ENHANCING SUCKER PRODUCTION IN BANANA AND ITS EFFECT ON THE BUNCH WEIGHT OF THE MOTHER PLANT

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THESIS
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DECLARATION

I hereby declare that this thesis entitled "Enhancing sucker production in banana and its effect on the bunch weight of the mother plant" is a bonafide record of research work done by me during the course of research and that the thesis has not previously formed the basis for the award to me of any degree, diploma, associateship, fellowship, or other similar title, of any other University or Society.

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CERTIFICATE

Certified that this thesis, entitled "Enhancing sucker production in banana and its effect on the bunch weight of the mother plant" is a record of research work done independently by Smt. LEKHA SREEDHAR, R under my guidance and supervision and that it has not previously formed the basis for the award of any degree, fellowship or associateship to her.

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Introduction

1. INTRODUCTION

One of the persistent worries of the banana growers the world over has been and continues to be the lack of quality planting material in sufficient number. In the Central American countries, there are very extensive plantations and as such, nurseries exclusively devoted for generation of planting material are in existence. In other countries, the planters bulk their population, at the same time harvesting economic yields. In such cases, as has been pointed out by Osborne (1963), the rate of sucker production and the total number of suckers produced assume great significance.

Since the edible cultivars of banana are vegetatively parthenocarpic and effectively seed sterile (Barker and Simmonds, 1951), banana is universally propagated through suckers. Except in very rare cases (like 'Nendran' cultivation on leased lands), three-to four-month old sword suckers are recommended (Nayar, 1962; Simmonds, 1966) due to the superior performance of the resultant plants as compared to those from older sword suckers or water suckers of different ages.

When new material is generated, multiplication can be effected, rather rapidly, through the use of corm bits (Nayar, 1962; Simmonds, 1966; Berrill, 1960), by adopting the methods

Suggested by Hamilton (1965), Ortiz and Fierro (1976), Ezhumah et al. (1977) or by resorting to nurseries (Wright, 1951). If the resultant propagules are weak, they can be upgraded (Ndubizu & Obiefuna, 1982).

In developing countries like India, fruit production and expansion have to occur concurrently. Periodical removal of the suckers (Wright, 1951; Gregory, 1952; Osborne, 1963; Satyanarayana et al., 1980), adopting wider spacing in the initial years to promote sucker production, methods of Barker (1959), Ascenso (1967) and application of growth substances (Annadurai, 1976; Anbazhagan, 1978; Annadurai and Shanmughavelu, 1978; Ravichandran, 1983) have been found to be useful to enhance sucker production. Surprisingly, the effect of these sucker enhancement treatments on the performance of the mother plants has not been assessed, except by Ravichandran (1983).

Although it is known that banana clones differ in their suckering ability (quantity and quality-wise), sufficient data have not been generated with regard to the natural suckering abilities of even the important clones. Simmonds (1966) has clearly pointed out this lacuna.

Thus, assessment of the natural sucker producing ability of the important cultivars of Kerala and standardisation of a method that would increase the sucker production (both quality and quantity-wise) without much deleterious effects on the mother plants were considered essential.

As such, investigations were carried out during 1983-85 to assess the natural sucker production in seven of the important cultivars of the State and to standardise a method that would generate a large number of sword suckers without much deleterious effects on the mother plants.

Review of Literature

2. REVIEW OF LITERATURE

One major problem in banana production can be the lack of sufficient planting materials. This problem arises because banana is parthenocarpic and planting materials are limited to the suckers or rhizomes. Efforts have been made to find ways to increase sucker production in order that the requirement of planting material can be met. Nurseries, exclusively devoted to generation of planting material (Simmonds, 1966) would be practical in the Central American countries where the banana plantations are in extensive scale. However, in countries like India, increasing the yield of suckers without relevance to the production of fruits may not be acceptable to the farmers. As has been pointed out by Simmonds (1966), the planters' chief worry would be how to make the crop pay while bulking the population. Under such conditions, the rate of sucker production and the total number of suckers produced assume significance (Osborne, 1963). An attempt has been made in this chapter to review the extant literature in these and related aspects.

2.1. Types of planting material

Simmonds (1966) and Wardlaw (1972) reviewed the terminology of the planting materials used in the different

parts of the World. There are two types of suckers, the sword suckers or spears (suckers with a well-developed base, pointed tip and narrow, sword-shaped leaves in the early stages) and the water suckers or umbrellas (small, undersized suckers with slender pseudostem, bearing broad leaves). Very young suckers bearing only scale leaves are called "peepers" or "sitters". Large corms that can be cut into "bits" or pieces (each containing a bud or an "eye") are called "heads" (sometimes, "bull heads"). The piece of pseudostem discarded from a head is called the "cabbage". The main growing point of a shoot is called the "heart".

Universally, banana is propagated through suckers (offsets). The edible cultivars are vegetatively parthenocarpic and effectively seed sterile (Barker and Simmonds, 1951), since the ovules atrophy (De Langhe, 1969).

The material preferred to for planting varies widely in the different parts of the World. In West Australia, "spear points" (which would be classified as "peepers") are preferred to the other types (Barnett, 1947). In Israel, Oppenheimer and Gottreich (1954) recommended well grown water suckers. In Martinique, according to Daudin (1955), heads

of plants which have flowered are preferred to the maidens. Daudin further stated that sword suckers are to be used as little as possible and should be regarded as the last resort. By contrast, in Jamaica, bits of large corms, maidens and sword suckers are considered satisfactory planting material, water suckers and peepers being rejected (Simmonds, 1966). Nayar (1962) recommended cutting of the parent rhizome into two (if its diameter is between 4.5 and 7.5 inches) or four (if its diameter is more than 7.5 inches) pieces and using the bits for planting. However, this method has been advocated only when planting material is scarce. The general recommendation was, however, to plant three-to four-month old sword suckers to take advantage of their precosity and heavier yields as compared to the water suckers (Nayar, 1962). When banana (particularly 'Nendran') is grown on leased lands (leased for a period of one year), older suckers are sometimes used for taking advantage of the early yield, even at the cost of a possible yield reduction.

2.2. Performance of the different types of planting material

The use of sword suckers has been so widely accepted that comparative evaluation of the performance of the different

types of planting material has been limited.

