STUDIES ON HERBAGE AND SEED PRODUCTION OF *Stylosanthes hamata* cv. VERANO UNDER DIFFERENT MANAGEMENT SYSTEM

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By

Anathbandhu Khara, M. Sc. (Ag.)

DEPARTMENT OF AGRONOMY
FACULTY OF AGRICULTURE
BIDHAN CHANDRA KRISHI VISWAVIDYALAYA
MOHANPUR, WEST BENGAL, INDIA

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Bidhan Chandra Krishi Viswavidyalaya

FACULTY OF AGRICULTURE

DEPARTMENT OF AGRONOMY

Prof. B.N. Chatterjee,
Ph.D. (Reading, U.K.),
F.I.S.A.

and

Dr. S. Maiti, Ph.D. (KU)

P. O. KALYANI, Dist. NADIA
Pin-741235
WEST BENGAL, INDIA.

No.....................   Dated 2-5-1989.

C E R T I F I C A T E

This is to certify that the work recorded in the Thesis entitled "Studies on herbage growth and seed Production of *S. hamata* cv. Verano under different management system" submitted by Sri Anathbandhu Khara for the award of the Degree of Doctor of Philosophy in Agronomy of the Faculty of Agriculture, Bidhan Chandra Krishi Viswavidyalaya, is the faithful and bonafide research work carried out under our personal guidance and supervision. The results of the investigation reported in the thesis have not so far been submitted for any other Degree or Diploma. The assistance, help and source of informations, as have been availed of during the course of investigation, have been duly acknowledged.

(B.N. Chatterjee)

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(S. Maiti)

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ABSTRACT

For analysing growth, development and productivity of Stylosanthes hamata cv. Verano (a promising forage legume), with a particular reference to seed production, a series of field experiments were conducted during the years 1984 to 1987 at the Central Research Farm, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur having sub-humid, sub-tropical climate and new alluvial (Entisol) soils in the Gangetic plains of West Bengal at 23^{o} N latitude and 9.75 m altitude. In each of the experiments the treatments consisted of two methods of establishment (line sown v. broadcast and widely spaced rows v. narrowly spaced rows) along with two defoliation treatments (no and one cutting) and two levels of phosphatic fertilization (0 and 80 kg P_2O_5 ha^{-1}). The main objectives were to find out herbage production at the early stage, flowering behaviour and seed production potential of the crop under different management practices based on the differences created through varied spacing, defoliation treatments and phosphatic fertilization.

Carribean stylo cv. Verano put forth a rank growth within two months after the mean seedling emergence date. It withstood considerable moisture stress and tolerated occasional waterlogging of short duration. The crop attained 85.2 cm of height in widely spaced (60 cm) rows as against 72.8 cm in the broadcast crop. Though defoliation at 60 - 62 DAMSE (days after mean seedling

emergence date) reduced plant height, but it did not affect biomass production and seed yield significantly. On an average 150 q ha^{-1} green herbage (38.0 q ha^{-1} of dry matter) was obtained at 60 - 62 DAMSE. Secondary and tertiary branches significantly influenced seed production; the correlation values of the relationship between secondary branches and seed yield (r values ranged from 0.689 to 0.929) as well as between tertiary branches and seed yield (r values ranged from 0.722 to 0.810) were close, positive and significant. Row spaced swards produced 21.6 and 12.2 % more of secondary and tertiary branches than the broadcast crop and there were approximately 5,000 secondary branches m^{-2} and 7,500 tertiary branches m^{-2} in widely apart (40 or 60 cm) row spaced crop. Early defoliation did not significantly affected the secondary and tertiary branches, although defoliated swards recorded 4 - 5 % more tertiary branches than the undefoliated crop, as observed in the first week of October. Phosphatic fertilizer @ 80 kg P_2O_5 ha^{-1} significantly increased the dry matter accumulation and branching (both secondary and tertiary) over 0 kg P_2O_5 ha^{-1}.

Flowering of Verano started from the terminal shoot apex and proceeded basipetally and its florets in inflorescence developed acropetally in order of their initiation.

Although Verano showed sparse flowering from July onwards, the peak period of flowering occured in November. Widely row spaced crop produced greater number of inflorescences m^{-2}, higher number of florets inflorescence^{-1} and higher test weight of seeds in comparison with narrowly row spaced swards. The number of inflorescences m^{-2} were as high as 8,000 in widely apart (40 and 60 cm) row spaced crops. Undefoliated swards had only 2 to 4 % more inflorescences over the defoliated swards recorded in mid-December. Widely spaced - crop had 7.4 number of florets inflorescence^{-1} while the narrowly spaced swards had 7.3 number of florets inflorescence^{-1}.

Number of seeds set floret^{-1} did not vary significantly between widely and narrowly - spaced crops. Defoliation also did not reduce number of seeds set floret^{-1} significantly. Earlier seed harvest in mid-December showed increased test weight and the same trend of variation continued up to third week of December, test weights, however, decreased with the passage of time. Early defoliation did not affect test weight of seeds.

Phosphatic fertilizer @ 80 kg P_2O_5 ha^{-1} significantly increased the inflorescences number per unit area (by 8 %), number of florets per inflorescence (by 7.5 %) and test weight of seeds (by 3.0 %). Number of seeds per set floret differed significantly with application of phosphatic fertilizer.

A positive, close and significant correlation existed between number of inflorescences per unit area and seed yield (r values ranged from 0.493 to 0.984), number of florets per inflorescence and seed yield (r values ranged from 0.874 to 0.977) as well as between test weight of seeds and seed yield (r values ranged from 0.549 to 0.971). On an average total seed yields which consisted of harvested seed material (56 %) and shattered seed material (44 %) collected through sweeping in case of row-spaced crop and by hand collection from the ground in case of broadcast crop, amounted to 98.57, 96.11, 85.26 and 69.84 g m^{-2} (or 9.86, 9.61, 8.53 and 6.98 q ha^{-1}) in 60, 40, 20 cm apart row-spaced and broadcast crops, respectively, over all the years. The difference in seed yield between 20 and 60 cm apart row spaced crop and between 40 and 60 cm apart row sown crop were 13.5 and 4.5 % respectively. In broadcast crop collection of shattered seeds from the ground was impracticable. There was not much difference in seed yield between undefoliated and defoliated swards. Phosphatic fertilizer increased seed yield by 11 % over unfertilized crop. The highest total yield recorded was 107 g m^{-2} or 10.7 q ha^{-1} with the application of 80 kg P_2O_5 ha^{-1}.

From the findings of the experiments it can be concluded that *Stylosanthes hamata* cv. Verano is a very promising forage legume in respect of herbage and seed production in the Gangetic plains. Swards of Verano if established with row-spacing of 40 to 60 cm with 80 kg P_2O_5 ha^{-1} and defoliated at vegetative stage, two months after the mean seedling emergence date (sometimes in the first week of July) could provide 140 q of green herbage (35 q on dry wt. basis) and 8 q ha^{-1} of seed. Thus, selling seeds at the rate of Rs.30 kg^{-1}, a farmer can fetch approximately Rs.24,000/- ha^{-1} with an investment of Rs.3,000/- ha^{-1}.

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CHAPTER 1

INTRODUCTION

1. INTRODUCTION

The grazing lands in India produce very little amount of dry biomass to meet the requirement of protein through the legumes to the huge cattle population of the country. Although various pasture legumes have been tried for introduction, *Stylosanthes* genus have wide preference on various types of climatic and edaphic condition in many countries of the world (Rai and Pathak, 1985). During the seventh five year plan, a national programme on the afforestation of wastelands has been initiated to increase the fuel and timber resources and to improve the environment through effective management and conservation. The economic utilization of the vast wastelands will largely depend upon the plantation of suitable fodder-cum fuel trees along with improved pasture development (Roy, 1986). In this system tree and pasture species so chosen, should be complimentary to each other and should produce high energy fuel along with bio-mass of high protein value to feed the huge cattle population. Improved pasture will not only meet part of our requirement of good fodder, but will also help to minimise flood and drought cycles, soil erosion and soil nutrient depletion, and to improve the fertility status of the soil (Patil *et al*., 1967; Velayudhan *et al*., 1973; Magoon *et al*., 1974; Gupta *et al*., 1974; Strutz and Parker, 1974; Hutton, 1975; Rai *et al*., 1980).

Stylosanthes is a relatively small genus of tropical legumes most species of which are native to South and Central America distributed between 30° North and South of equator (Burt *et al.*, 1970). *Stylosanthes hamata* is mainly found in the Carribean islands and in the adjoining coast lines of South and Central America and Florida in USA. It may occasionally be found in Brazil, but does not appear to be native of that country. *S. hamata* has several common names like 'Pencil flower' and 'Mother Segal' in West Indies and "Febeneque" in Venezuela. One cultivar Verano which is adapted in neutral to acid soils and dry to semiarid tropical condition is commercially available (Burt *et al.*, 1970). The Carribean stylo cv. Verano is originated from Venezuela at 16°N and 30 m altitude (Cameron and t' Mannetije, 1977).

Rai and Pathak (1985) reported that *Stylosanthes* prefer the tropical and sub-tropical climates with varied edaphic requirements. Out of these species *S. hamata* has been found most desirable and adaptive to wide ecological amplitude. They also observed that it can grow under partially inundated saline sodic soils with pH as high as 10.5 in calcereous wastelands and in ravine areas subject to high degree of erosion, *Stylosanthes* have the capacity to germinate, establish, grow, proliferate and compete with the degraded rangeland vegetation. It has the potential to colonise in the disturbed sites with fresh soil deposits and to save it from erosion.

Cultivars like *S. hamata* cv. Verano comes nearest to resolving the conflict between ecological and nutritional considerations. Verano has rapid germination rates, good seedling vigour, resistance to anthracnose, high seed yields and generally better competitive ability than *S. humilis* (Torsseli *et al.*, 1976).

Kretschmer *et al.* (1984) reported that tetraploid Verano produced more forage than common diploid types. *S. hamata* has strong branching system and native *S. hamata* flowers all the year round. It grows well on calcareous soil. It is a self polinating type. However, profuse seed production is a characteristics of *S. hamata* and this is undoubtedly one of the key factor in its survival in areas with long drought periods. It can even withstand flooding upto 40 days.

In India, in recent years, several species of *Stylosanthes* are tried. Among the *S. guianensis* cv. Endeavour, Graham, Cook and Schofield are performing well. The Carribean stylo cv. Verano has also been reported to perform well in almost all the regions of peninsular India, dry tracts of Rajasthan and also in the eastern regions of India that is, in Bihar and West Bengal (Chatterjee *et al.*, 1985; Prasad and Mukherjee, 1982). It has immense potential as a pasture legume in India. Chatterjee *et al.* (1985) reported that *S. guianensis* and *S. humilis* have good prospects in growing under eastern India at Ranchi and Kalyani (altitude 9.75 m latitude 23°N and 1300 to 1500 mm annual rainfall).

All these efforts have created consciousness amongst scientists and planners to expand the propagation of Stylosanthes and to renovate the existing poor pasture and rangelands in India. Naturally this has created demand for the supply of good seeds. Not much work has been done to analyse the seed production potentiality of Stylosanthes in India. In the work reported in the thesis an effort has been made to study the seed production potentiality of the Carribean stylo cv. Verano with the following objectives :-

1) To find out the effects of spacing, cutting and phosphatic fertilization on seed production ability of the crop.

2) To study the nature of flowering, grain filling, time of harvesting and their effect on seed production.

CHAPTER 2

REVIEW OF LITERATURE

2. REVIEW OF LITERATURE

2.1 General description of the crop

Amongst the pasture legumes genus *Stylosanthes* has been acclaimed superior to other legumes in the dry region or drought prone area. *Stylosanthes* performs better than the pasture legumes like Siratro, Glycine, Desmodium, etc. It can grow from neutral to acid or alkaline soil. The root system is deep and adapted to wide range of soil and climatic condition. Kerridge (1978) and Schultze *et al.* (1979) reported that its adaptability in neutral to acid infertile soil is good. This genus appears to be the best among the tropical pasture legumes in tolerating high aluminium, manganese, low phosphorus and molylodenum in soils.

Among the *Stylosanthes* species *S. hamata* cv. Verana is preferred as it is easy to establish and quite hardy to tolerate or escape drought. It can be included with various pasture grasses like Rhodes, Deenanath, Buffel grass, etc. As Verano has a very dense and good canopy, it not only helps to minimise soil erosion, but also enrich soil under sole cropping. *S. hamata* benefits the soil by 1.5 times more of organic carbon as compared to other species with low C/N ratio. Rai (1984) also reported that when harvested at monthly intervals it provides at least 1.34 times more nitrogen and 1.17 times more organic carbon resulting in lower C/N ratio as compared to other species.

It is reported by various authors that S. hamata as a sole crop or as a companion crop produces more dry matter in comparison with other Stylosanthes species. The introduction of Stylosanthes in Rhodes grass resulted in significantly higher harbage yield than Rhodes grass, Leucaena leucocephala mixture. The introduction of S. hamata showed better performance than S. guianensis in association with Rhodes grass (Prasad and Mukherjee, 1982). Prasad (1985) reported that S. hamata combined well with Deenanath grass in Chhotonagpur region of Bihar state of India. Rai and Patil (1985) reported that during rainy season, S. hamata either grown alone or in mixture with Dichanthium or Heteropogon was suitable for high yield. The maximum crude protein yield was recorded with S. hamata (14.96 q ha^{-1}). From monthly harvest, the highest production of dry matter (140.5 q ha^{-1}) was obtained with Cenchrus + S. hamata. Rai and Pathak (1985) reported production of 60.3 q ha^{-1} of dry forage and 7.9 q ha^{-1} of crude protein from S. hamata crop. This yield is higher than those of S. scabra, S. Viscosa and S. guianensis. Rai and Patil (1986) got 51.4 q of dry matter ha^{-1} in S. hamata in comparison to 5.9, 28.0, 31.2 and 31.1 q ha^{-1} (dry matter) in case of S. guianensis, S. scabra, S. humilis and S. Viscosa respectively. From chemical analysis of the plant, Singh (1985) found that S. hamata produced 36.5 % D.M. 14.11 % CP and 2.65 % water soluble carbohydrate. Crude protein and water soluble carbohydrate percentages are higher in S. hamata than S. Viscosa and S. scabra.

2.2 Crop growth favouring good seed production of *S. hamata* cv. Verano

Hopkinson (1984) suggested that in choosing a climate for seed production one should find out condition that allow each of the following successive stages of development to take place in proper order. The stages anticipated were :

1. Establishment,
2. Development of vegetative stage,
3. Sudden complete transition to reproduction.
4. Development of the seed and
5. Its ripening and harvest.

Under the agro-climatic condition with particular reference to the western and central regions of West Bengal, the stages suggested by Hopkinson (1984) are distinctly available in the uplands where the lands do not get submerged for more than 10 - 15 days.

There is no problem in growing *Stylosanthes* except fine stem Stylo. The fine stem Stylos are sub-tropical in origin and use (Stonard, 1968; Stonard and Bisset, 1970). Their flowering flush take place in summer i.e. probably induced by long day photoperiodic response (Cameron and t' Mannetje, 1977). Normally in the agro-climatic zone of West Bengal during seed maturing period there would be rains. Hence prospect of cultivation of fine stem stylo for seed production is very problematic one. For other cultivars of *Stylosanthes* particularly those of tropical origin, it was pointed out that they all flower in short or shortening days under Australian condition. They produce the most satisfactory seed crops in districts with a reliable summer wet season and a dry winter (Hopkinson and Walker, 1984). In these conditions these cultivars exploit the wet season for vegetative growth and the dry season for reproduction. In West Bengal after rainy season there follows a dry winter with falling temperature and diminished soil moisture. Such environment combines to induce a sudden and complete change from vegetative to reproductive activity. This view is also expressed by Ison and Hopkinson (1983). Naturally this dry winter promotes heavy and well synchronised flowering. The problem of frost injury in later flowering type like Seca does not affect the early flowering cultivators like Graham and Verano (Hopkinson and Walker, 1984).

Animal preference to *S. hamata* is better than *S. viscosa* (Rai and Patil, 1983). In a mixed pasture of *D. annulatum* + *S. hamata*, Rai (1984) observed that animals grazed on mixed pasture maintained their body weight for longer duration and the gain in weight was higher as compared to that recorded with *D. annulatum* alone. Singh *et al*. (1984) found that animals showed 22.5 g day^{-1} animal body weight gain. Winter (1977) reported that the average annual gains for the various stocking rate was greater in case of cv. Verano treatment, about 10 - 15 kg ha^{-1} higher than those in perennial legume treatment at each stocking rate.

2.3 Photoperiodic response of *S. hamata*

Carribean stylo *S. hamata* (L.) Taub is a day neutral crop (t' Mannetje, 1965). *S. hamata* is a short day crop (Cameron and t' Mannetje, 1979). *S. hamata* cv. Verano though flowers in all photoperiods in this region, but main flower-flush commences in short photoperiods. Cameron and t' Mannetje (1977) observed that when the photoperiod was of 10 to 11½ hrs, the main flower flush of Verano commenced indicating a quantitative short day response. Hopkinson and Reid (1976) also found that Verano stylo is a day neutral one. Sharma (1985) reported that *S. hamata* CPI 38842 took 58 to 93 days of crop growth for initiating first flower.

2.4 Temperature and moisture conditions favouring good seed production

Temperature affects vegetative growth, floral induction, growth and differentiation of inflorescence, blooming, pollen germination, seed setting and seed maturation (Humphreys, 1975). The effect of temperature on floral induction are quite complex and variable for and within the different photoperiod response classes (Chailakhyan, 1968). Cameron (1967) found that night temperature of 28°C or below and temperature of 25°C proved adverse in *S. humilis*. A regime of 35° / 30°C temperature prevented flowering of

S. guianensis and *S. hamata* (t' Mannetje, 1965). Cameron and t' Mannetje (1977) found that there were more inflorescence at 28° / 20°C than at 32° / 24°C and the introduction that flowered in all photoperiods (*S. hamata*, *S. sundaica* and *S. subsericea*) has progressively more inflorescences as photoperiod decreased. They found that at 32° / 24°C temperature, there were 13.3, 12.3, and 3.7 number of inflorescences at 10, 11½ and 14½ hrs. of photoperiod, respectively. Verano produces the maximum number of spikes at 31 / 24°C (from the range 20 / 16 to 35 / 38°C) (Argel and Humphreys, 1983a). Fisher and Campbell (1977) reported promotion of flowering of *S. humilis* plants undergoing moisture stress and this may also be involved in the flowering of Cook, Verano and *S. scabra* (J. M. Hopkinson, pers. Comm). Ludlow (1980a) and M.M. Ludlow and R.G. Kerslake, (unpublished data) opined that Verano is dehydration tolerator with low sensitivity to desicoation (-9.5 to -12.5 MPa) and substantial acclimation (osmotic adjustment of 0.8). Carvalho (1978) found that Verano appeared to have better postponement and lower sensitivity to dessication than *S. guianensis* cv. Schofield but unequivocal statements can not be made about the mechanisms.

2.5 Factors of establishment

2.5.1 Factor of spacing

Sward culture provides better forage production. It is less vulnerable to soil erosion and it reduce the management cost. But line sowing helps to (i) reduce the seed rate and (ii) to utilize larger area for cultivation with less quantity of seed materials in comparison with sward culture.

2.5.2 Plant population density

Rai and Patil (1986) and Kanodia et al. (1985) tried their experiments with a spacing of 50 cm between rows. Little work has, however, been done on the effect of spacing on seed production in S. hamata.

Townsville stylo requires denser population than the perennials or the most robust Verano. Population density is often so high after re-establishment of Verano and common stylos that the seedlings may suffer premature death from apparent shallow rooting unless thinned out (Hopkinson and Walker, 1984). Wilaipon et al. (1979) kept 51 plants m^{-2} in one experiment and 151 plants in another; and obtained more yield from 51 plants m^{-2}. For line sown crop 2½ to 3 kg ha^{-1} is sufficient to have good establishment.

2.5.3 Method of sowing and germination percentage

Gardener et al. (1984) are of the opinion that Verano stylo and Hunter lucerne have similar seed weights, but while Verano stylo appears best adapted to germination on the soil surface, lucerne has the ability to emerge from depth.

Sowing of seed for seed production is to be done every year for successful seed yield. Parenniating plants lack vigour (Loch, 1984), though Verano is a parennial legume of short lived nature (Gardener, 1977). Gardener (1986) reported that Verano plants regenerate each year. The purity of seed should be 99 % (Linnet, 1977).

Surface sown S. humilis and S. hamata gave best results when sown intact, and established on the severe surface environment existing on scalded areas (Mott et al., 1979).

Prepared seed beds or strips are recommended for good establishment of Verano (Agishi, 1982).

To minimise removal of seeds by predators, to reduce the possibility of false starts in fast germinators like S. hamata and to optimise germination in slower species, sowing should be done when there is requisite soil moisture stored in the soil (Mckeon and Brook, 1983).

The light requirement for rapid germination could explain the lack of germination of S. humilis and S. hamata in the field with rainfall at night followed by rapid surface drying after sunrise (Mckeon, 1978).

Intact seeds of *S. hamata* took 20 - 40 hrs to reach 50 % of maximum germination at 25°C (Mott *et al.*, 1976). Mott *et al.* (1976) also reported that moist soil surface above - 1 bar water potential (.1 MPa) is required for field germination of *S. hamata*.

Singh (1985) used 6 kg seed ha^{-1} in broadcasting for forage production. Sharma (1985) reported the germination percentage of 77 and 20 in May and June sown crops respectively. Rai and Pathak (1985) reported 90 % germination if treated in boiled water for 90 seconds. So the seed rate for seed production differs depending on spacing, germination percentage and test weight of seed.

2.5.4 Soil conditions favourable for establishment

Verano stylo was the best legume with no complete failure on any site. Soil differences continue to have the greatest effect on the performances of the species (Jones, 1979).

Edye et al. (1984) stated that *S. scabra* and *S. hamata* are adapted to acid red earth soils in regions with annual average rainfall over 600 mm. However, it is likely that both the species are adapted to low rainfall environment and a wide range of soil types. Winter (1977) reported from the results of experiments conducted in 1976 that Verano and seca will persist and give moderate production with low fertilizer inputs on three soils i.e. sandy red earth, a medium textured red earth and a enchrozen, but they fail to establish on the black earth. Sandy soil is favoured for Townsville stylo, Verano and fine stem stylo for better persistence and vigour (Hopkinson and Walker, 1984).

2.6 Weed control and other factors of seed production

In this context, the salient points are :

A. Effective weed control management and inter row cultivation, fertilization and prophyletic measures affect seed production.

B. Off types reliably be identified and rogued.

C. Removal of weeds for proper and effective distribution of soil moisture, light and nutrients.

D. Harvesting of weed free crop becomes easier and less time consuming.

E. In well managed fields ground sweeping becomes possible to collect fallen seed from inter-row space.

2.7 Fertilization affecting seed production

Jones (1974) reported beneficial effect of phosphorus at lower levels and the moderately to high levels (equivalent to between 96 to 192 kg ha^{-1}) in several groups of

Stylosanthes. A few of them developed foliar symptom resembling foliar toxicity and had depressed the dry matter accumulated in their tops to high concentration. The phosphorus requirement of some tropical legumes may be lower than that of lucerne (Olsen and Moe, 1971) and there is large difference between tropical legumes in the response of phosphorus. Thus, Stylosanthes species and Lotonis bainesii are efficient in uptake of phosphorus than some of the other species studied (Andrew, 1966; Bhent and Humphreys, 1970; Jones and Freites, 1970; Olsen and Moe, 1971). Naturally in the phosphorus deficient soil, application of phosphorus will help in proper growth of the legume. Rai and Patil (1985 and 1986) reported no significant response to P and K nutrients, this might be due to the fact that they utilized the soil phosphorus and potassium available in the soil.

Verano pastures showed marked response to phosphorus and a possible response to sulpher on the red earth at Hyderabad. There were no response to phosphorus on black clay soil at Ahmednagar and Dhari (Edye, 1984).

By growing a legume like Verano the N level in the soil increased. Gillard et al. (1980) reported that by analysing the soil there was significant increase in soil nitrogen at all sites except westwood. Satisfactory growth at low level of P_2O_5 at Wortham Park could account for continued legume dominance despite increased soil nitrogen. Jones and Peaks (1981) reported that one year of a Verano sward contributed the equivalent of 60 to 80 kg N ha^{-1} to the succeeding maize crop on the clay loam soil and about half that amount on the sand.

Gorf *et al.* (1979) in South America compared six *Stylosanthes* species on an oxisol from cari-magua (pH 4.3) and ranked them in terms of their phosphorus requirement to achieve 90 % of maximum dry matter yield : *S. capitata* (8.0) / *S. scabra* (11.0) / *S. viscosa* (15.5) / *S. hamata* (25.0) / *S. sympodial* (32.5) / *S. guianensis* (39.0) where values in parentheses are the phosphorus levels of the fertilized soils determined by Bray II method. Mosse *et al.* (1973) infered that the threshold concentration at which plants can take up phosphorus may be lowered when they are infected with mycorrhizae; the results of Yost and Fox (1970) for *S. hamata* would support this view point.

Carvalho *et al.* (1981) found the effects of aluminium toxicity to be severe when the plants were dependent on symbiotic nitrogen. The effects were delayed nodulation, a reduction in the number of plants nodulated and reduction in the number and size of the nodules. *S. hamata* exhibited greater tolerance and was only affected at above 75 M Al.

Very little work has been done so far on the effects of fertilization on seed production of *S. hamata*. Rai and Patil (1986) reported that by application of sulphur the seed yields can be increased appreciably. *S. hamata* produced 1.55 q of seed ha^{-1} followed by *S. humilis* 1.41 ha^{-1}. They also reported that sulphur application at the rate of 20 and 40 kg ha^{-1} gave higher seed yield than control, whereas application of 10 kg ha^{-1} did not increase yields over the control treatment.

2.8 Effect of defoliation on seed production

Loch and Humphreys (1970) found that defoliation at flower initiation, flower appearance or at advanced flowering stage sharply reduces seed production, despite relatively minor effects on plant growth. Pate (1958), Leopold *et al.* (1959) and Lockhart and Gottschall (1961) observed that the effect of flower removal in lengthening flowering period, stimulation of branching and delaying plant senescence is well known in annual legumes.

Wilaipon and Humphreys (1976) observed that the positive effect of early grazing by sheep on seed production of Verano was due to the decreased competition of the grasses growing along with Verano. Wilaipon *et al.* (1979) were of the view that *S. hamata* cv. Verano is clearly a plant in which high rates of leaf and shoot differentiation continued during the flowering period. Defoliated swards made a rapid recovery if appices and lamina were removed without destroying the auxillary buds. They were also of the view that in most environments where Verano is grown, some grazing in the growing season will not impair seed formation. They found that seed yield increased from 141 to 171 g m^{-2} when 60 % of the laminae only were removed at an early seed setting stage in a well grown sward (LAI 6.9). In another experiment they found that removal of 33 % of laminae at a similar advanced development stage increased seed yield from 106 to 180 g m^{-2}. They opined that these might be due to the effects of altered patterns of apical dominance, leaf differentiation and bud site removal to assimilate supply to the inflorescences and the consequence of delayed flowering. Decapitation provided it is done early enough to allow recovery by first flower initiation helps to achieve this objective in common stylo (Loch et al., 1976b) and has produced variable but sometimes beneficial effects with townsville stylo and Verano (Humphreys, 1979; Loch and Humphreys, 1970; Wilaipon et al., 1979). Thus defoliation can have favourable or adverse effect on seed production depending on the species, their physiological responses and climatic factors during seed production (Humphreys, 1980). Cutting every three weeks shows higher P concentration in apical tissue of Verano compared with those in uncut plants (Wilaipon et al., 1981).

2.9 Seed production potential

English *et al.* from their unpublished data reported by Hopkinson and Walker (1984) found that from one ha of Verano crop 8.72 $\pm$ 0.52 q ha^{-1} of seed could be collected by hand harvest. The amount of shattered seed would be 8.91 $\pm$ 0.42 q ha^{-1}. Whereas from machine harvest 8.0 q ha^{-1} of seed yield could be obtained. Rai and Patil (1986) reported maximum yield of *S. hamata* and *S. humilis* to be 1.55 q ha^{-1} and 1.40 q ha^{-1} respectively at Jhansi under rainfed condition. They also recorded production of 5.82 q ha^{-1} 3.68 q ha^{-1} and 3.08 q ha^{-1} of seed from *S. hamata*, *S. scabra* and *S. humilis* respectively. Sharma (1985) got 1.33 q of seed ha^{-1} in Western Rajasthan of India during the year 1976.

Agishi and Asare (1980) reported that yield from hand harvested seed ranges from 6.0 to 17.50 q ha^{-1}. Seed yields are reduced when plants age and population declines or when water and nutrients become limiting during seed formation (Argel, 1979). He also reported the possibility of presence of an inhibitor in the pod or testa which restrict germination.

2.10 Summary and future scope of work

It may be concluded that *S. hamata* cv. Verano has great potentiality to be cultivated as a pasture legume in India. Experiments conducted in the new alluvial soils of West Bengal showed good growth and profuse flowering.

A good amount of work on different species of *Stylosanthes* has been reported from Australia. Many of the research centres in India obtained seeds from CSIRO, Australia and acclaimed their performance. This has created great demand for seeds. But not much work has been done to evaluate the seed production potentiality of *Stylosanthes*, more particularly of *S. hamata* cv. Verano which has shown great promise in this country. *S. hamata* cv. Verano has been reported to be a short day plant. This provides a good scope for this crop to produce good amount of seeds in the dry winter months (November-December), when there is sufficient moisture in the soil. Further, Australian work has shown that seed establishment, fertilization and defoliation effect seed production of the pasture legumes like Verano appreciably. Thus, there is great scope to do some, systematic work on seed production aspect of Verano earlier not done in India, more particularly in the Eastern region of India with a clear wet summer and dry winter, in the well formed deep alluvial soils of West Bengal, where a good amount of moisture is available in the soil profile.

CHAPTER 3

MATERIALS AND METHODS

3. MATERIALS AND METHODS

Four sets of experiments were designed to evaluate the seed yield potentiality of the Carribean stylo cv. Verano under different treatments, methods of establishment, cutting intervals and phosphatic fertilisation during the years from 1984 to 1987 at the Central Research Farm, Gayeshpur of Bidhan Chandra Krishi Viswavidyalaya, West Bengal.

3.1 Experimental site

The Central Research Farm is situated at 23^{O}N latitude, 89^{O}E longitude and at an altitude of 9.75 m above mean sea level.

3.2 Experimental soil

The soil of the experimental field is alluvial and sandy loam in texture and is classified under the broad group of entisol. The physico-chemical properties of the experimental soil have been summarized in Table 3.1.

Table 3.1 Physico-chemical properties of soil (0 - 15 cm depth) of the experimental site

Clay %	Silt %	Sand %		Total N %	Available P_2O_5 (q ha^{-1})	Available K_2O (q ha^{-1})	pH
		Fine	Coarse				
20.2	34.0	34.5	6.8	0.068	0.22	1.52 to 1.55	6.8

3.3 Climatic condition

The climate of the zone is broadly classified as sub-tropical and sub-humid as it is situated just near the Tropic of Cancer. The cropping seasons of the region are broadly classified as -

i) Dry and hot (March to May),

ii) Warm and wet (June to September) and

iii) Cool and dry (October to February).

The average long term annual rainfall is 1450 mm. The bulk of rainfall is received between June and September. Relative humidity is generally high during this period. Experimental crops received 1145.0, 972.9, 1673.5 and 1646.6 mm of annual rainfall during the year 1984, 1985, 1986 and 1987, respectively.

The average maximum humidity recorded in different years were 95.9 % in September, 1984, 81 % in November, 1985, 90 % in October, 1986, and 85.3 % in October, 1987. The average day lengths including twilight interpolated in different months of the year have been summarised in Table 3.2.

Table 3.2 Average day lengths including twilight

Jan.		Feb.		Mar.		Apr.		May		Jun.	
h	m	h	m	h	m	h	m	h	m	h	m
11	44	12	13	12	48	13	30	14	20	14	20
Jul.		**Aug.**		**Sep.**		**Oct.**		**Nov.**		**Dec.**	
h	m	h	m	h	m	h	m	h	m	h	m
14	09	13	40	12	58	12	22	11	49	11	36

Details of the climatic condition pertaining to the period of experimentation (1984 to 1987) as recorded at the Meteorological observatory, located at Kalyani, Bidhan Chandra Krishi Viswavidyalaya, West Bengal have been presented in Table 3.3.

3.4 Cropping history of the experimental field

Previous crops grown in the experimental site usually consisted of pulses like chickpea, lentil and cowpea. During the year 1983, Carribean stylo cv. Verano was cultivated for the development of the desired Rhizobial bacteria in the experimental site.

3.5 Experimental details

3.5.1 Experiment no. 1a

Studies on the effect of two methods of crop establishment (Broadcasting v . line sowing at 40 cm apart rows),

Table 3.3 Meteorological Data (Pertaining to the years of Experimentation)

Month	LTA	Maximum Temp. (^{o}C)				LTA	Minimum Temp. (^{o}C)				LTA
		1984	1985	1986	1987		1984	1985	1986	1987	
Jan	25.4	24.3	27.0	23.4	25.8	9.9	12.1	12.1	13.8	11.4	7.6
Feb	27.8	28.9	29.0	28.1	29.6	13.2	14.8	14.6	15.6	15.1	7.9
Mar	32.9	34.9	35.5	33.9	30.7	19.9	20.7	23.7	20.6	19.8	23.4
Apr	36.8	35.5	40.5	35.0	36.1	23.9	24.7	23.5	23.3	22.7	62.3
May	36.4	35.1	42.0	34.8	36.6	25.1	27.1	20.0	25.2	24.1	102.6
Jun	36.6	35.9	34.5	34.0	35.3	25.0	28.2	21.0	27.7	26.2	274.3
Jul	32.3	30.0	32.5	31.8	32.4	26.7	29.2	25.0	26.5	25.3	285.6
Aug	32.6	32.7	31.5	33.7	32.6	24.7	25.7	24.0	26.7	25.7	291.1
Sep	32.7	32.6	32.5	31.0	31.9	25.5	25.4	25.0	24.9	26.3	272.2
Oct	30.2	32.4	30.5	31.0	35.0	23.8	24.3	23.5	22.2	23.3	114.7
Nov	29.4	30.4	30.1	30.1	32.7	16.1	18.2	18.6	16.5	12.7	17.2
Dec	25.9	27.1	27.5	27.0	28.5	11.2	11.3	12.3	14.6	8.7	3.2

LTA = Long Term Average (monthly mean of 25 years from 1963 to 1987 collected from Alipore Meteorological Station, Calcutta).

Table 3.3 (contd.)

Month	Rainfall (mm)				LTA	Max. Relative Humidity (%)				Min. Relative Humidity (%)				LTA
	1984	1985	1986	1987		1984	1985	1986	1987	1984	1985	1986	1987	
Jan	22.2	19.6	11.7	-	52.1	86.2	85.3	83.0	84	34.3	48.5	49	40	356
Feb	-	9.7	3.6	50.0	53.0	80.8	80.0	78	83	25.3	42.4	40	38	423
Mar	21.8	-	3.6	27.6	65.4	92.7	81.1	82	84	21.4	46.2	26	40	490
Apr	-	9.9	31.2	140.6	69.7	91.1	80.0	84	84	43.1	24	28	44	535
May	76.9	61.6	185.4	142.8	65.1	90.8	70	82	83	53.8	38	54	55	550
Jun	297.7	240.5	284.5	190.6	77.0	88.6	72	87	86	66.2	42	68	63	423
Jul	161.8	192.1	263.4	265.6	79.3	90.2	78	88	90	69.1	50	74	77	389
Aug	368.9	214.6	138.2	487.4	84.2	92.6	75	87	89	68.4	50	67	77	376
Sep	188.2	141.7	452.0	525.9	84.6	95.9	69	89	95.3	58.2	44	72	67.5	379
Oct	123.4	117.6	144.8	24.8	80.6	95.8	70	90	88.5	51.4	50	61	55.8	386
Nov	0.2	Nil	198.2	1.0	68.3	91.2	81	87	89.0	26.0	36	42	67.0	377
Dec	4.8	4.8	7.0	8.5	59.8	88.2	80	83	82.6	36.3	36	46	58.5	355

cutting regime and phosphatic fertilization on seed production of Carribean stylo cv. Verano.

Objectives:

(i) To find out the effect of broadcasting and line sowing with or without cutting at 60-62 days after mean seeding emergence date with or without application of phosphatic fertilizer on floral development and seed production of Verano, and

(ii) To find out the herbage production under two methods of crop establishment, cutting and fertilizer management as stated above.

3.5.1.1 Design: 2^3 factorial

3.5.1.2 Plot size: 5 m x 4 m = 20 sqm

3.5.1.3 Replication: 4

3.5.1.4 Treatments

(i) $S_bC_0F_0$: Broadcast sowing with no cutting and no phosphatic fertilization,

(ii) $S_bC_0F_{80}$: Broadcast sowing with no cutting and 80 kg P_2O_5 ha^{-1},

(iii) $S_bC_1F_0$: Broadcast sowing with one cutting at 60 days after mean seedling emergence date without phosphatic fertilizer application,

(iv) $S_bC_1F_{80}$: Broadcast sowing with one cutting at 60 days and fertilized with 80 kg P_2O_5 ha^{-1},

(v) $S_{40}C_0F_{80}$: Sowing in lines 40 cm apart with no cutting and no phosphatic fertilization,

(vi) $S_{40}C_0F_{80}$: Sowing in lines 40 cm apart with no cutting and fertilizer application @ 80 kg P_2O_5 ha^{-1},

(vii) $S_{40}C_1F_0$: Sowing in lines 40 cm apart with single cutting at 60 days without application of phosphatic fertilizer and

(viii) $S_{40}C_1F_{80}$: Sowing in lines 40 cm apart with single cutting at 60 DAMSE with application of 80 kg P_2O_5 ha^{-1}.

3.5.2 Experiment No. 1b

Studies on the effect of two methods of crop establishment (Broadcasting and line sowing in 60 cm rows apart), cutting regime and phosphatic fertilization on seed production of Carribean stylo cv. Verano.

Objectives

The objectives were similar to those of Experiment No. 1a. To measure the effect of wide rows apart in seed production, keeping the other treatments constant, this experiment was conducted for two years 1984 and 1985 and has been designated as Experiment no. 1b 1984 and 1b 1985.

3.5.2.1 Treatments: Same as in 1a except sown at 60 cm apart as against broadcast s and layout of the experiment were similar 1a.

