statistically similar to T_2 and significantly lesser than the treatments.

The circumference of the plant was observed more in T_4 (cabbage + palak) after 45 and 60 days but which was significantly superior to treatment T_1 (cabbage + onion) after 60 days and the treatments T_1, T_2 and T_6 after 45 days. There was no definate trends was observed on the production of circumference of plant.

4.4 Leaf area

The periodical data on average leaf area per plant were statistically analysed, which results are shown in Table 8.

Table 8 : Average leaf area per plant of cabbage (sq cm)

Treatments	Days after transplanting					
	15	30	45	60	75	90
T_1	12.00	120.00	262.58	604.16	948.33	958.00
T_2	11.96	116.66	262.50	606.66	948.66	957.33
T_3	12.38	125.00	262.66	609.16	948.33	957.83
T_4	12.05	121.66	262.50	614.16	948.00	957.83
T_5	12.16	116.66	261.66	606.66	948.66	958.66
T_6	12.41	118.33	261.83	612.50	948.83	958.83
SE ±	0.37	3.88	0.94	4.62	0.37	0.24
CD at 5%	-	-	-	-	-	0.72

Treatment differences in leaf area were not significant from 15 to 75 days of transplanting, but at 90 days of transplanting treatment difference in leaf area were significant. Treatment T_6 recorded maximum leaf area.

The next best treatment was T_5 , which was statistically superior as compared to T_3, T_4 and T_2. The lowest leaf area was noted in the treatment T_2 which was statistically not different from treatment T_4, T_3 and T_1.

4.5 Average plant spread (cm^2)

The periodical data of average plant spread were statistically analysed and the results of the same are depicted in Table 9.

Table 9 : Average plant spread of cabbage (sq cm)

Treatments	Days after transplanting					
	15	30	45	60	75	90
T_1	1340.66	1416.50	1606.33	1998.00	2241.33	2339.50
T_2	1362.00	1488.00	1628.00	1884.50	2216.00	2258.66
T_3	1354.16	1430.50	1626.00	1738.16	2476.66	2485.16
T_4	1349.83	1455.66	1606.33	1730.83	2465.00	2596.66
T_5	1323.33	1462.16	1652.00	1726.66	2426.00	2485.50
T_6	1309.50	1481.16	1588.33	1889.50	2449.83	2486.66
SE ±	23.10	22.03	29.27	93.23	83.98	91.07
CD at 5%	-	64.20	-	-	244.67	-

It can be seen from Table 9 that the treatment differences due to various intercropping treatments on the spread of cabbage were significant at 30 and 45 days after transplanting. At 30 days of transplanting the treatment T_2 recorded maximum spread of cabbage plant but it was statistically similar to T_6, T_5, T_4, T_3 and significantly better than T_1. The treatment T_6 was

statistically not different from T_5, T_4 and T_3 but it was significantly superior as compared to T_1. Remaining all treatments were statistically not different when compared with each other for recording spread of cabbage plant.

After 75 days of transplanting the treatment T_2, T_3 recorded maximum plant spread but it was statistically similar to T_4, T_6, T_5 and significantly superior over T_1 as well as T_2. The next best treatment was T_4 it was significantly superior over T_2. The minimum plant spread was noted in treatment T_2 which was statistically not different from the treatment T_1, T_5 and T_6.

4.6 Average weight of roots

The observations on fresh and dry weight of roots per plant at hargest were recorded and are presented in Table 10.

Table 10 : Average weight of cabbage roots

Treatments	Fresh weight of roots in (g)	Dry weight of roots in (g)
T_1	35.00	15.50
T_2	38.86	16.50
T_3	34.60	13.60
T_4	36.17	15.17
T_5	35.21	14.80
T_6	40.00	18.50
SE ±	1.21	0.60
CD at 5%	3.63	1.81

It is observed from Table 10 that the fresh weight of roots was maximum (40 g) and found significantly superior in treatment T_6 over all other treatment except treatment T_2. The treatment T_2 was statistically similar to T_4 and significantly superior to remaining treatments. Fresh weight of roots of treatments T_5, T_4, T_3 and T_1 was found at par with each other.

As regards dry weight of roots, it is also maximum in treatment T_6 which was significantly superior over all treatments. The treatments T_2, T_1, T_4 and T_5 were at par with each other and significantly better than T_3. The lowest dry weight of roots was noted in T_3 (cabbage + coriander).

4.7 Average weight of stem

Observations on fresh and dry weight of stem per plant at harvest were recorded and are presented in Table 11.

Table 11 : Average weight of stem of cabbage plant

Treatments	Fresh weight of stem in g	Dry weight of stem in g
T_1	82.84	36.30
T_2	92.75	38.00
T_3	89.22	37.50
T_4	88.33	36.25
T_5	85.23	36.00
T_6	100.50	40.50
SE ±	4.10	2.00
CD at 5%	12.30	-

Table 11 indicated that maximum stem weight of 100.5 g was recorded in treatment T_6 which was significantly higher than T_5 and T_1 and statistically similar to T_2, T_3 and T_4. However, except T_6, all other treatments were at par with each other in the production of fresh weight of stem per plant.

The effect of various treatments on the production of dry weight of stem per plant was observed to be non significant.

4.8 Average weight of leaves

The observations were recorded on fresh and dry weight of leaves per plant at the time of harvest and are presented in Table 12.