The data generated by Gregory (1952) revealed that peepers took 433 days to shooting as compared to 381 days taken by large sword suckers. The bunch weight was also more (6.6 kg Vs 6.3 kg) when sword suckers were used as the propagules. Malan (1953) found that the plants raised from old fruited stems came to bearing earlier than those from suckers or rhizomes. Oppenheimer and Gottreich (1954) who compared the performance of sword and water suckers observed that sword suckers flowering late, bore heavier bunches of better grade. Bhan and Mazumdar (1956) using butts (either whole or cut into two or four equal bits) from fruited and non-fruited plants observed that the initial growth was fastest in plants produced by whole butts of fruited plants and slowest in those produced by quarter bits of non-fruited plants. However, the ultimate growth and number of hands per bunch were not affected by the type of planting material. As such, corms from plants that have already produced bunches have been preferred (IFAC, 1957), the next best being corms from maiden suckers (plants about to shoot bunches). Bartolome and Sargoman (1958) who compared three kinds of banana planting

material (young sucker, old sucker and rhizome bit) could not observe significant differences in fruit yield and shooting capacity due to the planting material. Berrill (1960) observed that pieces of Cavendish corms (0.5 to 2.0 kg in weight) were better planting material than the suckers (25 to 96 cm girth), because the former produced a more uniform stand of vigorous and heavier bearing plants than the latter. Champion et al. (1962) compared young suckers with terminal buds and rhizomes of adult plants before and after flowering with lateral buds either active or dormant, with or without a portion of pseudostem attached. The best results were obtained with rhizomes bearing a single well developed side shoot each and retaining about 20 cm of the pseudostem that had already flowered. Nayar (1962) reported that sword suckers (of 'Monthan' and 'Poovan') flowered and fruited earlier than the water suckers. Srivastava (1963) concluded that sword suckers of 'Basrai' banana were more vigorous and produced bigger and heavier bunches in 11 months than what its water suckers did in 15 months. According to Simmonds (1966), whenever possible, deep suckers (sword suckers) should be chosen for planting. Trochoulias

(1966) recommended the use of large and medium spear points (sword suckers), as they produced bunches more quickly than the other types of planting material. Kalie and Sunarjono (1974) compared maiden suckers with peepers, corms and bits. They concluded that the use of bits resulted in highest quality bunches with the highest number of hands per bunch and the greatest bunch weight. Kaikari and Amankwah (1977) compared three types of planting material (sword suckers, maidens and bits) of three sizes (small, medium and large) of the cultivar 'Blata Kwada' during a 23-week period. The sword suckers were found to be the most suitable type, emerging early, giving the largest leaf area and producing the most vigorous plants. They were, however, found to be poor in suckering and thus, inferior to the maidens for the multiplication of new clonal material. Bits were found to be poor in growth and development. Ke and Ke (1980) who compared the suckers and corms of 'Giant Cavendish' banana found that the suckers yielded earlier and produced heavier bunches than the corms. Chattopadhyay et al. (1980) compared four-month old sword suckers, 10 to 15-day old peepers and 2.0 kg split rhizomes of Cavendish banana variety "Giant

Governor" . The height and girth of the plants were relatively larger when suckers were used as the planting materials. Suckers, in general, were found to produce more number of leaves, irrespective of the planting time. Early flowering and fruit maturity as well as heavier bunches were observed in the plants raised from suckers as compared to those from peepers and rhizomes.

2.3. Influence of the size of the propagules on production

As regards the influence of the size of the planting material on the performance of the resultant plants, the reports available are of contradictory nature.

Small suckers (not peepers) have been recommended as planting material (Jamaican Dep. Agri., 1952), since no difference in yield was observed between tall and short sword suckers. However, Oppenheimer and Gottreich (1954) observed that a difference of as little as one foot in the height of the suckers markedly influenced the time of flowering of the plant crop and hence, the yield. According to them, small suckers, flowering late, gave better grades; but lower yields. Large suckers proved superior to the smaller ones on account of their favourable influence on flowering, bunch weight and

subsequent sucker production. They pointed out that, ideally, the sucker size should be related to the planting time and the weather, and as such, later the planting, the bigger should be the sucker (in areas subjected to winter chilling). Nagpal et al. (1958) favoured the use of large planting material since in their trials, six-month old rhizomes gave higher yields than the two-month old ones. According to El Mahmoudi (1961), the best method for production of suitable, vigorous suckers for a plantation is to plant 20 cm tall suckers at 75 cm x 75 cm in a nursery. A comparative trial conducted by Neyra and Carranza (1972) included three sizes of corm (3.0, 5.0 and 7.0 kg) and three heights of sucker (0.5, 1.0 and 1.5 m). The corm pieces of 5.0 kg weight gave the highest yield and largest number of hands per bunch. Further, the resultant plants were tall, vigorous and early in yielding. Suckers (1.5 m tall) took 496 days to reach the harvest whereas the corm pieces (7.0 kg) took a long time to yield, requiring 554 days to shoot. Summarising the available information, Purseglove (1975) concluded that the size of the planting material will have some effect on the rate of development; small propagules

taking longer. He, however, added that the size of the propagule had little or no effect on the size of the resultant bunches.

2.4. Influence of the age of the propagules on production

Past research has not clearly brought out the influence of the age of the propagules on the growth and yielding ability of the resultant plants.

Bhan and Mazumdar (1961) compared the performance of suckers of four age groups (newly emerged, 2-month old, 3-month old and 4-month old) in 'Kabuli' and 'Martaman' varieties planted in the monsoon and autumn seasons. In the case of 'Kabuli' variety, the four-month old suckers planted in the autumn cropped the earliest; but produced the smallest bunches. The three-month old suckers recorded the largest number of hands and fingers, giving the highest yield. In the 'Martaman' variety, the age of the suckers did not exhibit significant influence on the days to flowering, number of hands and fingers, and yield. Jagirdar and Hussan (1968) who conducted a five-year experiment observed no significant difference in the growth and fruit production of banana raised from suckers of 1½, 2½ and 3½ months age. Nasharty et al.

(1969), using suckers of different age and size, could not find any difference in the growth and fruit production of the resultant plants.

2.5. Suckering abilities/qualities

Although it is known that the banana clones differ in their suckering ability (quantity and quality-wise), sufficient data have not been generated.

According to Osborne (1963), suckering qualities play an important part in arriving at the system of management that is adopted in order to satisfy the marketing requirement for the fruit and the rate of expansion, when a new clone is being established. The rate at which suckers are produced and the total number produced are thus of significance in assessing the potentialities of any banana clone for commercial acceptance. Simmonds (1966) reported that differences exist between the clones in their capacity to produce suckers. However, he observed that data on natural sucker production by the different clones are lacking.