In the crop established through bro difficult to enter the plots for intercult like seeding and thinning and also to reco observation. It was for this reason, in s ments line sowing was resorted to as again sowing for convenience, including sweeping collection of seed for yield estimation.

3.5.3 Experiment no. 1c

Studies on the effect of crop estab different row spacings under different cut fertilizer management treatments.

Objectives:

The objectives remained similar to Experiment no. 1a.

3.5.3.1 Treatments: The crop was establis spacings viz., 20 and 40 cm apart.

The design, layout and other detail those described in Experiment no. 1a.

PLATE 1 *Stylosanthes hamata* cv. Verano in flower during September 1987. Experiment No. 1c.

PLATE 2 Growth of broadcast Verano at 30 DAMSE (30 days after mean seedling emergence date) 1985.

The experiments here were designated as Experiment no. 1c - 1985, 1c - 1986 and 1c - 1987.

3.5.4 Experiment no. 1d

Studies on the effect of two methods of crop establishment (under two different row spacings), cutting regi and fertilizer management treatments on seed production po tial of stylo cv. Verano. This experiment was conducted f two years 1986 and 1987 and designated as Experiment no. 1 1986 and 1d - 1987.

Objectives:

Objectives of this experiment was similar to those of earlier experiments. To assess the seed production potential under wider row-spacings this experi ment was taken up considering the convenience of better management i.e. intercultural operation, harvesting, sweeping etc.

3.5.4.1 Treatments: Similar to Experiment no. 1c except row spacings were 40 and 60 cm apart as against 20 and 40 apart.

The design, lay out were similar to Experiment no.

3.6 Establishment of experimental crops

3.6.1 Land preparations

Land was prepared by ploughing and harrowing follow

PLATE 3 Growth of 40 cm row-spaced C. stylo at 21 DAMSE (21 days after mean seedling emergence date), 1986.

PLATE 4 Growth of 60 cm row-spaced C. stylo at 21 DAMSE (21 days after mean seedling emergence date), 1986

by rotovating bringing the soil into a fine tilth. The field was cleaned by removing exposed stubbles and weeds manually. Finally the plots were uniformly levelled by planking.

3.6.2 Seed treatment

Seeds of *S. hamata* cv. Verano having 10 % soft seed coat, were treated with concentrated sulphuric acid for 5 minutes. After thorough washing in clean water, the pods were air dried in shade and were sown in the experimental plots every year.

3.6.3 Seed rate

Seed rate of 3 kg ha^{-1} was used.

3.6.4 Fertilization

At the time of sowing all the plots received fertilizer @ 20 kg N and 40 kg K_2O ha^{-1} in the forms of urea and muriate of potash, Phosphatic fertilizer in the form of single super phosphate was applied as per treatments, at the time of sowing in addition to N and K applied. Treatment with 0 kg P_2O_5 ha^{-1} has been designated as unfertilized, and treatment with 80 kg P_2O_5 ha^{-1} as fertilized.

3.6.5 Sowing

The experimental crops were sown in the month of April except in the year 1984, taking the advantage of the rain received through Nor-Wester wind. Subsequently, the crops were irrigated once before the onset of usual monsoon rain.

3.7 Management of the crop

Thinning was done at the time of first weeding 15 days after the mean seedling emergence (DAMSE). Plant population was always maintained at the rate of 100 $\pm$ 15 m^{-2} in all the experiments in all the years. Second Weeding (except broadcast crop - not possible to effect weeding) was given 30 days after the mean seedling emergence date to keep the crop weed free.

3.8 Recording of bio-metrical observations

3.8.1 Measurement of plant height and recording of number of primary, secondary and tertiary branches

Height of 5 plants of cv. Verano were randomly measured from the ground level in all the treatments at 30 days interval from 1st week of July to 1st week of October in each year.

For measuring the primary branches two observations before and after cutting of the plants were recorded. Secondary branches were counted from 1st week of July to 1st week of October every year. For tertiary branches one observation during the October was recorded every year except in 1a experiment in 1984.

3.8.2 Herbage yield assessment

The experimental plot (20 sq m each) was further equally devided into two portions. One portion was ear-marked for destructive sampling and the other was utilized for recording biometrical observations.

The plants were cut at an height of 20 cm above the ground level 60 - 62 days after the mean seedling emergence date manually from m^{-2} area in all the plots from the portion reserved for destructive sampling. As per the treatments plants were also cut at the same height of 20 cm above the ground level on the same day i.e. 60 - 62 days after mean seedling emergence date. The weight of the samples were taken in the field. About 200 gm samples was taken to the laboratory for drying in a hot air oven at a temperature of 80°C for 8 to 10 hours till constant weights were obtained.

3.8.3 No. of inflorescences m^{-2}, number of florests inflorescence^{-1} and number of seeds set floret^{-1}

Flowering of cv. Verano generally started 56 to 59 days after mean seedling emergence date (DAMSE) although all plants do not flower synchronously. The main flush of flowering usually commenced from October onwards after ceasation of monsoon rain and a dip in temperature on the onset of winter months. Number of inflorescences were counted m^{-2} area fixed for counting branches at an interval of 15 days from 30 Sept. - 1 October to 15 December. Number of florets inflorescence^{-1} and number of seeds set floret^{-1} were counted from the randomly selected 100 inflorescences before the crop was harvested for assessing the seed yield.

3.8.4 Test weight of seed

One thousand seeds were counted from all the treatment combinations in each harvest and placed in the oven for drying at 60°C for measurement of test weight.

3.8.5 Assessment of seed production

Regular observations on the state of maturity of seeds were made. To assess the correct stage of harvesting, the crop was harvested at weekly intervals starting between mid-December and end of December.

As and when sufficient number of seeds matured first harvesting was made from 1 m x 1 m area demarcated for yield estimation. Second and final harvesting were done in the 7 - 8 days after the first and second samplings, respectively. After the final harvesting by the end of December, seeds left on the ground in each plot were collected through sweeping for estimation of the final yield. During the year 1987 the last harvest was made in the first week of January 1988 in experiment no. 1c and during the year 1984 in 1a experiment two harvestings were made with an interval of 10 days.

Generally harvesting was carried out in the early morning hours, to avoid too much shattering of seeds. Materials after each harvest were placed on the tarpaulins and dried properly. Then threshing was done by beating with stick. The collected seeds were cleaned manually and dried for few days in the sun. The highest seed yields obtained each year was calculated by adding harvested yield (highest quantity produced by cutting plants) and the sweeping collection made from unit area of the ground.

3.9 Method of statistical analysis

The results were subjected to the analysis of variance method as described by Panse and Sukhatme (1967). For comparison 'F' value and determination of critical difference at 5 % levels of significance, tables of Fisher and Yates were consulted.

The standard error of means (S. Em $\pm$) and the critical difference (C.D. at 5 %) values have been provided in the tables of results to compare the differences between the mean values.

CHAPTER 4

RESULTS

4. RESULTS

Seed production components of *S. hamata* as influenced by methods of establishment, cutting management and phosphorus fertilization were studied during the years from 1984 to 1987 as described under materials and methods. The results have been described and compared individually and collectively in this chapter.

Owing to uneven germination of *Stylosanthes*, the mean seedling emergence date has been referred to as 0 day and subsequent age of the crop as expressed DAMSE in the context, has been calculated with reference to 0 day, as the basis.

4.1 Experiment no. 1a

It was conducted in the year 1984 to find out the seed yield potentiality of *Stylosanthes hamata* cv. Verano under two methods of establishments broadcast sowing and line sowing in 40 cm apart rows, two cutting managements viz., no cut and cut at day 60-DAMSE (day after mean seedling emergence) and two levels of phosphatic fertilizer viz., 0 kg and 80 kg P_2O_5 ha^{-1}.

4.1.1 Plant height

Plant population was maintained at 100 $\pm$ 15 m^{-2}. The growth of the crop was fairly good.

4.1.1.1 Effect of spacing : Line sown crops had always significantly higher plant height than that of broadcast crops (Table 4.1). At 21 DAMSE, the plant heights in broadcast and line sown crops were 13.3 and 13.8, while at 55 DAMSE they were 32.2 and 36.0 and at 80 DAMSE were 40.3 and 46.5 cm (Table 4.1).

4.1.1.2 Effect of cutting : Cutting or defoliation had significant effect on plant height (Table 4.2). At 80 DAMSE the plant heights were 55.0 and 31.7 cm in uncut and cut (defoliated) crops respectively.

4.1.1.3 Effect of phosphatic fertilizer : Except at 21 DAMSE fertilized (P_{80}) crop was significantly taller than the unfertilized (P_0) crop (Table 4.3). At 55 DAMSE the plant heights in fertilized (P_{80}) and unfertilized (P_0) crops were 33.2 and 35.0 cm while at 80 DAMSE were 42.3 and 44.5 cm respectively.

4.1.2 Number of primary branches m^{-2}

4.1.2.1 Effect of spacing : On two occasions primary branches m^{-2} were recorded. In 40 cm row spaced crop number of primary branches were significantly more than those in broadcast crop at 60 and 90 DAMSE (Table 4.4). The number of primary branches in line sown and broadcast crops at 60 DAMSE were 776 and 699 m^{-2} respectively; the corresponding figures at 90 DAMSE were 1010 and 872 m^{-2}.

Table 4.1 Effect of spacing on plant height in cm (Experiment no. 1a - 1984)

Timing of observation	Methods of sowing: Broadcast	Methods of sowing: Row spacing (40 cm)	S.Em ±	CD at 5%
5.7.84 (21 DAMSE)	13.3	13.8	0.13	0.39
9.8.84 (55 DAMSE)	32.2	36.0	0.17	0.49
3.9.84 (80 DAMSE)	40.3	46.5	0.14	0.42

Table 4.2 Effect of cutting on plant height in cm (Experiment no. 1a - 1984)

Timing of observation	Cutting Management: No cut	Cutting Management: Cut at 60 DAMSE	S.Em ±	CD at 5%
5.7.84 (21 DAMSE)	13.6	13.5	0.13	NS
9.8.84 (55 DAMSE)	34.3	33.9	0.17	NS
3.9.84 (80 DAMSE)	55.0	31.7	0.14	0.42

Table 4.3 Effect of phosphatic fertilization on plant height in cm (Experiment no. 1a - 1984)

Timing of observation	P_2O_5 (kg ha^{-1})		S.Em ±	CD at 5 %
	0	80		
5.7.84 (21 DAMSE)	13.2	13.8	0.13	NS
9.8.84 (55 DAMSE)	31.2	35.0	0.17	0.49
3.9.88 (80 DAMSE)	42.3	44.5	0.14	0.42

Table 4.4 Effect of spacing on number of primary branches m^{-2} (Experiment no. 1a - 1984)

Timing of observation	Methods of sowing		S.Em ±	CD at 5 %
	Broadcast	Row spacing (40 cm)		
14.8.84 (60 DAMSE)	699	776	4.21	12.39
13.9.84 (90 DAMSE)	872	1010	10.59	31.15

4.1.2.2 Effect of cutting : As expected, before the imposition of cutting treatment no significant difference in primary branch number was recorded; but at 90 DAMSE uncut treatment had significantly higher (Table 4.5) number of branches (1252 m^{-2}) than cut treatment (630 m^{-2}).

4.1.2.3 Effect of phosphatic fertilizer : Fertilized (P_{80}) crop produced significantly greater number of primary branches both at 60 and 90 DAMSE than those in the unfertilized (P_0) crop. The number of primary branches in the unfertilized and fertilized crops were 723 and 753 m^{-2} respectively at 60 DAMSE; the corresponding figures were 922 and 960 at 90 DAMSE (Table 4.6).

4.1.3 Number of secondary branches m^{-2}

Number of secondary branches not only determined the dry matter accumulation of plants, but also influenced the number of bud sites, and floral spikes which invariably influenced the seed production potential.

4.1.3.1 Effect of spacing : At 60 DAMSE no significant differences was recorded between broadcast and line sown crops, but at 90 DAMSE line sown crop (40 cm row-spaced) had significantly higher number of secondary branches (2050 m^{-2}) than that of the broadcast crop (1945 m^{-2}) (Table 4.7).

Table 4.5 Effect of cutting on number of primary branches m^{-2} (Experiment no. 1a - 1984)

Timing of observation	Cutting management: No cut	Cutting management: Cut at 60 DAMSE	S.Em ±	CD at 5 %
14.8.84 (60 DAMSE)	740	736	4.21	NS
13.9.84 (90 DAMSE)	1252	630	10.59	31.15

Table 4.6 Effect of phosphatic fertilization on number of primary branches m^{-2} (Experiment no. 1a - 1984)

Timing of observation	P_2O_5 (kg ha^{-1}): 0	P_2O_5 (kg ha^{-1}): 80	S.Em ±	CD at 5 %
14.8.84 (60 DAMSE)	723	753	4.21	12.39
13.9.84 (90 DAMSE)	922	960	10.59	31.15

Table 4.7 Effect of spacing on number of secondary branches m^{-2} (Experiment no. 1a - 1984)

Timing of observation	Methods of sowing		S.Em ±	CD at 5 %
	Broadcast	Row spacing (40 cm)		
14.8.84 (60 DAMSE)	1540	1732	22.8	67.06
13.9.88 (90 DAMSE)	1945	2050	72.7	NS

Table 4.8 Effect of cutting on number of secondary branches m^{-2} (Experiment no. 1a - 19884)

Timing of observation	Cutting management		S.Em ±	CD at 5 %
	No cut	Cut at 60 DAMSE		
14.8.84 (60 DAMSE)	1604	1668	22.8	NS
13.9.88 (90 DAMSE)	2652	1343	72.7	213.71

4.1.3.2 Effect of cutting : At 60 DAMSE before cutting, no significant differences in secondary branch number was visible (Table 4.8); but at 90 DAMSE uncut treatment had significantly higher number of secondary branches (2652 m^{-2}) than that of cut treatment (1343 m^{-2}).

4.1.3.3 Effect of phosphatic fertilizer : At 60 DAMSE fertilized (P_{80}) crop showed significantly higher number of secondary branches (1717 m^{-2}) than that of the unfertilized (P_0) crop (1556 m^{-2}); but at 90 DAMSE no significant difference was noticed (Table 4.9).

4.1.4 Dry matter accumulation g m^{-2}

To find out the dry matter accumulation potentiality of Stylosanthes hamata cv. Verano, three samplings were recorded, 1st at 60 DAMSE, 2nd at 120 DAMSE and 3rd at 183 DAMSE.

4.1.4.1 Effect of spacing : On three counts dry matter accumulation were recorded in 1984. In all the observations row spaced (40 cm) crop showed significantly higher amount of dry matter accumulation than broadcast crops. 349.0 and 384.7 g at 60 DAMSE; 381.8 and 440.2 g at 120 DAMSE and 509.0 and 569.9 g (Table 4.10) at 183 DAMSE were the dry matter yield m^{-2} in broadcast and line sown crop respectively.

Table 4.9 Effect of phosphatic fertilization on number of secondary branches m^{-2} (Experiment no. 1 a - 1984)

Timing of observation	P_2O_5 (kg ha^{-1}) 0	80	S.Em ±	CD at 5 %
14.8.84 (60 DAMSE)	1556	1717	22.8	67.06
13.9.88 (90 DAMSE)	1967	2028	72.2	NS

Table 4.10 Effect of spacing on dry matter accumulation of plants g m^{-2} (Experiment no. 1a - 1984)

Time of observation	Methods of sowing		S.Em ±	CD at 5 %
	Broadcast	Row spacing (40 cm)		
14.8.84 (60 DAMSE)	349.0	384.7	3.73	10.98
13.10.84 (120 DAMSE)	381.8	440.2	3.11	9.15
14.12.84 (183 DAMSE)	509.0	569.9	7.83	23.04

4.1.4.2 Effect of cutting : In the year 1984 except at 120 DAMSE, no significant difference in dry matter accumulation was recorded between uncut and cut treatments.

Before cutting at 60 DAMSE, 363.2 and 370.6 g m^{-2} were the dry herbage accumulated. But at 120 DAMSE the dry matter yields were 458.3 and 363.7 g m^{-2} (Table 4.11) and these differed significantly. At 183 DAMSE, though the dry matter accumulation was more, but no significant difference was noticed between the two methods of sowing.

4.1.4.3 Effect of phosphatic fertilizer : Phosphatic fertilizer (P_{80}) increased the dry matter accumulation significantly in all the observations over the unfertilized (P_0) crops. 362.0 and 371.8 g, 402.3 and 419.7 g and 525.8 and 553.2 g (Table 4.12) were the dry matter accumulation m^{-2} at 60, 120 and 183 DAMSE in P_0-fertilized and P_{80}-fertilized crops respectively.

4.1.5 Number of inflorescences m^{-2}

4.1.5.1 Effect of spacing : Four countings of number of inflorescences m^{-2} were recorded starting from 2 Oct to 28 Nov. At 110 DAMSE line sown (40 cm) crop produced significantly more number of inflorescences (296 m^{-2}) than broadcast crop (248 m^{-2}). At 137 and 167 DAMSE similar were the trend of variation (Table 4.13). Inflorescence number m^{-2} recorded at 137 DAMSE were 1562 and 1697 m^{-2} and at 167

Table 4.11 Effect of cutting on dry weight of plants g m^{-2} (Experiment no. 1a - 1984)

Timing of observation	Cutting management		S.Em ±	CD at 5 %
	No cut	Cut at 60 DAMSE		
14.8.84 (60 DAMSE)	363.2	370.6	3.73	NS
13.10.84 (120 DAMSE)	458.3	363.7	3.11	9.15
14.12.84 (183 DAMSE)	545.7	533.2	7.83	NS

Table 4.12 Effect of phosphatic fertilizer application on dry matter accumulation of plants g m^{-2} (Experiment no. 1a - 1984)

Timing of observation	P_2O_5 (kg ha^{-1})		S.Em ±	CD at 5 %
	0	80		
14.8.84 (60 DAMSE)	362.0	371.8	3.73	10.98
13.10.84 (120 DAMSE)	402.3	419.7	3.11	9.15
14.12.84 (183 DAMSE)	525.8	553.2	7.83	23.04

DAMSE 3501 and 3733 m^{-2} in broadcast and line sown crops respectively. But at 152 DAMSE no significant difference in number of inflorescence m^{-2} between the two methods of sowing was observed.

4.1.5.2 Effect of cutting : Cutting at 60 DAMSE influenced significantly the number of inflorescences at 110 and 137 DAMSE, but in subsequent countings at 152 and 167 DAMSE, no significant difference in number of inflorescence was evident. The highest number of inflorescences m^{-2} counted at 167 DAMSE were 3695 and 3539 m^{-2} (Table 4.14) from uncut and cut treatments respectively.

4.1.5.3 Effect of phosphatic fertilizer : Except at 110 DAMSE in the three subsequent countings at 137, 152 and 167 DAMSE, the number of inflorescences was significantly higher in fertilized (P_{80}) than unfertilized (P_0) crops. The number of inflorescences in unfertilized and fertilized crops were 1541 and 1717 m^{-2} at 137 DAMSE, 2470 and 2918 m^{-2} at 152 DAMSE and 3392 and 3842 at 167 DAMSE respectively (Table 4.15).

4.1.6 Test weight of seed in g

Test weight of seed is one of the determining factor in seed yield. From each harvest seeds were collected and dried to find out the test weight of seed.

Table 4.13 Effect of spacing on number of inflorescences m^{-2} (Experiment no. 1a - 1984)

Timing of observation	Methods of sowing: Broadcast	Methods of sowing: Row spacing (40 cm)	S.Em ±	CD at 5 %
2nd Oct (110 DAMSE)	248	296	11.88	34.94
29 Oct (137 DAMSE)	1562	1697	20.87	61.38
13 Nov (152 DAMSE)	2698	2690	64.44	NS
28 Nov (167 DAMSE)	3501	3733	68.71	202.14

Table 4.14 Effect of cutting on number of inflorescences m^{-2} (Experiment no. 1a - 1984)

Timing of observation	Cutting management: No cut	Cutting management: Cut at 60-61 DAMSE	S.Em ±	CD at 5 %
2 Oct (110 DAMSE)	387	157	11.87	34.94
29 Oct (137 DAMSE)	1977	1282	20.87	61.38
13 Nov (152 DAMSE)	2742	2645	64.44	NS
28 Nov (167 DAMSE)	3695	3539	68.72	NS

4.1.6.1 Effect of spacing : In both the observations at 183 and 193 DAMSE, row spaced crop produced significantly higher 1000 seed weight than the broadcast sown crop. At 183 DAMSE the test weights were 2.60 and 2.63 g in the broadcast and row sown crops; the corresponding figures at 193 DAMSE were 2.57 and 2.62 g (Table 4.16).

4.1.62 Effect of cutting : Cutting did not influence significantly test weight of seeds (Table 4.17).

4.1.6.3 Effect of phosphatic fertilizer : Both at 183 and 193 DAMSE, phosphatic fertilizer (P_{80}) had significantly increased 1000 seed weight. At 183 DAMSE the seed weights in unfertilized (P_0) and fertilized treatment were 2.60 and 2.63 g per 1000 seeds respectively and the corresponding figures at 193 DAMSE were 2.57 and 2.61 g per 1000 seeds (Table 4.18).

4.1.7 Seed yield g m^{-2}

Experiment no. 1a was carried out only in 1984 to find out the effect of two methods of sowing, broadcasting and line sowing in 40 cm apart rows, two cutting treatments and two levels of phosphatic fertilizer on seed production of *Stylosanthes hamata* cv. Verano.

Table 4.15 Effect of phosphatic fertilizer on number of inflorescences (Experiment no. 1a - 1984)

Timing of observation	P_2O_5 (kg ha^{-1})		S.Em ±	CD at 5 %
	0	80		
2 Oct (110 DAMSE)	264	279	11.88	NS
29 Oct (137 DAMSE)	1541	1717	20.87	61.38
13 Nov (152 DAMSE)	2470	2918	64.44	189.56
29 Nov (167 DAMSE)	3392	3842	68.72	202.14

Table 4.16 Effect of spacing on 1000 seed weight in g (Experiment no. 1a - 1984)

Timing of observation	Methods of sowing		S.Em ±	CD at 5 %
	Broadcast	Row spacing (40 cm)		
14 Dec (183 DAMSE)	2.60	2.63	0.008	.002
24 Dec (193 DAMSE)	2.57	2.62	0.004	.001

Table 4.17 Effect of cutting on 1000 seed weight in g (Experiment no. 1a - 1984)

Timing of observation	Cutting management: No cut	Cutting management: Cut at 60 DAMSE	S.Em ±	CD at 5 %
14 Dec (183 DAMSE)	2.61	2.61	.008	NS
24 Dec (193 DAMSE)	2.59	2.60	.004	NS

Table 4.18 Effect of phosphatic fertilization on 1000 seed weight in g (Experiment No. 1a - 1984)

Timing of observation	P_2O_5 (kg ha^{-1}): 0	P_2O_5 (kg ha^{-1}): 80	S.Em ±	CD at 5 %
14 Dec (183 DAMSE)	2.60	2.63	.008	.002
24 Dec (193 DAMSE)	2.57	2.61	.004	.001

4.1.7.1 Effect of spacing : Two harvests for seed collection were made in the year 1984 one on 14 Dec i.e. at 183 DAMSE and another on 24 Dec i.e. at 193 DAMSE. In both the harvests, line sown crops gave significantly higher seed yield m^{-2} than broadcast crops. At 183 DAMSE, the yields were 31.8 and 39.94 g m^{-2} from broadcast and line sown crops respectively; correspondingly yields at 193 DAMSE were 39.14 and 44.12 g m^{-2} which were higher than those of first harvest made at 183 DAMSE (Table 4.19).

4.1.7.2 Effect of cutting : Uncut treatments produced significantly higher seed yield (37.74 g m^{-2}) than cut treatments (34.01 g m^{-2}) at 183 DAMSE. But no significant difference in seed yield was noticed at 193 DAMSE between two methods of sowing, although the harvested seeds yields were numerically higher than those of first harvest made at 183 DAMSE (Table 4.20).

4.1.7.3 Effect of phosphatic fertilization : In both the harvests made at 183 and 193 DAMSE, phosphatic fertiliser (P_{80}) significantly increased the seed yield. The seed yields in unfertilized (P_0) and fertilized (P_{80}) crops were 33.22 and 38.52 g m^{-2} at 183 DAMSE respectively; the corresponding figures at 193 DAMSE were 39.95 and 45.32 g m^{-2} (Table 4.21).

Table 4.19 Effect of spacing on seed yield g m^{-2} (Experiment no. 1a - 1984)

Timing of observation	Methods of sowing		S.Em ±	CD at 5 %
	Broadcast	Row spacing (40 cm)		
14 Dec (183 DAMSE)	31.80	39.94	0.99	2.91
24 Dec (193 DAMSE)	39.14	44.12	0.47	1.40
Mean	35.47	42.03	0.73	2.15

Table 4.20 Effect of cutting on seed yield g m^{-2} (Experiment no. 1a - 1984)

Timing of observation	Cutting management		S.Em ±	CD at 5 %
	No cut	Cut at 60 DAMSE		
14 Dec (183 DAMSE)	37.74	34.01	0.99	2.91
24 Dec (193 DAMSE)	41.43	41.84	0.47	NS
Mean	39.59	37.93	0.73	NS

Table 4.21 Effect of phosphatic fertilizer applicaton on seed yield g m^{-2} (Experiment no. 1a - 1984)

Timing of observation	P_2O_5 (kg ha^{-1}) 0	80	S.Em ±	CD at 5 %
14 Dec (183 DAMSE)	33.22	38.52	0.99	2.91
24 Dec (193 DAMSE)	39.95	45.32	0.47	2.40
Mean	36.59	41.92	0.73	2.15

At this stage another important thing noted was that quite a good amount of seed fell on the ground surface and in the broadcast crop it was difficult to collect through sweeping. So, in future experiments, the treatment of broadcast sowing was dropped and the productivity of *Stylosanthes* cv. Verano was evaluated from two different sets of experiments, one in which 20 cm was compared with 40 cm row spacing and in another experiment 40 cm row spaced crop was compared with 60 cm row spacing.

4.2 Experiment No. 1b

In 1 b experiment where the growth and productivity of Carribean stylo cv. Verano were analysed for two methods of sowing, two cutting treatments and two levels of phosphatic fertilizer, the crop growth was fairly good.

4.2.1 Crop height

4.2.1.1 Effect of spacing : There is a considerable increase in plant height in case of row-spaced (60 cm) crop than broadcast sown crop. For broadcast sown crop the height attained was 31.6 cm at 60 DAMSE (day after mean seedling emergence date) and 74.4 cm at 150 DAMSE whereas in row spaced crop it was 36 cm at 60 DAMSE and 91 cm at 150 DAMSE. Plant height increased from the month of July to first week of October as the temperature and rainfall were conducive for good vegetative growth. The average increases in plant height in 1985 sown crop (mean seedling emergence date 3.5.85) were 14, 22.4 and 23.5 cm from July to September, at 60, 120 and 150 DAMSE respectively. In 1984 sown crop (mean seedling emergence date 14.6.84) the heights were 10.3, 21.5 and 11.0 cm from August to October at 60, 120 and 150 DAMSE respectively (Table 4.22). Crop sown at 60 cm apart rows were significantly taller than broadcast crop.

4.2.1.2 Effect of cutting : As usual in the year 1984 and 1985, there were no significant difference in crop height between two methods of cutting at 60 (Table 4.23) DAMSE.

Uncut plants at later cuttings maintained better plant height than cut plants. Maximum height were obtained

Table 4.22 Effect of spacing on plant height in cm (Experiment no. 1b - 1984 and 1b - 1985)

Timing of observation	Year	Methods of sowing: Broadcast	Methods of sowing: Row spacing (60 cm)	S.Em ±	CD at 5 %
14.8.84 (60 DAMSE)	1984	31.6	36.0	0.28	0.82
2.7.85 (60 DAMSE)	1985	31.0	31.9	0;25	0.73
	Mean	31.3	34.0	0.27	0.78
13.9.84 (90 DAMSE)	1984	41.9	47.2	0.20	0.59
1.8.85 (90 DAMSE)	1985	43.0	45.9	0.30	0.89
	Mean	42.5	46.6	0.25	0.74
13.10.84 (120 DAMSE)	1984	63.4	73.8	0.42	1.25
31.8.85 (120 DAMSE)	1985	58.3	67.5	1.92	5.76
	Mean	60.9	70.7	1.17	3.46
12.10.84 (150 DAMSE)	1984	74.4	79.4	0.50	1.48
30.9.85 (150 DAMSE)	1985	71.1	91.0	1.27	3.74
	Mean	72.8	85.2	0.89	2.61

N.B. : Date of mean seedling emergence in 1984 - 14.6.84
Date of mean seedling emergence in 1985 - 3.5.85

Table 4.23 Effect of cutting on plant height in cm (Experiment no. 1b - 1984 and 1b - 1985)

Timing of observation	Year	Cutting management		S.Em ±	CD at 5 %
		No cut	Cut at 60 DAMSE		
14.8.84 (60 DAMSE)	1984	33.8	33.9	0.28	NS
2.7.85 (60 DAMSE)	1985	31.6	31.3	0.25	NS
	Mean	32.7	32.6	0.27	NS
13.9.84 (90 DAMSE)	1984	55.9	33.1	0.20	0.59
1.8.85 (90 DAMSE)	1985	58.3	30.2	0.30	0.89
	Mean	57.1	31.7	0.25	0.74
13.10.84 (120 DAMSE)	1984	77.7	59.6	0.42	1.25
31.8.85 (120 DAMSE)	1985	75.1	50.6	1.92	5.66
	Mean	76.4	55.1	1.17	3.46
12.11.84 (150 DAMSE)	1984	85.6	68.2	0.50	1.48
30.9.85 (150 DAMSE)	1985	86.5	75.8	1.27	3.74
	Mean	86.1	72.0	0.89	2.61

at 150 DAMSE (86.1 and 72.0 cm in uncut and cut treatments respectively).

4.2.1.3 Effect of phosphatic fertilizer : Phosphate fertilization (P_{80}) significantly increased plant height of cv. Verano which ranged from 34.6 cm at 60 DAMSE to 70.2 cm at 150 DAMSE in 1984. The corresponding figures in 1985 were 31 cm and 81.3 cm respectively (Table 4.24).

4.2.2 Number of primary branches m^{-2}

4.2.2.1 Effect of spacing : On two occasions primary branches were recorded. At 60 DAMSE in 1984, line sown crop had significantly higher mean number of primary branches (814 m^{-2}) than that of broadcast sown (754 m^{-2}) crop (Table 4.25). Similar effect was also recorded in 1985 at 60 DAMSE. At 120 DAMSE 1126 and 1381 m^{-2} in 1984 and 959 and 1160 m^{-2} in 1985 were primary branch number m^{-2} in broadcast and row spaced crops respectively.

4.2.2.2 Effect of cutting : Before cutting there was no significant difference in number of primary branches between uncut and cut treatments. But at 120 DAMSE in both the years uncut treatments had significantly higher number of primary branches than that in the cut treatment (Table 4.26); 1490 and 1018 in 1984, 1116 and 1003 in 1985 were the primary branches m^{-2} in the uncut and cut treatments, respectively.

Table 4.24 Effect of phosphatic fertilizer on plant height in cm (Experiment no. 1b - 1984 and 1b - 1985)

Timing of observation	Year	P_2O_5 (kg ha^{-1})		S.Em ±	CD at 5 %
		0	80		
14.8.84 (60 DAMSE)	1984	33.0	34.6	0.28	0.82
2.7.85 (60 DAMSE)	1985	31.0	31.9	0.25	0.73
	Mean	32.0	33.3	0.27	0.78
13.9.84 (90 DAMSE)	1984	42.1	47.0	0.20	0.59
1.8.85 (90 DAMSE)	1985	43.4	45.1	0.30	0.89
	Mean	42.8	46.1	0.25	0.74
13.10.84 (120 DAMSE)	1984	66.6	70.6	0.42	1.25
31.8.85 (120 DAMSE)	1985	60.8	65.0	1.92	NS
	Mean	63.7	67.8	1.17	3.46
12.11.84 (150 DAMSE)	1984	74.6	79.2	0.50	1.48
30.9.85 (150 DAMSE)	1985	80.1	81.3	1.27	NS
	Mean	77.4	80.3	0.89	2.61

Table 4.25 Effect of spacing on number of primary branches m^{-2}
(Experiment no. 1b - 1984 and 1b - 1985)

Timing of observation	Year	Methods of sowing: Broadcast	Methods of sowing: Row spacing (60 cm)	S.Em ±	CD at 5 %
14.8.84 (60 DAMSE)	1984	813	822	2.5	7.36
2.7.85 (60 DAMSE)	1985	695	805	5.8	16.98
	Mean	754	814	4.2	12.17
13.10.84 (120 DAMSE)	1984	1126	1381	7.3	21.42
31.8.85 (120 DAMSE)	1985	959	1160	23.0	67.63
	Mean	1043	1271	15.1	44.53

Table 4.26 Effect of cutting on number of primary branches m^{-2} (Experiment no. 1b - 1984 and 1b - 1985)

Timing of observation	Year	Cutting management		S.Em ±	CD at 5 %
		No cut	Cut at 60 DAMSE		
14.8.84					
(60 DAMSE)	1984	817	817	2.5	NS
2.7.85					
(60 DAMSE)	1985	751	749	5.8	NS
	Mean	748	783	4.2	NS
13.10.84					
(120 DAMSE)	1984	1490	1018	7.3	21.4
31.8.85					
(120 DAMSE)	1985	1116	1003	23.0	67.6
	Mean	1303	1011	15.1	44.5

4.2.2.3 Effect of phosphatic fertilizer : At 60 DAMSE in 1984, phosphatic fertilizer (P_{80}) had no significant effect in increasing number of primary branch, but in 1985 fertilized crops had significantly higher number of primary branches (766 m^{-2}) than unfertilized (P_0) crops (734 m^{-2}). At 120 DAMSE in both the years fertilized crops produced significantly more number of primary branches than unfertilized crops (Table 4.27).

4.2.3 Number of secondary branches m^{-2}

The secondary branches bear tertiary branches and all of them bear inflorescences. In 1b experiment secondary branches were counted from 60 DAMSE.

4.2.3.1 Effect of spacing : At 60 DAMSE in 1984, line sown crop had significantly higher (1877 m^{-2}) number of secondary branches than broadcast crop (1721 m^{-2}). In 1985, 1429 and 1477 were the secondary branch number m^{-2} from broadcast and line sown crop respectively and they did not differ significantly (Table 4.28).

At 90 DAMSE in 1984, secondary branch number between broadcast sown and line sown crop did not differ significantly whereas in 1985, 1013 and 2036 were the secondary branches m^{-2} in broadcast and line sown crops respectively and these were significantly different. At 120 DAMSE in

Table 4.27 Effect of phosphatic fertilizer on number of primary branches m^{-2} (Experiment no. 1b - 1984 and 1b - 1985)

Timing of observation	Year	P_2O_5 (kg ha^{-1})		S.Em ±	CD at 5 %
		0	80		
14.8.84 (60 DAMSE)	1984	815	819	2.6	NS
2.7.85 (60 DAMSE)	1985	734	766	5.8	16.98
	Mean	775	793	4.2	12.17
13.10.84 (120 DAMSE)	1984	1224	1283	7.3	21.42
31.8.85 (120 DAMSE)	1985	1025	1095	23.0	67.63
	Mean	1125	1189	15.1	44.53

Table 4.28 Effect of spacing on number of secondary branches m^{-2} (Experiment no. 1b - 1984 and 1b - 1985)

Timing of observation	Year	Methods of sowing		S.Em ±	CD at 5 %
		Broadcast	Row spacing (60 cm)		
14.8.84 (60 DAMSE)	1984	1721	1877	9.8	28.7
2.7.85 (60 DAMSE)	1985	1429	1477	19.4	NS
	Mean	1575	1677	14.6	NS
13.9.84 (90 DAMSE)	1984	2033	2260	76.2	NS
1.8.85 (90 DAMSE)	1985	1913	2036	35.5	164.2
	Mean	1973	2148	17.7	NS
13.10.84 (120 DAMSE)	1984	3249	3662	36.1	106.1
31.8.85 (120 DAMSE)	1985	3104	3783	95.1	279.7
	Mean	3177	3723	65.6	192.4
30.9.85 (150 DAMSE)	1985	4251	5350	80.5	236.8

both the years, 60 cm row - spaced crop produced significantly more number of secondary branches m^{-2} over broadcast crop; 3249 and 3662 m^{-2} in 1984, and 3104 and 3783 m^{-2} in 1985 were the number of secondary branches in broadcast and row spaced crop respectively. At 150 DAMSE in 1985 the broadcast crop had 4251 secondary branches m^{-2} and line sown crop had 5350 branches m^{-2} and these differed significantly.

4.2.3.2 Effect of cutting : Before cutting at 60 DAMSE the secondary branches in 1984 were 1782 and 1816 in uncut and cut crop respectively; in 1985 the corresponding figures were 1453 and 1455. With passage of time the number of secondary branches were more in uncut than in cut treatment and the differences became significant (Table 4.29).

At 150 DAMSE, in 1985 no significant difference could be found; 4912 and 4689 branches m^{-2} were recorded in uncut and cut treatments respectively.

4.2.3.3 Effect of phosphatic fertilizer : At 60 DAMSE, fertilized (P_{80}) crops had significantly more number of secondary branches m^{-2} over P_0-fertilized crop but in 1985, no significant difference in secondary branch number was observed between unfertilized and fertilized crops. At 90 DAMSE in both the years fertilized crops had significantly more number of secondary branches than P_0 fertilized

Table 4.29 Effect of cutting on number of secondary branches m^{-2} (Experiment no. 1b - 1984 and 1b - 1985)

Timing of observation	Year	Cutting management: Not cut	Cut at 60 DAMSE	S.Em ±	CD at 5 %
14.8.84 (60 DAMSE)	1984	1782	1816	9.8	28.70
2.7.85 (60 DAMSE)	1985	1453	1455	19.4	NS
	Mean	1618	1634	14.6	NS
13.9.84 (90 DAMSE)	1984	2734	1559	76.2	224.05
1.8.85 (90 DAMSE)	1985	2464	1484	35.5	104.34
	Mean	2599	1522	17.7	164.2
13.10.84 (120 DAMSE)	1984	3747	3164	36.1	106.1
31.8.85 (120 DAMSE)	1985	3608	3279	95.1	279.7
	Mean	3678	3222	65.6	192.4
30.9.85 (150 DAMSE)	1985	4912	4689	80.5	NS

crops; the figures were 1928 and 2365 in 1984; 1846 and 2102 in 1985 in the unfertilized and fertilized crops respectively (Table 4.30).