Table 12 : Average weight of leaves per plant of cabbage

Treatment	Fresh weight of leaves in g	Dry weight of leaves in g
T_1	380.00	120.00
T_2	387.43	121.20
T_3	361.40	117.00
T_4	352.00	115.50
T_5	387.52	120.50
T_6	408.84	126.25
SE ±	20.41	10.20
CD at 5%	-	-

It is observed from Table 12 that, the effects of various treatments on the fresh weight as well as on dry weight of leaves per plant was noted non-significant.

4.9 Yield of cabbage

Observations on head yield per plant, yield per plot and yield per hectare are presented in Table 13 and graphically depicted in Fig. 3.

Table 13 : Yield of cabbage as affected by various treatments and its monetary returns.

Treatments	Head weight per plant (kg)	Yield per plot (kg)	Yield per ha (q)
T_1	1.15	22.42	311.10
T_2	1.69	23.02	319.67
T_3	1.44	22.70	315.04
T_4	1.45	22.14	307.17
T_5	1.63	22.65	314.17
T_6	1.90	24.07	334.02
SE ±	0.14	0.31	4.42
CD at 5%	0.43	0.91	12.89

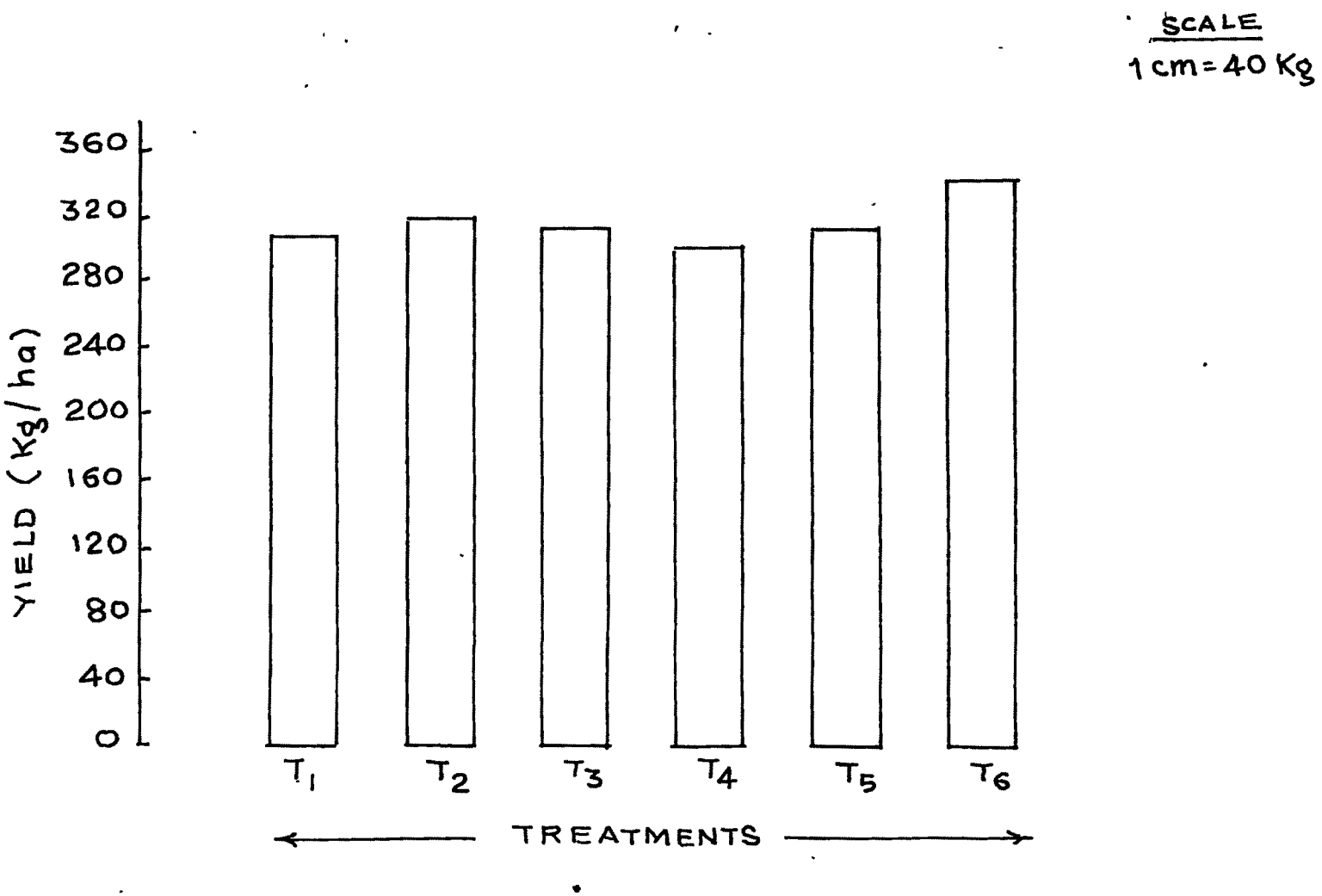


FIG.3. YIELD/ha OF CABBAGE AS AFFECTED BY VARIOUS TREATMENTS

Head weight

The average weight of cabbage head was significantly more in T_6 (cabbage sole crop) as compared to T_4, T_3 and T_1 but it was statistically not different from the treatment T_2 and T_5. The next best treatments were T_2 and T_5, T_4 and T_3. These four treatments were statistically not different from each other but significant than T_1. The minimum weight of cabbage head was observed in treatment T_1, which was statistically similar with T_3 and T_4 but significantly inferior as compared to rest of the treatments.