Wills and Berrill (1953) opined that persistant appearance of sword suckers is a sign of plant vigour. According to Nayar (1962), the production of water suckers in

abundance is a sign of unhealthy banana clump. He observed that the clumps which are old, over crowded, ill-managed and growing in shaded places are likely to produce more water suckers. He added that broad leaved suckers are normally not produced by healthy banana clumps.

Balakrishnan (1980) observed a strong correlation between the number of developed buds on the corm at planting and the number of suckers produced.

2.6. Growth of the suckers

As early as in 1911, Cook observed the depth of origin of the bud to be significant in determining the type of the suckers. He concluded that the buds of deep origin bear the narrow leaved sword suckers and the buds that develop at or near the soil surface, the broad leaved water suckers. According to Simmonds (1966), the rhizome system of banana is sympodial. He stated that the buds by which growth of the sympodium is carried on tend to be borne on the middle and upper parts of the parent corm. Nayar (1962) had earlier observed the attachment of the sword suckers to the parent rhizome to be closer and firmer, facilitating efficient drawal of nutrients from the parent and the build up of a more robust pseudostem.

Simmonds (1966) opined that water suckers originate superficially. De Langhe (1969) observed that the banana rhizomes regularly develop new buds from which suckers arise. According to him, a sucker consists of an ever increasing series of long leaf sheaths telescoped into each other. Turner (1972) defined suckers as lateral buds that had swollen to protrude more than 1.0 cm from the surface of the corm.

The growing point commences a lateral bud opposite the leaf axil of the parent corm which will be microscopically evident about ten leaf bases away from the apical meristem (Barker and Steward, 1962). After the formation of twelve leaves, the lateral bud begins to produce primordial leaves. The young bud then commences to grow through the cortical zone of the parent and an extension of the internal zone is laid down (Champion, 1963). Before reaching the external limits of the cortex, the lateral bud will have numerous scale like leaves. As the bud grows, each new leaf becomes larger than its predecessor. The new bud grows horizontally for four to five inches from the parent corm and then grows vertically. On reaching somewhere near the soil surface, the growing point stops vertical growth until flowering

commences. During this period, lateral growth of the new corm and pseudostem is evident.

Suckers derive their nutrition from the mother plant in their early stages. Once the photosynthetically active green leaves develop, the suckers synthesise their own food. Walmsley and Twyform (1968) showed that P^{32} readily moved from the mother plant to its suckers and vice versa. Balakrishnan (1980) also recorded similar movement of P^{32} in 'Robusta' plants. He further observed that the movement of P^{32} declined with increasing age. Using P^{32}, Rajeevan (1985) proved the existence of translocation of nutrients from the mother plant to its suckers, after the harvest of the former (whether half or the entire pseudostem of the mother plant was retained).

2.7. Influence of genomes and ploidy on sucker production

Differential behaviour of the clones belonging to the different genomic groups has been observed by many workers. As early as in 1946, Venkataramani reported more number of suckers in the balbisiana derivatives and less number in the derivatives of accuminata. Simmonds (1962) observed that with an increase in the balbisiana genome in the constitution, the

sucker production ability also increased. He, however, indicated that among the clones of similar genomes, variations may occur due to the differences at sub-specific level. Chakrabarty (1977) recorded greater production of suckers in 'Monthan' (ABB) and 'Robusta' (AAA) than in the other cultivars. On the contrary, Alagiamanavalan (1979) obtained profuse suckering in the cultivars of AA genome (among which 'Sanna Chenkadali' produced 20 suckers, followed by 'Matti' with 16). In the diploid cultivars of AB genome, 'Kunnan' and 'Vennettu Kunnan' produced large number of suckers. Balakrishnan (1980) reported that the pure accuminata cultivars 'Anaikomban' (AA), 'Robusta' (AAA) and 'Wather' (AAA) produced comparatively more number of suckers than the hybrid derivatives. However, 'Monthan' (ABB) produced more suckers than 'Robusta' (AAA). Ravichandran (1983) obtained the highest mean number of suckers (20.7) in 'Monthan'(ABB). 'Robusta' (AAA) and 'Poovan' (AAB) produced 15.2 and 13.9 suckers, respectively. Ravichandran observed that as the proportion of 'B' genomes increased, there was a proportionate increase in the production of water suckers.

The ploidy level of a clone is also known to influence

its suckering ability. Gregory (1954) compared 'Lacatan' and '1877' (a tetraploid). The tetraploid produced only 70 to 80 per cent of the suckers produced by 'Lacatan'. Dumas (1955) and Turner (1972) observed early suckering in diploid and triploid bananas and attributed this to the early release of lateral buds from the dominance of the mother plant. Balakrishnan (1980) in his studies with eight cultivars found that sucker production was indirectly proportional to the level of their ploidy. In his studies, the diploids produced the largest number of suckers and the tetraploids, the lowest. He found the triploids to be intermediate in this respect.

2.8. Sucker production Vs stage of growth of the mother plant

Summerville (1944) recognised four phases in the growth of the banana plant. According to him, the first two stages (I a and I b) were distinguishable only on physiological basis and constitute the vegetative phase. Floral (II) and fruiting (III) phases followed. He further stated that each stage is dependent on the preceding one. Wright (1951) observed that in 'Lacatan' banana, more than half the suckers produced by a plant were produced during the last four months

of the crop (including the fruiting period). Turner (1971) found that in the triploid 'Willaim Hybrid', the highest percentage of suckers was obtained during the last four months of the crop while in the others, more suckers were produced between the 15-leaf stage and flowering. Balakrishnan (1980) also observed maximum sucker production between the 15-leaf stage and flowering in all the varieties studied by him, except in the shy suckering tetraploids 'Hybrid Sawaii' and 'Klue Teparod' in which the sucker production was rapid after flowering. Ravichandran (1983) found that though suckers were harvested at the five stages, the maximum number of suckers were harvested in stage 2 (7½ months after planting). He attributed the subsequent reduction to the diversion of nutrients for the floral differentiation taking place within the mother plant.

With regard to the quality of suckers also, differences have been observed *vis a vis* stage of the crop. Water suckers appeared more in the later stages and this has been ascribed as due to the impedance in the translocation of nutrients from the mother plants to the suckers (Wardlaw *et al.*, 1939; Summerville, 1944; Simmonds, 1962) which forces

the suckers to produce broader lamina for their own survival.

2.9. Increasing sucker production

Attempts to increase sucker production have been made by several workers in the important banana growing areas of the world. Depending on the objective ie. whether rapid multiplication of a new clonal material alone is desired or whether the enhancement of sucker production is to be combined with fruit production, the methods vary.