4.2.4 Number of tertiary branches m^{-2}

4.2.4.1 Effect of spacing : Sympodial branching of Verano makes this plant functionally inderminate (Ison and Humphreys, 1984). Tertiary branches had the influence on the number of sites for inflorescence development. So at 109 DAMSE in 1984 and 151 DAMSE in 1985 i.e. on 1 October number of tertiary branches were counted in each year. In 1984, 60 cm row-spaced crop produced significantly higher number of tertiary branches over broadcast crop. Similar trend of difference was noticed in 1985 also. There were 5406 and 5845 number of tertiary branches m^{-2} in 1984 and; 6375 and 7562 m^{-2} in 1985 from broadcast and line sown crops respectively. Thus, tertiary branch m^{-2} were more in line sown crop than in the broadcast one, similar to the difference noted in case of secondary branches (Table 4.31).

4.2.4.2 Effect of cutting : At 109 DAMSE in 1984, no significant difference in tertiary branch number was recorded between uncut and cut treatments, but in 1985, cut treatments produced significantly higher number of tertiary branches m^{-2} than uncut treatments. 5546 and 5704 in 1984; 6744 and 7192 in 1985 were the tertiary branch number m^{-2} in uncut and cut treatments respectively (Table 4.32).

Table 4.30 Effect of phosphatic fertilizer on number of secondary branches m^{-2} (Experiment no. 1b - 1984 and 1b - 1985)

Timing of observation	Year	P_2O_5 (kg ha^{-1}) 0	80	S.Em ±	CD at 5 %
14.8.84 (60 DAMSE)	1984	1741	1857	9.8	28.7
2.7.85 (60 DAMSE)	1985	1440	1467	19.4	NS
	Mean	1591	1662	14.6	NS
13.9.84 (90 DAMSE)	1984	1928	2365	76.2	224.1
1.8.85 (90 DAMSE)	1985	1846	2102	35.5	104.3
	Mean	1887	2234	17.7	164.2
13.10.84 (120 DAMSE)	1984	3285	3626	36.1	106.1
31.8.85 (120 DAMSE)	1985	3254	3634	95.1	279.7
	Mean	3270	3630	65.7	192.4
30.9.85 (150 DAMSE)	1985	4572	5029	80.5	236.8

Table 4.31 Effect of spacing on the number of tertiary branches m^{-2} (Experiment no. 1b - 1984 and 1b - 1985)

Timing of observation	Year	Methods of sowing		S.Em ±	CD at 5 %
		Broadcast	Row spacing (60 cm)		
1 Oct					
(109 DAMSE)	1984	5406	5845	62.2	183.05
(151 DAMSE)	1985	6375	7562	123.2	362.51
	Mean	5891	6704	92.7	272.78

Table 4.32 Effect of cutting on number of tertiary branches m^{-2} (Experiment no. 1b - 1984 and 1b - 1985)

Timing of observation	Year	Cutting management		S.Em ±	CD at 5 %
		No cut	Cut at 60 DAMSE		
1 Oct					
(109 DAMSE)	1984	5546	5704	62.2	NS
(151 DAMSE)	1985	6744	7192	123.2	362.5
	Mean	6145	6448	92.7	272.8

4.2.4.3 Effect of phosphatic fertiliser : In 1984, fertilized (P_{80}) crops showed significantly higher number of tertiary branches (5784 m^{-2}) over unfertilized (P_0) crops (5467 m^{-2}). But in 1985, no significant difference was noticed between unfertilized (6785 m^{-2}) and fertilized (P_{80}) (7152 m^{-2}) crops (Table 4.33).

4.2.5 Dry matter accumulation g m^{-2}

As per treatment the crop was harvested at 60 DAMSE. Then onwards, the crop was harvested on 1-2 Oct and 14 December for recording the dry matter accumulation.

4.2.5.1 Effect of spacing : In the year 1984, the dry matter produced were 350.0, 392.1 and 504.7 g m^{-2} in case of broadcast crop at 60, 110 and 183 DAMSE respectively. The corresponding yields in the line sown crops were 389, 452.7 and 570.4 g m^{-2} and the differences between two treatments were significant (Table 4.34).

Thus, line sown crops always contributed higher dry matter which were significantly superior to those of the broadcast crop. On an average broadcast crop showed 15 - 20 per cent less dry matter accumulation than the line sown crop.

4.2.5.2 Effect of cutting : The dry matter accumulations in uncut treatment in 1984 ranged from 370 g m^{-2} at 60 to

Table 4.33 Effect of phosphatic fertilizer on number of tertiary branches m^{-2} (Experiment no. 1b - 1984 and 1b - 1985)

Timing of observation	Year	P_2O_5 (kg ha^{-1})		S.Em ±	CD at 5 %
		0	80		
1 Oct					
(109 DAMSE)	1984	5467	5784	62.23	183.05
(151 DAMSE)	1985	6785	7152	123.24	362.51
	Mean	6126	6468	92.7	272.78

Table 4.34 Effect on spacing on dry matter accumulation in crops g m^{-2} (Experiment no. 1b - 1984 and 1b - 1985)

Timing of observation	Year	Methods of sowing: Broadcast	Methods of sowing: Row spacing (60 cm)	S.Em ±	CD at 5 %
14 Aug (60 DAMSE)	1984	350.0	389.0	7.0	20.76
2nd Jul (60 DAMSE)	1985	315.5	374.7	4.5	13.37
	Mean	332.8	381.9	5.8	17.07
2 Oct (110 DAMSE)	1984	392.1	452.7	3.8	11.05
1 Oct (151 DAMSE)	1985	576.6	726.3	14.7	43.11
	Mean	483.9	589.5	9.2	27.06
14 Dec (183 DAMSE)	1984	504.7	570.4	8.9	26.26
(225 DAMSE)	1985	561.1	671.3	5.8	17.14
	Mean	532.9	620.9	7.4	21.7

536.9 g m^{-2} 183 DAMSE; the corresponding figures in 1985 were 343.1 g m^{-2} at 60 DAMSE to 686.8 g m^{-2} at 151 DAMSE. The differences in dry matter accumulation between the cut and uncut treatments were usually low and not significant except at 110 DAMSE in 1984 and 151 DAMSE in 1985 when uncut treatment showed on an average 18 % increase in dry matter accumulation (Table 4.35).

4.2.5.3 Effect of phosphatic fertilizer : Phosphatic fertilizer (P_{80}) helped in producing higher dry matter accumulation over control (P_0) except at 60 DAMSE in 1984 and at 151 DAMSE in 1985. In all other cases there were significant increase in dry matter accumulation in fertilized crops than unfertilized ones. In 1984, the highest yields were recorded at 183 DAMSE, whereas it occurred at 151 DAMSE in 1985. Due to phosphatic fertilization the increase in dry matter accumulation of line sown crop in 1984 at 183 DAMSE was 5 % and in 1985 it was 6 % at 151 DAMSE over broadcast crop (Table 4.36).

4.2.6 Number of inflorescences m^{-2}

Verano is a short day plant (Cameron and t'Mannetje, 1977) and it started flowering at 57 DAMSE. Under the agro-climatic condition of the Central Research Farm, flush of bloom only took place after ceasation of monosoonal rain and a dip in temperature. So, counting of inflorescence was taken up from the beginning of October.

Table 4.35 Effect of cutting on dry matter accumulation g m^{-2}
(Experiment no. 1b - 1984 and 1b - 1985)

Timing of observation	Year	Cutting management: No cut	Cutting management: Cut at 60 DAMSE	S.Em ±	CD at 5 %
14 Aug					
(60 DAMSE)	1984	370.0	369.0	7.1	NS
2 Jul					
(60 DAMSE)	1985	343.1	347.0	4.5	NS
	Mean	356.6	358.0	5.8	NS
2 Oct					
(110 DAMSE)	1984	477.4	367.4	3.8	11.05
1 Oct					
(151 DAMSE)	1985	686.8	615.1	14.7	43.11
	Mean	582.1	491.3	9.2	27.08
14 Dec					
(183 DAMSE)	1984	536.9	538.2	8.9	NS
(225 DAMSE)	1985	608.6	623.8	5.8	NS
	Mean	576.8	581.0	7.4	NS

Table 4.36 Effect of phosphatic fertilizer on dry matter accumulation g m^{-2} (Experiment no. 1b - 1984 and 1b - 1985)

Timing of observation	Year	P_2O_5 (kg ha^{-1})		S.Em $\pm$	CD at 5 %
		0	80		
14 Aug (60 DAMSE)	1984	360.3	378.7	7.1	NS
2 Jul (60 DAMSE)	1985	334.8	355.4	4.5	13.37
	Mean	347.6	367.1	5.8	NS
2 Oct (110 DAMSE)	1984	405.7	439.0	3.8	11.05
1 Oct (151 DAMSE)	1985	633.5	668.4	14.7	NS
	Mean	519.6	553.7	9.3	NS
14 Dec (183 DAMSE)	1984	523.0	552.1	8.9	26.26
(225 DAMSE)	1985	596.7	635.7	5.8	17.14
	Mean	559.9	593.9	7.4	21.70

4.2.6.1 Effect of spacing : At 109 DAMSE in 1984 no significant difference in number of inflorescences m^{-2} between broadcast and line sown crop was observed (Table 4.37). In 1985, there was significant difference in inflorescence number at 151 DAMSE. Line sown crop produced significantly higher number of inflorescences m^{-2} (496) over broadcast crop (438).

At 123 DAMSE in 1984, no significant difference existed between two methods of sowing. But in 1985 at 165 DAMSE 60 cm row spaced crop produced significantly more (1204) number of inflorescences m^{-2} than the broadcast crop (832). In 1984 at 138 DAMSE line sown crop produced significantly higher number of inflorescences (1937) over broadcast crop (1637). Similar was the trend of variation in 1985 crop at 180 DAMSE. In subsequent observations at 15 days interval similar significant differences in number of inflorescences m^{-2} were recorded; the number of inflorescences was more in widely spaced crop than those of broadcast crop, in both the years.

Same trend of variation continued till mid December (on 14 - 15 December). 5303 and 5864 m^{-2} in 1984 and 7641 and 8084 m^{-2} in 1985 were the number of inflorescences of broadcast and line sown crops respectively. The mean number of inflorescences m^{-2} on 14 December of two years showed significantly higher number of inflorescences in 60 cm row spaced crops (6974) than broadcast crop (6472) (Table 4.37).

Table 4.37 Effect of spacing as number of inflorescences m^{-2} (Experiment no. 1b - 1984 and 1b - 1985)

Timing of observation	Year	Methods of sowing: Broadcast	Methods of sowing: Row spacing (60 cm)	S.Em ±	CD at 5 %
1 Oct					
(109 DAMSE)	1984	252	285	16.9	NS
(151 DAMSE)	1985	438	496	12.5	36.8
	Mean	345	391	14.7	NS
15 Oct					
(123 DAMSE)	1984	521	533	15.2	NS
(165 DAMSE)	1985	832	1204	26.8	87.9
	Mean	677	869	21.0	61.8
30 Oct					
(138 DAMSE)	1984	1637	1937	29.0	85.4
(180 DAMSE)	1985	1412	1686	19.0	55.9
	Mean	1525	1812	24.0	70.6
14 Nov					
(153 DAMSE)	1984	2656	3094	47.4	139.4
(195 DAMSE)	1985	3167	3922	112.8	331.8
	Mean	2862	3511	80.1	235.6
29-30 Nov					
(169 DAMSE)	1984	3536	3754	62.6	148.1
(210 DAMSE)	1985	5893	6278	54.1	159.1
	Mean	4715	5016	58.3	171.6
14 Dec					
(183 DAMSE)	1984	5303	5864	93.1	273.8
(225 DAMSE)	1985	7641	8084	104.4	307.2
	Mean	6472	6974	98.7	290.5

4.7.2 Effect of cutting

On 1 October significant differences in the number of inflorescence m^{-2} were recorded in both the years between the uncut and cut treatments. Here uncut treatments 369 in 1984 and 511 in 1985 sown crops, produced significantly more number of inflorescences over cut (168 in 1984 and 424 in 1985 sown crops) treatments. Similar trend of variation was noticed in the subsequent observations recorded at 15 days interval, with the only exception that the differences between treatments became gradually less. Observations recorded on 30 November in 1984 and on 14 Dec in 1985, showed no significant difference between no cut and cut treatments. Mean number of inflorescence in 1985 rose to the tune of 3403 m^{-2} in uncut treatments recorded in mid-November. On 30 Oct in 1984 - 2206 and 1369; in 1985, 1625 and 1473 were the inflorescence m^{-2} of no cut and cut treatments respectively. On 14 Nov the number of inflorescences m^{-2} were 3072 and 2679 in 1984, 3733 and 3360 in 1985 from uncut and cut treatments respectively (Table 4.38). And on 14 Dec in 1984, 5876 and 5290, and in 1985, 7816 and 7908 were the number of inflorescences m^{-2}.

4.7.3 Effect of phosphatic fertilizer

Application of P_2O_5 @ 80 kg ha^{-1} helped in increasing the number of inflorescences as recorded in all the observations except that at 109 DAMSE in 1984 (Table 4.39).

Table 4.38 Effect of cutting on number of inflorescences m^{-2} (Experiment no. 1b - 1984 and 1b - 1985)

Timing of observation	Year	Cutting management: No cut	Cutting management: Cut at 60 DAMSE	S.Em ±	CD at 5 %
1 Oct					
(109 DAMSE)	1984	369	168	16.9	49.8
(151 DAMSE)	1985	511	424	12.5	36.8
	Mean	440	296	14.7	43.3
15 Oct					
(123 DAMSE)	1984	673	381	15.2	44.7
(165 DAMSE)	1985	1108	1928	26.8	78.9
	Mean	891	655	21.0	61.8
30 Oct					
(138 DAMSE)	1984	2206	1369	29.0	85.4
(180 DAMSE)	1985	1625	1473	19.0	55.8
	Mean	1916	1421	24.0	70.6
14 Nov					
(153 DAMSE)	1984	3072	2679	47.4	139.4
(195 DAMSE)	1985	3733	3360	112.8	331.8
	Mean	3405	3020	80.1	235.6
29-30 Nov					
(169 DAMSE)	1984	3728	3562	62.6	NS
(210 DAMSE)	1985	6207	5964	54.1	159.1
	Mean	4968	4763	58.3	171.6
14 Dec					
(183 DAMSE)	1984	5876	5290	93.1	278.8
(225 DAMSE)	1985	7816	7908	104.4	NS
	Mean	6846	6599	98.7	NS

Table 4.39 Effect of phosphatic fertilizer on number of inflorescences m^{-2} (Experiment no. 1b - 1984 and 1b - 1985)

Timing of observation	Year	P_2O_5 (kg ha^{-1}) 0	80	S.Em $\pm$	CD at 5 %
1 Oct					
(109 DAMSE)	1984	253	258	16.9	NS
(151 DAMSE)	1985	436	498	12.5	36.8
	Mean	345	392	14.7	NS
15 Oct					
(123 DAMSE)	1984	514	540	15.2	44.7
(165 DAMSE)	1985	923	1113	26.8	78.9
	Mean	719	827	21.0	61.8
30 Oct					
(138 DAMSE)	1984	1660	1914	29.0	85.4
(180 DAMSE)	1985	1478	1620	19.0	55.8
	Mean	1569	1767	24.0	70.6
15 Nov					
(153 DAMSE)	1984	2750	3000	47.4	139.4
(195 DAMSE)	1985	3254	2840	112.8	331.8
	Mean	3002	3420	80.1	235.6
29-30 Nov					
(169 DAMSE)	1984	3383	3903	62.6	184.1
(210 DAMSE)	1985	5778	6392	54.1	159.1
	Mean	4581	5148	58.3	171.6
14 Dec					
(183 DAMSE)	1984	5128	6038	93.1	272.8
(225 DAMSE)	1985	7549	8177	104.4	307.2
	Mean	6339	7108	98.8	290.5

Subsequently, fertilized crops showed higher number of inflorescences per unit area than the unfertilized (P_0) ones and the differences ranged from 8 to 13 %. Starting from only 253 inflorescences m^{-2} on 1 Oct 1984 at 109 DAMSE it rose upto 6038 inflorescences m^{-2} on 14 Dec 1984 at 183 DAMSE. Inflorescence number per unit area were higher in 1985 crop than that in 1984 crop. In 1985, fertilized crops produced 8177 number of inflorescences m^{-2} which was 8 % higher than that of broadcast crops.

4.2.7 Test weight of seeds in g

4.2.7.1 Effect of spacing : At 183 DAMSE in 1984 (Table 4.40) line sown crops showed significantly heavier seeds (2.64 g) than broadcast crop (2.60 g). In 1985 at 225 DAMSE significant difference was also recorded between line sown (2.72 g) and broadcast (2.70 g) crops. Observations recorded at 190 DAMSE in 1984 and at 232 DAMSE in 1985 showed similar trend of variation in 1000 seed weight. There was an indication that the seeds harvested later showed lighter weight than earlier harvested seed (Table 4.40).

4.2.7.2 Effect of cutting : Cutting treatments significantly affected 1000 seed weight (Table 4.41). At 183 DAMSE, 2.63 and 2.61 g were the 1000 seed weight in uncut and cut treatments, respectively in 1984. In 1985 similar was the trend of difference between the treatments. The mean 1000 seed weight of two years on 14 Dec showed significant

Table 4.40 Effect of spacing on 1000 seed weight in g
(Experiment no. 1b - 1984 and 1b - 1985)

Timing of observation	Year	Methods of sowing: Broadcast	Methods of sowing: Row spacing (60 cm)	S.Em ±	CD at 5 %
14 Dec					
(183 DAMSE)	1984	2.60	2.64	0.002	0.005
(225 DAMSE)	1985	2.70	2.72	0.002	0.005
	Mean	2.65	2.68	0.002	0.005
21 Dec					
(190 DAMSE)	1984	2.58	2.63	0.006	0.020
(232 DAMSE)	1985	2.69	2.71	0.002	0.007
	Mean	2.64	2.67	0.004	0.005
28-29 Dec					
(198 DAMSE)	1984	2.52	2.56	0.001	0.005
(239 DAMSE)	1985	2.63	2.68	0.004	0.010
	Mean	2.58	2.62	0.003	0.008

Table 4.41 Effect of cutting on 1000 seed weight in g (Experiment no. 1b - 1984 and 1b - 1985)

Timing of observation	Year	Cutting management		S.Em ±	CD at 5 %
		No cut	Cut at 60 DAMSE		
14 Dec					
(183 DAMSE)	1984	2.63	2.61	0.002	0.005
(225 DAMSE)	1985	2.72	2.71	0.002	0.005
	Mean	2.68	2.66	0.002	0.005
21 Dec					
(190 DAMSE)	1984	2.60	2.61	0.001	0.020
(232 DAMSE)	1985	2.70	2.71	0.002	0.007
	Mean	2.65	2.66	0.002	0.014
28-29 Dec					
(198 DAMSE)	1984	2.54	2.56	0.001	0.005
(239 DAMSE)	1985	2.65	2.66	0.004	0.010
	Mean	2.60	2.61	0.003	0.008

difference, 2.68 and 2.66 g being the 1000 seed weights of two treatments. At 190 DAMSE in 1984 and at 232 DAMSE in 1985 (21 Dec.) 2.60 and 2.61 g; and 2.70 and 2.71 g were the 1000 seed weight of no cut and cut treatments respectively. The treatment difference in seed weights recorded at 198 and 239 DAMSE in 1984 and 1985 respectively were significant, but seeds of this late harvest were slightly lighter than the early harvest crop.

4.2.7.3 Effect of phosphatic fertilizer : In 1984, at 183, 190 and 198 DAMSE the test weight of seeds were significantly higher in fertilized (P_{80}) crops than the unfertilized ones. The 1000 seed weights of the unfertilized crops were 2.60, 2.58 and 2.53 g and the corresponding figures of fertilized crops were 2.64, 2.63 and 2.55 g respectively. In 1985 the 1000 seed weights were slightly heavier and the treatment differences showed similar type of difference at 225, 232 and 239 DAMSE. Mean of two years also showed similar difference between unfertilized (P_0) and fertilized crops. The mean 1000 seeds weight of each harvest of two years also showed significant higher 1000 seeds weight in fertilized crops over unfertilized ones (Table 4.42).

4.2.8 Seed yield g m^{-2}

Experiment 1b was carried out in 1984 and 1985 to find out the effect of two methods of sowing, broadcasting

Table 4.42 Effect of phosphatic fertilizer on 1000 seed weight in g (Experiment no. 1b - 1984 and 1b - 1985)

Timing of observation	Year	P_2O_5 (kg ha^{-1}) 0	P_2O_5 (kg ha^{-1}) 80	S.Em ±	CD at 5 %
14 Dec					
(183 DAMSE)	1984	2.60	2.64	0.002	0.005
(225 DAMSE)	1985	2.70	2.73	0.002	0.005
	Mean	2.65	2.69	0.002	0.005
21 Dec					
(190 DAMSE)	1984	2.58	2.63	0.006	0.020
(232 DAMSE)	1985	2.69	2.72	0.002	0.007
	Mean	2.64	2.68	0.004	0.004
28-29 Dec					
(198 DAMSE)	1984	2.53	2.55	0.001	0.005
(239 DAMSE)	1985	2.63	2.69	0.004	0.010
	Mean	2.58	2.62	0.003	0.008

and line sowing in 60 cm apart rows, two cutting treatments and two levels of phosphatic fertilizer on seed production in Verano.

4.2.8.1 Effect of spacing : For seed collection the crop was harvested three times at intervals of 7 - 8 days to determine the correct stage of harvesting for the highest amount of seed.

First harvesting was done on 14 Dec at 183 DAMSE in 1984 and at 225 DAMSE in 1985. Seed yields (Table 4.43) in 1984 were 28.96 and 39.75 g m^{-2} in broadcast and 60 cm apart row spaced crops respectively and the difference was significant. In 1985, the same trend of variation in seed yield was noticed. Seed yield were 30.78 g m^{-2} and 44.04 g m^{-2} in broadcast and line sown (60 cm) crops respectively; difference recorded between two methods of sowing was significant. At subsequent harvests, after 7 - 8 days in both the years showed significant differences in seed yield between two methods of sowing. At 198 DAMSE in 1984 seed yields of 27.90 and 44.77 g m^{-2} were recorded under broadcast and row sown crops respectively and the difference was significant. Same was the trend of variation in 1985 at 239 DAMSE, 34.47 and 43.88 g m^{-2} being the seed yields in broadcast and 60 cm row-spaced crops respectively. The seed collected from ground after final harvests in both the years also showed significant differences

Table 4.43 Effect of spacing on seed yield g m^{-2} (Experiment no. 1b - 1984 and 1b - 1985)

Timing of observation	Year	Methods of sowing		S.Em ±	CD at 5 %
		Broadcast	Row spacing (60 cm)		
14 Dec					
(183 DAMSE)	1984	28.96	39.75	0.67	1.98
(225 DAMSE)	1985	30.78	44.04	0.32	0.93
	Mean	29.87	41.90	0.50	1.46
21 Dec					
(190 DAMSE)	1984	38.32	48.95	1.07	3.17
(232 DAMSE)	1985	37.46	57.06	0.70	2.05
	Mean	37.89	53.01	0.92	2.61
28-29 Dec					
(198 DAMSE)	1984	27.90	44.77	0.63	1.84
(239 DAMSE)	1985	34.47	43.88	0.92	2.70
	Mean	31.19	44.33	0.77	2.27
Seed collected					
from ground	1984	31.39	*33.05	0;55	1.57
by hand	1985	32.50	*43.60	0.34	0.99
	Mean	31.95	*41.33	0.44	1.28
Total yield	1984	69.71	93.44	0.80	2.37
	1985	71.70	103.47	0.52	1.52
	Mean	70.71	98.46	0.66	1.95

* Seed yield collected through sweeping.

between the two methods of sowing; they were 31.39 and 39.05 g m^{-2} in 1984; 32.50 and 43.60 g m^{-2} in 1985 in broadcast and line sown crops respectively.

The highest seed yield including hand collection from broadcast crop and sweeping from line sown crop was 93.44 g m^{-2} from line sown crops while the broadcast crop produced 69.71 g m^{-2} in 1984. In 1985 the highest yield recorded in line sown crops was 103.47 g m^{-2} as against only 71.7 g m^{-2} in broadcast crop.

4.2.8.2 Effect of cutting : In 1984, at 183 DAMSE (first harvest) seed yields (Table 4.44) were 35.28 and 33.42 g m^{-2} under uncut and cut treatments respectively, in 1985, the corresponding figures were 39.11 and 35.71 g m^{-2}. In both the years treatment differences were significant. At second harvest on 21 December the treatment differences were not significant in both the years and the yields were 43.08 and 44.20 g m^{-2} at 190 DAMSE in 1984 and 46.54 and 47.98 g m^{-2} at 232 DAMSE in 1985 in the uncut and cut treatments respectively. Seed yields recorded from last harvest on 28-29 December, the treatments difference was significant in both the years (at 198 DAMSE in 1984 and 239 DAMSE in 1985).

The seeds collected from the ground were 35.82 g m^{-2} in uncut and 34.83 g m^{-2} in cut treatments in 1984, and in 1985 the yields were 38.67 and 37.44 g m^{-2}. In 1985 only,

Table 4.44 Effect of cutting treatments on seed yield g m^{-2}
(Experiment no. 1b - 1984 and 1b - 1985)

Timing of observation	Year	Cutting management		S.Em $\pm$	CD at 5 %
		No cut	Cut at 60 DAMSE		
14 Dec					
(183 DAMSE)	1984	35.28	33.42	0.67	1.98
(225 DAMSE)	1985	39.11	35.71	0.32	0.93
	Mean	37.20	34.57	0.50	1.46
21 Dec					
(190 DAMSE)	1984	43.08	44.20	1.07	NS
(232 DAMSE)	1985	46.54	47.98	0.70	NS
	Mean	44.81	45.09	0.92	NS
28-29 Dec					
(198 DAMSE)	1984	33.16	39.50	0.63	1.84
(239 DAMSE)	1985	37.93	40.38	0.92	NS
	Mean	35.55	39.94	0.77	NS
Seed collected					
from ground	1984	*35.82	*34.63	0.53	NS
by hand and	1985	*38.67	*37.44	0.34	0.99
sweeping	Mean	*37.25	*36.04	0.44	NS
Total Yield	1984	78.90	78.83	0.80	NS
	1985	85.21	85.42	0.52	NS
	Mean	82.05	82.13	0.66	NS

* Seed yield collected through sweeping from the ground, as well as by hand.

the significant difference in seed yield between uncut and cut treatments was evident.

The highest yield achieved were 78.90 and 78.83 g m^{-2} in 1984; 85.25 and 85.42 g m^{-2} in 1985 from uncut and cut treatments respectively. Thus, the total seed yields between uncut and cut treatments did not differ widely in both the years.

4.2.8.3 Effect of phosphatic fertilizer : Phosphatic fertilizer (P_{80}) significantly increased seed yield in all the harvests recorded. At 183 DAMSE in 1984, significant difference in seed yield between unfertilized (P_O) (31.16 g m^{-2}) and fertilized (37.55 g m^2) crops was recorded. In 1985, the seed yields were 35.46 and 39.36 g m^{-2} in fertilized (P_O) and fertilized (P_{80}) crops respectively and they were significant different (Table 4.45). The corresponding figures of seed yield at 190 DAMSE in the unfertilized and fertilised crops were 39.25 and 48.03 g m^{-2} in 1984 and at 239 DAMSE, in 1985 the yields were 44.25 and 50.28 g m^{-2}. The yields came down to 32.62 and 39.06 g m^{-2} in 1984 and 35.64 and 42.68 g m^{-2} in 1985 in the unfertilized and fertilized crops respectively on 28 - 29 December (at 198 DAMSE in 1984 and 239 DAMSE in 1985).

The seed collected from ground (by hand from broadcast sowing and by sweeping from line sown crops) differed

Table 4.45 Effect of phosphatic fertilizer on seed yield g m^{-2} (Experiment no. 1b - 1984 and 1b - 1985)

Timing of observation	Year	P_2O_5 (kg ha^{-1}) 0	80	S.Em ±	CD at 5 %
14 Dec					
(183 DAMSE)	1984	31.16	37.55	0.67	1.98
(225 DAMSE)	1985	35.46	39.36	0.32	0.93
	Mean	33.31	38.46	0.50	1.46
21 Dec					
(190 DAMSE)	1984	39.25	48.03	1.07	3.17
(232 DAMSE)	1985	44.25	50.28	0.70	2.04
	Mean	41.75	49.16	0.92	2.61
28-29 Dec					
(198 DAMSE)	1984	32.62	39.06	0.63	1.84
(239 DAMSE)	1985	35.46	42.68	0.91	2.70
	Mean	34.13	40.87	0.77	2.27
Seed collected					
from ground	1984	*35.19	*37.26	0.53	1.57
by hand and	1985	*36.89	*39.21	0.34	0.99
sweeping	Mean	*36.04	*38.24	0.44	1.28
Total yield	1984	74.44	85.29	0.80	2.37
	1985	81.14	89.49	0.52	1.52
	Mean	77.79	87.39	0.66	1.95

* Seed yield collected through sweeping from the ground, as well as by hand.

significantly in yield in both the years and these were 35.19 and 37.26 g m^{-1} in 1984 and 36.89 and 39.21 g m^{-2} in 1985 from unfertilized and fertilized crops respectively. P_{80}-fertilization caused 15 % increase in seed production in 1984 and it was only 9 % in 1985.

4.3 Experiment no. 1c

In 1c experiment where the growth and productivity of Carribean stylo cv. Verano were analysed at two row spacings, two cutting treatments and two levels of phosphatic fertilizer, the growth of the crop was fairly good.

4.3.1 Plant height

4.3.1.1 Effect of spacing : In 1985, the height of the plants recorded (Table 4.46) at 60 DAMSE ranged from 28.7 to 31.3 cm and the treatment differences were significant between two spacings. In 1986 and 1987 at 60 DAMSE differences in plant heights were also significant between 20 and 40 cm row spacings. In 1986, 35.4 and 37.5 cm and in 1987, 38.7 and 39.8 cm were the plant heights in 20 and 40 cm row spaced crops respectively at 60 DAMSE. At 90 DAMSE in 1985, 40 cm apart row spaced crop were significantly taller (40.9 cm) than 20 cm apart row spaced (39.9 cm) crops. In 1986 at 90 DAMSE no significant difference in plant height was noticed; but at 90 DAMSE in 1987, the heights were 44.4 and 45.8 cm in 20 and 40 cm apart row crops respectively and these were significantly different. At 120 DAMSE, 61.8 and 63.5 cm and

Table 4.46 Effect of spacing on height of the plant in cm
(Experiment no. 1c - 1985, 1c - 1986 and 1c - 1987)

Timing of observation	Year	Row spacings in cm 20	40	S.Em ±	CD at 5 %
2-3 Jul					
(60 DAMSE)	1985	28.7	31.3	0.55	1.62
	1986	35.4	37.5	0.26	0.76
	1987	38.7	39.8	0.14	0.42
	Mean	34.3	36.2	0.32	0.93
1-2 Aug					
(90 DAMSE)	1985	39.9	40.9	0.27	0.80
	1986	44.0	44.5	0.37	NS
	1987	44.4	45.8	0.22	0.65
	Mean	42.8	43.7	0.29	
31 Aug-1 Sep					
(120 DAMSE)	1985	61.8	63.5	0.21	0.61
	1986	59.7	61.8	0.28	0.83
	1987	61.4	62.8	0.45	NS
	Mean	61.0	62.7	0.32	0.94
30 Sep-1 Oct					
(150 DAMSE)	1985	76.3	80.9	0.63	1.85
	1986	82.1	88.2	0.82	2.40
	1987	79.8	85.7	0.29	0.87
	Mean	79.4	85.7	0.58	1.71

Dates of mean seedling emergence - 3.5.1985; 4.5.1986; 3.5.87. DAMSE - Day after mean seedling emergence date.

at 150 DAMSE 76.3 and 80.9 cm were the plant heights in 1985 in 20 and 40 cm apart row crops respectively and the differences were significant. Similar trend of variation was also noticed in 1986. But in 1987 at 120 DAMSE there was no significant difference in plant height between the two row spacings; at 150 DAMSE in 1987, however, significant difference was noticed. The mean heights of three years at 150 DAMSE also showed significant differences in plant height between 20 and 40 cm row spaced crop; 79.4 and 85.7 cm were the average plant heights in 20 and 40 cm row-spaced crops at the stage.

4.3.1.2 Effect of cutting : Except at 60 DAMSE, before cutting in all the three years the plant heights at 90, 120 and 150 DAMSE differed significantly (Table 4.47) between uncut and cut treatments. For uncut treatments in 1985 at 60, 90, 120 and 150 DAMSE the plant heights were 29.8, 51.4, 76.5, and 81.7 cm respectively whereas in cut treatments the heights were 30.1, 29;4, 48.7 and 75.6 cm respectively. At 150 DAMSE the heights were 94.2 and 76.3 cm in 1986 and 91.3 and 74.2 cm in 1987 from uncut and cut treatment respectively.

4.3.1.3 Effect of phosphatic fertilizer : Phosphatic fertilizer (P_{80}) distinctly influenced plant height at 60 to 150 DAMSE (Table 4.48). In all the three years fertilized plants were significantly taller than unfertilized (P_0) plants.

Table 4.47 Effect of cutting on plant height in cm (Experiment no. 1c - 1985, 1c - 1986 and 1c - 1987)

Timing of observation	Year	Cutting management		S.Em ±	CD at 5 %
		No cut	Cut at 60-62 DAMSE		
2-3 Jul	1985	29.8	30.1	0.55	NS
(60 DAMSE)	1986	36.4	36.5	0.26	NS
	1987	39.3	39.3	0.14	NS
	Mean	35.1	35.3	0.32	NS
1-2 Aug	1985	51.4	29.4	0.27	0.80
(90 DAMSE)	1986	60.8	27.6	0.37	1.09
	1987	56.6	33.6	0.22	0.65
	Mean	56.3	30.2	0.29	0.85
31 Aug-1 Sep	1985	76.5	48.7	0.21	0.61
(120 DAMSE)	1986	74.7	46.8	0.28	0.83
	1987	77.4	47.0	0.47	1.38
	Mean	76.2	47.5	0.32	0.94
30 Sep-1 Oct	1985	81.7	75.6	0.63	1.85
(150 DAMSE)	1986	94.2	76.3	0.82	2.40
	1987	91.3	74.2	0.29	0.87
	Mean	89.0	75.4	0.58	1.71

Table 4.48 Effect of phosphatic fertilization on plant height in cm (Experiment no. 1c - 1985, 1c - 1986 and 1c - 1987)

Timing of observation	Year	P_2O_5 (kg ha^{-1}) 0	80	S.Em ±	CD at 5 %
2-3 Jul					
(60 DAMSE)	1985	28.8	31.2	0.55	1.62
	1986	34.9	38.0	0.26	0.76
	1987	38.0	40.5	0.14	0.42
	Mean	33.9	36.6	0.32	0.93
1-2 Aug					
(90 DAMSE)	1985	39.8	41.0	0.27	0.80
	1986	42.4	46.1	0.37	1.09
	1987	44.2	46.0	0.22	0.65
	Mean	42.1	44.4	0.29	0.85
31 Aug-1 Sep					
(120 DAMSE)	1985	61.2	64.0	0.21	0.61
	1986	59.2	62.3	0.28	0.83
	1987	60.6	63.7	0.47	1.38
	Mean	60.3	63.3	0.32	0.94
30 Sep-1 Oct					
(150 DAMSE)	1985	77.2	80.0	0.63	1.85
	1986	83.7	86.8	0.82	2.40
	1987	81.5	84.0	0.29	0.87
	Mean	80.6	83.6	0.58	1.71

In 1985, 28.8 and 31.2 cm, in 1986, 34.9 and 38.0 cm and in 1987, 38.0 and 40.5 cm were the plant heights from unfertilized and fertilized crops at 60 DAMSE respectively.

The plant heights increased with passage of time and the fertilized plants always recorded taller plant heights than the unfertilized plants.

The mean heights of plants of 3 years at 60, 90, 120 and 150 DAMSE were 33.9, 42.1, 60.3 and 80.6 cm respectively in unfertilized plants and 36.6, 44.4, 63.3 and 83.6 cm respectively from fertilized plants and the treatment differences were significant at every stage.

4.3.2 Number of Primary branches m^{-2}

4.3.2.1 Effect of spacing on number of primary branches : Primary branches were counted twice in a year. One was before a cutting and another after the same cutting. In 1985 at 60 DAMSE there was no significant difference in number of primary branches between 20 and 40 cm row-spaced crop. But in 1986 at 42 DAMSE and in 1987 at 60 DAMSE there were significant differences in number of primary branches between the two row spacings immediately before cutting. With passage of time the number of primary branches increased and the treatment difference were significant except in 1985 at 81 DAMSE. The average of three years at 81 DAMSE were 805 and 848 number of primary branches m^{-2} in 20 and 40 cm apart row spaced crops respectively.

Table 4.49 Effect of spacing on number of primary branches m^{-2} (Experiment no. 1c - 1985, 1c - 1986 and 1c - 1987)

Timing of observation	Year	Row spacings in cm 20	40	S.Em ±	CD at 5 %
Before cutting					
2 Jul (60 DAMSE)	1985	799	804	5.4	NS
15 Jun (42 DAMSE)	1986	621	657	8.8	25.8
2 Jul (60 DAMSE)	1987	863	933	8.5	24.9
	Mean	761	798	7.5	NS
After cutting					
22-23 Jul (81 DAMSE)	1985	762	792	13.0	NS
	1986	776	821	8.1	23.9
	1987	877	930	11.8	34.8
	Mean	805	848	11.0	32.2

4.3.2.2 Effect of cutting : At 42 and 60 DAMSE there were no significant differences in number of branches between uncut and cut treatments in all the three years. In 1985, 801 and 803 m^{-2} in 1986, 636 and 642 m^{-2} and in 1987, 900 - 896 m^{-2} were the primary branches in no cut and one cut treatments respectively. With passage of time the number of branches increased with significant differences between treatments. The mean of three years at 81 DAMSE were 1091 and 561 m^{-2} in uncut and cut treatments respectively (Table 4.50) and these differed significantly.

4.3.2.3 Effect of phosphatic fertilization : Except in 1985, significant differences in primary branch number at 42 and 81 DAMSE in 1986 and 60 and 81 DAMSE in 1987 were recorded (Table 4.51). The number of primary at 42 DAMSE were 632 and 656 m^{-2} in 1986, 856 and 940 m^{-2} at 60 DAMSE in 1987 in unfertilized (P_0) and fertilized (P_{80}) treatments respectively. The fertilized crops always produced significantly higher number of primary branches than in unfertilized crops at 81 DAMSE (22 - 23 July) except in 1985.