Yield

It can be seen from Table 13 that the yield per plot and per hactare was significantly more in treatment T_6 as compared to other treatments. Remaining all other treatments were statistically similar with each other.

Economics

Monetary return of intercrops

The yield of net plot of various intercrops were converted into q/ha and by following the prices as shown in Appendix B the monetary return was calculated. It was statistically analysed and represented in Table 14 and graphically depicted in Fig.4.

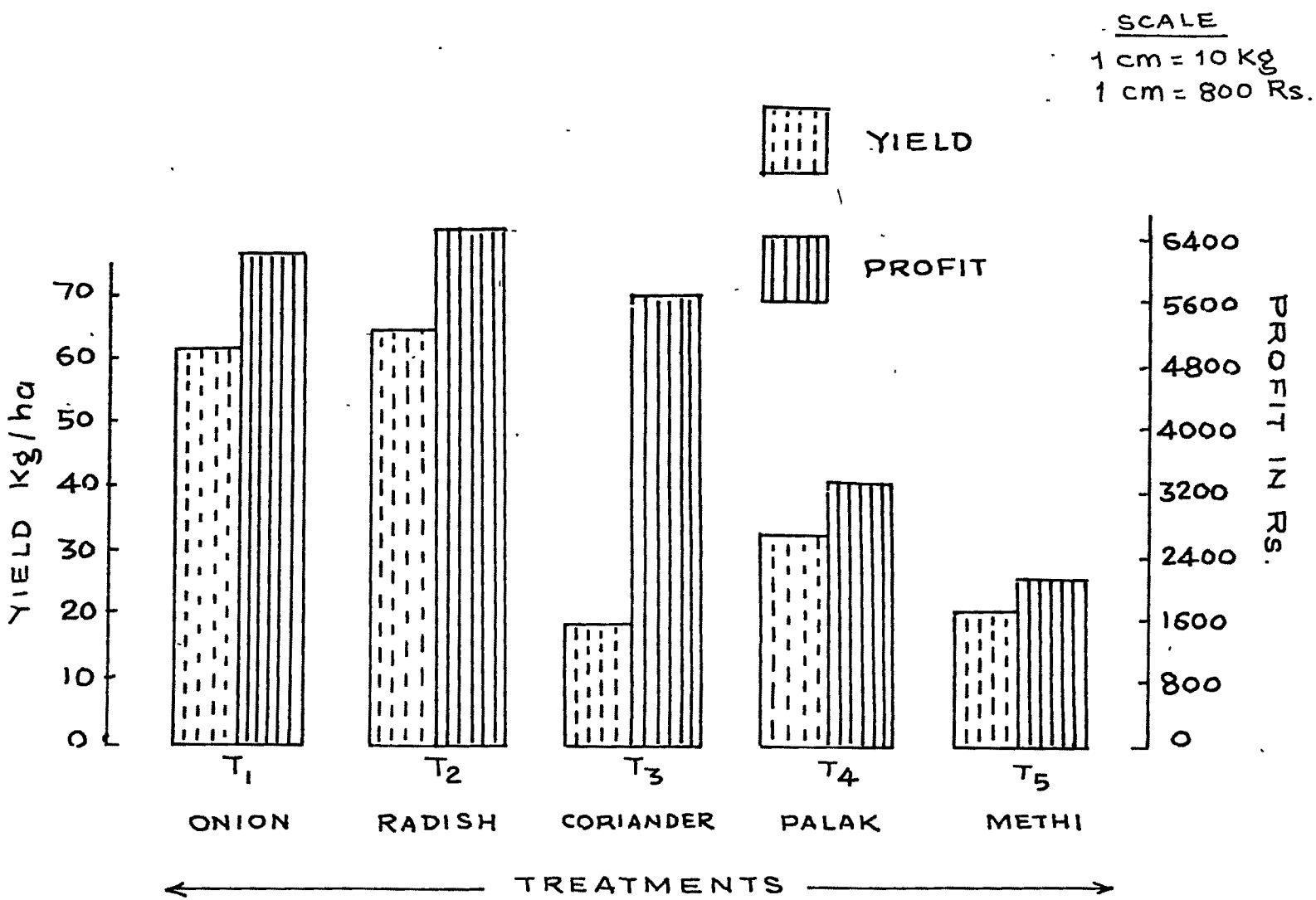


FIG. 4. YIELD AND PROFIT OF INTERCROPS

Table 14 : Yield and monetary return of intercrops

Treatment	Intercrop	Yield (q/ha)	Monetary return from intercrop in Rs.
T_1	Onion	62.50	6250
T_2	Radish	64.48	6448
T_3	Coriander	18.93	5679
T_4	Palak	33.54	3350
T_5	Methi	22.54	2254
SE ±		0.79	148
CD at 5%		2.33	438

The data on the yield of intercrops revealed statistical significance (Table 14). An intercrop of radish gave 64.48 q/ha yield, which was statistically similar to the yield of onion and significantly superior over all other intercrops. The palak was the next best crop which was also significantly superior to methi and coriander. An intercrop coriander recorded significantly lowest yield as compared to all crops when taken as on intercrop.

It can be seen from Table 14 that the monetary return from radish was Rs. 6,448/- followed by onion (Rs. 6,250/-), these two treatments were statistically similar and significantly superior to other three leafy vegetables taken as an intercrop.