2.9.1. Rapid multiplication of new clonal material

Selection of healthy rhizomes with a diameter of 20 to 25 cm, splitting them into several pieces (each containing a good bud) and planting the pieces in a propagator yielded as much as 14.2 suckers per corm (Jamaican Dept.Agri., 1952). From French Cameroons, Borel (1952) reported that cutting back the 'Gros Michel' pseudostem to 0.6 m above the collar after fruiting (mattocking) gave increased sucker production. "Goosenecking" (notching the top of the pseudostem of the leading plant before fruiting, practised in Jamaica) results in the destruction of the crown and is believed to stimulate sucker production. Wright (1950), however, showed

that this practice was ineffective in stimulating sucker production and was, indeed, harmful in so far as it caused the death of the mother plant. Based on his trials with tetraploid bananas, Osborne (1963) also arrived at the same conclusion regarding the practise of "goosenecking". A similar technique for the rapid multiplication of the cultivar 'Basrai' was described by De Langhe (1961) in which six-month old mother plants were cut off at the ground level. The central bud was then eliminated to accelerate the development of the lateral buds. Suckers were periodically harvested when they were 20 to 30 cm tall. By this method, six to eight suckers per mat could be obtained during a period of six months. Hamilton (1965) obtained as much as 150 suckers per corm within six months, by destroying the apical meristem of the corms to induce axillary bud formation, planting the corms in a rooting medium and rooting the plantlets arising out of the adventitious buds. However, the resultant propagules were small and weak, requiring constant supervision. Ortiz and Fierro (1976) observed that removal of the apex with a modified cork borer would increase the sprouting of suckers. They opined that this method

could be used for rapid multiplication of new clones. Ezumah et al. (1977) obtained 3159 suckers (required for planting 4.45 ha) from 18 original rhizomes within a 16-month period by planting the large rhizomes in boxes filled with soil/vermiculite (in shade or in humidity chamber), detaching the suckers and planting them in a field nursery or in cans, followed by transplanting them to commercial fields for subsequent sucker production there. Gopimony and Kannan (1978) who irradiated 'Nendran' rhizomes with doses of gamma rays (1.0 to 8.0 Kr) observed that production of suckers from the irradiated side of the rhizomes was reduced by all the treatments, especially by doses above 4.0 Kr. Sucker production from the opposite side was, however, not affected. Sucker survival on the irradicated side, four months after planting, was markedly reduced by doses above 2 Kr; but on the opposite side, they observed little difference.

A method of upgrading the weak propagules was described by Ndubizu and Obiefuna (1982). Some peepers (of about 200 g weight, emerging from the ground and having only scale leaves) were retained on the mat and the others were separated

and grown in polybags or in a nursery. These, after four to five months, were found to be excellent propagation material.

In countries like Jamaica, nurseries with the sole objective of producing maximum possible yield of suckers for distribution to the planters are in existence. In such cases, fruit production in the nurseries is considered irrelevant. Wright (1951) observed that since more than half the suckers produced by a plant were produced in the last four months of the crop (during the fruiting period), the nursery plants should also be allowed to grow to fruiting stage, even if the fruit yield is irrelevant or virtually a waste.

2.9.2. Combining the production of suckers and fruits

Methods that would increase the yield of suckers without relevance to the production of fruits may not be acceptable to the banana growers of India. Combination of fruit and sucker production would facilitate fruit production and expansion concurrently. Periodical removal of the suckers, alteration of spacing, subjecting the mother plants to different sucker enhancement treatments (including appli-

cation of growth substances), etc. have been attempted with this goal in mind.

2.9.2.1. Periodical sucker removal

Wright (1951) observed that removal of the suckers at peeper stage resulted in an increase in sucker production, upto 7.9 per mat in 'Lacatan' banana (average of three densities 640, 1450 and 2610 plants per acre). On the contrary, the removal of suckers at the sword stage yielded only 5.6 suckers per plant. However, he cautioned that the peepers are delicate planting material and cannot be directly distributed to the planters. Further, peeper removal can make the parent plant susceptible to blow down by wind. In a series of sucker removal treatments, Gregory (1952) also obtained higher yields of planting material in peeper removal than in the removal of suckers at a later stage of development. Gregory added that peepers were not suitable for commercial planting as they exhibited delayed production and poor yields. Osborne (1963) found that the tetraploid 'Bodles Altafort', which was roughly equal to 'Lacatan' in sucker production by the heading back method, was much more productive if the suckers were removed at two-month interval.

'Lacatan' thus gave 8.7 suckers per plant per year and 'Bodles Altafort', 11.3. He stated that when fruit and sucker production are combined, an annual multiplication rate of five suckers can only be expected. According to him, an annual multiplication of roughly ten times is about the limit for the method described here. Osborne, however, supported the view of Wright (1951) that such plants needed propping. According to Satyanarayana et al. (1980), periodical removal of 'Karpoora Chakkarakeli' suckers (at five or six-week interval) by digging them out with a portion of corm significantly increased the number of suckers produced per plant (17.03 and 14.4 suckers, against 4.99 under the normal practice of pruning back the suckers at the ground level), besides hastening flowering and increasing the yield by 12.0 per cent.

2.9.2.2. Spacing of the mother plants

Wright (1951) observed that while net sucker/ha (number of suckers produced minus number of suckers used for planting) can be increased within limits by wider spacing, economic density has to be followed for obtaining heavy yields. He, therefore, recommended change of planting density

from year to year, starting in the early stages with a low density (to promote suckering) and increasing to high density limits after a few years when relatively abundant quantity of planting material has become available.

2.9.2.3. Sucker enhancement treatments

Barker (1959) obtained a 20.6:1 ratio of multiplication, after six months, by forced suckering and digging out of young suckers (when they attained a trimmed weight of 0.68 kg and a height of 60 to 90 cm) from the mother plants. Suckering was forced by stripping the older leaf sheaths from the pseudostem for exposing the buds at the base. The leaf sheaths were divided lengthwise and the halves pulled sideways and upwards to expose the basal buds. The buds were then ringed with a sharp knife to prevent damage to it when the next sheath was removed. Two to three sheaths were removed so that the last exposed bud was 2.0 cm in size (as big as a thumb nail). Soil was heaped around the stem just covering the buds. The operation was repeated every two weeks. Ravichandran (1983) tested this method under Coimbatore conditions and could obtain a mean multiplication ratio of only 13.3:1. He argued that the exposure of the tender

buds, ringing them and then heaping soil over them invariably killed or dried up the young sprouts.