4.3.3 Number of secondary branches m^{-2}

4.3.3.1 Effect of spacing : Williams and Gardener (1984) reported from the experiments conducted in Phytotron at Council of Scientific and Industrial Research Organisation, Australia and found that dry matter production and stem

Table 4.50 Effect of cutting on number of primary branches m^{-2} (Experiment no. 1c - 1985, 1c - 1986 and 1c - 1987)

Timing of observation	Year	Cutting management: No cut	Cutting management: Cut at 60-62 DAMSE	S.Em ±	CD at 5 %
Before cutting					
2 Jul (60 DAMSE)	1985	801	803	5.4	NS
15 Jun (42 DAMSE)	1986	636	462	8.8	NS
2 Jul (60 DAMSE)	1987	900	869	8.4	NS
	Mean	779	780	7.5	NS
After cutting					
(81 DAMSE)	1985	1074	480	13.0	34.1
	1986	1078	519	8.1	23.9
	1987	112	685	11.8	34.8
	Mean	1091	561	11.0	32.2

Table 4.51 Effect of phosphatic fertilization on number of primary branches m^{-2} (Experiment no. 1c - 1985, 1c - 1986 and 1c - 1987)

Timing of observation	Year	P_2O_5 (kg ha^{-1}) 0	80	S.Em ±	CD at 5 %
Before cutting					
2nd Jul (60 DAMSE)	1985	799	803	5.4	NS
15 Jun (42 DAMSE)	1986	632	656	8.8	25.8
2 Jul (60 DAMSE)	1987	856	940	8.5	24.9
	Mean	759	799	7.5	NS
After cutting					
22-23 Jul (81 DAMSE)	1985	769	785	13.0	NS
	1986	770	826	8.1	23.9
	1987	857	950	11.8	34.8
	Mean	799	854	11.0	

elongation of Verano was limited by mean weight temperatures below approximately 22^{o}C. Under this agro-climatic condition prevailing temperatures in Nadia district started declining from the month of October onwards. Accordingly number of secondary branches m^{-2} was counted till October every year.

At 60 DAMSE it was found that there was no significant difference in number of secondary branches m^{2} between the two differently row spaced crops in all the three years (Table 4.52). The number of secondary branches m^{-2} varied from 1491 in 1987 to 1841 in 1985 in 20 cm row-spaced crop and in 40 cm apart row sown crops from 1603 in 1987 to 1832 in 1986. But after the cutting was imposed at 60 - 62 DAMSE both in 1985 and 1986 at 90 DAMSE there were significant difference in number of secondary branches m^{-2} between 20 and 40 cm row spaced crops but it was not so in 1987.

The mean number of secondary branches m^{-2} in three years were at 60 DAMSE, 1697 and 1714 m^{-2}, at 90 DAMSE, 2447 and 2674 m^{-2}, at 120 DAMSE, 3831 and 4067 m^{-2}, and at 150 DAMSE, 4478 and 4885 m^{-2} recorded from 20 and 40 cm row spaced crops respectively.

4.3.3.2 Effect of cutting : Number of secondary branches m^{-2} at 60 DAMSE before cutting did not differ significantly in any of the three years. Between uncut and cut treatments,

Table 4.52 Effect of spacing on number of secondary branches m^{-2} (Experiment no. 1c - 1985, 1c - 1986 and 1c - 1987)

Timing of observation	Year	Row spacing in cm 20	40	S.Em ±	CD at 5 %
2-3 Jul					
(60 DAMSE)	1985	1841	1708	188.9	NS
	1986	1764	1832	35.1	NS
	1987	1491	1603	43.9	NS
	Mean	1697	1714	89.3	NS
1-2 Aug					
(90 DAMSE)	1985	2481	2599	37.1	109.1
	1986	2338	2537	38.0	111.9
	1987	2504	2707	75.0	NS
	Mean	2447	2674	50.1	147.2
31 Aug-1 Sep					
(120 DAMSE)	1985	3803	4009	57.2	168.7
	1986	3544	3626	46.9	NS
	1987	4146	4565	29.5	86.7
	Mean	3831	4067	44.5	131.1
30 Sep-1 Oct					
(150 DAMSE)	1985	4400	4918	104.2	306.5
	1986	4015	4272	148.7	NS
	1987	5000	5464	126.4	371.8
	Mean	4478	4885	126.2	NS

the number of secondary branches varied from 1548 in 1987 to 1882 in 1985 from uncut treatment and 1546 in 1987 to 1791 in 1986 from cut treatments (Table 4.53). At 90 DAMSE there were significant differences in number of secondary branches m^{-2} in all the three years. From uncut treatments the numbers ranged from 3108 m^{-2} in 1986 to 3320 m^{-2} in 1985 and from cut treatments these were 1760 m^{-2} in 1985 to 2015 m^{-2} in 1987. Uncut treatment was significantly superior to cut treatments in this aspect. The same trend of significant difference was noticed at 120 DAMSE in all the three years. From uncut treatments the number of secondary branches recorded were 4337, 3922 and 4625 m^{-2} in 1985, 1986 and 1987, respectively; corresponding figures from cut treatments were 3475, 3248 and 4086 m^{2}. But at 150 DAMSE no significant difference was noticed in any of the year. The average number of secondary branches m^{-2} of all the three years at 150 DAMSE were 4767 and 4857 from uncut and cut treatment respectively. Cutting treatment did not affect the number of secondary branches m^{-2} at 150 DAMSE i.e. before the main flush of flowering.

4.3.3.3 Effect of phosphatic fertilization : Phosphatic fertilizer (P_{80}) had considerable effect in increasing secondary branches m^{-2} as evident from the observations from 60 to 150 DAMSE, except on two occasions one at 60 DAMSE in 1985 and at 150 DAMSE in 1986 (Table 4.54).

Table 4.53 Effect of cutting on number of secondary branches m^{-2} (Experiment no. 1c - 1985, 1c - 1986 and 1c - 1987)

Timing of observation	Year	Cutting management		S.Em ±	CD at 5 %
		No cut	Cut at 60-62 DAMSE		
2-3 Jul					
(60 DAMSE)	1985	1882	1668	188.9	NS
	1986	1805	1791	35.1	NS
	1987	1548	1546	43.9	NS
	Mean	1745	1668	89.3	NS
1-2 Aug					
(90 DAMSE)	1985	3320	1760	37.1	109.1
	1986	3108	1767	388.0	111.9
	1987	3196	2015	75.0	220.7
	Mean	3208	1847	50.1	147.2
31 Aug-1 Sep					
(120 DAMSE)	1985	4337	3475	57.2	168.7
	1986	3922	3248	46.9	137.8
	1987	4625	4086	29.5	86.7
	Mean	4295	3603	44.5	131.1
30 Sep-1 Oct					
(150 DAMSE)	1985	4622	4696	104.2	NS
	1986	4410	4682	148.7	NS
	1987	5270	5193	126.4	NS
	Mean	4767	4857	126.2	NS

Table 4.54 Effect of phosphatic fertilization on number of secondary branches m^{-2} (Experiment no. 1c - 1985, 1c - 1986 and 1c - 1987)

Timing of observation	Year	P_2O_5 (kg ha^{-1})		S.Em ±	CD at 5 %
		0	80		
2-3 Jul					
(60 DAMSE)	1985	1794	1755	188.9	NS
	1986	1697	1900	35.1	103.2
	1987	1431	1663	43.9	130.0
	Mean	1641	1773	89.2	NS
1-2 Aug					
(90 DAMSE)	1985	2451	2629	37.1	109.1
	1986	2320	2554	38.0	111.8
	1987	2473	2739	75.0	220.7
	Mean	2415	2641	50.1	147.2
31 Aug-1 Sep					
(120 DAMSE)	1985	3768	4044	57.4	168.7
	1986	3443	2728	46.9	137.8
	1987	4117	4595	29.5	86.7
	Mean	3776	4122	44.5	131.1
30 Sep-1 Oct					
(150 DAMSE)	1985	4505	4813	104.2	306.5
	1986	4339	4752	148.7	NS
	1987	4926	5538	126.4	371.8
	Mean	4590	5034	126.2	NS

At 60 DAMSE the number of secondary branches m^{-2} in 1986 were 1697 and 1900 m^{-2} in 1987 these were 1431 and 1663 m^{-2} from unfertilized (P_0) and fertilized (P_{80}) crops respectively. The average number of secondary branches m^{-2} at 90 DAMSE were 2415 and 2641 from unfertilized and fertilized crops respectively. Similar significant differences in secondary branch number were noticed in all the three years at 120 DAMSE and 150 DAMSE. In 1987 at 150 DAMSE the highest number of secondary branches recorded were 4926 and 5538 m^{-2} from unfertilized and fertilized crops respectively. In 1985 the number of secondary branches were 4505 and 4813 m^{-2} and in 1986 these were 4339 and 4752 m^{-2} respectively at 150 DAMSE.

4.3.4 Number of tertiary branches m^{-2}

Tertiary branch is one of important determining factor in influencing inflorescence number.

4.3.4.1 Effect of spacing : Terminal apices of the secondary and tertiary branches largely influenced the inflorescence development. Hence, tertiary branch is an important factor to be considered for seed production. At 150 DAMSE in all the three years, tertiary branches m^{-2} were counted. In 40 cm row spaced crop significantly higher number of tertiary branches were recorded in 1986 and 1987. In 1986 the number were 6459 and 7283 m^{-2} from 20 and 40 cm row spaced crops respectively; in 1987, the corresponding figures were 7067 and 7634 m^{-2}. The average tertiary branches m^{-2} of the three years in 20 and 40 cm apart row spaced crop were 6665 and 7271 m^{-2} (Table 4.55) respectively.

4.3.4.2 Effect of cutting : There was no significant difference in number of tertiary branches m^{-2} between uncut and cut treatments (Table 4.56). In 1985 the number were 6561 and 6814 m^{-2} from uncut and cut treatments respectively; these were 6771 and 6962 m^{-2} in 1986 and 7224 and 7377 m^{-2} in 1987. Defoliation at early stage did not reduce the number of tertiary branches significantly at 150 DAMSE.

4.3.4.3 Effect of fertilization : Only in 1987, significant difference was noticed between fertilized (P_{80}) and unfertilized (P_0) crops (Table 4.57) and 6927 and 7776 were the number of tertiary branches m^{-2} from unfertilized and fertilized crops respectively. In 1985 and 1986 P_{80}-fertilization had no significant effect on number of tertiary branches.

4.3.5 Dry matter accumulation of plants g m^{-2}

4.3.5.1 Effect of spacing : To assess the herbage yield potentiality of S. hamata cv. Verano the crop were cut at 60 - 62, 150 - 152 and 224 - 225 DAMSE. In 1985 there was significant difference in herbage yield g m^{-2} between two row spacings i.e. 20 and 40 cm; the herbage yields were 332.70 and 336.96 g m^{-2} from 20 and 40 cm row spaced crops

Table 4.55 Effect of spacing on number of tertiary branches m^{-2} (Experiment no. 1c - 1985, 1c - 1986 and 1c - 1987)

Timing of observation	Year	Row spacings in cm		S.Em ±	CD at 5 %
		20	40		
30 Sep-1 Oct					
(150 DAMSE)	1985	6478	6898	257.5	NS
	1986	6459	7283	216.8	637.7
	1987	7067	7634	159.2	468.3
	Mean	6665	7271	211.2	NS

Table 4.56 Effect of cutting on number of tertiary branches m^{-2} (Experiment no. 1c - 1985, 1c - 1986 and 1c - 1987)

Timing of observation	Year	Cutting management		S.Em ±	CD at 5 %
		No cut	Cut at 60-62 DAMSE		
30 Sep-1 Oct					
(150 DAMSE)	1985	6561	6814	257.5	NS
	1986	6771	6962	216.8	NS
	1987	7224	7377	158.2	NS
	Mean	6885	7051	211.2	NS

Table 4.57 Effect of phosphatic fertilization on number of tertiary branches m^{-2} (Experiment no. 1c - 1985, 1c - 1986 and 1c - 1987)

Timing of observation	Year	P_2O_5 (kg ha^{-1}) 0	P_2O_5 (kg ha^{-1}) 80	S.Em ±	CD at 5 %
30 Sep-1 Oct					
(1500 DAMSE)	1985	6407	6970	257.5	NS
	1986	6583	7151	216.8	NS
	1987	6927	7776	159.2	468.3
	Mean	6639	7299	211.2	NS

respectively. In 1986 and 1987, however, there were no significant differences in herbage yield between different row-spaced crops (Table 4.58). At 150 - 152 DAMSE the dry matter accumulations were 704.37 and 720.71 g m^{-2} in 1986 and 688.38 and 719.10 g m^{-2} in 1987, from 20 and 40 cm row-spaced crops respectively (Table 4.58) and the differences were significant. At 224-225 DAMSE in all the years dry matter accumulation of the crop sown in 40 cm apart rows were significantly more than those recorded in 20 cm row spaced crop. These amounted to 612.0 and 657.88 g m^{-2} in 1985, 733.48 and 750.42 g m^{-2} in 1986, 606.68 and 643.85 g m^{-2} in 1987 in plots established at 20 and 40 cm apart rows respectively. For the mean (Table 4.58) of three years it is apparent that dry herbage yields at 150 - 162 DAMSE, were 687.95 g m^{-2} in 20 cm apart row spaced crop and 705.94 g m^{-2} in 40 cm row spaced crop. It was also observed that during the year 1986 the dry herbage yield was more at 150 - 152 and 224 - 225 DAMSE in comparison with that of 1985 and 1987. This may be due to the fact that in 1986 more moisture was available than in other years.

4.3.5.2 Effect of cutting : Defoliation had no significant effect in dry herbage accumulation at 150 - 152 DAMSE. The dry matter accumulations were 689.0 and 660.1 g m^{-2} in 1985 from uncut and cut treatments respectively; corresponding

Table 4.58 Effect of spacing on dry matter accumulation of plants g m^{-2} (Experiment no. 1c - 1985, 1c - 1986 and 1c - 1987)

Timing of observation	Year	Row spacing in cm 20	40	S.Em ±	CD at 5 %
2-4 Jul					
(60-62 DAMSE)	1985	332.70	336.96	1.57	4.60
	1986	352.26	357.53	5.84	NS
	1987	366.42	369.81	3.86	NS
	Mean	350.46	354.77	3.75	NS
30 Sep-2 Oct					
(150-152 DAMSE)	1985	671.1	678.02	4.26	NS
	1986	704.37	720.71	2.79	8.20
	1987	688.38	719.10	3.74	10.96
	Mean	687.95	705.94	3.59	10.56
14 Dec					
(224-225 DAMSE)	1985	612.76	657.88	8.80	25.90
	1986	733.48	750.42	3.84	11.31
	1987	606.68	643.85	7.88	23.17
	Mean	650.97	684.05	6.84	20.13

figures in 1986 were 723.9 and 704.18 g m^{-2} and in 1987 these were 733.33 and 674.15 g m^{-2} (Table 4.59). In 1986 increased dry herbage yield (729.73 g m^{-2}) was recorded even at 224 - 225 DAMSE from cut treatments though uncut treatment yielded significantly more dry matter (754.16 g m^{-2}).

The mean dry herbage yield of three years at 150 - 152 DAMSE showed significant differences between uncut and cut treatments, the yields were 715.41 and 679.48 g m^{-2} from uncut and cut treatments, respectively. At 224 - 225 DAMSE the dry herbage accumulation were 675.83, 659.19 g m^{-2} from uncut and cut treatments respectively.

4.3.5.3 Effect of phosphatic fertilization : Phosphatic fertilizer (P_{80}) had significant effect in increasing dry matter (DMA) accumulation. Probert and Williams (unpublished data) found that Verano responded well in the first year at 40 kg P_2O_5 ha^{-1}.

From the results obtained from two P-fertilizer treatments taken in three years at 60 - 62, 150 - 152 and 224-- 225 DAMSE showed that except in 1986 at 60 DAMSE there were always significant increase in dry herbage yield in fertilized (P_{80}) crops over the unfertilized (P_0) crops these were 325.12 and 343.14 g m^{-2} from unfertilized and fertilized crops in 1985 and 360.78 and 375.45 g m^{-2} in

Table 4.59 Effect of cutting on dry matter accumulation of plants g m^{-2} (Experiment no. 1c - 1985, 1c - 1986 and 1c - 1987)

Timing of observation	Year	Cutting management		S.Em ±	CD at 5 %
		No cut	Cut at 60-62 DAMSE		
2-4 Jul					
(60 DAMSE)	1985	333.34	334.93	1.57	NS
	1986	353.48	356.33	8.88	NS
	1987	367.67	368.56	3.86	NS
	Mean	351.50	353.27	3.45	NS
30 Sep-2 Oct					
(150-152 DAMSE)	1985	689.00	660.10	4.26	12.52
	1986	723.90	704.18	2.79	8.20
	1987	733.33	674.15	3.73	10.96
	Mean	715.41	679.48	3.59	10.56
14 Dec					
(224-225 DAMSE)	1985	643.92	626.73	8.80	NS
	1986	754.16	729.73	3.84	11.31
	1987	629.42	621.11	7.88	NS
	Mean	675.83	659.19	6.84	NS

1987 respectively. At 150 - 152 DAMSE in all the three years there were significant increases in dry matter accumulation from fertilized crops and these were 658.77 and 690.30 g m^{-2} in 1985, 701.35 and 723.74 g m^{-2} in 1986 and 685.31 and 722.17 g m^{-2} in 1987 from unfertilized and fertilized crops respectively (Table 4.60). Similar significant difference in dry matter accumulation were noticed in all the three years at 224 - 225 DAMSE. From the mean dry herbage yields of three years at 150 - 152 DAMSE, it became apparent that the fertilized crops recorded significantly higher dry matter accumulation over the unfertilized crops. The average response was 7.13 kg dry herbage per kg of P_2O_5 applied in the form of single superphosphate.

4.3.6 Number of inflorescence m^{-2}

4.3.6.1 Effect of spacing : S. hamata cv. Verano flowered after attaining an age of 56 days or so, but maximum synchronised flowering occured only in shorter photoperiods, which generally commences from the month of October. Accordingly, number of inflorescence m^{-2} was recorded from the month of October till the first seed harvest was made in all the years. Countings of inflorescences were made at an interval of 14 - 16 days.

In all the three years there were significant difference in the number of inflorescences between 20 and 40 cm

Table 4.60 Effect of phosphatic fertilization on dry matter accumulation of plants g m^{-2} (Experiment no. 1c - 1985, 1c - 1986 and 1c - 1987)

Timing of observation	Year	P_2O_5 (kg ha^{-1}) 0	P_2O_5 (kg ha^{-1}) 80	S.Em ±	CD at 5 %
2-4 Jul					
(60 DAMSE)	1985	325.12	343.14	1.57	4.60
	1986	345.96	363.85	5.84	NS
	1987	360.78	375.45	3.86	11.36
	Mean	343.95	360.81	3.75	NS
30 Sep-2 Oct					
(150-152 DAMSE)	1985	658.77	690.30	4.26	12.52
	1986	701.35	723.74	2.79	8.20
	1987	685.31	722.17	3.73	10.96
	Mean	672.81	712.07	3.50	10.59
14 Dec					
(224-225 DAMSE)	1985	614.52	656.13	8.80	25.90
	1986	732.65	751.31	3.84	11.31
	1987	605.65	644.87	7.88	23.17
	Mean	650.94	684.10	6.84	20.13

row-spaced sward. The number of inflorescences were 474 and 517 m^{-2} in 1985, 474 and 522 m^{-2} in 1986, and 511 and 617 m^{-2} in 1987 in 20 and 40 cm row spaced crops respectively. But from the next counting taken on 15 - 16 October it was found that there were no significant differences between the different spacings in all the three years. Number of inflorescences m^{-2} significantly differed in 1985 and 1986 during the period from 30th October to first November (180 DAMSE) between the two row spaced crops whereas in 1987 there was no significant difference between two row spaced crops (Table 4.61). Number of inflorescences recorded were 1581 and 1696 m^{-2} in 1985, 1617 and 1743 m^{-2} in 1986 in 20 and 40 cm spaced crops respectively. At 195 - 196 DAMSE, in all the years no significant difference in number of inflorescences were recorded between two row spaced crops except in the year 1985.

As the photoperiod shortened, number of inflorescences m^{-2} increased rapidly thereby indicating a quantitative short day response of Verano although Verano is reported to have a day neutral response. Counting of inflorescences made between 30 November - first December (210 DAMSE) in all the years revealed that 40 cm row spaced crop bore significantly higher number of inflorescences (6206 m^{-2}) than 20 cm row spaced crop (5940 m^{-2}) in the year 1985. In 1986, the corresponding figures were 5623

Table 4.61 Effect of spacing on number of inflorescences m^{-2}
(Experiment no. 1c - 1985, 1c - 1986 and 1c - 1987)

Timing of observation	Year	Row spacing in cm 20	40	S.Em ±	CD at 5 %
30 Sep-1 Oct					
(150 DAMSE)	1985	474	517	13.0	38.1
	1986	474	522	14.1	41.4
	1987	511	617	15.9	46.9
	Mean	486	552	14.3	42.1
15-16 Oct					
(165 DAMSE)	1985	1373	1354	65.0	NS
	1986	1175	1306	51.3	NS
	1987	1031	1029	23.2	NS
	Mean	1193	1230	46.5	NS
30 Oct-1 Nov					
(180 DAMSE)	1985	1581	1696	31.1	91.6
	1986	1617	1743	42.4	124.9
	1987	2092	2285	79.4	NS
	Mean	1763	1908	51.0	NS
15-16 Nov					
(195 DAMSE)	1985	3300	3480	77.5	NS
	1986	2816	3182	65.9	193.8
	1987	3344	3647	78.4	230.5
	Mean	3153	3447	73.9	217.4
30 Nov-1 Dec					
(210 DAMSE)	1985	5940	6206	69.5	204.4
	1986	5183	5623	129.2	379.1
	1987	6521	7289	110.0	323.6
	Mean	6881	6372	102.9	NS
14 Dec					
(224-225 DAMSE)	1985	8135	8568	138.8	408.2
	1986	6962	7253	83.3	245.0
	1987	9799	10068	487.8	NS
	Mean	8299	8630	236.6	NS

and 5183 m^{-2} and in 1987, 6521 and 7289 m^{-2} were the number of inflorescences from 20 and 40 cm rows respectively when the day length was 11 hours 42 minutes. From the observation on number of inflorescences made on 14 December (at 224 - 225 DAMSE) having a day length of 11 hours 26 minutes or so, there was considerably increased number of inflorescences m^{-2}. Except in 1987, in 1985 and 1986, there were significant differences in the number of inflorescences between the two row spaced crops (Table 4.61) at 224 - 225 DAMSE.

In 1985 the number of inflorescences m^{-2} were 8135 and 8568 m^{-2} from 20 and 40 cm row spaced crops respectively; corresponding figures in 1986 were 6962 and 7253 m^{-2}. Though the number of inflorescences in 1987 were more than that of 1985 and 1986, but the difference between two row spacings was not significant.

4.2.6.2 Effect of cutting : In 1985 from uncut and cut treatments the number of inflorescences recorded were 563 and 428 m^{-2} respectively. Similar was the trend of variation in 1986 and 1987. Almost the similar trend of variation was noticed on 15 - 16 October (at 165 DAMSE and 30 October - 1 November at 180 DAMSE) except in 1987, when there was no significant difference in inflorescence number between the two row spacings. In 1985 the number of inflorescences from undefoliated and defoliated swards were

1727 and 1550 m^{-2} respectively at 180 DAMSE, and these differed significantly. No significant difference was observed between uncut and cut treatments in 1987 only. From the observations (Table 4.62) recorded in 15 - 16 November i.e. (at 195 DAMSE) in all the three years it was found that except in 1986, there were no significant differences in number of inflorescences m^{-2} due to the imposition of defoliation at 60 - 62 DAMSE; in 1986, number of inflorescences were 3163 and 2835 in uncut and cut treatments respectively; this might not be due to the effect of cutting but some other factors influencing the initiation of flowers e.g. soil moisture regime. Subsequent recording on 30 November - 1st December (at 210 DAMSE) and 14 December (at 224 - 225 DAMSE) revealed that out of 6 observations, only in two cases i.e. in 1985 on 30 November - 1st December (at 180 DAMSE) and 1986 on 14 December at 224 - 225 DAMSE there were significant differences in number of inflorescences between the two differently spaced crops. During 1987, from 15 - 16 October to 14 December, there were no significant differences in number of inflorescences m^{-2} between 20 cm and 40 cm spaced crops. Early cutting or defoliation at vegetative stage did not hamper the population of growing points and floral spikes.

4.3.6.3 Effect of phosphatic fertilization : Application of phosphatic fertilizer (P_{80}) invariably helped in increasing number of inflorescences m^{-2} as evident from the

Table 4.62 Effect of cutting on number inflorescences m^{-2}
(Experiment no. 1c - 1985, 1c - 1986 and 1c - 1987)

Timing of observation	Year	Cutting management		S.Em ±	CD at 5 %
		No cut	Cut at 60-62 DAMSE		
30 Sep-1 Oct					
(150 DAMSE)	1985	563	428	13.0	38.1
	1986	574	422	14.1	41.4
	1987	624	805	15.9	45.9
	Mean	587	451	13.3	42.1
15-16 Oct					
(165 DAMSE)	1985	1496	1230	65.0	191.1
	1986	1341	1142	51.4	151.1
	1987	1060	971	23.2	NS
	Mean	1299	1114	46.5	183.5
30 Oct-1 Nov					
(180 DAMSE)	1985	1727	1550	31.1	91.6
	1986	1747	1613	42.5	124.9
	1987	2256	2121	79.4	NS
	Mean	1910	1284	51.0	150.6
15-16 Nov					
(195 DAMSE)	1985	3398	3381	77.5	NS
	1986	3163	2835	65.9	193.8
	1987	3609	3414	78.4	NS
	Mean	3390	3210	73.9	NS
30 Nov-1 Dec					
(210 DAMSE)	1985	6184	5962	69.5	204.4
	1986	5527	5279	129.2	NS
	1987	7034	6775	110.0	NS
	Mean	6248	6005	102.9	NS
14 Dec					
(224-225 DAMSE)	1985	8442	8260	138.8	NS
	1986	7250	6966	83.3	245.0
	1987	9913	9953	113.6	NS
	Mean	8535	8393	236.6	NS

five observations recorded from 30th September to 14th December (from 150 to 225 DAMSE) in all the three years (Table 4.63).

Even at 150 DAMSE i.e. 90 days after cutting there were significant differences of number of inflorescence between two differently fertilized (P_{80}-fertilized and P_0-fertilized) crops. The number of inflorescences were 463 - 527 in 1985, 477 and 519 in 1986 and 514 and 615 in 1987 in unfertilized and fertilized crops respectively. In subsequent observation on 15 - 16 October (165 DAMSE) except 1987, the number of inflorescences between unfertilized and fertilized crops significantly differed. Almost similar trend of significant variation was noticed in subsequent observations made on 30 October - 1st November (at 180 DAMSE), 15 - 16 November (at 195 - 196 DAMSE), 30 November - 1 December (210 DAMSE) and 14 December (224 - 225 DAMSE).

4.3.7 Number of florets inflorescence^{-1}

4.3.7.1 Effect of spacing : The number of florets inflorescence^{-1} counted from the harvests made on 14 December (at 224 - 225 DAMSE) in all the years showed significant higher number of florets inflorescence^{-1} in 40 cm apart row spaced crop than 20 cm apart row spaced crop except in the year 1985 (Table 4.64). Number of florets inflorescence^{-1} from all the other harvests made at 231 - 232 and 238 - 239 DAMSE

Table 4.63 Effect of phosphatic fertilization on number of inflorescences m^{-2} (Experiment no. 1c - 1985, 1c - 1986 and 1c - 1987)

Timing of observation	Year	P_2O_5 (kg ha^{-1})		S.Em ±	CD at 5 %
		0	80		
30 Sep-1 Oct					
(150 DAMSE)	1985	463	527	13.0	38.1
	1986	477	519	14.1	41.4
	1987	514	615	15.9	45.9
	Mean	485	554	14.3	51.1
15-16 Oct					
(165 DAMSE)	1985	1244	1482	65.0	191.1
	1986	1123	1361	51.4	151.1
	1987	990	1042	23.2	NS
	Mean	1119	1295	46.5	NS
30 Oct-1 Nov					
(180 DAMSE)	1985	1549	1727	31.1	91.6
	1986	1626	1734	42.5	NS
	1987	2029	2384	79.4	233.7
	Mean	1734	1936	51.0	150.6
15-16 Nov					
(195 DAMSE)	1985	3207	3573	77.5	228.0
	1986	2704	3295	65.9	193.8
	1987	3196	3827	78.4	230.5
	Mean	3035	3565	73.9	217.4
30 Nov-1 Dec					
(210 DAMSE)	1985	3735	6411	69.5	204.4
	1986	5100	5706	129.2	380.0
	1987	6434	7373	110.0	323.5
	Mean	5757	6496	102.9	302.8
14 Dec					
(224-225 DAMSE)	1985	8044	8658	138.8	408.2
	1986	6743	7473	83.3	245.0
	1987	9721	10146	487.8	NS
	Mean	8169	8759	236.6	329.1

Table 4.64 Effect of spacing on number of florets inflorescence^{-1} (Experiment no. 1c - 1985, 1c - 1986 and 1c - 1987)

Timing of observation	Year	Row spacing in cm 20	40	S.Em ±	CD at 5 %
14 Dec					
(224-225 DAMSE)	1985	6.5	6.7	0.12	NS
	1986	6.5	6.6	0.02	0.05
	1987	6.6	6.7	0.02	0;05
	Mean	6.5	6.7	0.05	NS
21-22 Dec					
(231-232 DAMSE)	1985	7.5	7.6	0.01	0.03
	1986	6.8	6.8	0.02	0.06
	1987	7.7	7.9	0.02	0.04
	Mean	7.3	7.4	0.02	0.04
28-29 Dec					
(238-239 DAMSE)	1985	7.5	7.6	0.01	0.04
	1986	6.9	7.1	0.02	0.06
	1987	7.6	7.6	0.01	0.04
	Mean	7.3	7.4	0.01	0.05

showed significantly higher number of florets inflorescence^{-1} in 40 cm apart row spaced crop in comparison with 20 cm apart row spaced crop. It was observed that the number of florets inflorescence^{-1} ranged from 6.5 to 6.7 in first harvest, whereas there was considerable increase in number of florets inflorescence^{-1} in second harvest and that ranged from 6.8 in 1986 to 7.7 in 1987 in 20 cm row spaced crop. Corresponding figures in 40 cm apart row spaced crops ranged from 6.8 in 1986 to 7.9 in 1987 (Table 4.64).

4.3.7.2 Effect of cutting : From the harvest made on 14 December (224 - 225 DAMSE) in all the three years except in 1985, there were significant variation in number of florets inflorescence^{-1} due to the effect of cutting. In second harvest made between 21 - 22nd December (231 - 232 DAMSE) there were no significant variations between uncut and cut treatments. From the third harvest recorded between 28 - 29 December (238 - 239 DAMSE) except in 1986, there were significant variation in number of florets inflorescence^{-1} in 1985 and 1987. The floret number inflorescence^{-1} of second harvest were higher than those recorded in first harvest (Table 4.65).

4.3.7.3 Effect of phosphatic fertilization : In all the observations made in three years except in the first harvest made on 14 December 1985 at 224 - 225 DAMSE, fertilized

Table 4.65 Effect of cutting on number of florets inflorescence^{-1} (Experiment no. 1c - 1985, 1c - 1986 and 1c - 1987)

Timing of observation	Year	Cutting management: No cut	Cutting management: Cut at 60-62 DAMSE	S.Em ±	CD at 5 %
14 Dec					
(224-225 DAMSE)	1985	6.7	6.5	0.12	NS
	1986	6.6	6.4	0.02	0.05
	1987	6.8	6.5	0.02	0.05
	Mean	6.7	6.5	0.05	NS
21-22 Dec					
(231-232 DAMSE)	1985	7.5	7.5	0.02	NS
	1986	6.8	6.8	0.01	NS
	1987	7.8	7.8	0.02	NS
	Mean	7.4	7.4	0.02	NS
28-29 Dec					
(238-239 DAMSE)	1985	7.5	7.6	0.01	0.04
	1986	7.0	7.0	0.02	NS
	1987	7.6	7.6	0.01	0.04
	Mean	7.4	7.4	0.01	NS

(P_{80}) crops produced significantly higher number of florets inflorescence^{-1} than those recorded in unfertilized (P_0) crops (Table 4.66). Mean number of florets inflorescence^{-1} from first harvest were 6.4 in unfertilized; 6.7 in fertilized crops; the corresponding figures in both second and third harvests were 7.3 and 7.4 at 231 - 232 DAMSE and 238 - 239 DAMSE.

4.3.8 Number of seeds set floret^{-1}

4.3.8.1 Effect of spacing : One of the factors responsible for seed yield is number of seeds floret^{-1}. On each harvest in each of the three years, the number of seeds set floret^{-1} were counted from the randomly selected 100 florets. The harvest made on 14 December i.e. at 224 - 225 DAMSE revealed that except in 1987, there was no significant difference between crops established at 20 and 40 cm apart rows. The crop established in 40 cm rows produced significantly higher (Table 4.67) number of seeds floret^{-1} (1.7) than those from the crop established in 20 cm apart rows (1.66) in 1987. But in subsequent harvest made at 231 - 232 DAMSE i.e. on 21 - 22 December, there were no significant differences in seed number set floret^{-1} between two crops established under different row spacings in all the three years. But from the last harvest in 1987, significant increase in number of seeds set floret^{-1} in crop established at 40 cm apart row (1.64) over those established in 20 cm apart rows (1.58) was recorded.

Table 4.66 Effect of phosphatic fertilization on number of florets inflorescence^{-1} (Experiment no. 1c - 1985, 1c - 1986 and 1c - 1987)

Timing of observation	Year	P_2O_5 (kg ha^{-1}) 0	P_2O_5 (kg ha^{-1}) 80	S.Em ±	CD at 5 %
14 Dec (224-225 DAMSE)	1985	6.5	6.8	0.12	NS
	1986	6.4	6.7	0.02	0.05
	1987	6.5	6.8	0.02	0.05
	Mean	6.4	6.7	0.05	NS
21-22 Dec (231-232 DAMSE)	1985	7.5	7.6	0.02	0.03
	1986	6.8	6.8	0.01	0.06
	1987	7.7	7.9	0.02	0.04
	Mean	7.3	7.5	0.02	0.04
28-29 Dec (238-239 DAMSE)	1985	7.5	7.6	0.01	0.04
	1986	6.9	7.1	0.02	0.06
	1987	7.6	7.7	0.01	0.04
	Mean	7.3	7.5	0.01	0.05

Table 4.67 Effect of spacing on number of seeds set floret^{-1}
(Experiment no. 1c - 1985, 1c - 1986 and 1c - 1987)

Timing of observation	Year	Row spacing in cm 20	40	S.Em ±	CD at 5 %
14 Dec					
(224-225 DAMSE)	1985	1.61	1.62	0.01	NS
	1986	1.66	1.67	0.02	NS
	1987	1.66	1.71	0.01	0.03
	Mean	1.64	1.66	0.01	NS
21-22 Dec					
(231-232 DAMSE)	1985	1.66	1.65	0.01	NS
	1986	1.66	1.69	0.01	NS
	1987	1.71	1.72	0.01	NS
	Mean	1.67	1.69	0.01	NS
28-29 Dec					
(238-239 DAMSE)	1985	1.59	1.61	0.01	NS
	1986	1.66	1.68	0.02	NS
	1987	1.58	1.64	0.01	0.04
	Mean	1.61	1.64	0.02	NS

4.3.8.2 Effect of cutting : Defoliation i.e. cutting at early vegetative stage had no effect on the number of seeds set floret^{-1} on all the harvests made at weekly interval spanning from 224 - 225 to 238 - 239 DAMSE (Table 4.68).

In 1985 the number of seeds set floret^{-1} recorded were 1.62 and 1.61 at 224 - 225 DAMSE, 1.64 and 1.64 at 231 - 232 DAMSE and 1.58 and 1.61 at 238 - 239 DAMSE from uncut and cut treatments respectively; in 1986 corresponding figures were 1.67 and 1.65 (first harvest), 1.67 and 1.68 (second harvest) and 1.66 and 1.69 (third harvest) and in 1987, those figures were 1.71 and 1.65, 1.71 and 1.73 and 1.60 and 1.63 respectively.

4.3.8.3 Effect of phosphatic fertilization : Phosphatic fertilizer (P_{80}) had significant effect in increasing the number of seeds set floret^{-1}. Except in 1986, at 224 - 225 DAMSE and at 238 - 239 DAMSE in all the other harvest of three years, significant effect of P_2O_5 in increasing seed number set floret^{-1} were recorded (Table 4.69). The harvest made on 224 - 225 DAMSE in 1985 and 1987 gave 1.58 and 1.65, 1.63 and 1.73 number of seeds set floret^{-1} from unfertilized and fertilized crops respectively. The harvests made at 231 - 232 DAMSE in all the years showed significant increase in number of seeds from fertilized crops over unfertilized crops. The mean number of seeds of second harvest of three years also showed significant increase in number of seeds

Table 4.68 Effect of cutting on number of seeds set floret^{-1} (Experiment no. 1c - 1985, 1c - 1986 and 1c - 1987)

Timing of observation	Year	Cutting management: No cut	Cutting management: Cut at 60-62 DAMSE	S.Em ±	CD at 5 %
14 Dec (224-225 DAMSE)	1985	1.62	1.61	0.01	NS
	1986	1.67	1.65	0.02	NS
	1987	1.71	1.65	0.01	0.03
	Mean	1.67	1.63	0.01	NS
21-22 Dec (231-232 DAMSE)	1985	1.64	1.64	0.01	NS
	1986	1.67	1.68	0.01	NS
	1987	1.71	1.73	0.01	NS
	Mean	1.67	1.68	0.01	NS
28-29 Dec (238-239 DAMSE)	1985	1.58	1.61	0.01	NS
	1986	1.66	1.69	0.02	NS
	1987	1.60	1.63	0.01	NS
	Mean	1.61	1.64	0.01	NS

Table 4.69 Effect of phosphatic fertilization on number of seeds set floret^{-1} (Experiment no. 1c - 1985, 1c - 1986 and 1c - 1987)

Timing of observation	Year	P_2O_5 (kg ha^{-1}) 0	80	S.Em ±	CD at 5 %
14 Dec					
(224-225 DAMSE)	1985	1.58	1.65	0.01	0.05
	1986	1.65	1.68	0.02	NS
	1987	1.63	1.73	0.01	0.03
	Mean	1.62	1.69	0.01	0.04
21-22 Dec					
(231-232 DAMSE)	1985	1.62	1.66	0.01	0.04
	1986	1.65	1.70	0.01	0.04
	1987	1.70	1.74	0.01	0.04
	Mean	1.66	1.70	0.01	0.04
28-29 Dec					
(238-239 DAMSE)	1985	1.58	1.62	0.01	0.04
	1986	1.65	1.69	0.02	NS
	1987	1.58	1.65	0.01	0.04
	Mean	1.60	1.65	0.01	0.04

floret^{-1} in fertilized crops. Seed number set floret^{-1} of the last harvest made at 238 - 239 DAMSE gave almost the same trend of significant variation like that of first harvest. Except in 1986, in other two years there were significant differences in number of seeds floret^{-1} between the unfertilized (1.58 in 1985 and 1987) and fertilized crops (1.62 and 1.65 in 1985 and 1987 respectively).