The coriander gave Rs. 5,679/- from one hectare area when it was grown as an intercrop in cabbage during rabi season which was significantly superor to palak and methi. The palak as an intercrop also gave significantly more profit than methi.

Gross profit and net profit in rupees

The gross profit per hectare was calculated by multiplying the average prices of that period (Appendix-C). The net profit was workedout by deducting the cost of cultivation of respective treatments. The calculated data were statistically analyse. Theresults of the same are presented in Table 15 and graphically shown in Fig. 5.

Table 15 : Gross profit and net profit in rupees

Treatments	Gross profit in Rs.	Net profit in Rs.
T_1	37360.66	30921.66
T_2	38415.00	32404.00
T_3	37183.16	31521.16
T_4	34067.66	28156.66
T_5	33665.50	27625.50
T_6	33402.33	28288.33
T_7	34780.33	27721.33
T_8	22245.00	17811.00
T_9	29397.00	24368.00
T_{10}	15740.00	10837.00
T_{11}	36573.00	30260.00
SE ±	581.16	581.48
CD at 5%	1661.00	1661.00

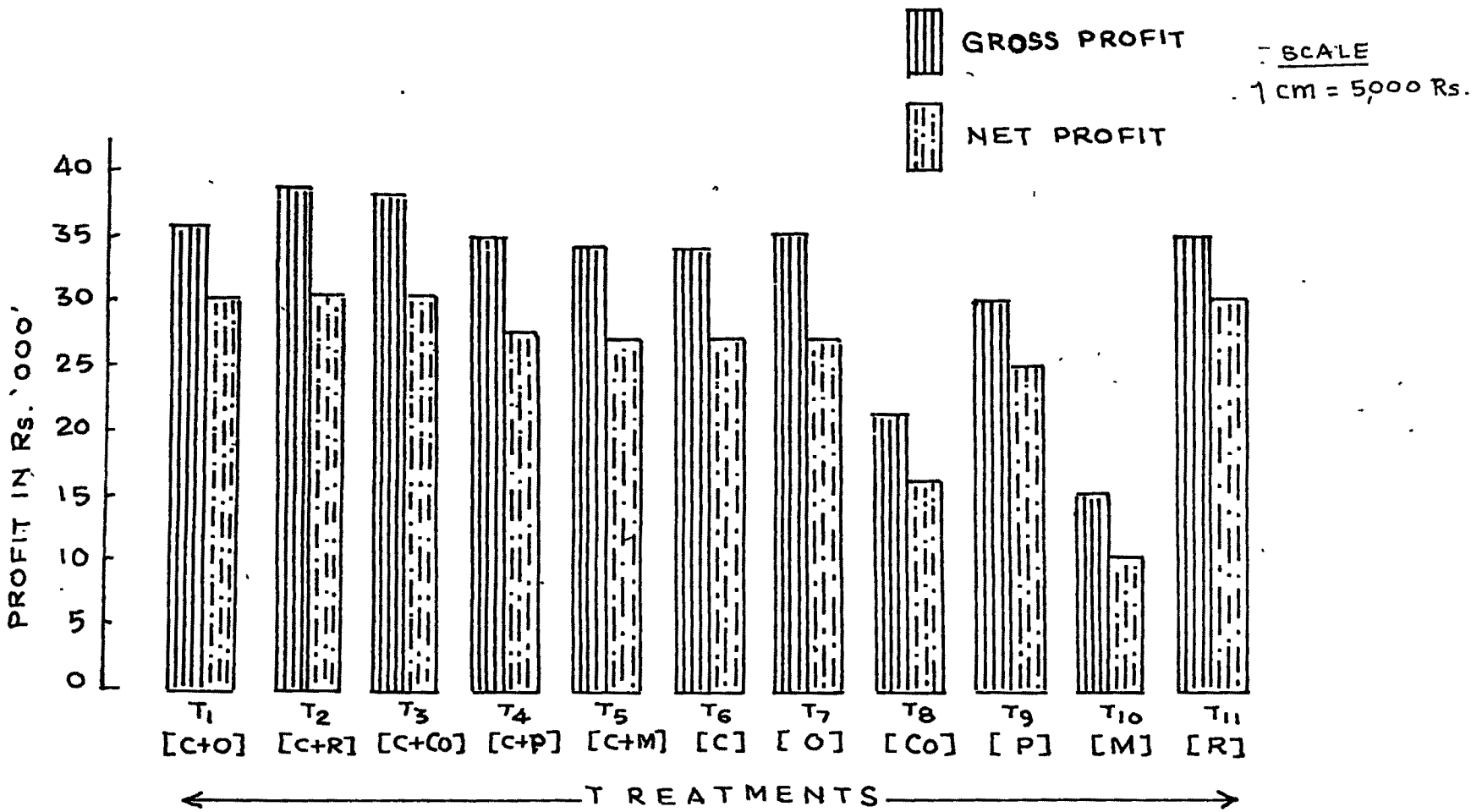


FIG. 5. GROSS AND NET PROFIT

It is very clear from the Table 15 that the treatment cabbage + radish (T_2) recorded highest gross prifit of Rs. 38,415/- which was statistically not different from T_1 (cabbage + onion) and T_3 (cabbage + coriander), but it was significantly superior to all other treatments either as sole crop or as a combination treatment.