Ascenso (1967) developed a simple technique for the rapid multiplication of 'Gros Michel' banana. Mother plants were earthed up and fertilised with nitrogen (@ 720 g ammonium sulphate per plant per year in four equal dressings) to force suckering. Young suckers were detached when they attained 25 to 30 cm height and planted out at a spacing of 1.5 x 1.5 m, regularly watered and fertilized with ammonium sulphate. By this method, a multiplication rate of 15.5:1 was obtained after nine months, the range being 9.0 to 30.0. According to Ravichandran (1983), although sucker production in banana is mainly a function of ploidy, it could be stepped up through suitable agronomic techniques. Of the different techniques he tried, Ascenso's method gave a mean multiplication rate of 16.9:1. The method also recorded the least number of water suckers, besides giving good plant vigour, early shooting, short maturity period, good grade and heavy yield.

2.9.2.4. Application of growth substances to step up sucker production

Modification of plant growth by chemical means conti-

nues to interest the plant scientists. Among the growth substances, 2-chloroethyl phosphonic acid (ethrel, ethephon) has been found to be useful for stepping up sucker production in banana, pineapple, etc.

Annadurai (1976) reported increased sucker production in 'Monthan' consequent on ethrel (250 ppm) application. Anbhazhakan (1978) recorded similar results with 350 ppm ethrel in 'Poovan', 'Monthan' and 'Nendran' banana. Annadurai and Shanmughavelu (1978) reported stimulated sucker production in 'Monthan' on the application of ethrel. In Ravichandran (1983)'s studies, ethrel 400 ppm proved better than the other treatments (Ascenso's method and Barker's method) with respect to sucker production. However, the proportion of water suckers was found to be increased. Ethrel, particularly at the higher concentrations, reduced the plant vigour besides lowering the bunch characters.

In pineapple cultivars 'Cayena Lisa' and 'Sugar Loaf', Salaza and Rios (1971) and Norman (1975) observed that ethrel interfered with the formation of slips and ground suckers.

Kender et al. (1968) observed a marked increase in rhizome production in blueberry plants as a result of ethrel application.

2.10. Other effects observed on ethrel application

Ethrel (2-chloroethyl phosphonic acid) has shown a wide spectrum of regulatory effects on plant growth. Lockard (1975) reported that in banana, ethrel retarded the vegetative growth, besides causing epinasty. Annadurai (1976) found that ethrel 250 ppm induced early shooting in 'Monthan'. Anbazhagan (1978) recorded significant reduction in the pseudostem height and leaf area, and delayed shooting (the greatest delay being with 350 ppm ethrel) on ethrel application. Annadurai and Shanmughavelu (1978) observed that ethrel (ethephon) at 250 or 500 ppm applied to 3-month old banana suckers (from 60 days after planting to flowering)stimulated sucker production. However, the chemical retarded the plant growth, delayed the flowering and reduced the bunch weight (by 51.8 per cent). The treatment did not, however, alter the chemical composition of the fruits.

Cooke and Randall (1968) found that ethrel retarded the vegetative growth besides causing epinasty of the pineapple leaves. Edgerton and Greenhalgh (1969), and Ketchie and Williams (1970) also observed retardation of the vegetative growth of pineapple, on ethrel application. In the

pineapple cultivars 'Cayena Lisa' and 'Sugar Loaf', Salaza and Rios (1971) and Norman (1975) observed significant retardation of vegetative growth, on application of ethrel.

In 'Co 1' variety of papaya, Alagiamanavalan (1971) reported that the production of leaves and the leaf area were not appreciably affected by ethrel. On the contrary, Selvaraj (1972) observed 80 to 100 per cent reduction in the leaf number at the early stages, on application of ethrel. However, such inhibitory effects were not significant during the later stages.

Kender et al. (1968) reported that foliar spray of ethrel to low bush blueberry decreased the length of the stem and increased the number of the rhizomes. The spray caused injury to the leaves.

In mango, Chacko et al. (1972) demonstrated that spraying ethephon at 200 to 2000 ppm advanced the flowering of the mango variety Langra in the 'on' year by 15 to 20 days. During the 'off' year, while the untreated trees did not flower, the trees subjected to ethephon 200 ppm sprays exhibited early and heavy flowering. The untreated trees did not flower at all. Pandey et al. (1973) sprayed ethrel 240 ppm at 15-day

interval on previously bearing branches of 'Dashehari' mango. They observed that 87.5 per cent on the sprayed shoots differentiated fruit buds whereas only 5.0 per cent of the untreated (control) shoots did so. When sprayed on previously non-bearing branches, 80 per cent of the shoots flowered (as against 75 per cent in the unsprayed branches). Chacko et al. (1974) found that ethephon at 1000 ppm sprayed five times at weekly intervals induced heavy flowering in ringed and non-ringed juvenile mango seedlings.

Proebsting and Will (1973) reported that ethephon delayed blossoming in sweet cherry by three to five days. In several stone fruits including sweet cherry and plum, Dennis (1976) observed delayed blooming consequent on ethephon application.

2.11. Correlation between growth parameters in banana

Simmonds (1966) recorded significant correlation between the number of leaves at shooting and yield, as well as between the girth of the pseudostem at 1.0 m height and yield.

Annadurai (1976) and Anbazhakan (1978) observed negative correlation between the height of the plants and sucker production. In the studies conducted by Balakrishnan (1980), the bunch characters did not show association with the number of suckers produced.

Materials and Methods

3. MATERIALS AND METHODS

3.1. Cultivars*

The cultivars selected for this study were:

Palayankodan [Musa (AAB group) 'Palayankodan']

It is a tall and stout variety with large leaves and heavy bunches. It is also the commonest variety cultivated throughout South India. The distinguishing characters are the rose-pink colouration of the outerside of the midrib when young and the heavy bunches with closely packed fruits hanging down vertically. The fruits are small to medium in size, held firmly in the bunch and have distinct mammillary tip. The rind is thin and the pulp, cream with an aggreeable sub-acid taste. The rind is golden-yellow with a tinge of rush-red colouration. The peduncle is glabrous and the pedicel short. The bract is deep purple and glaucous outside, dark red and polished inside. The apex is rounded. Male flowers are pigmented and deciduous. The ovule is four-seriate. The hands are very compact with 11 to 18 fingers in a hand. The fingers are terete, cylindric, four to five ridged, with two ridges rather prominent.