Although the number of seeds set floret^{-1} was not significantly different between fertilized and unfertilized crops at 224 - 225 DAMSE and at 238 - 239 DAMSE in 1986, but from the mean of three years it was found that at every harvest there was significant difference in number of seeds set floret^{-1}; 1.62 and 1.69, 1.66 and 1.70 and 1.60 and 1.65 were the number of seeds set floret^{-1} from unfertilized and fertilized crops respectively.

4.3.9 Test weight (1000 seed weight) of seed in g :

4.3.9.1 Effect of spacing : Individual seed weight is one of the determining factor of seed yield. To ascertain seed weight, 1000 mature seeds of each harvest in each year was weighed. It was found that the 1000 seed weight was higher when harvested early in the season in comparison with those from late harvests (Table 4.70). There was significant difference in 1000 seed weight between the two row spacings. The 1000 seed weights were 2.71 and 2.73 g in 1985, 2.43 and 2.44 g in 1986 and 2.70 and 2.73 g in 1987 in crops

Table 4.70 Effect of spacing on 1000 seed weight in g (Experiment no. 1c - 1985, 1c - 1986 and 1c - 1987)

Timing of observation	Year	Row spacings in cm 20	40	S.Em ±	CD at 5 %
14 Dec					
(224-225 DAMSE)	1985	2.71	2.73	0.02	0.01
	1986	2.43	2.44	0.0008	NS
	1987	2.70	2.73	0.006	0;02
	Mean	2.61	2.63	0.01	NS
21-22 Dec					
(231-232 DAMSE)	1985	2.66	2.68	0.0009	0.003
	1986	2.44	2.44	0.002	0.005
	1987	2.70	2.72	0.005	0.02
	Mean	2.60	2.61	0.002	NS
28-29 Dec					
(238-239 DAMSE)	1985	2.57	2.61	0.002	0.005
	1986	2.41	2.42	0.0007	0.002
	1987	2.60	2.61	0.01	NS
	Mean	2.52	2.55	0.004	NS

spaced at 20 and 40 cm apart rows respectively. The three years mean weight of 1000 seeds of first harvest made on 224 - 225 DAMSE were 2.61 and 2.63 g in 20 and 40 cm spaced crop respectively. The same trend of variation in the test weight of the seed harvested at 231 - 232 DAMSE was noticed. The 1000 seed weight were 2.66 and 2.68 g in 1985, 2.44 and 2.44 g in 1986 and 2.70 and 2.72 g in 1987 in 20 and 40 cm apart row spaced crops respectively. In the last harvest, 1000 seed weight except in 1987, differed significantly between the two row spacings.

4.3.9.2 Effect of cutting : Defoliation caused significant effect at early harvest on 1000 seed weight. The 1000 seed weight from uncut and cut treatments (Table 4.71) were 2.73 and 2.71 g in 1985 and 2.45 and 2.44 g in 1986 respectively. In 1987 there was no significant difference in 1000 seed weight between uncut and cut treatments. In subsequent harvest made at 231 - 232 DAMSE the cut treatments showed significantly higher 1000 seed weight than that in the uncut treatments; 2.66 and 2.68 g in 1985, 2.44 and 2.44 in 1986 and 2.70 and 2.72 g in 1987 were the 1000 seed weights from uncut and cut treatments respectively. Similar was the trend of variation in the last harvest made at 238 - 239 DAMSE except in 1987 where no significant difference was found.

Table 4.71 Effect of cutting on 1000 seed weight in g (Experiment no. 1c - 1985, 1c - 1986 and 1c - 1987)

Timing of observation	year	Cutting management: No cut	Cutting management: Cut at 60-62 DAMSE	S.Em ±	CD at 5 %
14 Dec					
(224-225 DAMSE)	1985	2.73	2.71	0.02	0.01
	1986	2.45	2.44	0.0008	0.002
	1987	2.71	2.72	0.006	NS
	Mean	2.63	2.62	0.009	NS
21-22 Dec					
(231-232 DAMSE)	1985	2.66	2.68	0.0009	0.003
	1986	2.44	2.44	0.002	0.005
	1987	2.70	2.72	0.005	0.02
	Mean	2.60	2.61	0.003	0.009
28-29 Dec					
(238-239 DAMSE)	1985	2.58	2.61	0.002	0.005
	1986	2.41	2.42	0.0007	0.002
	1987	2.59	2.61	0.01	NS
	Mean	2.53	2.55	0.004	0.015

4.3.9.3 Effect of phosphatic fertilization : Phosphatic fertilization (P_{80}) significantly increased the test weight (Table 4.72). The 1000 seed weights from unfertilized (P_0) and fertilized (P_{80}) crops were 2.71 and 2.73 g, 2.65 and 2.69 g and 2.58 and 2.61 g obtained from first (at 224 - 225 DAMSE), second (at 231 - 232 DAMSE) and third (at 238 - 239 DAMSE) harvests respectively in 1985. Similar was the trend of variation in test weights in 1986 and 1987. There was a decline in 1000 seed weight with successive harvests except in the year 1986, when in both first and second harvests, the test weight of seeds remained identical.

4.3.10 Seed yield g m^{-2}

4.3.10.1 Effect of spacing : In all the years of study (1985, 1986 and 1987) there was significant variation in seed yield between the crops established under two different row spacings (Table 4.73) at 224 - 225, 231 - 232 and 238 - 239 DAMSE. Even in 1987 at 246 DAMSE the seed yield from 40 cm row spaced crop was significantly superior to that from 20 cm row spaced crop. Mean seed yields obtained at 224 - 225 DAMSE were 32.27 g m^{-2} in the crop spaced in 20 cm rows and 36.83 g m^{-2} in the crop established in 40 cm apart row. At 231 - 232 DAMSE the mean seed yields were 47.0 and 53.1 g m^{-2} with 20 and 40 cm row spacings respectively. At 238 - 239 DAMSE seed yields were 36.62 and 42.82 g m^{-2} in 20 and 40 cm row spaced crops respectively.

Table 4.72 Effect of phosphatic fertilization on 1000 seed weight in gg (Experiment no. 1c - 1985, 1c - 1986 and 1c - 1987)

Timing of observation	Year	P_2O_5 (kg ha^{-1})		S.Em ±	CD at 5 %
		0	80		
14 Dec					
(224-225 DAMSE)	1985	2.71	2.73	0.02	0.01
	1986	2.42	2.46	0.0008	0.002
	1987	2.69	2.74	0.006	0.002
	Mean	2.61	2.64	0.009	0.01
21-22 Dec					
(231-232 DAMSE)	1985	2.65	2.69	0.0009	0.003
	1986	2.42	2.46	0.002	0.005
	1987	2.69	2;73	0.005	0.02
	Mean	2.59	2.63	0.003	0.009
28-29 Dec					
(238-239 DAMSE)	1985	2.58	2.61	0.002	0.005
	1986	2.40	2.43	0.0007	0.002
	1987	2.57	2.63	0.01	0.04
	Mean	2.52	2.56	0.004	0.02

Table 4.73 Effect of spacing on seed yield g m^{-2} (Experiment No. 1c - 1985, 1c - 1986 and 1c - 1987)

Timing of observation	Year	Row spacings in cm 20	40	S.Em ±	CD at 5 %
14 Dec					
(224-225 DAMSE)	1985	33.99	40.65	0.39	1.14
	1986	26.10	29.57	0;40	1.16
	1987	36.71	40.27	0.39	1.16
	Mean	32.27	36.83	0.39	1.15
21-22 Dec					
(231-232 DAMSE)	1985	47.90	52.10	0.94	2.77
	1986	33.72	42.10	0.89	2.63
	1987	59.37	65.10	1.26	3.72
	Mean	47.00	53.10	1.03	3.04
28-29 Dec					
(238-239 DAMSE)	1985	34.27	40.59	0.33	0.97
	1986	40.60	47.86	0.63	1.85
	1987	35.00	40.00	0.48	1.40
	Mean	36.62	42.82	0.48	1.41
5th Jan 1988					
(246 DAMSE)	1987	27.87	30.66	0.55	1.62
Seed yield received from sweeping	1985	36.84	38.98	0.92	NS
	1986	29.87	31.93	0.64	1.89
	1987	38.20	48.00	1.02	2.99
	Mean	34.97	39.64	0.86	NS
Highest yield produced	1985	87.74	91.08	0.93	2.73
	1986	70.47	79.79	0.64	1.87
	1987	97.57	113.10	1.25	3.36
	Mean	85.26	94.66	0.94	2.65

Dates of mean seedling emergence - 3.5.85; 4.5.86; 3.5.87, where DAMSE = Day after mean seedling emergence date

The mean differences in seed yields in 1985, 1986 and 1987 at 224 - 225, 231 - 232 and 238 - 239 DAMSE were all significant.

The highest seed yield in 1985 was obtained when the harvest was made at the end of third week in December. 47.9 and 52.1 g m^{-2} were the seed yields in 20 and 40 cm row spaced crops respectively, the corresponding figures were 59.37 and 65.1 g m^{-2} in 1987. During the year 1986 the highest yields were obtained when harvested in the last week of December (at 238 - 239 DAMSE).

Except in 1985, the 40 cm row spaced crop produced significantly higher seed yield (31.93 g m^{-2} in 1986; and 48.0 g m^{-2} in 1987) from sweepings over 20 cm row spaced crop sweepings (29.87 g m^{-2} in 1986 and 38.20 g m^{-2} in 1987).

The total yields including sweeping in all the three years was significantly more in 40 cm row-spaced crop than 20 cm row spaced crop. The highest yields were 87.74 and 91.08 g m^{-2} in 1985. 70.47 and 79.79 g m^{-2} in 1986 and 97.57 and 113.1 g m^{-2} in 1987 from 20 and 40 cm row spaced crops respectively.

4.3.10.2 Effect of cutting : Defoliation affected flowering at the earlier stages. Although flowering started after 56 days of mean seedling emergence date, but in defoliated swards flowering did not take place after cutting was imposed. During the month of September when there was decline in day and night temperatures some of the uncut crops showed flowering, but at that time in defoliated swards no flower was visible. Wilaipon et al. (1979) reported while working in Australia that in case of Verano, defoliation at early vegetative and early floral induction stages did not impair inflorescence density as it enhanced the rate of subsequent bud site differentiation. At the first harvest seed yields recorded at 224 - 225 DAMSE i.e. 164 - 165 days after cutting, showed significant difference between undefoliated and defoliated swards. In 1985, 39.84 and 34.8 g m^{-2} in 1986, 29.60 and 26.1 g m^{-2} and in 1987, 40.39 and 36.59 g m^{-2} seed yields were obtained in uncut and cut treatments respectively (Table 4.74). Mean yield of three years at 224 - 225 DAMSE also recorded similar difference; the yields were 36.61 g m^{-2} and 32.50 g m^{-2} from uncut and cut treatments respectively. In subsequent cutting after a week there was no significant difference in seed yield between cut and uncut swards. When harvested at 231 - 232 DAMSE the seed yields were better in cut treatments. The seed yields of the harvests made at 238 - 239 DAMSE, in all the three years, showed that from cut treatments, seed yields were significantly higher than that in uncut treatments except in 1986.

Table 4.74 Effect of cutting on seed yield g m^{-2} (Experiment no. 1c - 1985, 1c - 1986 and 1c - 1987)

Timing of observation	Year	Cutting management: No cut	Cutting management: Cut at 60-62 DAMSE	S.Em ±	CD at 5 %
14 Dec					
(224-225 DAMSE)	1985	39.84	34.80	0.39	1.14
	1986	29.60	26.10	0.40	1.16
	1987	40.39	36.59	0.39	1.15
	Mean	36.61	32.50	0.39	1.15
21-22 Dec					
(231-232 DAMSE)	1985	49.93	50.00	0.94	NS
	1986	36.99	38.84	0.89	NS
	1987	61.81	62.65	1.26	NS
	Mean	49.58	50.50	1.03	NS
28-29 Dec					
(238-239 DAMSE)	1985	35.26	39.59	0.33	0.97
	1986	44.26	44.21	0.63	NS
	1987	35.29	39.77	0.47	1.40
	Mean	38.27	41.19	0.48	1.67
5th Jan 1988					
(246 DAMSE)	1987	25.93	32.60	0.55	1.62
Seed yield received from sweeping	1985	38.85	36.98	0.92	NS
	1986	32.01	29.78	0.64	1.89
	1987	43.28	42.94	1.02	NS
	Mean	38.05	36.58	0.86	NS
Total yields	1985	88.78	86.98	0.93	NS
	1986	76.27	73.99	0.64	1.87
	1987	105.09	105.59	1.25	NS
	Mean	90.04	88.85	0.94	NS

In the year 1987, fourth harvest was made on fifth January (at 246 DAMSE) 1988. Seed yield from cut treatments gave significantly better yield than uncut treatments. The seed yield received including sweeping were 88.78 and 86.98 g m^{-2} in 1985, 76.27 and 73.99 g m^{-2} in 1986, 105.09 and 105.59 g m^{-2} in 1987.

4.3.10.3 Effect of phosphatic fertilization : There was significant effect of phosphatic fertilizer on the seed yield. It was observed that in each harvest of a year, fertilized (P_{80}) crops produced significantly high seed yields than unfertilized (P_0) crops. The crop when harvested at 224 - 225 DAMSE, the yields in 1985 were 34.04 and 40.59 g m^{-2} from unfertilized and fertilized crops respectively. Even in the seed yields of harvest effected on 14 December every year (224 - 225 DAMSE) gave significant increase in seed yield in case of fertilized crops (Table 4.75).

The same trends of significant variation were noticed in subsequent harvests made at 231 - 232 and 238 - 239 DAMSE. In second harvest the yields were 47.15 and 52.81 g m^{-2} in 1985, in 1986, 34.83 and 41.0 g m^{-2} and in 1987, 58.19 and 66.27 g m^{-2} from unfertilized and fertilized crops respectively. From the mean yields of the second harvests of three years, the seed yields were 46.72 g m^{-2} from unfertilized and 53.36 g m^{-2} from fertilized crops. From the last

Table 4.75 Effect of phosphatic fertilization on seed yield g m^{-2} (Experiment no. 1c - 1985, 1c - 1986 and 1c - 1987)

Timing of observation	Year	P_2O_5 (kg ha^{-1}) 0	80	S.Em ±	CD at 5 %
14 Dec					
(224-225 DAMSE)	1985	34.04	40.59	0.39	1.14
	1986	23.80	31.88	0.40	1.16
	1987	35.46	41.52	0.39	1.16
	Mean	31.10	38.00	0.39	1.15
21-22 Dec					
(231-232 DAMSE)	1985	47.15	52.81	0.94	2.77
	1986	34.83	41.00	0.89	2.63
	1987	58.19	66.27	1.26	3.72
	Mean	46.72	53.36	1.03	3.04
28-29 Dec					
(238-239 DAMSE)	1985	34.40	40.45	0.33	0.97
	1986	48.68	47.79	0.63	1.85
	1987	33.96	41.10	0.48	1.40
	Mean	39.01	43.11	0.48	1.41
5th Jan					
(246 DAMSE)	1987	26.63	31.90	0.55	1.62
Seed Yield received from sweeping	1985	35.23	40.59	0.92	2.71
	1986	27.96	33.84	0.64	1.89
	1987	40.69	45.53	1.02	2.99
	Mean	34.63	39.99	0.86	2.53
Total yields	1985	82.38	93.40	0.93	2.73
	1986	76.64	81.63	0.64	1.87
	1987	98.88	111.80	1.25	3.36
	Mean	85.97	95.61	0.94	2.65

harvest made at 238 - 239 DAMSE in 1985, the seed yield obtained were 34.40 and 40.45 g m^{-2}; in 1986 48.68 and 47.79 g m^{-2}; and in 1987 the corresponding yields were 33.96 and 41.1 g m^{-2} from unfertilized and fertilized crops respectively. Mean yield of three harvests of all the years also showed significant increase in seed yield from fertilized crops. Seed collected from sweeping also showed the significant higher yield in fertilized crops. In 1985 seed yields through sweeping were 35.23 and 40.59 g m^{-2}; in 1986 these were 27.96 and 33.84 g m^{-2} and in 1987, 40.69 and 45.33 g m^{-2} from unfertilized and fertilized crops respectively. Total highest seed yield of each year including sweeping were 82.38 and 93.4 g m^{-2} in 1985, 76.64 and 81.63 g m^{-2} in 1986 and 98.88 and 111.8 g m^{-2} in 1987 from unfertilized and fertilized crops respectively.

One thing was evident that during the year 1986, the highest seed yield obtained was from the last harvest i.e. harvested on 238 - 239 DAMSE. But in 1985 and in 1987, the highest yields recorded, were from the second harvest i.e. at 231 - 232 DAMSE. Possibly due to rain in the month of November in 1986, seed maturity of early harvests were affected, subsequent maturity delayed and seed setting as well as maturity were benefitted in the last harvest made at 238 - 239 DAMSE.

4.4 Experiment no. 1d

Experiment no. 1d was carried out during the years 1986 and 1987. Wider spacings of 40 and 60 cm rows apart were adopted keeping all the other treatments similar to that of experiment no. 1c. For easy collection of seed materials and thereby to find out the maximum seed yield to be obtained, this experiment no. 1d was resorted to during the years 1986 and 1987.

4.4.1 Plant height

4.4.1.1 Effect of spacing : The plant heights at 30 days intervals during the period from 60 to 150 DAMSE (days after mean seedling emergence date) were recorded. In the year 1986, plant heights between two row spaced crops differed significantly in all the observations except at 90 DAMSE (Table 4.76). In 1987, no significant effect of spacing was evident in all the four observations. In 1986 at 60, 120 and 150 DAMSE the plant heights were 37.1 and 38.8 cm; 62.6 and 63.3 cm; 74.3 and 75.8 cm from 40 and 60 cm row spaced crops respectively (Table 4.76). In 1987, though the plant heights recorded were better than that of 1986 crop but no significant difference between two row spaced crop was found. Mean plant heights at 90 and 120 DAMSE of both 1986 and 1987 crop did not differ irrespective of 40 and 60 cm row spacings but at 60 and 150 DAMSE

Table 4.76 Effect of spacing on plant height in cm (Experiment no. 1d - 1986 and 1d - 1987)

Timing of observation	Year	Row spacings in cm 40	60	S.Em ±	CD at 5 %
3 Jul					
(60 DAMSE)	1986	37.1	38.8	0.38	1.13
	1987	39.7	41.6	0.74	NS
	Mean	38.4	40.2	0.56	1.65
2 Aug					
(90 DAMSE)	1986	46.4	46.8	0.70	NS
	1987	51.2	51.8	0.27	NS
	Mean	48.8	49.3	0.49	NS
1 Sep					
(120 DAMSE)	1986	62.6	63.3	0.16	0.47
	1987	63.4	63.9	0.29	NS
	Mean	63.0	63.6	0.23	NS
1 Oct					
(150 DAMSE)	1986	74.3	75.8	0.18	0.54
	1987	83.5	87.0	1.49	NS
	Mean	78.9	81.4	0.84	2.46

DAMSE = Days after mean seedling emergence

date - 4.5.86 and 4.5.87

mean plant heights of 40 and 60 cm row spaced crops differed significantly showing 60 cm apart rows superior to 40 cm apart rows.

4.4.1.2 Effect of cutting : At 60 DAMSE, before cutting, plant heights in both the years as usual did not differ significantly; but cutting had affected the plant height in subsequent observation at 90 DAMSE in both the years. Uncut treatments had higher plant heights than cut treatments (Table 4.77). Similar was the trend of variation in plant heights due to cutting treatments in subsequent dates of observations in both the years.

4.4.1.3 Effect of phosphatic fertilizer : Phosphatic fertilizer (P_{80}) had significant effect in increasing the plant heights (Table 4.78). In 1986, at 60, 90, 120 and 150 DAMSE the plant heights in 40 and 60 cm row spaced crops were 36.7 and 39.2, 45.0 and 48.2, 61.4 and 64.5, 73.0 and 76.5 cm respectively. Similar was the trend of variation in plant heights in 1987. The mean plant heights of both the years also showed significant effect of phosphatic fertilization over control (P_0).

4.4.2 Number of primary branches m^{-2}

Number of primary branches were counted on two occasions in each year.

Table 4.77 Effect of cutting on plant heights in cm (Experiment no. 1d - 1986 and 1d - 1987)

Timing of observation	Year	Cutting management: No cut	Cutting management: Cut at 60 DAMSE	S.Em ±	CD at 5 %
3 Jul					
(60 DAMSE)	1986	38.2	37.8	0.38	NS
	1987	40.5	40.7	0.74	NS
	Mean	39.4	39.3	0.56	NS
2 Aug					
(90 DAMSE)	1986	62.7	30.5	0.70	2.05
	1987	72.0	30.9	0.27	0.78
	Mean	67.4	30.7	0.49	1.42
1 Sep					
(120 DAMSE)	1986	77.0	49.0	0.16	0.47
	1987	78.5	48.8	0.29	0.85
	Mean	77.8	48.9	0.23	0.66
1 Oct					
(150 DAMSE)	1986	84.8	65.4	0.18	0.54
	1987	94.9	75.6	1.49	4.38
	Mean	89.9	70.5	0.84	2.46

Table 4.78 Effect of phosphatic fertilization on plant height in cm (Experiment no. 1d - 1986 and 1d - 1987)

Timing of observation	Year	P_2O_5 (kg ha^{-1}) 0	80	S.Em ±	CD at 5 %
3 Jul					
(60 DAMSE)	1986	36.7	39.2	0.38	1.13
	1987	39.1	42.2	0.74	2.17
	Mean	37.9	40.7	0.56	1.65
2 Aug					
(90 DAMSE)	1986	45.0	48.2	0.70	2.06
	1987	49.5	53.2	0.27	0.78
	Mean	47.3	50.7	0.49	1.42
1 Sep					
(120 DAMSE)	1986	61.4	64.5	0.16	0.47
	1987	62.0	65.3	0.29	0.85
	Mean	61.7	64.9	0.23	0.66
1 Oct					
(150 DAMSE)	1986	73.0	76.5	0.18	0.54
	1987	82.3	88.2	1.49	4.38
	Mean	77.7	82.4	0.84	2.46

4.4.2.1 Effect of spacing : In both the years, no significant difference in number of primary branches m^{-2} was o found due to difference in spacing in all the dates of observations (Table 4.79).

4.4.2.2 Effect of cutting : Before cutting at 45 and 60 DAMSE in 1986 and 1987 respectively no significant difference was found but at 90 DAMSE in both the years uncut treatments had more primary branches than those in cut treatments. The branch number were 1209 and 671 m^{-2} and 1161 and 714 m^{-2} in uncut and cut treatments in 1986 and 1987 respectively.(Table 4.80).

4.4.2.3 Effect of phosphatic fertilization : At 45 DAMSE in 1986, fertilized crops had significantly higher number of primary branches m^{-2} (693) than in unfertilized crops (636); but in 1987 at 60 DAMSE, no significant difference was recorded. At 90 DAMSE in both the years, fertilized crops had significantly higher number of primary branches in comparison with unfertilized crops. The number of primary branches were 911 and 970 m^{-2} in 1986, 909 and 966 m^{-2} in 1987 from unfertilized and fertilized plots, respectively (Table 4.81).

4.4.3 Number of secondary branches m^{-2}

4.4.3.1 Effect of spacing : Secondary branches m^{-2} were counted at one month interval from 60 DAMSE onwards. At

Table 4.79 Effect of spacing on number of primary branches m^{-2} (Experiment no. 1d - 1986 and 1d - 1987)

Timing of observation	Year	Row spacings in cm 40	60	S.Em ±	CD at 5 %
18 Jun					
(45 DAMSE)	1986	662	668	5.0	NS
3 Jul					
(60 DAMSE)	1987	892	902	15.9	NS
	Mean	777	785	10.4	NS
2 Aug					
(90 DAMSE)	1986	920	961	17.4	NS
	1987	932	942	8.6	NS
	Mean	926	952	13.0	NS

Table 4.80 Effect of cutting on the number of primary branches m^{-2} (Experiment no. 1d - 1986 and 1d - 1987)

Timing of observation	Year	Cutting management No cut	Cut at 60	S.Em ±	CD at 5 %
18 Jun					
(45 DAMSE)	1986	662	667	5.0	NS
3 Jul					
(60 DAMSEO	1987	889	950	15.9	NS
	Mean	776	786	10.4	NS
2 Aug					
(90 DAMSE)	1986	1209	671	17.4	51.30
	1987	1161	714	8.6	25.17
	Mean	1185	693	13.0	38.24

Table 4.81 Effect of phosphatic fertilization on number of primary branches m^{-2} (Experiment no. 1d - 1986 and 1d - 1987)

Timing of observation	Year	P_2O_5 (kg ha^{-1}) 0	80	S.Em ±	CD at 5 %
18 Jun (45 DAMSE)	1986	636	693	5.0	14.64
3 Jul (60 DAMSE)	1987	877	917	15.9	NS
	Mean	757	805	10.4	NS
2 Aug (90 DAMSE)	1986	911	970	17.4	51.30
	1987	909	966	8.6	25.17
	Mean	910	968	13.0	28.24

60 DAMSE in 1986, 2200 and 2426 m^{-2} were the secondary branch number in 40 and 60 cm row-spaced crop respectively and these differed significantly. But in 1987 at 60 DAMSE no significant difference was found between two row spaced crop. At 90 DAMSE in 1986, no significant difference in secondary branch number was evident but in 1987, 2714 and 2930 were secondary branches m^{-2} at 40 and 60 cm spaced crops and the difference was significant (Table 4.82). At 120 DAMSE in 1986, significant difference between two row spacings was not found although the secondary branches m^{-2} were 3684 and 3753 m^{-2} in 40 and 60 cm row spaced crops, respectively. As Verano continued to have sympodial branching, secondary branches m^{-2} increased upto 150 DAMSE; difference between two row spacings in both the years were not found significant.

4.4.3.2 Effect of cutting : In 1987, at 60 DAMSE, there was no significant difference between uncut and cut treatments (Table 4.83). But at 90 DAMSE in 1986 there was significant difference between uncut and cut treatments. The number of secondary branches recorded were 3716 and 2941 m^{-2} in uncut and cut treatments in 1986; in 1987, the corresponding figures were 3248 and 2397 m^{-2} and these differed significantly. At 120 DAMSE also there was significant difference in secondary branch number in uncut (3999) over cut treatments (3438) and similar

Table 4.82 Effect of spacing on number of secondary branches m^{-2} (Experiment no. 1d - 1986 and 1d - 1987)

Timing of observation	Year	Row spacings in cm 40	60	S.Em ±	CD at 5 %
3 Jul					
(60 DAMSE)	1986	2200	2426	23.9	70.55
	1987	2456	2501	24.8	NS
	Mean	2328	2467	24.4	71.68
2 Aug					
(90 DAMSE)	1986	3295	3363	56.2	NS
	1987	2714	2930	39.5	116.25
	Mean	3005	3147	47.9	NS
1 Sep					
(120 DAMSE)	1986	3684	3753	38.2	NS
	1987	3766	3999	61.9	182.16
	Mean	3725	3876	50.1	147.27
1 Oct					
(150 DAMSE)	1986	4640	4678	30.1	NS
	1987	5462	5576	80.5	NS
	Mean	5051	5127	55.3	NS

Table 4.83 Effect of cutting on number of secondary branches m^{-2} (Experiment no. 1d - 1986 and 1d - 1987)

Timing of observation	Year	Cutting management: No cut	Cutting management: Cut at 60 DAMSE	S.Em ±	CD at 5 %
3 Jul					
(60 DAMSE)	1986	2827	1799	23.9	70.55
	1987	2473	2483	24.8	NS
	Mean	2650	2141	24.4	71.68
2 Aug					
(90 DAMSE)	1986	3716	2941	56.2	165.34
	1987	3248	2397	39.5	116.25
	Mean	3482	2669	47.9	140.80
1 Sep					
(120 DAMSE)	1986	3999	3438	38.2	112.37
	1987	4509	3255	61.9	182.16
	Mean	4254	3347	50.1	147.27
1 Oct					
(150 DAMSE)	1986	4628	4691	30.1	NS
	1987	5627	5411	80.5	NS
	Mean	5128	5051	55.3	NS

was the trend of variation in 1987. But at 150 DAMSE in both the years, no significant difference in branch number were noticed between uncut and cut treatments.

4.4.3.3 Effect of phosphatic fertilizer : Phosphatic fertilizer application @ 80 kg ha^{-1} had significant effect in increasing secondary branch number at 60 DAMSE in both the years. The secondary branch number m^{-2} were 2193 and 2432 in 1986, and 2332 and 2624 in 1987, in unfertilized (P_0) and fertilized (P_{80}) plots respectively. At 90 DAMSE in 1986, no significant effect of fertilizer was noticed between unfertilized and fertilized plots (Table 4.84). In 1987, significant effect of fertilizer was evident, there were 2593 and 3052 number of secondary branches m^{-2} in unfertilized and fertilized plots, respectively. At 120 DAMSE in both the years significant differences in secondary branch number were recorded. At 120 DAMSE the mean secondary branch of two years showed significant difference between unfertilized and fertilized plots. At 150 DAMSE in 1986, significant variation between unfertilized and fertilized plots was recorded whereas in 1987, no significant effect was noticed.

4.4.4 Number of tertiary branches m^{-2}

<u>Stylosanthes hamata</u> cv. Verano bore huge number of tertiary branches in all the experiments. Hence only one counting was made at 150 DAMSE in the Experiment No. 1d.

Table 4.84 Effect of phosphatic fertilization on number of secondary branches m^{-2} (Experiment no. 1d - 1986 and 1d - 1987)

Timing of observation	Year	P_2O_5 (kg ha^{-1}) 0	60	S.Em ±	CD at 5 %
3 Jul					
(60 DAMSE)	1986	2193	2432	23.9	70.55
	1987	2332	2624	24.8	72.80
	Mean	2263	2528	24.4	71.68
2 Aug					
(90 DAMSE)	1986	3183	3474	56.2	165.34
	1987	2593	3052	39.5	116.25
	Mean	2888	3263	47.9	140.80
1 Sep					
(120 DAMSE)	1986	3569	3868	38.2	112.37
	1987	3708	4057	61.9	182.16
	Mean	3639	3963	50.1	147.27
1 Oct					
(150 DAMSE)	1986	4440	4879	30.1	88.42
	1987	5282	5756	80.5	236.87
	Mean	4861	5318	55.3	162.7

4.4.4.1 Effect of spacing : In 1986 at 150 DAMSE, 60 cm row spaced crop had significantly higher number of tertiary branches (7282) m^{-2} than in 40 cm row spaced crop (6983 m^{-2}). In 1987 at 150 DAMSE though the number of tertiary branches were more than that of 1986, yet the number of tertiary branches due to spacing did not differ significantly (Tab. 4.85).

4.4.4.2 Effect of cutting : In 1986, at 150 DAMSE, cut treatments produced (Table 4.86) significantly higher number of tertiary branches (7347 m^{-2}) than uncut treatments (6918 m^{-2}); but in 1987, no significant difference existed between uncut (7709 m^{-2}) and cut (7884 m^{-2}) treatments.

4.4.4.3 Effect of phosphatic fertilizer : In the year 1986 only, there was significant difference in tertiary branch number between P_0-fertilized (6759 m^{-2}) and P_{80}-fertilized (7506 m^{-2}) crops but in 1987, although the tertiary branch number was higher than 1986, yet the difference was not significant (4.87).

4.4.5 Dry matter accumulation in g m^{-2}

To measure the herbage yield the crop was harvested three times in both the years.

4.4.5.1 Effect of spacing : At 60 DAMSE no significant difference was recorded in dry matter accumulation between two differently row spaced crops in both the

Table 4.85 Effect of spacing on number of tertiary branches m^{-2} (Experiment no. 1d - 1986 and 1d - 1987)

Timing of observation	Year	Row spacings in cm		S.Em ±	CD at 5 %
		40	60		
1 Oct (150 DAMSE)	1986	6983	7282	81.6	240.14
	1987	7500	8090	469.0	NS
	Mean	7242	7686	316.1	NS

Table 4.86 Effect of cutting on number of tertiary branches m^{-2} (Experiment no.1d - 1986 and 1d - 1987)

Timing of observation	Year	Cutting management		S.Em ±	CD at 5 %
		No cut	Cut at 60 DAMSE		
1 Oct (150 DAMSE)	1986	6918	7347	81.6	240.14
	1987	7709	7884	469.0	NS
	Mean	7314	7616	316.1	NS

Table 4.87 Effect of phosphatic fertilization on number of tertiary branches m^{-2} (Experiment no. 1d - 1986 and 1d - 1987)

Timing of observation	Year	P_2O_5 (kg ha^{-1}) 0	80	S.Em ±	CD at 5 %
1 Oct					
(150 DAMSE)	1986	6759	7506	81.6	240.14
	1987	7428	7811	469.0	NS
	Mean	7094	7659	316.1	NS

years (Table 4.88). At 60 DAMSE 1986, dry herbage weights amounting to 362.6 and 356.7 g m^{-2} were recorded in 40 and 60 cm row spaced crops respectively. At 150 DAMSE in 1986, 60 cm row spaced crop accumulated significantly more dry matter (738.2 g m^{-2}) than 40 cm row spaced crop (726.0 g m^{-2}). But at 150 DAMSE in 1987, no significant difference in dry matter yield was recorded. At 224 - 225 DAMSE no significant difference were observed either in 1986 or in 1987 (Table 4.88). In 1986; 768.6 and 772.2 and in 1987, 756.2 and 760.0 were the dry matter accumulation g m^{-2} recorded from 40 and 60 cm row spaced crop respectively.

4.4.5.2 Effect of cutting management : At 60 DAMSE before cutting there was no significant difference in dry matter accumulation. But after cutting, the dry matter accumulation at 150 DAMSE, varied significantly between uncut and cut treatments in both the years. The dry matter yields were 741.7 and 722.6 g m^{-2} in uncut and cut treatments respectively in 1986 at 150 DAMSE. Similar trend of variation was also recorded in 1987 when dry matter yield obtained were 753.4 g m^{-2} from uncut treatments and 672.3 g m^{-2} from cut treatments and these differed significantly. At 224 DAMSE in 1986, uncut treatments produced significantly higher dry matter (776.3 g m^{-2}) than cut treatments (764.4 g m^{-2}) and in 1987, the same trend of

Table 4.88 Effect of spacing on dry matter accumulation of g m^{-2} (Experiment no. 1d - 1986 and 1d - 1987)

Timing of observation	Year	Row spacings in cm 40	60	S.Em ±	CD at 5 %
3 Jul					
(60 DAMSE)	1986	362.6	356.7	4.84	NS
	1987	346.6	348.9	2.99	NS
	Mean	354.6	352.8	3.91	NS
1 Oct					
(150 DAMSE)	1986	726.0	738.2	2.43	7.13
	1987	711.2	714.5	7.90	NS
	Mean	718.6	726.4	5.17	NS
14-15 Dec					
(224-225 DAMSE)	1986	768.6	772.2	3.36	NS
	1987	756.2	760.0	2.66	NS
	Mean	762.4	766.1	3.01	NS

significant difference in dry matter accumulation was recorded (Table 4.89).

4.4.5.3 Effect of phosphatic fertilizer : Phosphatic fertilizer (P_{80}) had significantly increased dry matter accumulation. At 60 DAMSE in 1986, dry matter accumulation were 348.4 and 370.9 g m^{-2} in fertilized crops before cutting and in 1987, the corresponding figures were 341.0 and 354.5 g m^{-2}. At 150 DAMSE i.e. 90 days after cutting in 1986, 721.8 and 742.6 g m^{-2} dry matter accumulation were recorded from unfertilized (P_0) and fertilized (P_{80}) crops respectively. In 1987 at 150 DAMSE there was significant difference between unfertilized (695.3 g m^{-2}) and fertilized (730.3 g m^{-2}) crops (Table 4.90). The mean dry matter yields of two years at 150 DAMSE showed significant difference between unfertilized and fertilized crops. At 224 - 225 DAMSE similar trend of significant variation was observed. The mean dry matter yield of two years at day 224 - 225 also showed significant difference between two levels of fertilizer application (P_2O_5).

4.4.6 Number of inflorescences m^{-2}

Although Verano is a short day (Cameron and Mannetje 1977) crop but it flowers beyond short day also. It is

Table 4.89 Effect of cutting on dry matter accumulation of plants g m^{-2} (Experiment no. 1d - 1986 and 1d - 1987)

Timing of observation	Year	Cutting management: No cut	Cutting management: Cut at 60 DAMSE	S.Em ±	CD at 5 %
3 Jul					
(60 DAMSE)	1986	360.8	358.6	4.84	NS
	1987	347.9	347.6	2.98	NS
	Mean	354.4	353.1	3.91	NS
1 Oct					
(150 DAMSE)	1986	741.7	722.6	2.43	7.13
	1987	753.4	672.3	7.90	23.24
	Mean	747.6	697.5	5.17	15.19
14-15 Dec					
(224-225 DAMSE)	1986	776.3	764.4	3.36	9.90
	1987	774.3	742.0	2.60	7.80
	Mean	775.3	753.2	3.01	8.86

Table 4.90 Effect of phosphatic fertilization on dry matter accumulation of plants g m^{-2} (Experiment no. 1d - 1986 and 1d - 1987)

Timing of observation	Year	P_2O_5 (kg ha^{-1}) 0	80	S.Em $\pm$	CD at 5 %
3 Jul (60 DAMSE)	1986	384.4	370;9	4.84	14.23
	1987	341.0	354.5	2.98	8.76
	Mean	344.7	362.7	3.91	11.50
1 Oct (150 DAMSE)	1986	721.8	742.6	2.43	7.13
	1987	695.3	730.3	7.90	23.24
	Mean	708.6	736.5	5.17	15.19
14-15 Dec (224-225 DAMSE)	1986	772.2	796.0	3.36	9.90
	1987	744.5	771.8	2.66	7.82
	Mean	760.9	784.0	3.01	8.86

rather a weak short day plant. In Verano at 56 DAMSE flowering was observed in the experimental plots. But the flowering was very sparse and all the plants did not come to bloom. So from October at each year counting of inflorescences were made at an interval of 14 - 15 days.