The treatment T_1 (cabbage + onion), T_3 (cabbage + coriander) and T_{11} (radish sole crop) were statistically similar and significantly superior to all remaining treatments. Which was followed by T_7, T_4, T_5 and T_6, all these treatments were at par and significantly superior to treatments T_9, T_8 and T_{10}. These treatments (T_9, T_8 and T_{10}) were next best in sequence in giving gross profit per hectare.

It is evident from Table 15 that the highest net pfofit per hectare was gained from the treatment T_2 (cabbage + radish) of Rs. 32,404/- followed by T_3 (cabbage + coriander) and T_1 (cabbage + onion) of Rs. 31,521.16 and 30,927.66, respectively. These three treatments were statistically similar and significantly better than other treatments except T_{11} (radish sole crop). Which was at par with T_3 and T_1. The treatment T_{11} was also significantly better than remaining treatments.

The treatments T_6, T_4, T_7 and T_5 were intermediate giving more than Rs. 25,000/- net profit per hectare, these were statistically similar and significantly superior to T_9, T_8 and T_{10} in sequence. Significantly lesser profit was recorded in the treatment T_{10} methi sole crop as compared to allother treatments under study.

DISCUSSION

CHAPTER V

DISCUSSION

Growing two or more crops together on the same land is known as intercropping. Where the main crop are grown at certain spacing and intercrops in between the rows. This practice is mainly followed by gardener on high price land and where much of the work is done by hand. With the consideration of the time of each crop is to be planted, the habit of the growth, the space is to be required by each crop at various stages of growth and the time when each is expected to mature. Care should be exercised to prevent one crop from seriously interfering with another at a critical period of development.

The usual method of cultivation of various cole crops is as sole crop at the pspacing of 45 to 60 cm in rows and 30 to 60 cm in plant. In this method of planting only one crop can be taken for a period of 3 to 4 months. The growth of these crops particularly cabbage is very low up to 55 to 60 days after transplanting and much of the land in between these crops remain unutilized. If some inter crop is taken in between these crop having either short duration or having straight growth is benificial. As Thomson and Kelly (1959) mentioned various advantages of intercropping as follows :

1. Economy of space, which is important with high priced land.

2. Saving in tillage as the same ploughing and fitting of the land serve for two or more crops.

3. Complete utilization at the nutrients and surplus applied to one crop being available for another.

4. Increase gross returns from the area cultivated.

On the contrary they have mentioned certain disadvantages also, as increase in labour cost, larger demand of nutrients and moisture and greater difficulty in controlling insects and diseases.

The experimental results in respect of growth and yield of cabbage as influence by taking an intercrops like onion, radish, coriander, palak and methi are critically discussed in this chapter.

5.1 Effect of intercrops on growth

The growth and vigour of plant is an indication and power and forcefulness of the plant which ultimately result is better production. The aspect of growth critically studied in cabbage were height of plant, circumference of stem, number of leaves, area of leaf and spread of plant.

It can be seen from the Table 5 and 6 that the height of plant and number of leaves per plant were observed onon-significant at all the stages of growth expect after 15 days

in height of plant and after 45 days in number of leaves per plant indicating that there was no effect on growth of the plant on these two growth contributing characters of the plant. Similar type of results were also noted by Mendal et al. (1973) in cassava due to intercropping of cowpea, groundnut, black gram, green gram, sunhemp, etc. No adverse effect on growth of maize was also observed due to growing of bhendi, cowpea, radish, clusterbean, lablab, beat root, khokhol and carrot as intercrops (Meenakshi et al., 1974).

The circumference of the cabbage plant (Table 7) was significantly affected due to intercrop at all the stages of the growth expect after 30 days of transplanting. The treatment T_6 cabbage (solecrop) was significantly superior to T_1 (cabbage + onion) and statistically similar at the final stage of growth. Whereas no definite trends was observed on the production of circumference of plant when observed on the various stages of growth. The thicker stem in the sole crop might have gained due to optimum space for growth.

The data presented in Table 8 indcate that the difference in leafarea were non significant from 15 to 75 days of transplanting. However, the differences in leaf area were significant at the final stage of growth which was recorded at 90 days after transplanting, where

significantly more leaf area was observed in the treatment T_6 (cabbage sole crop) as compared to other treatment except T_5 (cabbage + methi). This observation also clearly indicate that there is no adverse effect of intercrop onthe main crop of cabbage upto 75 days. However, a superior growth in respect of leaf area was noted at the final stage in T_6 might be due to optimum space for growth was gained in sole crop. These observations are strongly supported by the findings of Randhawa and Sharma et al. (1973).

The spread of plant (Table 9) showed that the treatment differences due to various intercropping were significant at 30 and 75 days only and non significant in the remaining stages of growth. But there was no specific increase or decrease of spread of cabbage plant due to intercroppingof various crops.

5.2 Fresh weight and dry matter production

It can be seen from the table 10 and 11 that the fresh weight of root and stem was found significantly superior in treatment T_6 (sole crop) but it was statistically similar to treatment T_2 in case of fresh weight of roots and statistically similar to T_2, T_3 and T_4 in respect of fresh weight of stem.

As regards to dry weight, the treatment T_6 was significantly superior over all other treatments in the production of dry weight of roots. Similarly though the dry weight of stem was observed more in T_6 but it fail to show any significant difference from the other treatments. These observations clearly indicate that the fresh and dry weight of the root and shoot was more in thesole crop. These observations are supported by the findings of Patil (1988), he reported that the sole crop of all the solanaceous crops produce more growth as compared to thecrops where intercrops were taken.