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* The descriptions are mainly based on Jacob, K.C. (1952), Madras Bananas, Superintendent, Government Press, Madras. The synonyms of the seven cultivars are given in Appendix IV.

An average bunch weighs nearly 15 kg. This, being a triploid belonging to the AAB group, is intermediate in sucker production, between the diploids and the tetraploids. On an average, the sucker production of this cultivar ranges between four and five.

Nhaliooovan [Musa (AB group) 'Nhalipoovan']

In Kerala, it is indispensable in all house compounds and whenever possible is grown as an intercrop in coconut gardens. This variety is medium-sized with slender yellowish-green pseudostem and can be recognised by the reddish petiole margin, terete fruits, thin and papery rind and white firm flesh which is very sweet. The fruits are invariably small. The average bunch weight is about 12 kg with about 150 fruits per bunch. Duration is 12 to 13 months.

Being a diploid, this cultivar has a profuse suckering habit. On an average the plant produces about 12 to 15 suckers per plant.

Nendran [Musa (AAB group) 'Nendran']

The 'Nendran' fruit is known in all parts of the world as plantain. In Kerala, this is considered as a variety

suitable for dessert, cooking and processing purposes.

The plants are medium sized, with very long fruits. The leaves of the young plants incline towards the ground unlike in the other varieties and have dark blotches. The margin of the petiole and the upper half of the outer leaf sheaths are reddish. The peduncle is glabrous and drooping. There are female and persistent male flowers. The bract is persistent with outside, purple and glaucous and inside, red with parallel wrinkles which are dark red towards the margins.

The fruits are relatively longer and thicker than those of the other bananas. The bunch is not compact and weighs 12 to 15 kg with about 50 fruits per bunch. The bunches can be harvested in about 11 months after planting. The fruit is curved and angular and has prominent pedicel as well as apex. The rind is thick and bright-yellow when ripe. The pulp is firm and yellowish with a characteristic taste.

This cultivar is intermediate in sucker production, with an average of three to five suckers per plant.

Poovan [Musa (AAB group) 'Poovan']

This is a choice table variety and is priced high in all parts of India where it is cultivated. The plants are moderately vigorous and can be identified by the yellowish-green stem with brownish blotches, reddish margin of the petiole and leaf sheath, and a few persistent male flowers after the female phase.

On an average, the bunches weigh about 12 kg, containing 60 to 80 fruits in five to seven hands. The fruit is slightly round with a shade less of green colour and less pronounced apex. The rind is thin and develops an ivory yellow colour when ripe. The flesh is white and rather firm, but very tasty and sweet with a pleasant apple flavour.

Intermediate in sucker production, the cultivar produces about three to five suckers per plant.

Robusta [Musa (AAA group) 'Robusta']

'Robusta'is a semi-tall mutant of 'Dwarf Cavendish'. It possesses desirable export qualities and is priced much in the international market. Because of the high yield

potential, the area under this cultivar is rapidly expanding. As there are good markets within the State and outside for 'Robusta', steps at present are being taken to increase its production further by intensive and extensive methods of cultivation.

The fruits retain the green colour of the rind even when ripe. The average bunch weight ranges from 12 to 18 kg. The fruit is long and large, with a thick rind. Being a triploid accuminata derivative, it is poor in suckering habit, producing only two to three suckers per plant.

Red Banana [Musa (AAA group) 'Red Banana']

This is popular in Kerala, especially towards the South. The colour of the pseudostem, petiole, midrib and fruit rind is deep purplish red. The bunch is compact with attractive red-rinded fruits. The fruit is of good size, slightly curved with a blunt apex. The rind is thick and during ripening, the colour changes from red to orange-yellow. The ripe fruit has a characteristic strong flavour.

It is a long duration variety and takes about 15 to 18 months from planting to harvest. The cultivar is poor in suckering habit being a triploid accuminata derivative.

Monthan [Musa (ABB group) 'Monthan']

This leading culinary variety has fairly tall, vigorous stout plants which are drought resistant. It is easily recognised by the green, robust pseudostem. The peduncle is long and the bunches, heavy with large fruits of rounded apex. It takes about 13 months from the time of planting to harvest. The peduncle is glabrous. The outside of the bract is purple and very glaucous. The inside is deep red and shining with an elliptic apex. The pedicel is (5) unequal sided, and five ridged, all the ridges being prominent. The hands number from five to six, with 11 fingers in a hand. The fruits are terete with (5) unequal sides and five ridges, two ridges being prominent.

The fruits are long with good girth in the middle, plump and straight with blunt or knobbed apex. The rind is thick and green. The suckering ability of this variety is rather poor.

3.2. Planting material

Suckers of uniform size and age (three-month old) were selected.

3.3. Treatments

In the first experiment for assessment of natural sucker production, the following cultivars constituted the treatments:

T_1 - Palayankodan
T_2 - Nhalipoovan
T_3 - Nendran
T_4 - Poovan
T_5 - Robusta
T_6 - Red Banana
T_7 - Monthan

In the second experiment which aimed at enhancing the sucker production in Musa (AAA) 'Robusta', the following were the treatments:

T_1 - Ascenso's method with removal of 30 cm tall suckers
T_2 - Barker's method with removal of 30 cm tall suckers
T_3 - Ethrel 400 ppm with removal of 30 cm tall suckers
T_4 - Barker's method without stripping of the outer leaf sheaths, coupled with removal of 30 cm tall suckers
T_5 - Ascenso's method without application of ammonium sulphate, coupled with removal of 30 cm tall suckers

T_6 - Shallow planting with removal of 30 cm tall suckers

T_7 - Control 1 [as per the Package of Practices recommendations] coupled with removal of 30 cm tall suckers

T_8 - Control 2 [as per the Package of Practices recommendations]

T_9 - Ascenso's method with removal of 60 cm tall suckers

T_{10} - Barker's method with removal of 60 cm tall suckers

T_{11} - Ethrel 400 ppm with removal of 60 cm tall suckers

T_{12} - Barker's method without stripping of the outer leaf sheaths, coupled with removal of 60 cm tall suckers

T_{13} - Ascenso's method without application of ammonium sulphate, coupled with removal of 60 cm tall suckers