4.4.6.1 Effect of spacing : At 150 - 151 DAMSE the number of inflorescences m^{-2} did not differ significantly in 1986 but in 1987 there was significant difference. The number of inflorescences m^{-2} were 477 and 489 m^{-2} in 1986 and 580 and 663 m^{-2} in 1987 from 40 and 60 cm row spaced crops respectively (Table 4.91). The mean inflorescence number of two years significantly differed between two spacings; 529 and 576 m^{-2} were the number of inflorescences in 40 and 60 cm spacings, respectively. Similar trend of variation was found at 165 DAMSE. Significant difference between two row spacings was noticed in 1987 but not in 1986. In the subsequent observations at 180 DAMSE significant difference in inflorescence number m^{-2} was noticed in 1986; 1844 and 1951 were the inflorescences m^{-2}, formed in 40 and 60 cm row-spaced plots respectively. But there was no significant difference in number of inflorescences in 1987 although the number of inflorescences m^{-2} were more (2304 m^{-2} in 40 cm and 2480 m^{-2} in 60 cm row spaced crop). But the mean of two years showed significant variation in number of inflorescences m^{-2}. At 195 - 197 DAMSE in 1986,

Table 4.91 Effect of spacing on number of inflorescences m^{-2} (Experiment no. 1d - 1986 and 1d - 1987)

Timing of observation	Year	Row spacings in cm 40	60	S.Em $\pm$	CD at 5 %
1-2 Oct					
(150-151 DAMSE)	1986	477	489	5.4	NS
	1987	580	663	14.0	41.24
	Mean	529	576	9.7	28.63
16-17 Oct					
(165 DAMSE)	1986	720	764	22.6	NS
	1987	1082	1266	23.6	69.54
	Mean	901	1015	23.0	67.72
31 Oct-1 Nov					
(180 DAMSE)	1986	1844	1951	32.0	94.25
	1987	2304	2480	90.1	NS
	Mean	2074	2216	56.1	179.62
15-17 Nov					
(195 DAMSE)	1986	2803	2857	97.8	NS
	1987	3202	3392	46.1	135.73
	Mean	3003	3125	71.9	NS
30 Nov-1 Dec					
(210 DAMSE)	1986	5619	5751	85.2	NS
	1987	6327	6645	43.5	127.89
	Mean	5973	6198	64.3	189.26
14-15 Dec					
(224 DAMSE)	1986	7600	7836	45.3	133.19
(225 DAMSE)	1987	10215	10458	177.7	NS
	Mean	8908	9147	111.5	NS

no significant difference in inflorescence number between two row spaced crops was found but in 1987, 60 cm row spaced crops produced significantly higher number of inflorescences (3392 m^{-2}) than that (3202 m^{-2}) of the 40 cm row spaced crops. At 210 DAMSE in the year 1986 number of inflorescences of two years also differed significantly between 40 and 60 cm row spacings. At 224 - 225 DAMSE in 1986 there was significant difference in number of inflorescences, 7600 m^{-2} in 40 cm row spaced crops and 7836 m^{-2} in 60 cm row spaced crops. But in 1987 the treatment difference was not significant although inflorescence number was more than that of 1986.

4.4.6.2 Effect of cutting : Cutting although imposed at 60 DAMSE but it had the significant effect in producing decreased number of inflorescences m^{-2} at 150 - 151 and 165 DAMSE. In 1986 at 150 - 151 DAMSE there was significant difference in number of inflorescences m^{-2} in between uncut (530 m^{-2}) and cut (436 m^{-2}) treatments. In 1987 also the similar significant difference was recorded. The mean number of inflorescences both at 150 - 151 and 165 DAMSE differed significantly between uncut and cut treatments. At 180 DAMSE in 1986, uncut treatments produced significantly higher number of inflorescences (2001 m^{-2}) than that of cut treatment (1794). But in

1987, the treatment difference was not significant. At 195 DAMSE in 1986 significant difference in inflorescence number between two cutting treatments was noticed (3037 in uncut and 2624 in cut treatments). Also in the year 1987 uncut treatments gave significantly higher number (3508 m^{-2}) of inflorescences than cut treatments (Table 4.92). At 210 - 211 DAMSE, no significant difference was recorded between two cutting managements. But in 1987, significantly higher number of inflorescences, 6678 m^{-2} from uncut treatments was recorded than in cut (6294 m^{-2}) treatments. At 224 - 225 DAMSE in 1986, significant difference was also observed; 7790 and 7646 m^{-2} being the inflorescence number in uncut and cut treatments, respectively. In 1987, no significant difference was noticed.

4.4.6.3 Effect of phosphatic fertilizer : Phosphatic fertilizer (P_{80}) had significantly increased the number of inflorescences per unit area in both the years (Table 4.93). In 1986, in unfertilized (P_0) crops 479, 698, 1794, 2638, 5397, 7357 number of inflorescences m^{-2} were recorded at 150; 165; 180; 195; 210 and 224 DAMSE respectively; the corresponding figures in fertilized crops were 489, 786, 2001, 3023; 5973 and 8079. In 1987 at 151 DAMSE 582 and 662, at 165 DAMSE 1098 and 1250, at 180 DAMSE 2179 and 2607, at 197 DAMSE, 2978 and 3617, at 211 DAMSE 6169 and 6802 and

PLATE 5 Biometrical observations being recorded at 180 DAMSE, 1987. Experiment No. 1d.

PLATE 6 Biometrical observations being recorded at 195 DAMSE, 1987. Experiment no. 1c.

Table 4.92 Effect of cutting on number of inflorescences m^{-2} (Experiment no. 1d - 1986 and 1d - 1987)

Timing of observation	Year	Cutting management: No cut	Cutting management: Cut at 60 DAMSE	S.Em ±	CD at 5 %
1-2 Oct					
(150-151 DAMSE)	1986	530	436	5.4	16.01
	1987	665	578	14.0	41.24
	Mean	598	507	9.7	28.63
16-17 Oct					
(65 DAMSE)	1986	808	676	22.4	65.90
	1987	1330	1018	23.6	69.54
	Mean	1069	847	23.0	67.72
31 Oct-1 Nov					
(180 DAMSE)	1986	2001	1794	32.0	94.25
	1987	2467	2320	90.1	NS
	Mean	2234	2057	56.1	179.62
15-17 Nov					
(195 DAMSE)	1986	3037	2624	97.8	287.74
	1987	3508	3086	46.1	135.73
	Mean	3273	2555	72.0	211.74
30 Nov-1 Dec					
(210 DAMSE)	1986	5751	5618	85.2	NS
	1987	6678	6294	43.5	127.89
	Mean	6215	5956	64.3	189.26
14-15 Dec					
(224 DAMSE)	1986	7790	7646	45.3	133.19
(225 DAMSE)	1987	10481	10193	177.6	NS
	Mean	9136	8920	111.6	NS

Table 4.93 Effect of phosphatic fertilisation on number of inflorescences m^{-2} (Experiment no. 1d - 1986 and 1d - 1987)

Timing of observation	Year	P_2O_5 (kg ha^{-1}) 0	80	S.Em ±	CD at 5 %
1-2 Oct					
(150-151 DAMSE)	1986	479	489	5.4	NS
	1987	582	662	14.0	41.24
	Mean	530	576	9.3	28.63
16-17 Oct					
(165 DAMSE)	1986	698	786	22.4	65.90
	1987	1098	1250	23.6	69.54
	Mean	898	1018	23.0	67.72
31 Oct-1 Nov					
(180 DAMSE)	1986	1794	2001	32.0	94.25
	1987	2179	2607	90.1	264.97
	Mean	1987	2304	56.1	179.62
15-17 Nov					
(195 DAMSE)	1986	2638	3023	97.8	287.74
	1987	2978	3617	46.1	135.73
	Mean	2808	3320	72.0	211.70
30 Nov-1 Dec					
(210 DAMSE)	1986	5397	5973	85.2	250.62
	1987	6169	6802	43.5	127.89
	Mean	5783	6388	64.3	189.25
14-15 Dec					
(224 DAMSE)	1986	7357	8079	45.3	133.19
(225 DAMSE)	1987	9970	10703	177.6	NS
	Mean	8664	9391	111.4	327.00

at 225 DAMSE 9970 and 10703 were the inflorescence number m^{-2} from unfertilized and fertilized crops respectively.

4.4.7 Number of florets inflorescence^{-1}

4.4.7.1 Effect of spacing : Differences in the number of florets inflorescence^{-1} between two row spacings were not significant in any observations (Table 4.94). At 40 cm row spacing the number of florets inflorescence^{-1} ranged from 6.5 at 224 - 225 DAMSE to 7.9 at 238 - 239 DAMSE; the corresponding figures at 60 cm row spacing were from 6.5 to 7.9 florets inflorescence^{-1}. At 231 - 232 DAMSE the number of florets in both the row spaced crops increased over the number of florets inflorescence^{-1} at 224 - 225 DAMSE.

4.4.7.2 Effect of cutting : At 224 DAMSE in 1986 there was significant difference in number of florets inflorescence^{-1} between uncut (6.6) and cut (6.6) treatements. In 1987 also significant difference was noticed.

The mean number of florets inflorescence^{-1} of two years at 224 - 225 DAMSE were 6.6 and 6.5 from uncut and cut treatments, respectively and these differed significantly. At 231 DAMSE in 1986, cut treatment produced significantly higher number (6.8) of florets inflorescence^{-1} than uncut (6.8) treatments whereas in 1987 though floret number inflorescences^{-1} was more than that of 1986, but the difference was not significant (Table 4.95). At 238

Table 4.94 Effect of spacing on number of florets inflorescence^{-1} (Experiment no. 1d - 1986 and 1d - 1987)

Timing of observation	Year	Row spacings in cm 40	60	S.Em ±	CD at 5 %
14-15 Dec					
(224-225 DAMSE)	1986	6.6	6.6	0.01	NS
	1987	6.5	6.5	0.01	NS
	Mean	6.6	6.6	0.01	NS
21-22 Dec					
(231-232 DAMSE)	1986	6.8	6.8	0.006	NS
	1987	7.9	7.9	0.01	NS
	Mean	7.3	7.4	0.008	NS
28-29 Dec					
(238-239 DAMSE)	1986	7.0	7.0	0.01	NS
	1987	7.5	7.5	0.01	NS
	Mean	7.3	7.3	0.01	NS

Table 4.95 Effect of cutting on number of florets inflorescence^{-1} (Experiment no. 1d - 1986 and 1d - 1987)

Timing of observation	Year	Cutting management		S.Em ±	CD at 5 %
		No cut	Cut at 60 DAMSE		
14-15 Dec					
(224-225 DAMSE)	1986	6.6	6.6	0.01	0.03
	1987	6.6	6.5	0.01	0.03
	Mean	6.6	6.5	0.01	0.03
21-22 Dec					
(231-232 DAMSE)	1986	6.8	6.8	0.006	0.02
	1987	7.9	7.9	0.01	NS
	Mean	7.3	7.4	0.008	0.03
28-29 Dec					
(238-239 DAMSE)	1986	7.0	7.0	0.01	NS
	1987	7.5	7.7	0.01	0.04
	Mean	7.3	7.3	0.01	NS

DAMSE in 1986, there was no significant difference in number of florets inflorescence^{-1} between uncut and cut treatments. In 1987, significantly higher number of florets (7.7) inflorescence^{-1} were recorded in cut treatments than that of uncut treatments (7.5).

4.4.7.3 Effect of phosphatic fertilizer : Number of florets inflorescence^{-1} increased significantly by the application of phosphatic fertilizer @ 80 kg ha^{-1}. At 224 DAMSE in 1986 there was significant difference in floret number between unfertilized (6.5) and fertilized (6.7) crops (Table 4.96) in 1987 the corresponding number of florets inflorescence^{-1} were 6.5 and 6.6 at 225 DAMSE.

At 231 - 232 DAMSE also in both the years significant response to phosphatic fertilizer (P_{80}) were found. The mean number of florets inflorescence^{-1} also differed significantly. The same trend of significant difference was noticed at 238 - 239 DAMSE 7.0 and 7.1 in 1986 and 7.5 and 7.6 in 1987 were the florets inflorescence^{-1} formed from unfertilized (P_0) and fertilized crops respectively.

4.4.8 Number of seeds set floret^{-1}

4.4.8.1 Effect of spacing : From the observations made at each harvest it was found that at 224 DAMSE in 1986 there was significant differences in number of seeds set floret^{-1};

Table 4.96 Effect of phosphatic fertilization on number of florets inflorescence^{-1} (Experiment no. 1d - 1986 and 1d - 1987)

Timing of observation	Year	P_2O_5 (kg ha^{-1}) 0	80	S.Em ±	CD at 5 %
14-15 Dec					
(224-225 DAMSE)	1986	6.5	6.7	0.01	0.03
	1987	6.5	6.6	0.01	0.03
	Mean	6.5	6.6	0.01	0.03
21-22 Dec					
(231-232 DAMSE)	1986	6.8	6.8	0.006	0.02
	1987	7.8	8.0	0.01	0.04
	Mean	7.3	7.4	0.008	0.03
26-29 Dec					
(238-239 DAMSE)	1986	7.0	7.1	0.01	0.03
	1987	7.5	7.6	0.01	0.04
	Mean	7.2	7.3	0.07	0.04

1.65 and 1.68 were the seed number in 40 and 60 cm row spaced crop respectively. But in 1987 no significant difference was noticed. The mean number of seeds set floret^{-1} for two years were 1.64 and 1.65 from 40 and 60 cm row spaced crops respectively at 224 - 225 DAMSE (Table 4.97). In 1986 no significant difference was noticed but in 1987, 60 cm row spaced crop produced significantly higher number of seeds set floret^{-1} (1.66) than 40 cm row spaced crop (1.64); 1.69 and 1.71 were the mean number of seeds floret^{-1} formed at 231 - 232 DAMSE under two different spacing treatments respectively. At 238 - 239 DAMSE in both the years, no significant difference was noticed in seed number between two row spaced treatments in either of the years of experimentation.

4.4.8.2 Effect of cutting : Cutting did not affect significantly the seed number floret^{-1} except at 224 DAMSE in 1986. In 1986 at 224 DAMSE, 1.69 and 1.65 were the seed number from uncut and cut treatments respectively. No significant differences were noticed either at 231 - 232 or at 238 - 239 DAMSE (Table 4.98).

4.4.8.3 Effect of phosphatic fertilizer : Phosphatic fertilizer (P_{80}) significantly increased the number of seeds set floret^{-1}. At 224 DAMSE in 1986 there was significant difference in number of seeds set floret^{-1} between

Table 4.97 Effect of spacing on number of seeds set $floret^{-1}$
(Experiment no. 1d - 1986 and 1d - 1987)

Timing of observation	Year	Row spacings in cm 40	60	S.Em ±	CD at 5 %
14-15 Dec (224-225 DAMSE)	1986	1.65	1.68	0.005	0.02
	1987	1.63	1.61	0.01	NS
	Mean	1.64	1.65	0.01	NS
21-22 Dec (231-232 DAMSE)	1986	1.73	1.75	0.009	NS
	1987	1.64	1.66	0.009	0.03
	Mean	1.69	1.71	0.01	NS
28-29 Dec (238-239 DAMSE)	1986	1.72	1.74	0.007	NS
	1987	1.62	1.64	0.01	NS
	Mean	1.67	1.69	0.01	NS

Table 4.98 Effect of cutting on number of seeds set floret^{-1} (Experiment no. 1d - 1986 and 1d - 1987)

Timing of observation	Year	Cutting management		S.Em ±	CD at 5 %
		No cut	Cut at 60 DAMSE		
14-15 Dec (224-225 DAMSE)	1986	1.69	1.65	0.005	0.02
	1987	1.64	1.61	0.01	NS
	Mean	1.67	1.63	0.01	0.02
21-22 Dec (231-232 DAMSE)	1986	1.74	1.73	0.009	NS
	1987	1.65	1.66	0.009	NS
	Mean	1.70	1.70	0.01	NS
28-29 Dec (238-239 DAMSE)	1986	1.74	1.72	0.007	NS
	1987	1.63	1.64	0.01	NS
	Mean	1.69	1.68	0.01	NS

P_0-fertilized (1.63) and P_{80}-fertilized (1.70) crops. In 1987 at 225 DAMSE 1.59 and 1.66 were the number of seeds set floret^{-1} in fertilized and unfertilized crops respectively and the difference was significant. Similar trend of variation was observed at 231 - 232 DAMSE both in 1986 and 1987. At 238 - 239 DAMSE 1.70 and 1.75 seeds floret^{-1} were recorded in 1986 in fertilized and unfertilized crops respectively. In 1987 at 239 DAMSE the number of seeds floret^{-1} were 1.61 and 1.65 from unfertilized and fertilized crops respectively. The mean number of seeds at 224 - 225, 231 - 232 and 238 - 239 DAMSE were 1.61 and 1.68, 1.67 and 1.72 and 1.66 and 1.70 in fertilized and unfertilized crops respectively (Table 4.99) and differences were significant.

4.4.9 Test weight of seeds (1000 seed weight)

4.4.9.1 Effect of spacing : Seed weight is one of the most important factors that influence considerably the ultimate seed yield. In 1d experiment three harvestings were made and from each harvest records were taken to have the test weight (1000 seed weight) produced under different spacing management. In 1986 and 1987 at 224 - 225 DAMSE, no significant differences were found in 1000 seed weight between crops established under two spacings, seed weight in 60 cm row spaced crop had significantly higher (2.74 g) than that (2.73 g) in 40 cm row spaced crop at 231 - 232 DAMSE (Table 4.100). Similar trend of variation was found at

Table 4.99 Effect of phosphatic fertilization on number of seeds $floret^{-1}$ (Experiment no. 1d - 1986 and 1d - 1987)

Timing of observation	Year	P_2O_5 (kg ha^{-1}) 0	80	S.Em ±	CD at 5 %
14-15 Dec (224-225 DAMSE)	1986	1.63	1.70	0.005	0.02
	1987	1.59	1.66	0.01	0.04
	Mean	1.61	1.68	0.01	0.03
21-22 Dec (231-232 DAMSE)	1986	1.72	1.75	0.009	0.03
	1987	1.62	1.68	0.009	0.03
	Mean	1.67	1.72	0.01	0.03
28-29 Dec (238-239 DAMSE)	1986	1.70	1.75	0.007	0.02
	1987	1.61	1.65	0.01	0.03
	Mean	1.66	1.70	0.01	0.03

Table 4.100 Effect of spacing on 1000 seed weight in g
(Experiment no. 1d - 1986 and 1d - 1987)

Timing of observation	Year	Row spacings in cm 40	60	S.Em ±	CD at 5 %
14-15 Dec					
(224-225 DAMSE)	1986	2.45	2.45	0.002	NS
	1987	2.73	2.73	0.007	NS
	Mean	2.59	2.59	0.005	NS
21-22 Dec					
(231-232 DAMSE)	1986	2.45	2.45	0.003	NS
	1987	2.73	2.74	0.002	0.007
	Mean	2.59	2.60	0.002	NS
28-29 Dec					
(238-239 DAMSE)	1986	2.42	2.42	0.002	NS
	1987	2.66	2.67	0.002	0.005
	Mean	2.54	2.55	0.002	0.005

238 - 239 DAMSE. In 1986, 2.42 and 2.42 g and in 1987 2.66 and 2.67 g were the seed weights from 40 and 60 cm spaced crops respectively and the differences were signi- ficant only in 1987.

4.4.9.2 Effect of cutting : At 224 DAMSE in 1986, 1000 seed weights were 2.46 and 2.44 g from uncut and cut treatments respectively and the difference was significant. In 1987 no significant difference in test weight was found at 225 DAMSE. In the subsequent harvests at 231 - 232 DAMSE no significant difference between uncut and cut treatments in 1000 grainwweight was found both in 1986 and in 1987 (Table 4.101).

In 1987 at 231 - 232 DAMSE, 1000 seed weights were more than those found at 224 - 225 DAMSE, 2.74 g from both uncut and cut treatments. At 238 - 239 DAMSE in both the years cut treatments produced higher 1000 seed weight (2.43 and 2.67 g) than uncut treatments (2.42 and 2.66 g) in 1986 and 1987 respectively.

4.4.9.3 Effect of phosphatic fertilizer : In both the years at 224 - 225 DAMSE there were significant differences in 1000 seed weight between unfertilized (P_0) and ferti- lized (P_{80}) crops. In 1986, 1000 seed weight from unferti- lized and fertilized crops were 2.44 and 2.47 g, respect- ively (Table 4.102), 2.70 and 2.75 g were the 100 seed

Table 4.101 Effect of cutting on 1000 seed weight in g
(Experiment no. 1d - 1986 and 1d - 1987)

Timing of observation	Year	Cutting management		S.Em ±	CD at 5 %
		No cut	Cut at 60 DAMSE		
14-15 Dec					
(224-225 DAMSE)	1986	2.46	2.44	0.002	0.006
	1987	2.72	2.73	0.007	NS
	Mean	2.59	2.59	0.005	NS
21-22 Dec					
(231-232 DAMSE)	1986	2.44	2.45	0.003	NS
	1987	2.74	2.74	0.002	NS
	Mean	2.59	2.60	0.003	NS
28-29 Dec					
(238-239 DAMSE)	1986	2.42	2.43	0.002	0.004
	1987	2.66	2.67	0.002	0.005
	Mean	2.54	2.55	0.002	0.005

Table 4.102 Effect of phosphatic fertilization on 1000 seed weight in g (Experiment no. 1d - 1986 and 1d - 1987)

Timing of observation	Year	P_2O_5 (kg ha^{-1}) 0	80	S.Em ±	CD at 5 %
14-15 Dec					
(224-225 DAMSE)	1986	2.44	2.47	0.002	0.006
	1987	2.70	2.75	0.007	0.002
	Mean	2.57	2.61	0.005	0.004
21-22 Dec					
(231-232 DAMSE)	1986	2.43	2.46	0.003	0.008
	1987	2.72	2.75	0.002	0.007
	Mean	2.58	2.61	0.003	0.008
28-29 Dec					
(238-239 DAMSE)	1986	2.41	2.43	0.002	0.004
	1987	2.62	2.70	0.002	0.005
	Mean	2.52	2.57	0.002	0.005

weight in 1987. Similar trend of variation was recorded in subsequent harvest at 231 - 232 DAMSE. The mean 1000 seed weight at 231 - 232 DAMSE of two years were 2.58 and 2.61 g and these differed significantly.

At 238 - 239 DAMSE in 1986 fertilized (P_{80}) crops had significantly higher test weight (2.43 g) than unfertilized (P_0) plots (2.41 g). In 1987 also significant difference was found, 2.62 (unfertilized) and 2.70 g (fertilized) were the 1000 seed weight. Mean 1000 seed weight at 238 - 239 DAMSE of two years were 2.52 (unfertilized) and 2.57 g (fertilized).

4.4.10 Seed yield g m^{-2}

Experiment no. 1d was continued for two years 1986 and 1987 keeping all the treatments similar with two row spacings of 40 and 60 cm.

4.4.10.1 Effect of spacing : Three harvests with an interval of a week were taken in each year of 1986 and 1987 to assess the correct stage of harvesting and quantum of seed yield. At 224 - 225 DAMSE at 40 cm row spacing, 29.99 g m^{-2} and in 60 cm row spacing, 32.59 g m^{-2} were the seed yields in 1986. In 1987 the seed yields were 36.17 and 36.63 g m^{-2} from 40 and 60 cm row spaced crops respectively (Table 4.103). In 1986, there was significant difference in seed

Table 4.103 Effect of spacing on seed yield g m^{-2} (Experiment no. 1d - 1986 and 1d - 1987)

Timing of observation	Year	Row spacings in cm 40	60	S.Em ±	CD at 5 %
14 Dec (224 DAMSE)	1986	29.99	32.59	0.30	0.88
15 Dec (225 DAMSE)	1987	36.17	36.63	1.33	NS
	Mean	33.08	34.61	0.82	NS
21 Dec (231 DAMSE)	1986	40.28	46.08	1.41	4.15
22 Dec (232 DAMSE)	1987	67.39	70.79	2.08	NS
	Mean	53.84	58.44	1.75	NS
28 Dec (238 DAMSE)	1986	49.83	51.41	0.62	NS
29 Dec (239 DAMSE)	1987	42.93	44.53	0.29	0.84
	Mean	46.38	47.97	0.45	1.33
Yield received from sweeping	1986	31.78	32.40	1.00	NS
	1987	47.57	51.05	0.69	2.04
	Mean	39.68	41.73	0.85	NS
Highest yield including sweeping	1986	81.61	83.81	0.81	NS
	1987	114.96	121.84	1.39	4.08
	Mean	98.29	102.83	1.10	3.23

yield between two row spaced crops, but in 1987 the difference was not significant. Similar trend of variation continued at 231 - 232 DAMSE. At 238 - 239 DAMSE in both the years, 60 cm apart line sown crops produced significantly higher (51.41 g m^{-2}) seed yield than in 40 cm apart row sown crops (49.83 g m^{-2}) in 1986, while in 1987 44.53 and 42.93 g m^{-2} were the seed yield from 60 and 40 cm row spaced crops respectively.

At 238 - 239 DAMSE the mean seed yields were 46.38 and 47.97 g m^{-2} from 40 and 60 cm row spaced crops respectively. The highest seed yield 49.83 and 51.41 g m^{-2} in 40 and 60 cm row spacing, respectively were harvested at 238 - 239 DAMSE in 1986; in 1987 the highest yield recorded were 67.39 and 70.79 g m^{-2} at 231 - 232 DAMSE i.e. 21 - 22 December in 40 and 60 cm apart row spaced crops respectively.

The seed yield obtained from sweeping in 1986 were 31.78 and 32.40 g m^{-2} in 40 and 60 cm spacing respectively and these did not differ significantly but in 1987, 47.57 and 51.05 g m^{-2} were the yields from 40 and 60 cm row spaced crops respectively and these were significantly different (Table 4.103).

Highest seed yield including sweeping in 1986 were 81.61 and 83.81 g m^{-2} from 40 and 60 cm row spacing, respectively; in 1987 the corresponding figures were 114.96 and 121.84 g m^{-2}, and the treatment difference was significant in 1987 only.

4.4.10.2 Effect of cutting : From the results it was found that cutting or defoliation at an early vegetative stage did not affect optimum synchonisation for development of closed canopy having sufficient number of shoot population and did not affect ultimate seed yield. In 1986 seed yield from uncut (35.57 g m^{-2}) and cut treatments (27.01 g m^{-2}) differed significantly but in 1987 no significant difference was noticed in seed yield between uncut and cut treatments. Uncut treatments yielded 36.66 g m^{-2} against cut treatments (31.04 g m^{-2}), mean yield at 224-225 DAMSE.

In subsequent harvest at 231 - 232 DAMSE in 1986 and 1987, no significant differences in seed yield were found between uncut and cut treatments. The harvest made at 238 - 239 DAMSE in 1986, showed no significant difference in seed yield between uncut and cut treatments but in 1987 cut treatments produced (44.82 g m^{-2}) significantly higher yield than uncut treatments (42.64 g m^{-2}). Sweeping collections (seed quantity) were 31.47 and 32.71 g m^{-2} from no cut and cut treatments in 1986 and in 1987, 49.27

and 49.34 g m^{-2} were the corresponding figures. The highest seed yield including sweeping collection obtained from uncut treatments were 81.86 and 117.63 g m^{-2} in 1986 and 1987 respectively and from cut treatments the corresponding figures were 83.56 and 119.17 g m^{-2} (Table 4.104). Cut treatments produced higher yield than uncut treatments in respect of highest seed yield.

4.4.10.3 Effect of phosphatic fertilizer : Verano cultivar responded to phosphatic fertilizer. At 224 - 225 DAMSE the fertilized crop had significantly more (28.33 g m^{-2}) seed yield than unfertilized (P_0) plots (34.34 g m^{-2}). Also mean seed yield of two years from fertilized (P_{80}) crops was significantly higher (36.75 g m^{-2}) than unfertilized crops (30.94 g m^{-2}) at 224 - 225 DAMSE. In the next harvest at 231 - 232 DAMSE the similar significant effect of P_2O_5 (P_{80}) was noticed in both the years. Seed yields of 40.08 and 46.27 g m^{-2} in 1986 and 64.47 and 73.72 g m^{-2} in 1987 were recorded from unfertilized and fertilized crops respectively. Mean seed yield at 231 - 232 DAMSE were 52.28 and 60.0 g m^{-2} in unfertilized and fertilized crops respectively and these also different significantly. At the last harvest i.e. at 238 - 239 DAMSE both in 1986 and 1987, seed yield between fertilized and unfertilized crops varied significantly. The mean seed yield at 238 - 239 DAMSE also showed that the fertilized crops produced

Table 4.104 Effect of cutting on seed yield g m^{-2} (Experiment no. 1d - 1986 and 1d - 1987)

Timing of observation	Year	Cutting management: No cut	Cutting management: Cut at 60 DAMSE	S.Em ±	CD at 5 %
14 Dec (224 DAMSE)	1986	35.57	27.01	0.30	0.88
15 Dec (225 DAMSE)	1987	37.75	35.06	1.33	NS
	Mean	36.65	31.04	0.82	2.40
21 Dec (231 DAMSE)	1986	41.91	44.55	1.41	NS
22 Dec (232 DAMSE)	1987	68.36	69.83	2.08	NS
	Mean	55.14	57.19	1.75	NS
28 Dec (238 DAMSE)	1986	50.39	50.85	0.62	NS
29 Dec (239 DAMSE)	1987	42.64	44.82	0.29	0.84
	Mean	46.52	47.84	0.46	NS
Yield received from sweeping	1986	31.47	32.71	1.00	NS
	1987	49.27	49.34	0.69	NS
	Mean	40.37	41.03	0.85	NS
Maximum yield including sweeping	1986	81.86	83.56	0.81	NS
	1987	117.63	119.17	1.39	NS
	Mean	99.5	101.37	1.10	NS

significantly higher seed yield (49.40 g m^{-2}) than unfertilized (Table 4.105) crops (45.04 g m^{-2}). Phosphatic fertilizer @ 80 kg ha^{-1} gave maximum seed production at 231 - 232 DAMSE in 1987; whereas in 1986 it was at 238 - 239 DAMSE. Yields obtained fromsweeping after final harvest showed significant difference between unfertilized and fertilized crops both in the year 1986 and 1987. The yields were 29.24 and 34.95 g m^{-2} in 1986 and 47.30 and 51.31 and g m^{-2} from sweeping from unfertilized and fertilized crops respectively.

The highest mean seed yield including sweeping collection also differed significantly between fertilized (106.81 g m^{-2}) and unfertilized (94.33 g m^{-2}) treatments. The increased yield due to P_{80}-fertilization ranged from 9.85 to 10.6 % in respect of total seed yield (including sweeping collection) concerned.

Table 4.105 Effect of phosphatic fertilizer on seed yield $g\ m^{-2}$ (Experiment no. 1d - 1986 and 1d - 1987)

Timing of observation	Year	P_2O_5 (kg ha^{-1}) 0	80	S.Em ±	CD at 5 %
14 Dec (224 DAMSE)	1986	28.23	34.34	0.30	0.88
15 Dec (225 DAMSE)	1987	33.65	39.16	1.33	3.91
	Mean	30.94	36.75	0.82	2.40
21 Dec (231 DAMSE)	1986	40.08	46.27	1.41	4.15
22 Dec (232 DAMSE)	1987	64.47	73.72	2.08	6.12
	Mean	52.28	60.00	1.75	5.13
28 Dec (238 DAMSE)	1986	47.65	53.59	0.62	1.82
29 Dec (239 DAMSE)	1987	42.43	45.20	0.29	0.84
	Mean	45.04	49.40	0.46	1.33
Yield received from sweeping	1986	29.24	34.95	1.00	2.94
	1987	47.30	51.31	0.69	2.04
	Mean	38.27	43.13		
Maximum yield including sweeping	1986	79.89	88.59	0.81	2.38
	1987	111.77	125.03	1.39	4.08
	Mean	94.33	106.81	1.10	3.23

CHAPTER 5

DISCUSSION

5. DISCUSSION

Stylosanthes has now appeared to be an important forage/pasture crop in tropical countries in view of the fact that it establishes well even in eroded, leached and acidic soil of poor nutritive status. A good amount of work that has been reported from India in the special issue on stylo research and development of the Indian Journal of Range Management Vol 6, 1985, mostly evaluated the stand establishment and herbage productivity of the crop. These have mostly been done on *Stylosanthes guianensis* a summer growing perennial pasture legume and *Stylosanthes hamata* a short lived legume (Gardener, 1977) but perenniating through regeneration of seeds with the advent of monsoon showers. This has created great interest to the researchers as well as developmental workers to utilize this latter crop for herbage production. This has lead to a great demand of seeds. It has been felt necessary to understand the ways in which spacing, defoliation and fertilization affect seed production of this forage crop.

Stylosanthes hamata cv. Verano appeared to be very promising crop for herbage production in the sub-humid, sub-tropical climate prevailing in the Gangetic plains of West Bengal. Under natural condition the crop can easily be established with available rainfall or irrigation water,

PLATE 7 Full grown Verano plants showing branches and roots.

right from the month of March when the mean temperatures rise above 30°C. Depending upon the availability of rainfall/irrigation water, the crop can be defoliated a number of times. Under undefoliated condition sparse flowering is observed from the month of July; the peak period of flowering, however, is observed in the end of November and continued in December. The plant dies after shedding of seeds. Even if the crop is established in wide apart rows the regenerated crop, next year becomes thickly populated. In pasture persistency is governed by the number of defoliation / grazing.

5.1 Effect of spacing on seed yield

To start with, two separate experiments were laid out with two cutting and two fertilizer treatments under two methods of crop establishment viz., broadcasting @ 3 kg seeds ha^{-1} and line sowing, 40 cm (Experiment no. 1a) and (Experiment no. 1b) 60 cm apart. It was difficult to collect the seeds shed on the ground level through sweeping. So in Experiment no. 1c spacings were altered to 20 and 40 cm apart and in Experiment no. 1d spacing of 40 and 60 cm were adopted. Even in the experimental crop established in rows 20 cm apart, collection of seeds through sweeping encountered a great difficulty due to the rank growth of the crop. As discussed in the Result chapter earlier in Experiment no. 1b the seed collected on 21-22 December amounted to 53.01 g m^{-2} i.e. (5.3 q ha^{-1}) and it was appreciably more than (Fig. 5.1) that obtained from the broadcast crop (37.89 g m^{-2}); in addition to this 41.33 g m^{-2} was obtained from sweeping between 60 cm apart line sown crop. In broadcast crop nothing could be obtained by sweeping. In other words, the seed yield in line sown crop was 53.01 + 41.33 or 94.34 g m^{-2}. In Experiment no. 1c yield of seed as recorded at 231 - 232 (21-22 December) DAMSE were more in 40 cm apart rows (53.1 g m^{-2}) than that recorded at 20 cm apart (47.0 g m^{-2}). The yield recorded through sweeping was 39.64 g m^{-2} in 40 cm rows apart, so the total yield amounted to 92.74 g m^{-2} and this yield ranged from 79.79 in 1986 to 113.1 g m^{-2} in 1987 (Fig. 5.2).