The observations noted in respect of fresh and dry weight of leaves (Table 12) was observed to be non-significant indicating that there is no effect of intercrop of fresh and dry weight of leaves of cabbage. Similar types of observations was also noted by Meenakshi et al. (1974).

5.3 Effect of intercrop on yield

In the plant science particularly where leaves as in case of cabbage is a yield in terms of quality and quantity is directly related with the growth of that plant.

The results noted in Table 13 indicates that the head weight per plant was significantly more in treatment T_6 (cabbage sole crop) as compared to T_4, T_3 and T_1 but it was

statistically not different from the treatment T_2 and T_5. It may be due to more growth recorded in this treatments in respect of height, leaf area and plant spread.

The results of Table 13 indicates that the yield per plot and per hectare was also significantly more in treatment T_6 (cabbage solecrop). It was followed by T_2 and T_5 but these two treatments were statistically not different from the remaining treatments. This may be due to production of good growth and bigger size of heads produce in these treatments. These results indicates that therei is some adverseeffect of intercrops on the yield of cabbage as a main crop and this effect is also not similar with all crops when grown as intercrops. These results are strongly supported by the findings of Zende and Patil (1973) in cane production and Umrani et al. (1984). in turmeric.

On the contrary the benificial effects of intercropping also reported by Singh and Singh (1973). They observed that sugarcane intercrop with potato gave slightly higher cane yield than pure autum crop.

5.4 Economics of intercropping

5.4.1 Yield and monetary returns of intercrop

The production of vegetables is important on quantity and quality basis. However, profits in commercial vegetable

growing is much depend on the prices fetching to a particular vegetable during the season of production.

It is evident from the data presented in Table 14 clearly indicates that the highest yield per hectare of an intercrop was produce by radish which wqs followed by onion. Significantly minimum yield was recorded by coriander when taken as an intercrop. When the prices of that season were considered the higher monetary returns was gained from radish followed by onion and coriander. It means through the production of coriander was very poor on quantity basis still due to high price of this vegetable in the market was responsible to give third position in terms of money. The duration of this crop was also minimum such considerations are also essential while advocating the pattern of inter-cropping in vegetables.

5.4.2 Gross profit and net profit

While working out the economics it is not sufficient to see the gross profit of any pattern of vegetable cultivation but at the same time it is most importance to see the net gain to the grower by adopting that system of cultivation. As it can be seen from Table 15 that the treatment T_2 (cabbage + radish) recorded highest gross profit of Rs. 38,415/- which was statistical not different from T_1 (cabbage + onion) and

T_3 (cabbage + coriander) but it was significantly superior to all other treatments either cultivated as sole crop or as a combination treatments. But the net profit gained was more in T_2 (cabbage + radish) of Rs. 32,404/- followed by T_3 (cabbage + coriander) and T_1 (cabbage + onion) of Rs. 31,521/- and 30,921/- respectively. This change in sequence in gross profit and net profit was due to the cost of cultivation (Appendix-B) required for a parricular treatment which is also important while selecting a particular pattern of intercropping.

From the Table 15 it can also be seen that the treatment T_{11} (sole crop of radish) was fourth in order in giving gross and net profit per hectare followed by T_7 (sole crop onion) in gross profit per hectare. Through the sole crop of any vegetablelike radish which consumption is comparatively less is givingm more profit on calculation basis, it should be born inm mind that fresh vegetable are living organisums therefore, they under go normal life processe they respire, they loose water through transpiration and they under go chemical changes. These processes contribute to the gradual deterioation of the product. Hence they can not be cultivated on very large scale. Otherwise, there will be a drastic fall in the prices and the cultivation of such vegetables will be uneconomical. Therefore, while planning the vegetable

SUMMARY AND CONCLUSION

CHAPTER - VI

SUMMARY AND CONCLUSION

An experiment " A study of intercropping in cabbage (Brassica oleracea var. capitataL.) " was conducted at a Department of Horticulture, Marathwada Agricultural University, Parbhani during the rabi season of 1988-89. The five intercrops in cabbage were studied viz. onion (Allium cepa L.), Radish (Raphanus sativus L.), Coriander (coriandrum sativum L.), Palak (Beta vulgaris L.) and Methi (Trigonella forenumgraecumL.).

The experiment waslaid out in Randomised block design with eleven treatments. They were replicated for six times.

The various observations were noted in respect of growth, dry matter production, yield and economics which are summarised below.

1. There was no significant effect of any treatment on the average height of the plant and average number of leaves per plant at all the stages of growth, except 15 days after transplanting in height and except 45 days after transplanting in case of number of leaves per plant.

2. At final stage the circumference of the cabbage plant was more in treatment T_6 (cabbage sole drop) which was significantly superior to T_1 (cabbage + onion) and statistically similar to all the remaining treatments.

3. Treatment differences in leaf area were not significant from 15 to 75 days after transplanting but at 90 days after transplanting treatment T_6 (cabbage sole crop) were recorded significantly more leaf area as compar to other treatments except T_5 (cabbage + methi). The treatment T_5 was also significantly better than T_3 (cabbage + coriander), T_4 (cabbage + palak) and T_2 (cabbage + radish) in this respect.