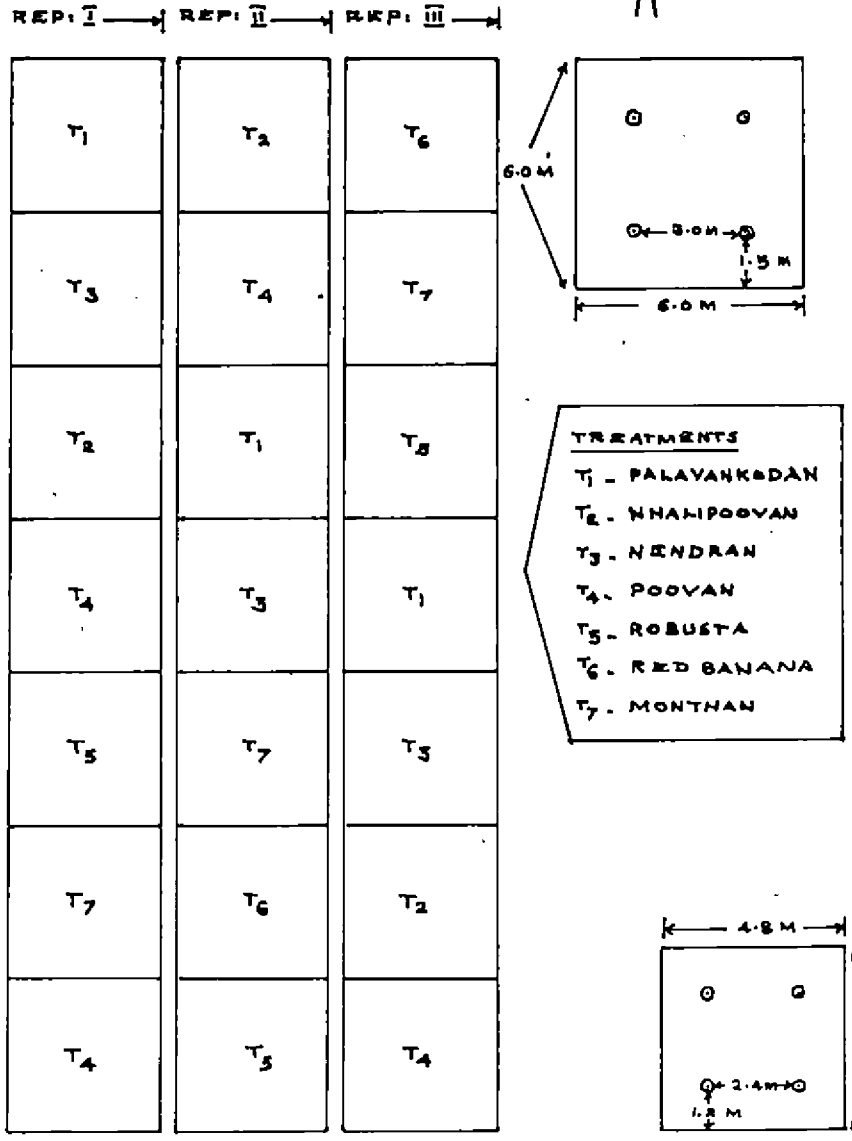
T_{14} - Shallow planting with removal of 60 cm tall suckers

T_{15} - Control 1 [as per the Package of Practices recommendations] coupled with removal of 60 cm tall suckers

3.4. Details of the field experiments

Field trials were laid out in Randomised Block Design, replicating the seven cultivars three times in the first experiment and the fifteen treatments two times in the second experiment. There were four plants in each plot (one more than what was suggested by Prabhakaran et al.,

FIG. 1 A LAYOUT OF THE EXPERIMENT



TREATMENTS

T_1 - PALAVANKODAN
T_2 - NJALIPOOVAN
T_3 - NENDRAN
T_4 - POOVAN
T_5 - ROBUSTA
T_6 - RED BANANA
T_7 - MONTHAN

DESIGN . 7 X 3 RBD

FIG. 1 B LAYOUT OF THE EXPERIMENT

TREATMENTS	HEIGHT OF SUCKER REMOVAL 30 cm	60 cm
ASCENSO'S METHOD	T_1	T_9
BARKER'S METHOD	T_2	T_{10}
ETHREL 400 ppm	T_3	T_{11}
BARKER'S METHOD MINUS OUTER BARK STRIPPING	T_4	T_{12}
ASCENSO'S " " AMMONIUM SULPHATE APPLICATION	T_5	T_{13}
SHALLOW PLANTING	T_6	T_{14}
PACKAGE OF PRACTICE RECOMMENDATIONS WITH SUCKER REMOVAL	T_7	T_{15}
CONTROL	T_8	

REPLICATION I

T_1	T_5	T_9	T_{13}	T_4
T_3	T_{10}	T_6	T_8	T_{14}
T_2	T_7	T_{11}	T_{15}	T_{12}

REPLICATION II

T_4	T_2	T_3	T_1	T_5
T_9	T_{13}	T_6	T_{11}	T_8
T_{14}	T_{15}	T_{10}	T_7	T_{12}

DESIGN - 15 X 2 RBD

1978). The suckers were planted in 0.50 m^3 pits and spaced at 3.0 x 3.0 m. for the first experiment and 2.4 x 2.4 m for the 'Robusta' plants in the second experiment. The pits were filled with farm yarm manure and wood ash at the rate of 10 kg/pit and 2 kg/pit, respectively. Inorganic fertilizers and Phorate were applied to all the plants uniformly as per the recommendations in the Package of Practices.

Accordingly in the first experiment, the varieties received the following:

Variety	Quantity (gm/plant) of		
	Urea	Superphosphate	Muriate of Potash
Palayankodan	218	1200	800
Nhalipoovan	435	1200	800
Nendran	414	638	600
Poovan, Robusta, Red Banana and Monthan	435	1200	800

These were applied in two split doses, the first at the second and the second, at the fourth month of planting.

Shallow basins of about 10 cm depth were taken around

the plants (60 cm away from the pseudostem). The fertilizers were applied in these basins and covered with soil. The plants, which were rainfed, were irrigated immediately after each fertilizer application.

3.5. Preparation and application of ethrel

Stock solution of 2,500 ppm ethrel (39.56% purity 2-chloroethyl phosponic acid obtained from M/s Agromore Ltd., Bangalore) was prepared (one ppm = one mg of the chemical (ai) dissolved in 1000 ml of water). The required concentrations were prepared by diluting the stock solution with distilled water. A few drops of 'Teepol' were added to the spray solution to serve as a sticker. The upper and lower surfaces of the foliage were sprayed to run off with the plant growth regulator solutions as per the treatments. At the time of spraying, a polythene sheet was spread around the plant to prevent entry of the chemical into the soil. The liquid thus collected was discarded.