Under Australian condition the productivity reported by Hopkinson and Walker (1984) amounted to 872 ± 52 kg ha^{-1} by hand harvest. It may be pointed out here that they used sucking machine to collect seed from the crops sown in widely spaced rows. In Experiment no. 1d there was not much difference in the productivity of the seeds between row spaced crop at 40 and 60 cm apart (Fig. 5.3). The results of experiments carried out during the last four years revealed that a seed yield from 70 to 110 g m^{-2} or in other words 7 to 11 q ha^{-1} can be obtained, 56 % of which can be collected through cutting the plant material and the rest (44 %) need to be collected through sweeping till we can have a variety of synchronous maturity; the

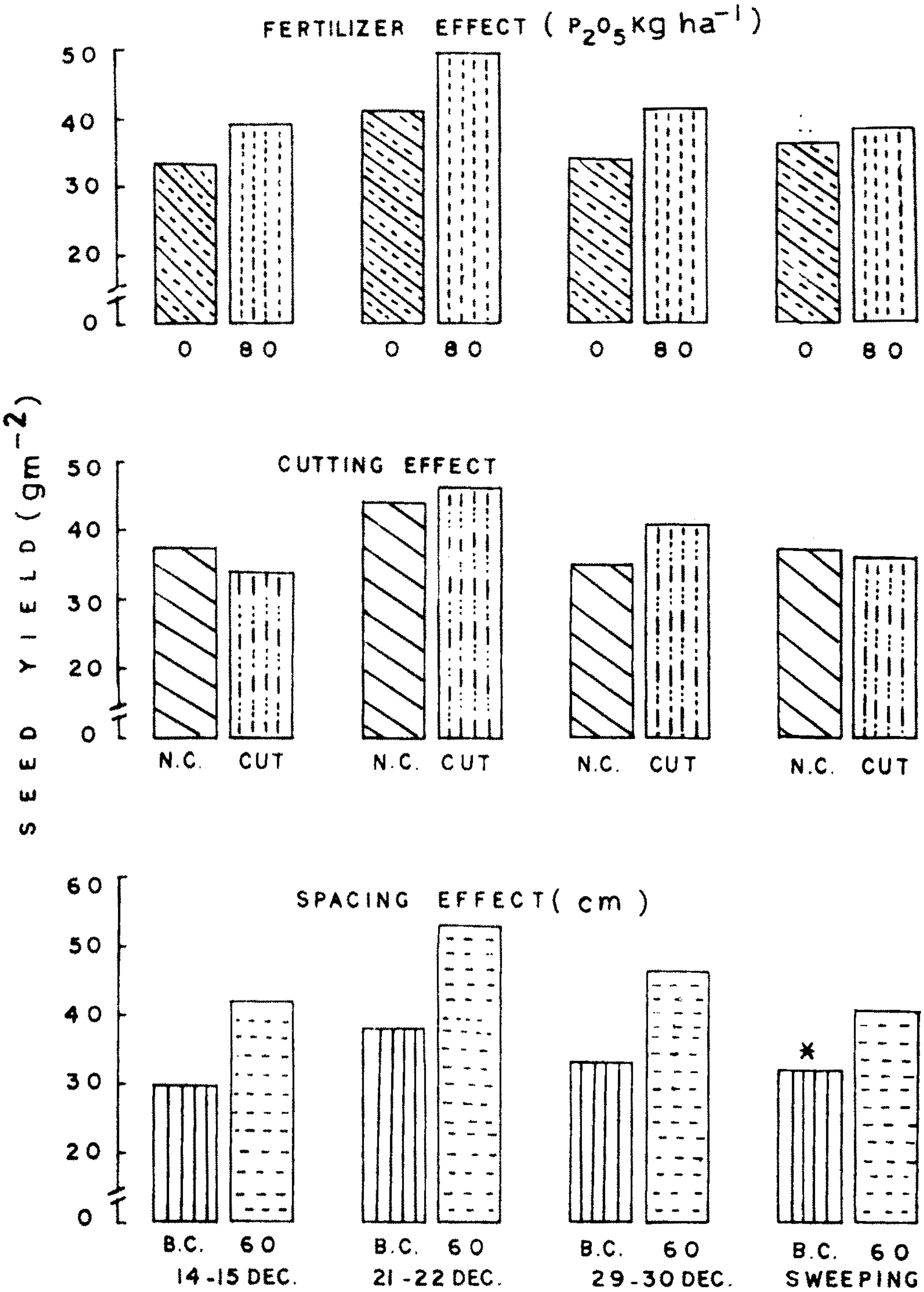

Fig. 5.1 EFFECTS OF FERTILIZER (PHOSPHATE),CUTTING TREATMENTS AND ROW-SPACING ON SEED YIELD ON DIFFERENT DATES (* Hand collected- no sweeping) IN Expt. 1b

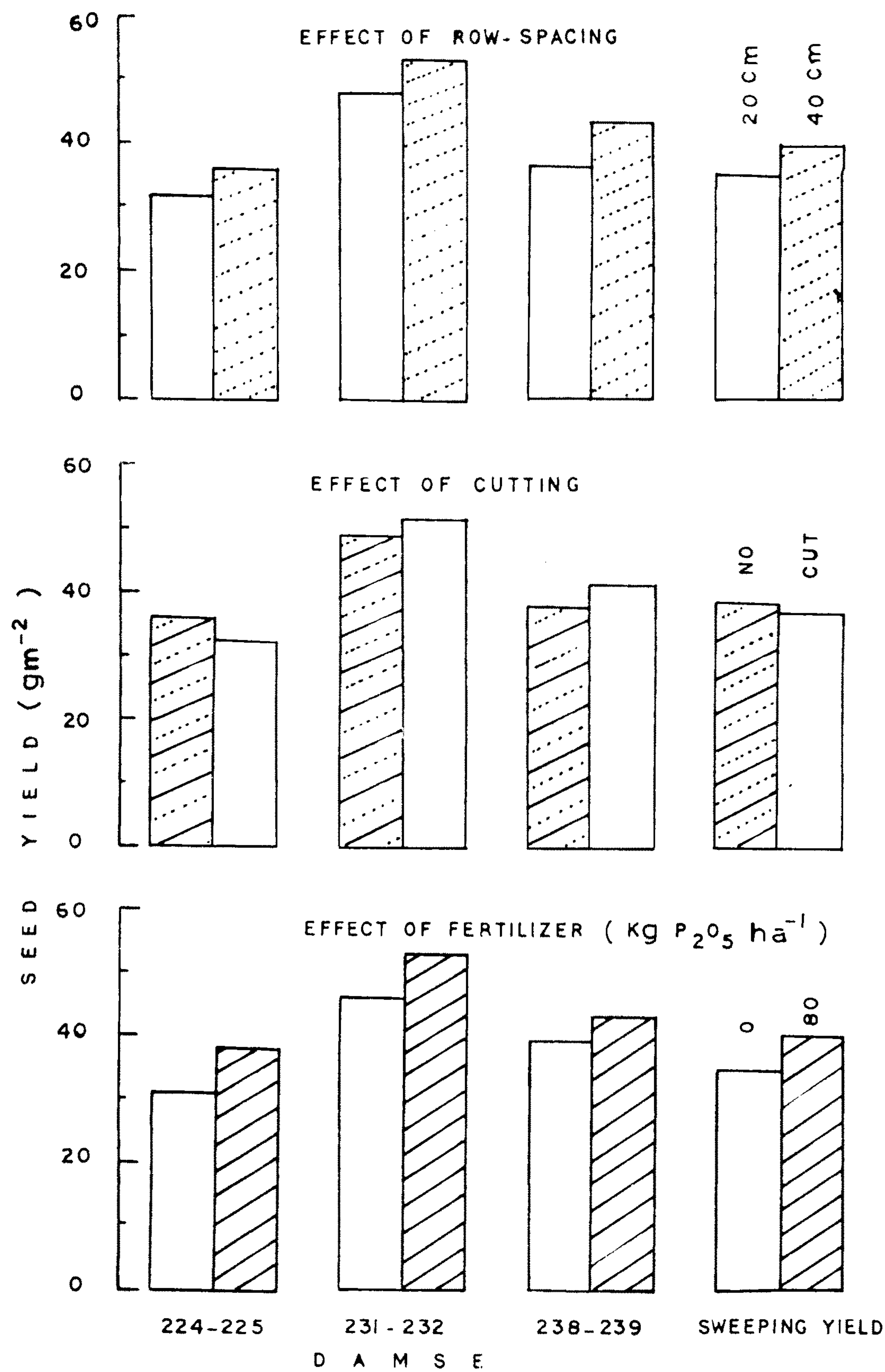

Fig. 5.2 EFFECT OF DIFFERENT LEVELS OF P_2O_5 CUTTING TREATMENTS AND SPACING ON SEED YIELD gm^{-2} IN Expt. 1c

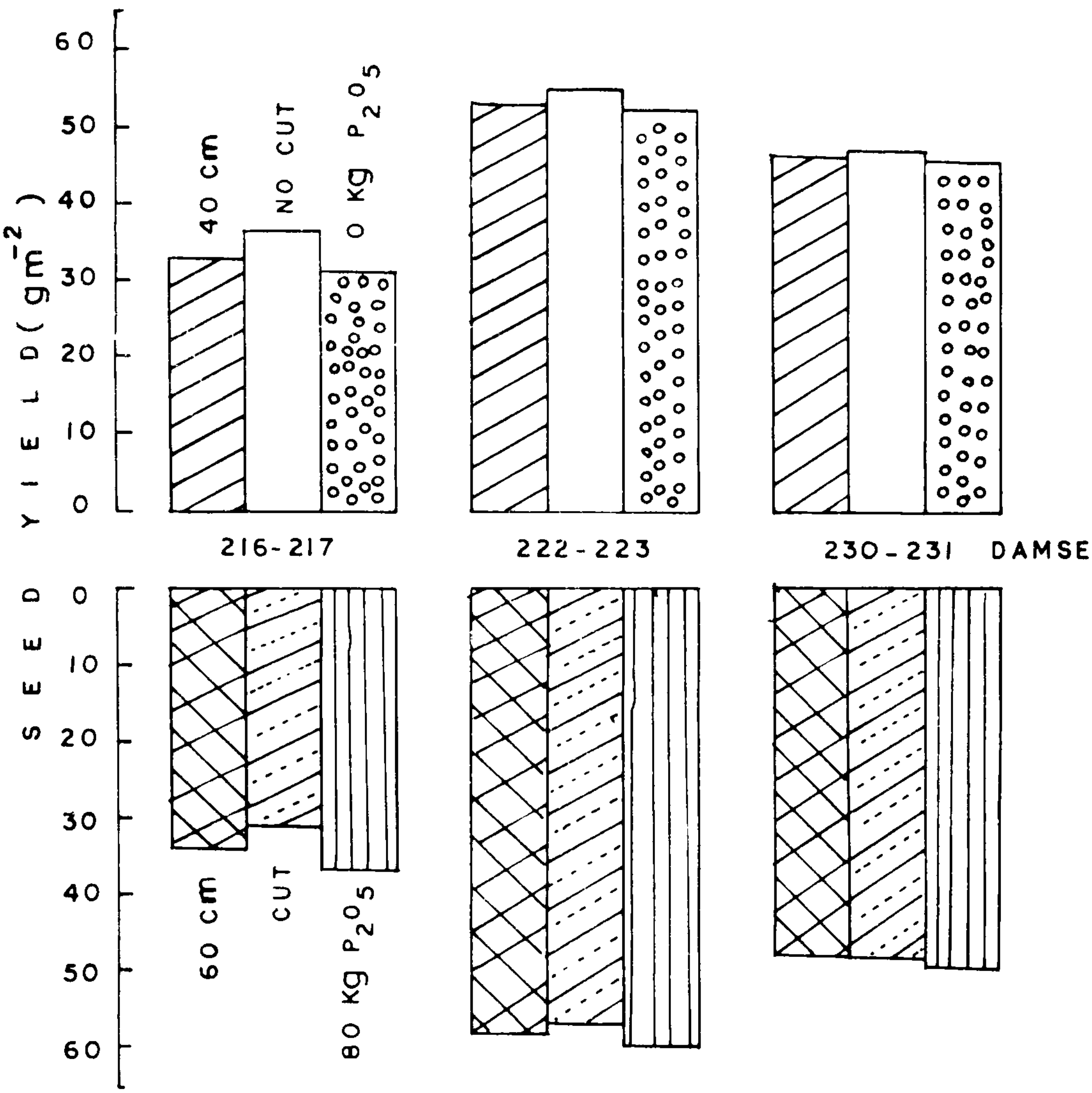

Fig. 5.3 EFFECT OF SPACING, CUTTING AND PHOSPHATIC FERTILIZER APPLICATION ON SEED PRODUCTION OF cv. VERANO IN Expt. 1d

practices of collection of seeds through sweeping can only be profitably continued as long as the price of seed is high.

5.2 Effect of defoliation on seed yield

As depicted in Fig. 5.1, 5.2 and 5.3, at the second harvest i.e. on 21 - 22 December (231 - 232 DAMSE), the seed productivity under one cutting treatment showed an edge over uncut treatment, although the treatment difference was not wide and significant. This might be due to the quick restoration of leaf canopy and inflorescence density to the levels of undefoliated swards as it was observed by Wilaipon et al. (1979).

By cutting once at 60 DAMSE, herbage productivity to the tune of 140 - 150 q ha^{-1} could be obtained and can be fed to the animals.

5.3 Effect of fertilizer on seed yield

As discussed earlier in the Results chapter and depicted in Fig. 5.1, 5.2 and 5.3 application of single super phosphate at the rate of 80 kg P_2O_5 ha^{-1} significantly increased the productivity of Verano in neutral sandy loam soil, having 21.80 kg ha^{-1} of available phosphate. The productivity of Verano at the second harvest in crop spaced at 40 and 60 cm apart rows under one cut treatment with 80 kg P_2O_5 ha^{-1} gave yields as high as 10.4 and 11.1 q ha^{-1} respectively. Kanodia et al. (1985) reported good seed yield (3.10 q ha^{-1}) of Verano by applying 40 kg P_2O_5 ha^{-1} at Jhansi, India.

5.4 Dry matter accumulation (DMA)

In the first cutting at 60 - 62 DAMSE (Sometime in July) the dry matter accumulation of the lush green herbage ranged from 140 to 160 q ha^{-1} (35.45 q dry herbage) with an average of 150 q ha^{-1}. Rai and Patil (1985) obtained 127.1 q ha^{-1} herbage yield from S. hamata, at Jhansi.

The dry matter accumulation (DMA) at the time of harvest of the crop did not show wide differences between the spacing and cutting treatments (uncut treatment showed an edge over the cut treatment) phosphatic fertilizer, however showed significantly more DMA than the unfertilized (P_0) crop (Fig. 5.4 and 5.5).

Under 'no cut' treatment, however, the number of secondary branches m^{-2}, which is an important growth attribute affecting seed productivity, was significantly more than the 'one cut' treatment till 150 DAMSE (Fig. 5.6). Similarly wider spacing also, on an average, showed greater number of secondary branches than close spacing. Phosphatic fertilizers also increased number of secondary branches m^{-2}.

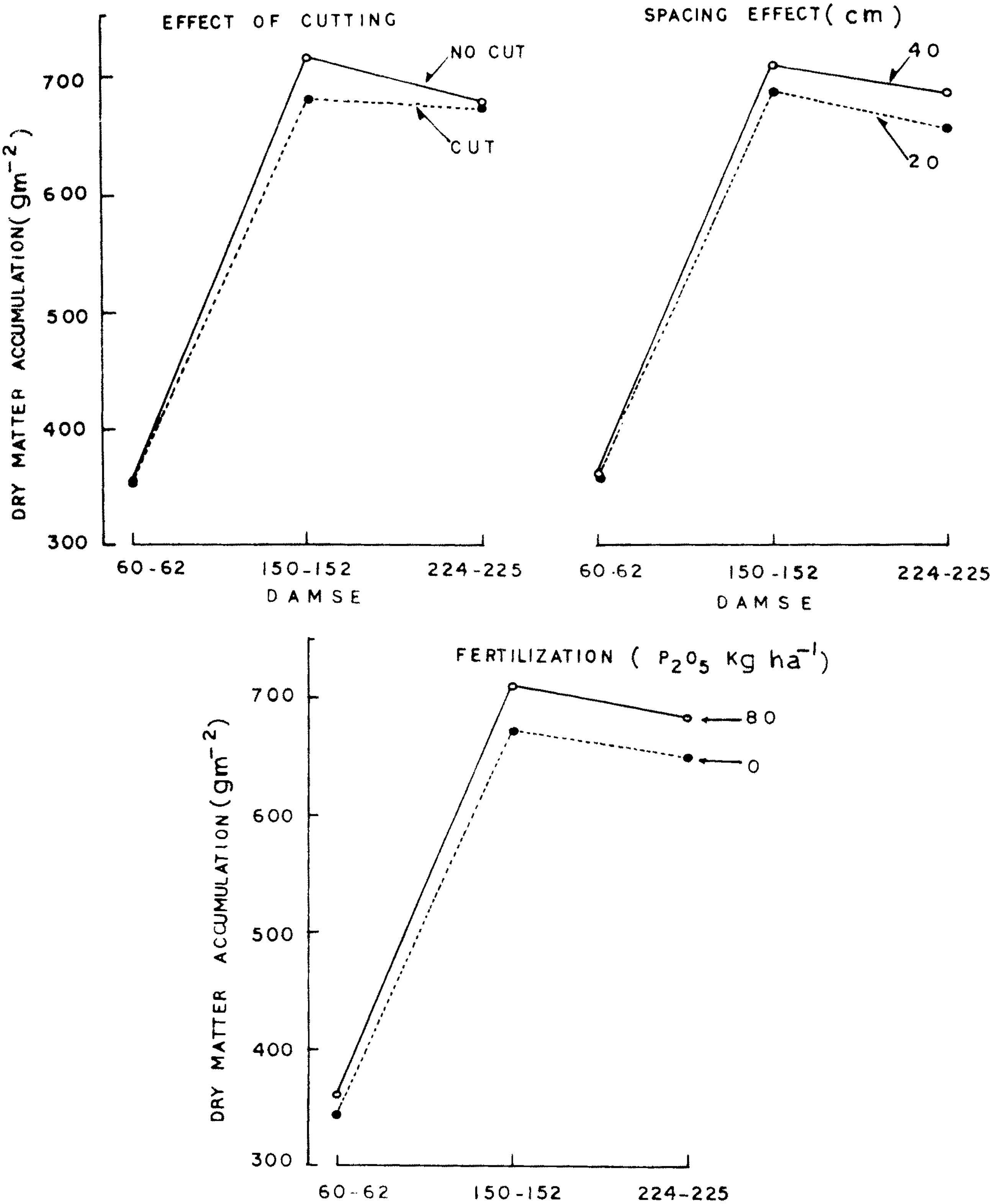

Fig. 5.4 SHOWING EFFECT OF FERTILIZER (PHOSPHATE), CUTTING TREATMENTS AND ROW-SPACING ON DRY MATTER ACCUMULATION IN DIFFERENT DAMSE IN CARRIBEAN STYLO cv. VERANO IN Expt. 1c

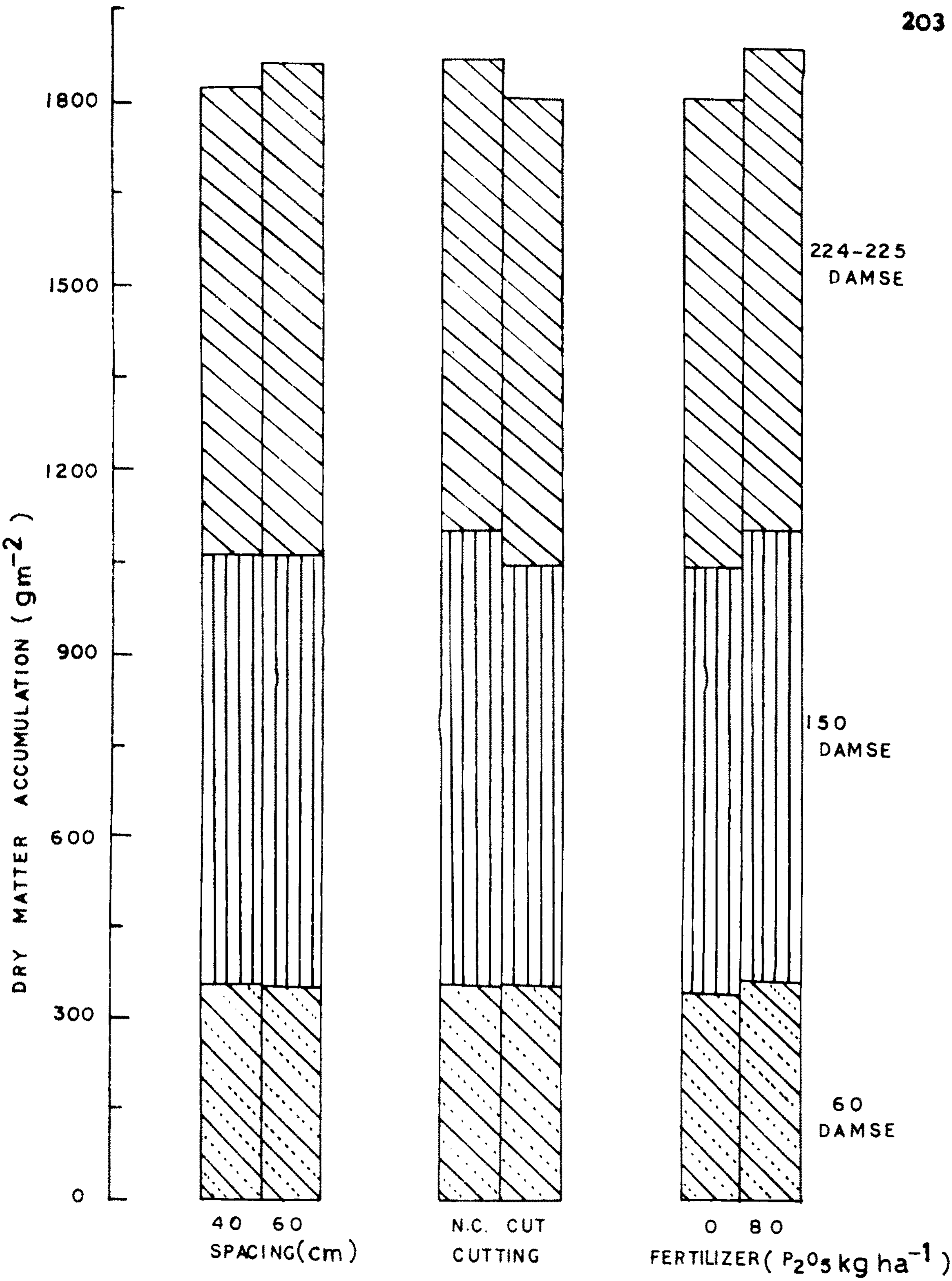

Fig. 5.5 SHOWING THE EFFECT OF FERTILIZER (PHOSPHATE), CUTTING TREATMENTS AND ROW-SPACING IN DRY MATTER ACCUMULATION WITH PASSAGE OF TIME IN C. Stylo cv. VERANO IN Expt. 1d

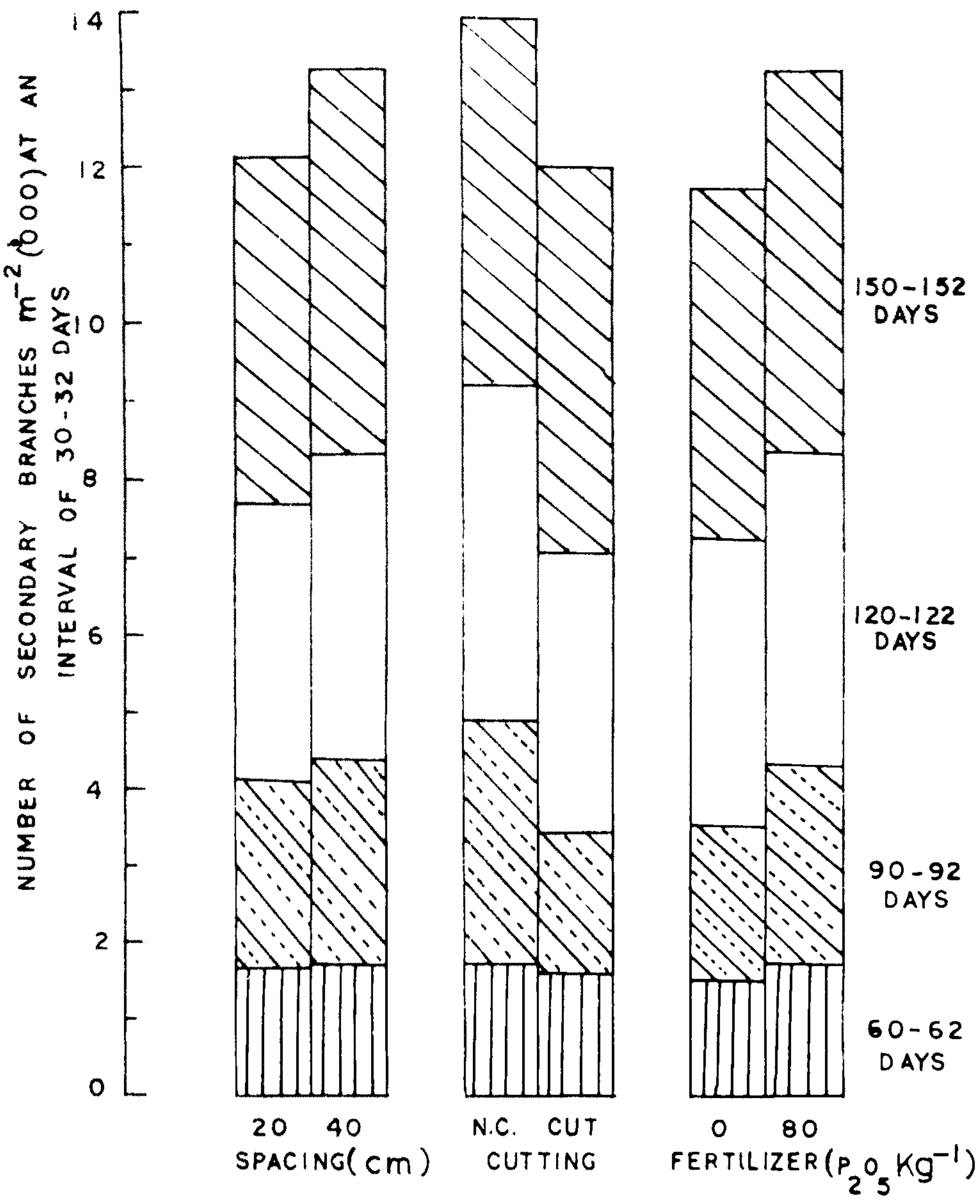

Fig. 5.6 EFFECTS OF FERTILIZER, CUTTING AND SPACING ON INCREASE IN NUMBER OF SECONDARY BRANCHES IN Expt. 1c

Number of tertiary branches, which favour better seed production, was more under one cut treatment than no cut treatment. Similarly, wider spacing and phosphatic fertilizer also increased the number of tertiary branches of the crop (Fig. 5.7).

5.5 Influence of treatments on the yield components

The yield components of Stylosanthes hamata cv. Verano consist of number of inflorescences (raceme) per unit area, number of florets inflorescence^{-1}, number of seeds floret^{-1} and the test weight of the seeds. The first flowering of Verano was observed in July, but it was very sparse at this time when heavy rainfall was received and the sky remained overcast with clouds. During this time the crop also put forth a good amount of vegetative growth. Quantitative short day response type S. hamata cv. Verano did not show the sharp distinction between the vegetative and reproductive phases of development, and its vegetative development continued so long growing conditions were favourable. Similar observations have been reported by Torssell et al. (1976). It may be worth repeating that the peak period of flowering was in the end of November continued in December (Fig. 5.7 and 5.8). The number of inflorescences m^{-2} were always high in the fertilized, undefoliated and widely spaced crop (Fig. 5.8 and 5.9) and it might be as high as 10,703 m^{-2}; the average (Fig. 5.9) was 9391 m^{-2}.

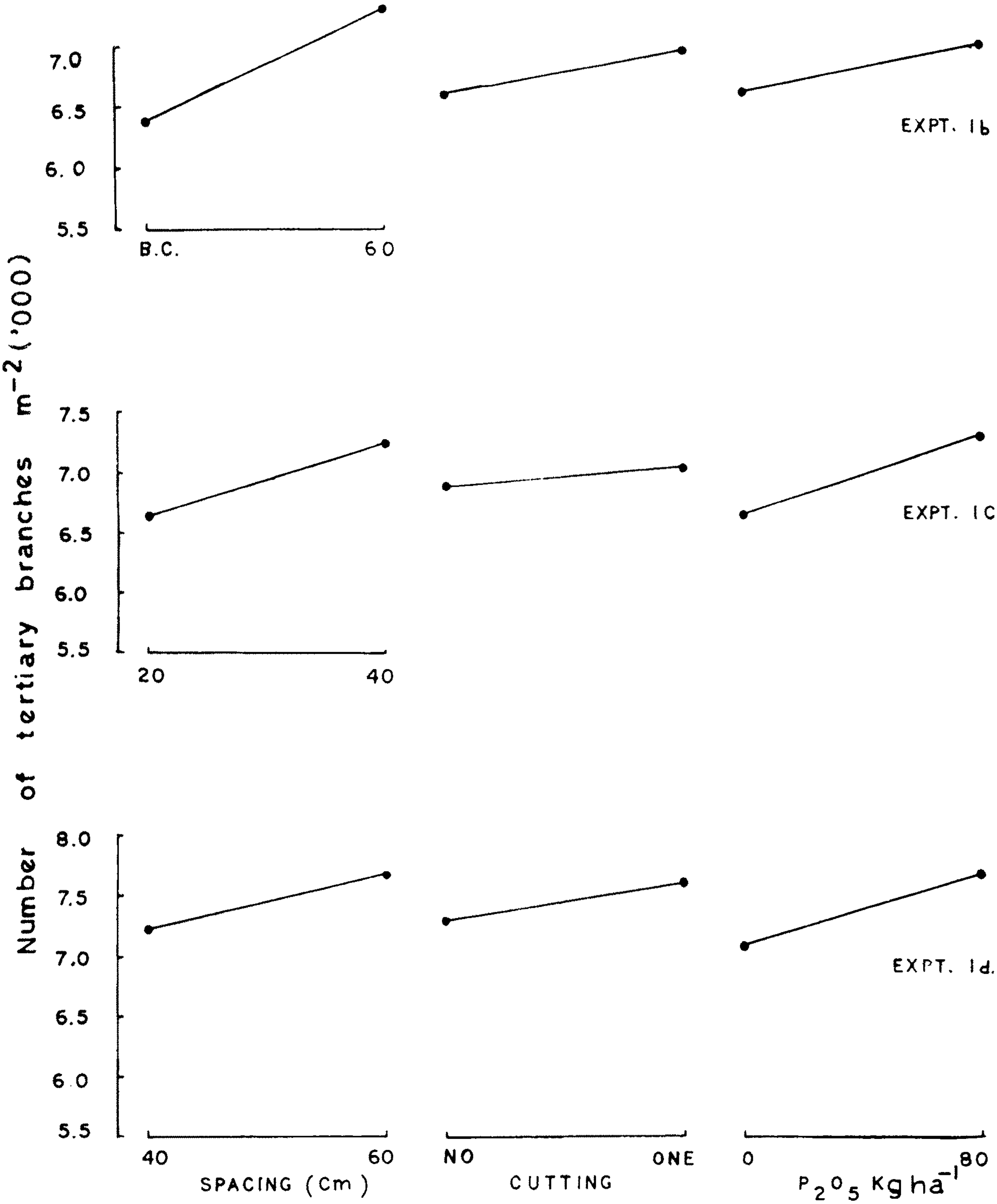

Fig.5.7 EFFECTS OF METHOD OF ESTABLISHMENT, CUTTING TREATMENTS AND PHOSPHATIC FERTILIZATION ON THE NUMBER OF TERTIARY BRANCHES IN C.STYLO cv. VERANO IN Expt. 1b, 1c and 1d

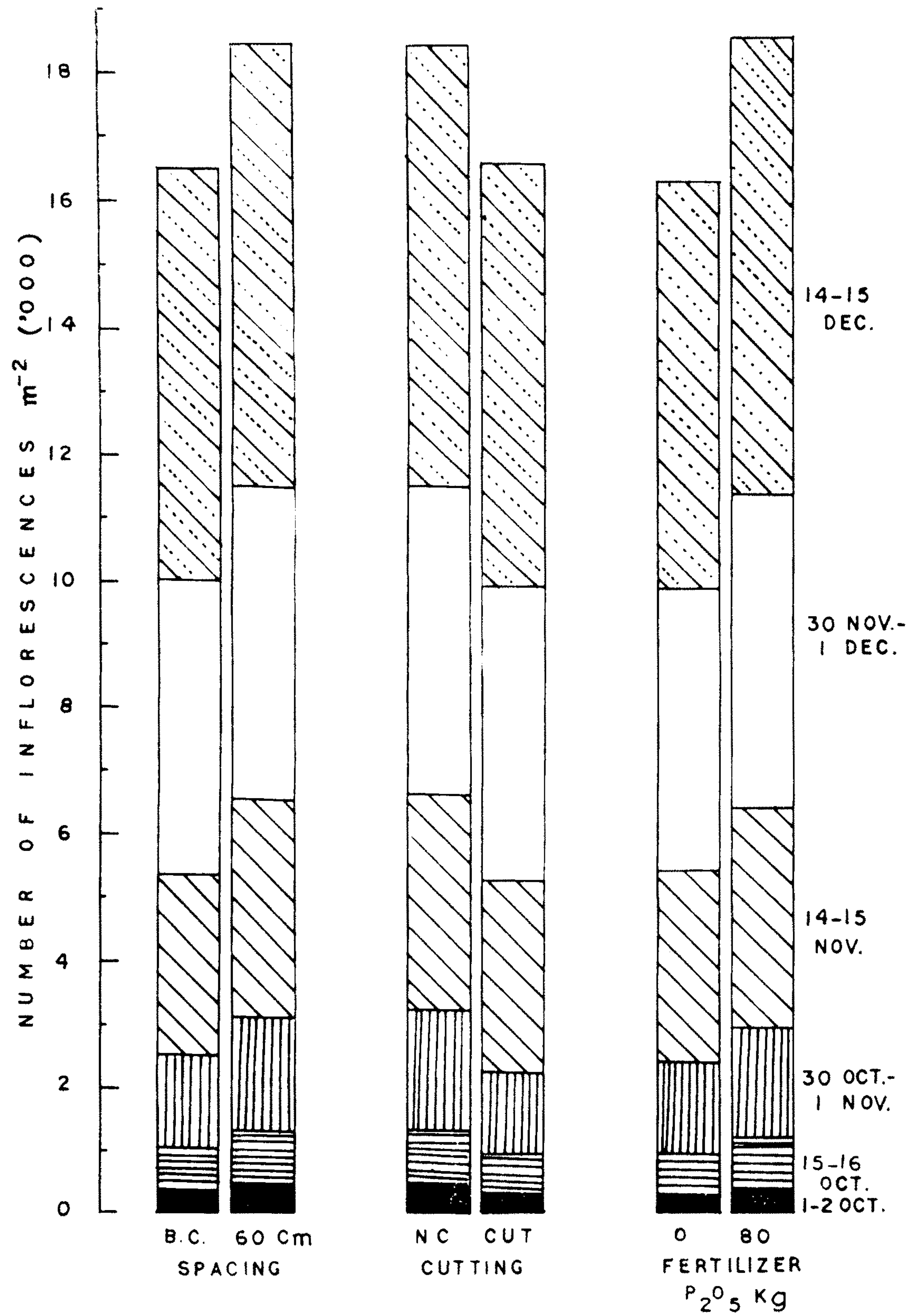

Fig.5.8 EFFECT OF FERTILIZER, CUTTING AND METHOD OF ESTABLISHMENT OF C. Stylo cv. VERANO IN NUMBER OF INFLORESCENCE WITH PASSAGE OF TIME IN Expt. 1b

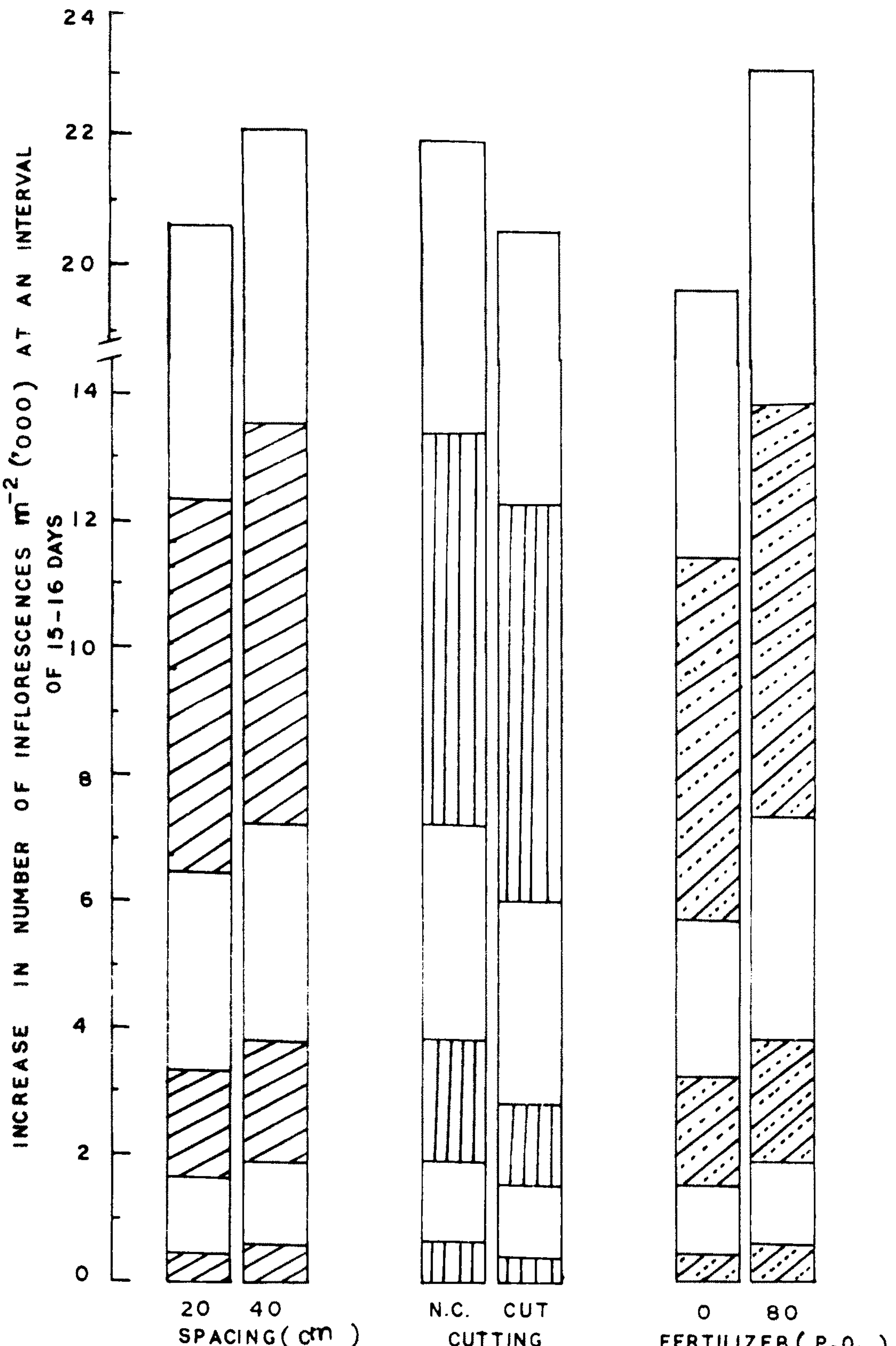

Fig. 5.9 EFFECT OF FERTILIZER (PHOSPHATE) CUTTING TREATMENTS AND ROW-SPACING ON NUMBER OF INFLORESCENCE ON DIFFERENT DAMSE IN Expt. 1c

The flowers after fertilization took about 16 to 18 days to mature, but because of non-synchronous nature of flowering in Verano, flowering and maturity continued for a long period. To assess the best time of harvesting of the crop to obtain the highest seed yield commercially, it was observed that the crop should be harvested by third week of December; harvesting later reduced yields.

Due to the shattering habit of Verano when the crop is harvested by mid-December, still a good amount of seeds of the total produces may be collected through sweeping. Collection of seeds through sweeping can only be possible if there is no rain, but it occasionally happens in the Gangetic plains of West Bengal in the month of December.

The number of florets inflorescence^{-1} was always slightly high in the P_{80}-fertilized and widely spaced crop (Fig. 5.10). The effect of cutting did not significantly affect the number of florets inflorescence^{-1} though there was a trend of increase with passage of time up to third week of December. Usually it ranged from 6.5 to 8 florets inflorescence^{-1}.