4. There was no effect on intercropping treatments on the spread of cabbage plant at various stages of growth except after 30 and 75 days after transplanting where differences were noted significant however, there was no any increasing or decreasing trend in this respect was observed.

5. Fresh weight of roots and fresh weight of stem was significantly affected due to various treatments. They were significantly more in treatment T_6 (cabbage sole crop) followed by T_2 (cabbage + radish). These two treatments were not statisti cally different from each other.

6. The dry weight of roots observation was recorded significant where also T_6 recorded significantly more dry weight of root followed by T_2 (cabbage + radish). However, non significant differences due to various treatments were noted on the dry weight of stem.

7. Non significant differences were noted in respect of fresh weight of leaves and dry weight of leaves of cabbage plant due to various intercropping treat--ments.

8. The average weight of cabbage head was significantly more in T_6 (cabbage sole crop) as compared to other treatments except T_2 (cabbage + radish) and T_5 (cabbage + methi).

9. The yield of cabbage per plot and per hactare was significantly more in treatment T_6 (cabbage sole crop) as compared to other treatments however, remaining all other treatments were statistically similar with each other.

10. More yield of intercrop was observed in radish (64.48 q/ha) followed by onion (62.50 q/ha). These two intercrops were statistically similar and significantly better than palak, methi and coriander in the production of yield q/ha, when grown as an intercropping in cabbage.

11. The highest monetary returns of Rs. 6,448.00 was gained in radish followed by onion of Rs. 6,250.00. These two treatments were statistically similar and significantly better than other treatments. The next best intercrop was observed coriander which gave the monetary return of Rs. 5,679.00.

12. The treatment T_2 (cabbage + radish) recorded highest gross profit and net profit of Rs.38,415.00 and Rs. 32,404.00 per hactare respectively. The next best treatment was T_3 (cabbage + coriander) and T_1 (cabbage + onion) which gave the net profit of Rs. 31,521.00 and Rs. 30,921.00 respectively. These three treatments were statistically similar and significantly better than other treatments except T_{11} (radish solec crop).

CONCLUSION

From one season data of this experiment it can be concluded that intercropping of radish, onion and coriander is highly profitable in cabbage crop. These three treatments gave an additional income of Rs. 6,448.00, Rs. 6,250.00 and Rs. 5,679.00 respectively with slight reduction in cabbage yield.

The combine treatments of cabbage + radish (T_2), cabbage + coriander (T_3) and cabbage + onion (T_1) gave net profit of Rs. 32,404.00, Rs. 31,521.00, and Rs. 30,921.00 respectively while the sole crop of cabbage (T_6) recorded an income of Rs. 28,288.00 only.

As these are the findings from one season data those should be further tested for couple of years.

LITERATURE CITED

LITERATURE CITED

Allen, J.R. and R.K. Obura (1983). Yield of cane, cowpea and soyabean under different intercropping system. Agro. J. 75 (6) : 1005-1008.

Benganzo, J.C.E.O. (1985). Observations on beans as an associated crop with coffee and cassava. (Hort. Abst. 55 (6824).

Brown, J.E.; W.E. Splittstosser and J.M. Gerber (1985). Production and economic returns of vegetable intercropping systems. J. Amer. Soc. Hort. Sci. 110 (3) : 350-353.

Gallash, H. (1975). Integration of cash and food cropping in the low land of Pupa New Guinea. Abst. Tropical Agric. May 1978. (5) : 129.

Itulya, F.M. (1980). The influence of intercropping on growth and yield of summer squash (Cucurbita peps L.), Mung bean (Phaseolus aurcus Roxb.) and Pinto bean (Phaseolus vulgaris L.) A Dissertation Abst. International Aug. 1980 41 (2). 424 B.

Jain, T.C. (1978). Barley or wheat as intercrop with potato Indian Farming 28 (3). 7-9.

Kaith, D.S. (1980). Intercropping and its after effect on the yield kalazira. Indian cocoa, Arecanut and speces J. (1980). 4 (2) : 39-41.

Kar, K.; R.L. Bhoj and P.C. Kapoor (1972). Intercropping in sugarcane with onion for higher production and better economic returns. Indian sugar 22 (4) : 321-326.

Koregave, B.A. (1964). Effect of mixed cropping on the growth and yield of suran. Indian J. Agro. 9 (4) : 255-260.

Liao, H.C. and F. Montas (1978). Studies on intercropping tomatoes and cabbage. Vegetables for the Hot Humid Tropics. News letter (Puerto Rico) No. 3 : 44-48, 1978. Abst. Tropical Agric. Nov. 1980. 6 (11) : 85.

Maheswari, S.K.; B.N. Dahatonde, S. Yadav and S.K. Gangrade (1985). Possibilities of growing tubes crops in multiple cropping. Proc. of a symposium on multiple cropping. Published by Indian Society of Agro., I.A.R.S., New Delhi. 307-309.

Margate, R.Z. and S.S. Magat (1983). Coconut based multistory cropping. Phillipines J. Crop. Sci. 8 (2) : 81-86 (Hort. Abst. 55 : 9087).

Mandall et al. (1973). Central Crop Research Institute, Trivendrum.

Meenakshi, K.; A.K. Fazlullah Khan and R. Appadural (1974). Studies on intercropping of short duration vegetables with maize. Madras Agril. J.Aug. 1974. 61(8):389.

Mehroha, P.N. and A.A. Ali (1970). A scientific analysis of mixed cropping. Science and culture 36 (4) : 196.