The number of seeds floret^{-1} ranged from 1.64 to 1.74 and the treatment differences were not significant in most of the cases under different row spacings and different cutting managements, but fertilizer (P_{80}) significantly

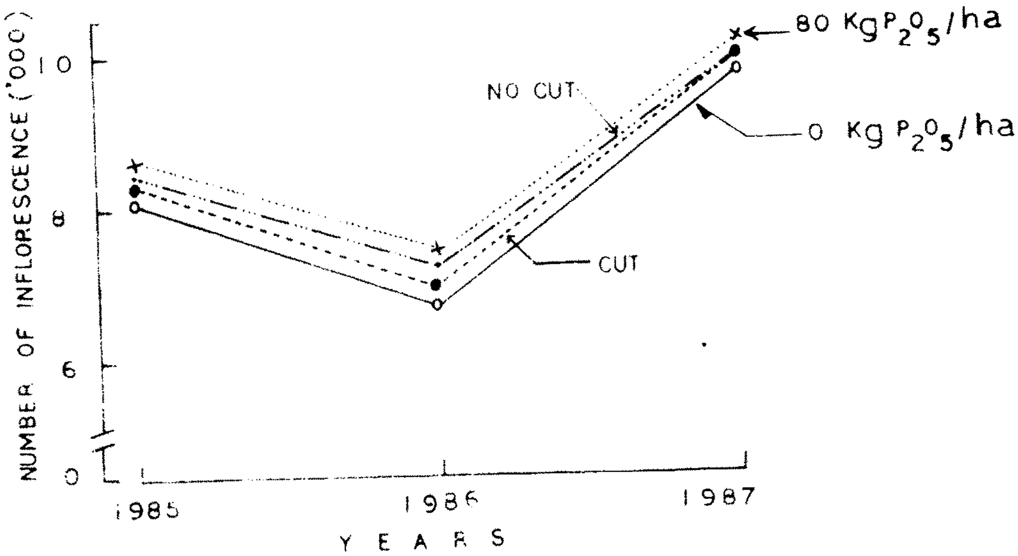

Fig. MAXIMUM NUMBER OF INFLORESCENCE RECORDED IN *S. hamata* Cv. VERANO IN DIFFERENT YEARS

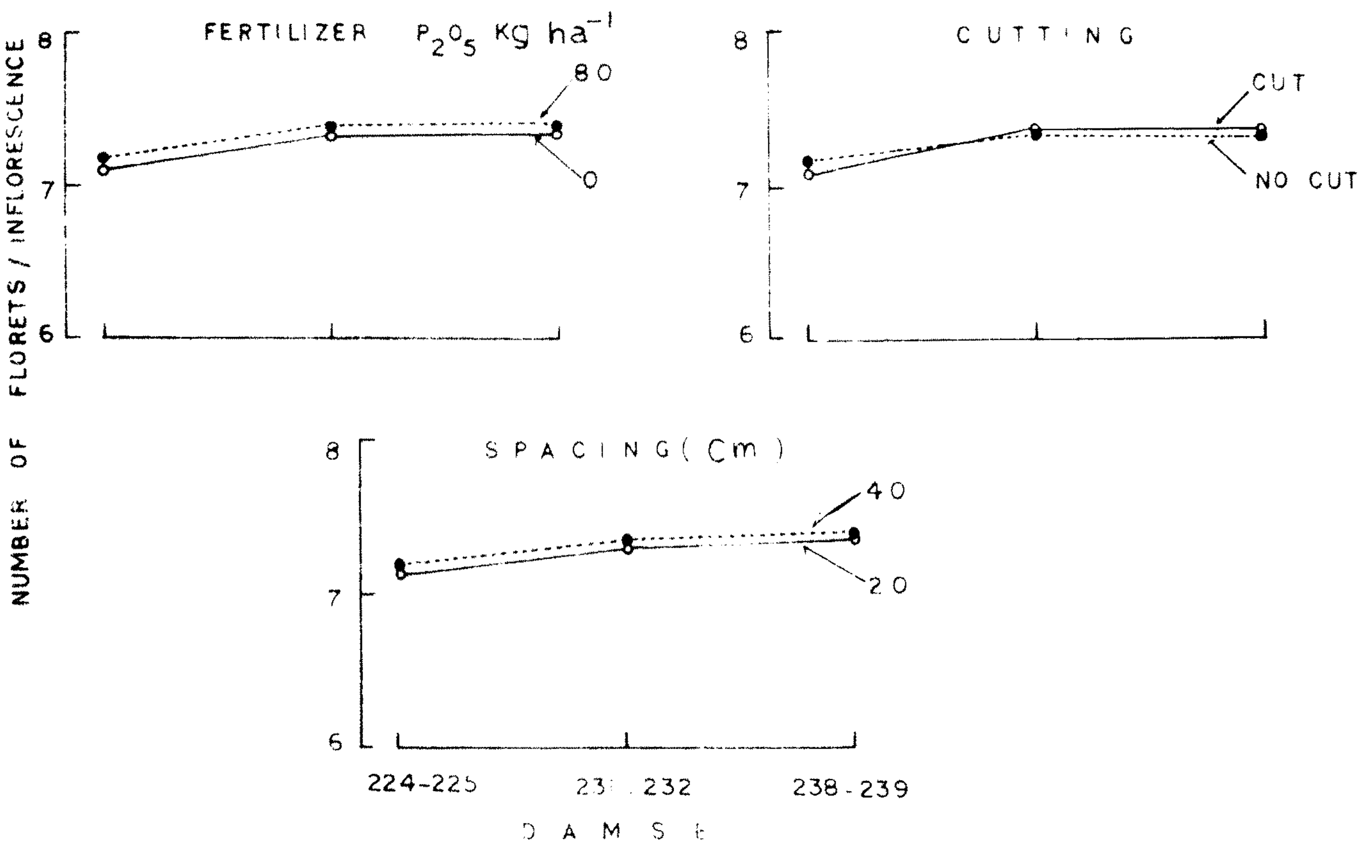

Fig. 5.10 EFFECTS OF FERTILIZER APPLICATION, CUTTING AND SPACING TREATMENTS ON NUMBER OF FLORETS PER INFLORESCENCE ON DIFFERENT DAYS AFTER MEAN SEEDLING EMERGENCE DATE IN Expt. 1C

increased the number of seeds floret^{-1}. The test weight of seeds (1000 seed weight) ranged from 2.41 to 2.70 gm and was influenced by different treatments; phosphatic fertilizer and uninterrupted growth showed positive effect when harvested between mid-December and third week of December (Fig. 5.11).

5.5.1 Relationship between dry matter accumulation and seed yield:

The relationship between DMA and seed yield was not close and significant except in Experiment no. 1b (r = 0.8844) and the correlation values ranged from -0.003 to 0.885. The seed yields under defoliated and undefoliated crop did not differ widely and significantly in most of the cases. Loch et al. (1976) also reported that defoliation made early in the season did not affect seed production.

5.5.2 Relationship amongst secondary branches, tertiary branches and seed yield:

The relation of secondary branches m^{-2} and tertiary branches m^{-2} with seed yield g m^{-2} were positive, close and significant (Table 5.1 and 5.2, Fig. 5.12 and 5.13).

5.5.3 Relationship between number of inflorescences m^{-2} and seed yield:

The relationship between the number of inflorescences m^{-2} with seed yield were close, significant and positive (Table 5.3, Fig. 5.14).

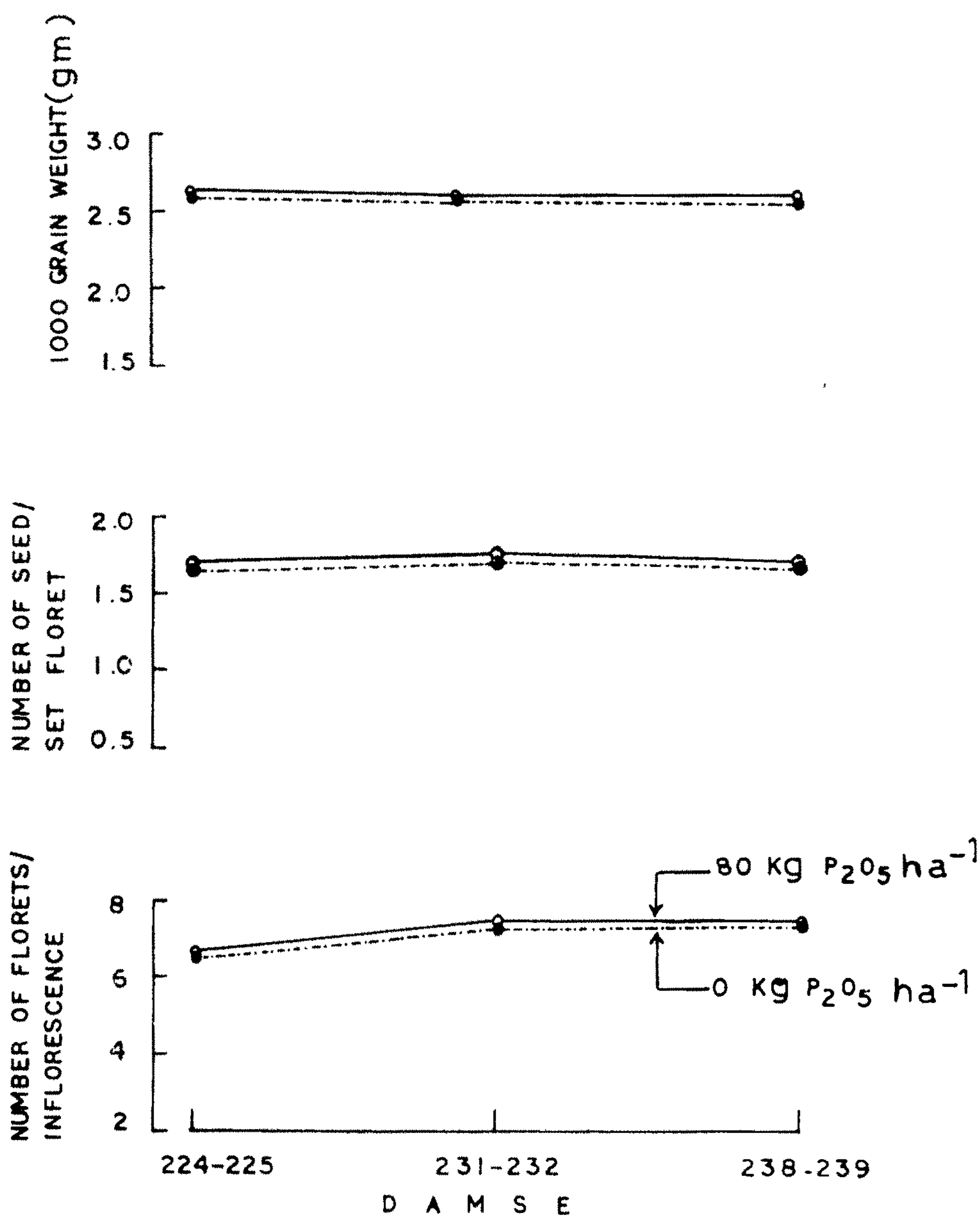

Fig. 5.11 SHOWING EFFECT OF FERTILIZER (PHOSPHATE) ON NUMBER OF FLORETS PER INFLORESCENCE, NUMBER OF SEED PER FLORET AND TEST WEIGHT ON DIFFERENT DAMSE IN Expt. 1d

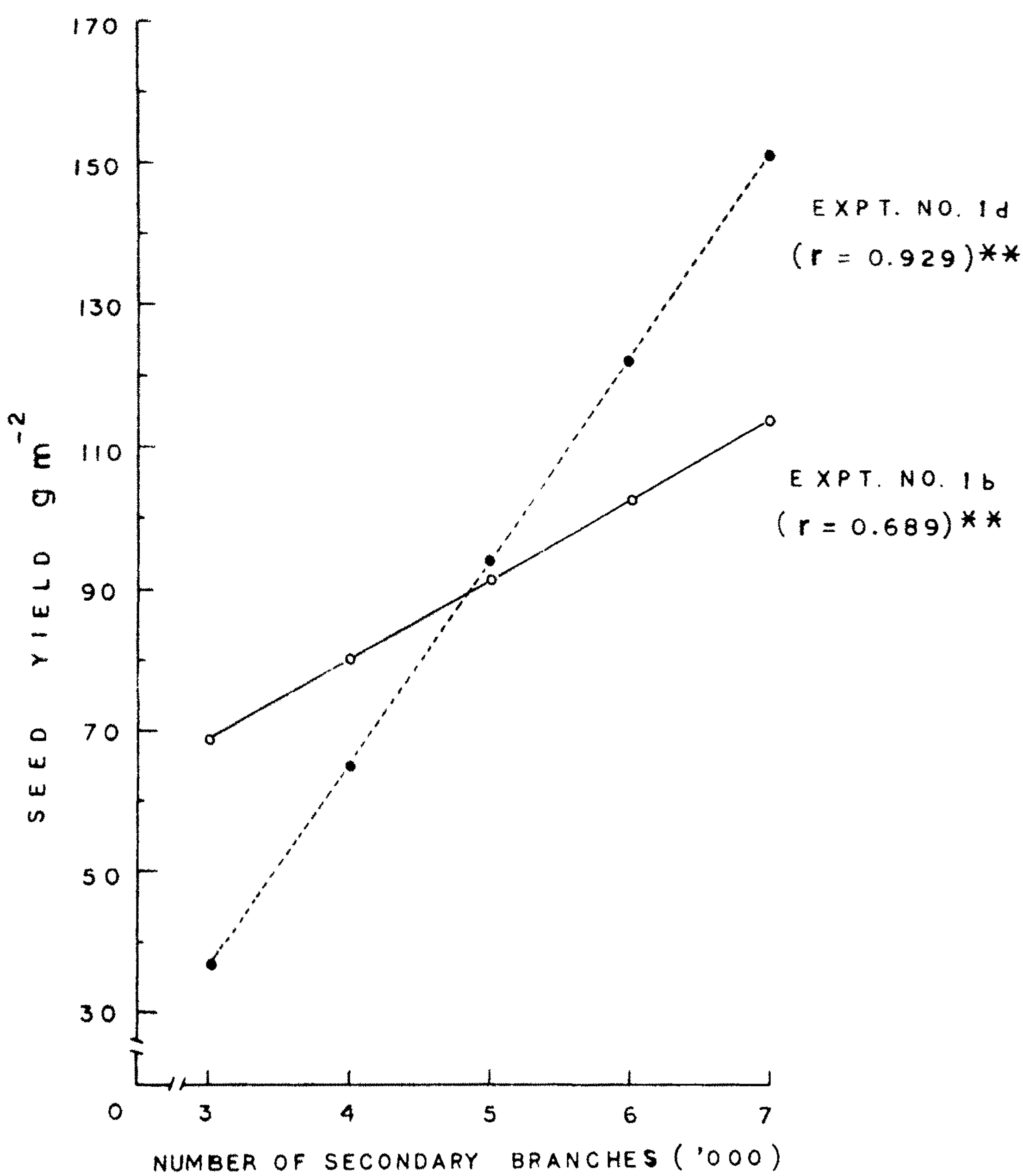

Fig. 5.12 RELATIONSHIP BETWEEN SECONDARY BRANCHES AND SEED YIELD IN Expt. No. 1b AND 1d

Table 5.1 Relationship between secondary branches and seed yield

Experiment Number	r value	Y =	SD(Y) (±)
1b	0.689 *	35.39 + (0.0113X)	14.627
1c	0.851 **	-44.64 + (0.0277X)	15.354
1d	0.929 **	-48.92 + (0.0286X)	19.962

Table 5.2 Relationship between tertiary branches and seed yield

Experiment Number	r value	Y =	SD(Y) (±)
1b	0.722 **	5.97 + (0.0121X)	14.627
1c	0.750 **	-54.48 + (0.0205X)	15.354
1d	0.810 **	-102.13 + (0.0271X)	19.962

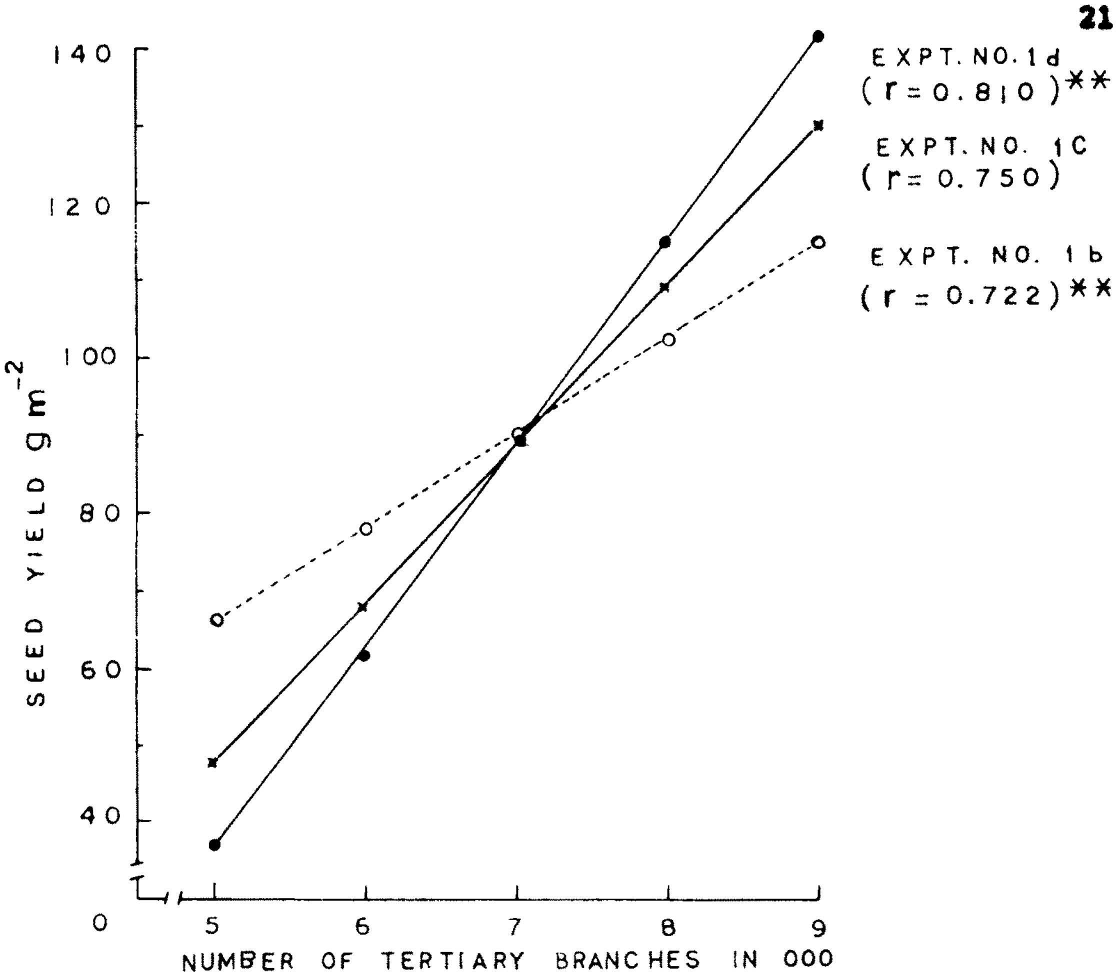

Fig. 5.13 RELATIONSHIP BETWEEN SEED YIELD AND TERTIARY BRANCHES IN Expt. 1b, 1c AND 1d

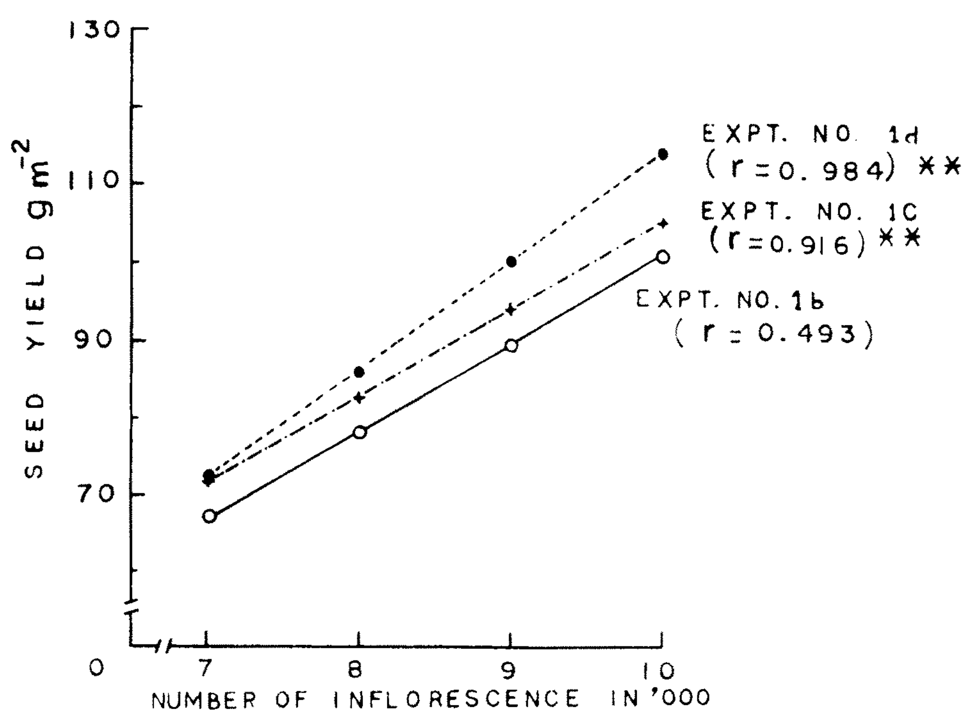

Fig. 5.14 RELATIONSHIP BETWEEN INFLORESCENCE AND SEED YIELD IN Expt. 1b, 1c AND 1d

Table 5.3 Relationship between number of inflorescence and seed yield

Experiment Number	r values	Y =	SD(Y) (±)
1b	0.493 *	44.77 + (0.0056X)	14.627
1c	0.916**	-7.48 + (0.0114X)	15.354
1d	0.984**	-25.07 + (0.0139X)	19.962

5.5.4 Relationship between number of florets inflorescence^{-1} and seed yield:

A close, positive and significant correlation between number of florets inflorescence^{-1} and seed yield was evident in both the experiments (Table 5.4 and Fig. 5.15).

Table 5.4 Relationship between number of florets inflorescence^{-1} and seed yield

Experiment Number	r value	Y =	SD(Y) (±)
1c	0.845**	-183.27 + (34.7361X)	15.354
1d	0.977**	-215.83 + (42.4682X)	19.962

5.5.5 Relationship between number of seeds floret^{-1} and seed yield:

The relationship between number of seeds floret^{-1} and seed yield was not always close and significant. In Experiment no. 1c a close, positive and significant (r value 0.7000) relationship was recorded between the number of seed floret^{-1} and seed yield. whereas in experiment no. 1d it was not found.

5.5.6 Relationship between test weight of seed and seed yield:

Test weight of seed showed to be one of most important determining factor in seed potential of the crop. A positive, close and significant co-relation existed between the test weight of seed and seed yield (Table 5.5, Fig. 5.16).

Table 5.5 Relationship between test weight of seed and seed yield

Experiment Number	r value	Y =	SD(Y) (±)
1b	0.549 *	-280.11 + (163.55X)	14.627
1c	0.777**	-162.17 + (96.2099X)	15.354
1d	0.971**	-232.37 + (128.327X)	19.962

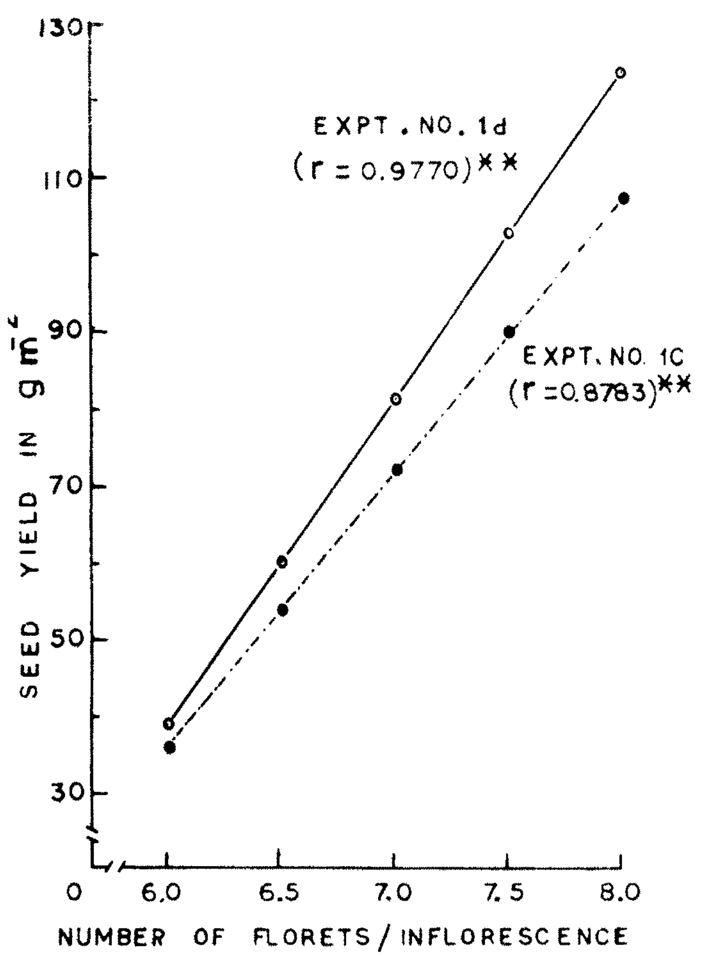

Fig. 5.15 RELATIONSHIP BETWEEN SEED YIELD AND NUMBER OF FLORETS PER INFLORESCENCE IN Expt. 1d AND 1c

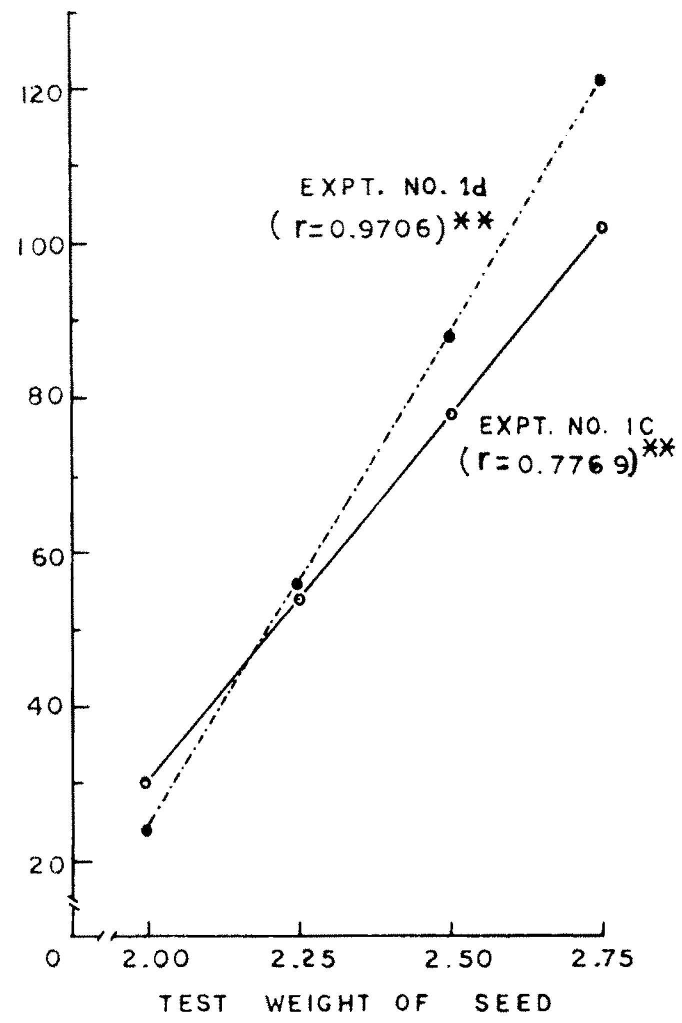

Fig. 5.16 RELATIONSHIP BETWEEN SEED YIELD AND TEST WEIGHT OF SEED IN Expt. 1d AND 1c

Thus, from the above discussion it is apparent that under the agro-climatic conditions prevailing in the Gangetic plains of West Bengal, Verano can produce seeds to the tune of 900-1100 kg ha^{-1} when sown in rows 40 or 60 cm apart with one or no cut treatment fertilized with 80 kg P_2O_5 ha^{-1}. Although seed collection through sweeping between the rows is expensive, but in view of the heavy demand of seed and its high cost it is worthwhile to collect seeds through sweeping which amount to 43 to 45 % of the total produce. One cutting of the herbage at 60 days after mean seedling emergence date (DAMSE) could provide 140 - 160 q ha^{-1} (dry weight 35 - 40 q ha^{-1}) of green herbage for feeding animals without affecting the seed production potential of the crop. The productivity of seed per unit area was influenced by secondary and tertiary branches. It was also dependent on number of inflorescences per unit area, number florets inflorescence^{-1} and the test weight of seeds. The number of seeds floret^{-1} was least affected by the experimental treatments viz., methods of sowing, cutting treatments.

CHAPTER 6

SUMMARY AND CONCLUSION

6. SUMMARY AND CONCLUSION

To evaluate the growth, development and productivity of Carribean stylo cv. Verano, four sets of field experiments were conducted during the years 1984 to 1987 at the Central Research Farm, Bidhan Chandra Krishi Viswavidyalaya having sub-humid, sub-tropical climate and new alluvial (Entisol) soils, located at $23^{o}N$ latitude and 9.75 m altitude. The experimental treatments consisted of two methods of establishment broadcast and row sown, two cutting treatments (no cut and one cut) and two levels of phosphatic fertilizer treatments (0 and 80 kg P_2O_5 ha^{-1}); in later experiments instead of broadcast sowing, line sown treatments with different spacings were included. The objectives were to find out the biomass and seed production potentiality of the crop, to study the flowering behaviour of the crop as affected by different spacing, cutting and fertilizer management and to study the relationship between different growth attributes and yield components with the productivity of the crop.

Widely spaced crop attained significantly higher plant height than the broadcast or closely row-spaced crops. Maximum average height of 85.2 cm was recorded in 60 cm apart row sown crop as against 72.8 cm in broadcast sown crop. Defoliation slightly reduced the height of plants. Phosphatic fertilizer significantly increased the plant height.

Number of primary branches of 60 cm apart row spaced crop were 18 % more than the broadcast crop. It was only 5 % more in 40 cm apart row spaced crop than those of 20 cm apart row spaced crop. Secondary branches significantly influenced the seed yield, defoliation at early developmental stage did not increase shoot density. Broadcast sown swards produced 21.6 % less number of secondary branches than 60 cm row spaced crop. Similarly, 40 cm apart row spaced crop produced 9 % more secondary branches (4885 m^{-2}) than the 20 cm part row spaced crop (4478 m^{-2}). The 40 and 60 cm apart row spaced crops produced 5051 and 5127 m^{-2} of secondary branches respectively, in experiment no. 1d and the difference was significant. Defoliation did not affect significantly the number of secondary branches m^{-2} at 150 DAMSE, undefoliated swards, however, had slightly more number of secondary branches than the defoliated sward. Phosphatic fertilizer increased secondary branches upto 8.6 % over unfertilized crops. Maximum number of secondary branches m^{-2} was recorded (5318 m^{-2}) in fertilized crops. In experiment no. 1b the 60 cm apart row spaced crop had (6704 m^{-2}) nearly 12.2 % more of tertiary branches than that recorded in broadcast sown crop (5891 m^{-2}), significant difference, however was noticed in experiment no. 1c and 1d, between the spacing treatments. Defoliation did not significantly increase the tertiary branches, although there were 5 % more of tertiary branches in the undefoliated swards. Phosphatic fertilizer did not influence tertiary branching except in experiment no. 1a where there were 5 % more of tertiary branches in the fertilized crops than the unfertilized ones.

Dry matter accumulation (DMA) recorded at 224 - 225 DAMSE (1 - 2 December) in wide row spaced crop had significantly higher amount of DMA than the broadcast crop or narrowly spaced crop (20 cm apart rows). On an average the wider row spaced crop produced 680 to 690 g dry matter m^{-2} i.e. about 15 % more than broadcast or narrowly row spaced crop. Undefoliated sward although had higher DMA till 150 DAMSE, did not show significant difference in accumulation later at 224 - 225 DAMSE. Maximum dry matter accumulation from undefoliated swards recorded was 775 g m^{-2} (77.5 q ha^{-1}) in experiment no. 1d at 224 - 225 DAMSE and that was only 3 % more over defoliated swards. Phosphatic fertilization in all the experiments increased DMA over unfertilized (P_0) crop and the increase ranged from 3 to 6 % . Treatment differences in dry matter accumulation did not show any significant relationship with seed yields, this occured because of the shattering of leaves and seeds at later stages.

<u>Stylosanthes</u> <u>hamata</u> cv. Verano though flowered in all photoperiods, had progressively more inflorescences as photoperiods decreased. It was also noticed that at 56 to 59 DAMSE the initiation of flowers commenced, but

main flush of flowering took place during November-December when there was a dip in temperature (max 27 to 32^{o}C and min. 11 to 18^{o}C). No significant difference was noticed between 40 and 60 cm row-spaced crops. In broadcast sown crop the number of inflorescences (6472 m^{-2}) was lower than 60 cm row-spaced crop (6974 m^{-2}). The number of inflorescences m^{-2} ranged from 7000 to 9000 m^{-2} in wide spaced crops (40 and 60 cm) in different years. Defoliation although affected the flowering at the earlier stages of development, but with the passage of time, difference found in the number of inflorescences between uncut (undefoliated) and cut (defoliated) treatments was closer and not significant, although undefoliated swards had slightly (2 to 4 %) more number of inflorescences than the defoliated (one cut) treatment. Phosphatic fertilization increased the number of inflorescences by 6 to 10 % and the increases were always significant. A close positive correlation existed between seed yield and number of inflorescences (r value ranged from 0.493 to 0.984). Number of florets inflorescence^{-1} was positively correlated with the seed yield (r values ranged from 0.874 to 0.977). Widely spaced crop had higher number of florets inflorescence^{-1} (7.4) than that (7.3) of narrowly spaced crop. At 231 - 232 DAMSE (Table 4.64) the number of florets inflorescence^{-1} in 40 and 60 cm apart row spaced crops, however, did not differ significantly. Defoliation at early stage of harvest immediately affected the number of florets inflorescence^{-1}, but with the passage of time this difference was narrowed down to insignificant level. Phosphate fertilization (7.5) significantly increased the number of florets inflorescence^{-1} over the control treatment (7.3).

Widely spaced crop produced more number of seeds (1.64 to 1.69) floret^{-1} than that (1.6) of narrowly spaced (20 cm) crop at 224 - 225 DAMSE. Defoliation also did not affect the number of seeds floret^{-1}. Maximum number of seeds floret^{-1} (1.73) was recorded at 231 - 232 DAMSE (21 - 22nd December). Phosphatic fertilization significantly increased the number of seeds floret^{-1} over unfertilized crop in most of the observations.

Test weight or 1000 seed weight is one of the most important determining factor affecting seed production potentiality of Verano. Widely row spaced crop recorded higher test weight (2.59 to 2.68 g) than that (2.57 to 2.65 g) of broadcast or narrowly row (20 cm apart) spaced crop. The seed weights were more in the first (14 - 15 December) and second (21 - 22 December) harvests, than the subsequent harvests or in other words with the passage of time, the seed weights declined. At the first harvest undefoliated treatment had slightly higher test weight of seeds although it did not always differ significantly and with passage of time the difference diminished to insignificant level. Phosphatic fertilization increased test weight of seed significantly (about 3 %) in all the experiments. The relationship between the test weight of seeds and seed yields of the crop was positively correlated (r values ranged from 0.549 to 0.971).

Widely spaced (60 cm apart rows) crop also recorded significantly higher seed yields (average yield 98.57 g m^{-2}) than that (average yield 69.84 g m^{-2}) from broadcast sown crop. Crops established in 40 cm apart rows gave significantly higher (12 %) seed yield (96.11 g m^{-2}) than 20 cm row spaced crop (85.26 g m^{-2}). The 60 cm row spaced produced an average yield of 98.57 g m^{-2} which was 3 % more than the yield from 40 cm row spaced crop, although in one experiment significant difference in seed yield between 40 and 60 cm row-spaced crop was observed. Defoliation at 60 - 62 DAMSE affected seed yield when harvested in mid December. Undefoliated swards had significantly higher seed yield (varying from 7 to 15 %) than the undefoliated crop but with the passage of time even after a week interval the seed yield of undefoliated crop was in level with that of defoliated one. This might be due to the shattering of early matured seeds. Phosphatic fertilization had significantly increased (11 %) the seed yield in all the experiments as against the unfertilized (P_O) crop.

It can, thus, safely be concluded that *Stylosanthes hamata* cv. Verano is a very good producer of both herbage and seed under the agro-climatic conditions prevailing in the Indo-Gangetic plains of West Bengal, India. Swards of Verano if sown in the month of April-May at 40 to 60 cm apart rows with 80 kg P_2O_5 ha^{-1} and defoliated in the month of July and left for seed production, a good amount of green forage amounting to 140 q ha^{-1} and seed yield of 7 to 9 q ha^{-1} could be obtained and that can fetch at the present price level (Rs.30 kg^{-1}) a revenue of Rs.24,000.00 or so ha^{-1} with an additional benefit of nitrogen fixation in soil with capital investment of about Rs.3,000 ha^{-1}.

CHAPTER 7

FUTURE SCOPE OF RESEARCH

7. FUTURE SCOPE OF RESEARCH

The present work has indicated that *Stylosanthes hamata* cv. Verano can produce a good amount of seed in Entisol soil in the Gangetic plains of West Bengal, where the climatic condition is more humid than in the Western part of the State. Further, in the Western part of the state, the soil is relatively poor and is exposed to occasional droughts. For seed production the drier districts may be more suitable than the humid districts of West Bengal. It is important, therefore that the productivity of seed of Verano need to be evaluated in the districts of Purulia and Bankura or both in the red and alluvial soils. The keeping quality of seeds while stored in different types of containers need also to be evaluated. Further, there is scope to work upon the nutritive requirement of the crop in drier regions of the State where the soil may be bit eroded, acidic and low in available phosphate. The crop takes a long time for seed production. There is scope to do some more work on the time of sowing, number of cutting and on timings of harvesting of the crop in addition to the nutritional aspect of the crop.

Stylosanthes hamata cv. Verano started flowering in the photoperiod prevailing in July. As progressively more inflorescences came out with decreased photoperiods, the peak period of flowering was recorded sometimes by the end of November and continued in December. This long drawn flowering creates difficulties in seed collection. There is need either to select a variety of synchronous flowering within a short time interval or to evolve some agronomic measures including use of growth regulants to synchronise flowering.

Further, seed collection, and processing are getting very costly and imperfect through manual labour and sweeping of the ground with brooms. There is need to evolve some mechanical devices for collection of clean seeds.

CHAPTER 8

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8. BIBLIOGRAPHY

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