Nagre, K.T. (1979). Studies on the effect of intercropping on the growth, yield and economics of rainfed cotton. Ind. J. Agro. 24 (4) : 390-394.

Natra, A.P. and B.N. Chattarjee (1986). Intercropping of soybean with rice, maize and pigeonpea. Ind. J. Agric. Sci. 56 (6) : 413-417.

Patil, M.B. (1988). Intercropping in vegetable. M.Sc. (Agri.) thesis, MAU : Parbhani.

Prabhakar, M. and N.G. Pillai (1984). Multiple cropping systems with tuber crops. Indian Farming, 33 (12) : 25-28.

Premnath et al. (1987). Vegetables for the tropical Region I.C.A.R., New Delhi, 1-2.

Rajshakaran, A.; S.P. Palaniapplan and P. Balsubramanium (1983). Yield and monetary returns from maize and intercrop in Tamil Nadu. Ind. J. Agric. Sci. 53 (9) : 857.

Ramkrishnan Nayar, T.V. (1976). Intercropping in young robusta coffee. Indian coffee, Feb. 1976. 40 (2-3) : 70-74.

Randhawa, G.S. and C.B. Sharma (1973). Possibilities of intercropping in Banana. Proc. of a symposium on multiple cropping published by Indian Society of Agro. I.A.R.I., New Delhi. 326-327.

Sharma, R.S.; J.P. Tiwari and G.S. Rathi (1983). Intercropping of wheat, potato, onion and sunflowers in sugarcane. J.N.K.V.V. Res. J. Jabalpur, 17 (314) : 253-257. (Hort. Abst. 39 : 9826).

Singh, P.P. and Kartar Singh (1973). Studies on the intercropping. Published by Indian Society of Agro., I.A.R.I., New Delhi. 310-311.

Singh, B.P. and J.P. Singh (1986). Intercropping of wild turnip in taramira and chickpea in dry arid soils of Haryana. Ind. J. Agric. Sci. 56 (2) : 96-100.

Thompson, H.C. and W.C. Kelly (1959). Vegetables crops, published by Tata MC Graw-Hill Publishing Co. Ltd. Bombay, New Delhi. 150-152.

Tiwari, R.; D.K. Singh and B.K.P. Thakur (1983). An economic analysis of spraying planted S. cane with or without intercrops in Bhiar. Indian Sugar Crops J. 9 (1) : 10-11.

Umrani, N.K.; R.B. Patil and H.K. Pawar (1984). Studies on profit potentials of different intercropping systems with turmeric. Ind. J. Agro. 29 (3) :

Zende, G.K. and R.S. Patil (1973). Intercropping in sugarcane in Maharashtra. Proc. of a symposium on multiple cropping. Published by Indian Society of Agro., I.A.R.I., New Delhi. 320-321.

APPENDIÇES

APPENDIX-A

Monthly average meteorological data from October 1988 to March 1989

Months	Temperature ^{o}C		Humidity %		Evaporation in mm	Rainfall in mm	No. of rainy days	Bright sun shine
	Max	Min	A.M.	P.M.				
Oct	32.5	17.5	77	32	5.8	10.0	3	9.7
Nov	30.7	12.9	77	25	5.8	1.6	0	10.5
Dec	28.1	10.9	74	28	4.5	0	0	10.3
Jan	30.6	12.5	71	28	4.9	0	0	10.5
Feb	34.4	11.6	51	13	6.9	0	0	10.6
Mar	34.3	18.0	61	25	7.5	85.0	5	8.7

APPENDIX-B

Treatments	Cost of seed	Raising of seedling	Preparatory tillage	Transplanting/sowing	Cost of manures and fertilizer	Application cost
T_1	430	270	345	870	3150	96
T_2	500	195	345	480	3117	96
T_3	330	195	345	480	2901	96
T_4	330	195	345	480	3150	96
T_5	396	195	345	480	3143	96
T_6	230	195	345	240	2863	96
T_7	600	250	345	2000	2863	96
T_8	300	-	345	760	2108	96
T_9	300	-	345	600	2863	96
T_{10}	500	-	345	600	2537	96
T_{11}	800	-	345	1500	2763	96

(Continued)

APPENDIX-B (Continued) :

Treat-ments	Secon-dary tillage	Cost of plant prote-ction	Cost of harvest-ing	Market-ing	Total cost	Gross cost/ average	Net profit
T_1	480	85	613	100	6439	37360	30921
T_2	480	85	613	100	6011	38415	32404
T_3	480	85	650	100	5662	37183	31521
T_4	480	85	650	100	5911	34071	28156
T_5	480	85	720	100	6040	33665	27625
T_6	480	85	480	100	5114	33402	28288
T_7	320	85	400	100	7059	34772	27713
T_8	320	85	320	100	4434	22245	17811
T_9	320	85	320	100	5029	29397	24368
T_{10}	320	85	320	100	4903	15740	10837
T_{11}	320	85	304	100	6313	36573	30260

APPENDIX-C

Sr. No.	Name of crops	Range of prices from Nov. to March (Rs. per kg)	Price taken for calculation in Rs.
1.	Onion	0.50 to 1.50	1.0
2.	Radish	0.50 to 1.50	1.0
3.	Coriander	2 to 5	3.0
4.	Palak	0.50 to 2.00	1.0
5.	Methi	0.50 to 2.00	1.0
6.	Cabbage	0.50 to 1.50	1.0