Foliar sprays were given at 15-day intervals, commencing from 120 days after planting till shooting.

3.6. Observations recorded

3.6.1. Assessment of natural sucker production in the seven cultivars

Sucker characters

Number of suckers produced

The number of suckers produced by each of the four observational plants was recorded every fortnight and averaged.

Type of suckers produced

The number of sword suckers and water suckers produced by each of the four observational plants was recorded every fortnight and averaged.

Sucker Ratio

The Sucker Ratio was computed by dividing the number of sword suckers by the number of water suckers.

Sucker Production Index

By multiplying the Sucker Ratio with the number of suckers produced, the Sucker Production Index was obtained.

Height of the suckers

The height of suckers produced by each of the four observational plants was recorded at harvest of the mother plants and the average height worked out.

Leaf production by the suckers

The number of leaves produced by the suckers of the four observational plants was recorded at harvest of the mother plants and the average worked out.

Mother plant characters

Duration of flowering

The date of flowering of the four observational plants was observed, based on which the number of days taken for shooting by each plant was worked out and averaged.

Duration of fruit set

The time taken (days) from setting of the first hand to that of the last hand was recorded for each of the four observational plants and averaged.

Date of maturity of the bunch

Based on the dates of shooting and harvest, the number of days taken for bunch maturation was estimated and the average for the four observational plants, worked out.

Total duration

Based on the dates of planting and harvest, the total

duration for each of the observational plant was worked out and averaged.

Bunch characters

Weight of the bunch

The peduncles of the harvested bunches were cut, leaving 22.5 cm above the first hand and 5.0 cm below the last hand. The bunches of the four observational plants were then weighed and averaged.

Per day yield

By dividing the weight of the bunches by the total duration, the per day yield was obtained for the four observational plants. These were then averaged.

Number of hands per bunch

The number of hands in the bunches produced by the four observational plants was counted and averaged.

Number of fingers per hand (Gottreich, et al., 1964)

The number of fingers in the second hand of the bunches produced by the observational plants was counted and averaged.

Average length, girth and weight of the fingers

These characters were recorded on the middle finger of the top row of the second hand (Gottreich et al., 1964) of the bunches produced by the observational plants.

The length of the fruit was measured as the distance between the stalk end and the apex. The girth was recorded at the middle portion of the fruit. The weight of the individual fruits was also taken.

These observations made on the four bunches obtained from each plot were averaged.

3.6.2. Enhancement of suckering

Sucker characters

Number of suckers produced

The number of suckers produced by each of the four treatment plants was recorded at weekly intervals. From the data, the number of suckers produced during each of the four growth stages of the mother plants was worked out and averaged.

The following are the growth stages of the mother plants, as described by Summerville (1944).

Early vegetative phase: Initial two months, from planting to the first fertilizer application.

Late vegetative phase: The next two months, the period between the first and the second fertilizer applications.

Pre-flowering phase: The period between the second fertilizer application and shooting.

Post-flowering phase: The last phase of the mother plants, between shooting and harvest of the bunch.

Type of suckers produced

The number of sword suckers and water suckers produced by each of the four treatment plants was observed every week and the counts averaged.

Sucker Ratio and Sucker Production Index

These were computed as described under 3.6.1. for each of the treatment plant and averaged.

Number of leaves on the suckers at separation

As per the various treatments, the suckers were removed when they attained heights of 30 cm and 60 cm. At

seperation, the number of leaves of the suckers produced by each of the four observational plants was recorded and averaged.

Weight of suckers at separation

The suckers produced by each of the four treatment plants, on removal as per the treatment requisites, were weighed and the average weight computed.

Girth of the pseudostem at seperation

After removal of the suckers according to the treatment requirements, the girth of the pseudostem just above the rhizome was recorded. The average girth was then worked out.

Mother plant characters

Height at flowering

In each of the four treatment plants, the height of the pseudostem at flowering was measured and averaged. The height was measured from the ground level to the point between the youngest first and second leaf axils.

Girth of pseudostem at flowering

At flowering, the girth of the pseudostem at the

ground level was measured for each of the four treatment plants and averaged.

Number of functional leaves at flowering

At flowering, the number of functional leaves in each of the four treatment plants was counted and averaged.

Duration of flowering

The date of flowering of the four observational plants was observed, based on which the number of days taken for shooting by each plant was worked out and averaged.

Duration of fruit set

The time taken (days) from setting of the first hand to that of the last hand was recorded for each of the four treatment plants, and averaged.

Date of maturity of the bunch

Based on the dates of shooting and harvest, the number of days taken for bunch maturation was estimated and the average of the four treatment plants worked out.

Total duration

Based on the dates of planting and harvest, the total duration for each of the treatment plant was worked out and averaged.

Bunch characters

Weight of the bunch

The peduncles of the harvested bunches were cut, leaving 22.5 cm above the first hand and 5.0 cm below the last hand. The bunches of the four treatment plants were then weighed and averaged.

Per day yield

By dividing the weight of the bunch by the total duration, the per day yield was obtained for the four treatment plants. These values were then averaged.

Number of hands per bunch

The number of hands in the bunches produced by the four treatment plants was counted and averaged.

Number of fingers per hand

The number of fingers in the second hand (Gottreich et al., 1964) of the treatment bunches was counted and averaged.

Average length, girth and weight of the fingers

The average length, girth and weight were taken of

the middle fingers of the top rows of the second hands (Gottreich et al., 1964) of the treatment bunches.

The length of the fruit was measured as the distance between the stalk end and the apex. The girth was recorded at the middle portion of the fruit. The weight of each fruit was also taken.

The observations for the four treatment plants were averaged.

3.7. Statistical treatment of the data

The data generated in the studies were subjected to statistical analysis. The analysis of variance technique for Randomised Block Design was employed to test the superiority of the cultivars and the treatments (Panse and Sukhatme, 1978). The extent of association among the observed characters was measured by the correlation coefficients (Fisher, 1954). Path coefficient analysis (Wright, 1923) was done for estimating the direct and indirect effects of various characters on yield.

Results

4. RESULTS

4.1. Assessment of natural sucker production

A comparative evaluation of seven popular banana cultivars of the region (Palayankodan, Nhalipoovan, Nendran, Poovan, Robusta, Red Banana and Monthan) was made to assess their (natural) sucker production ability. The review of literature indicated the necessity for assessing the different aspects of natural sucker production *vis a vis* flowering behaviour, and yield and yield contributing characters of the mother plants. The results are presented in this chapter.

4.1.1. Flowering behaviour of the mother plants

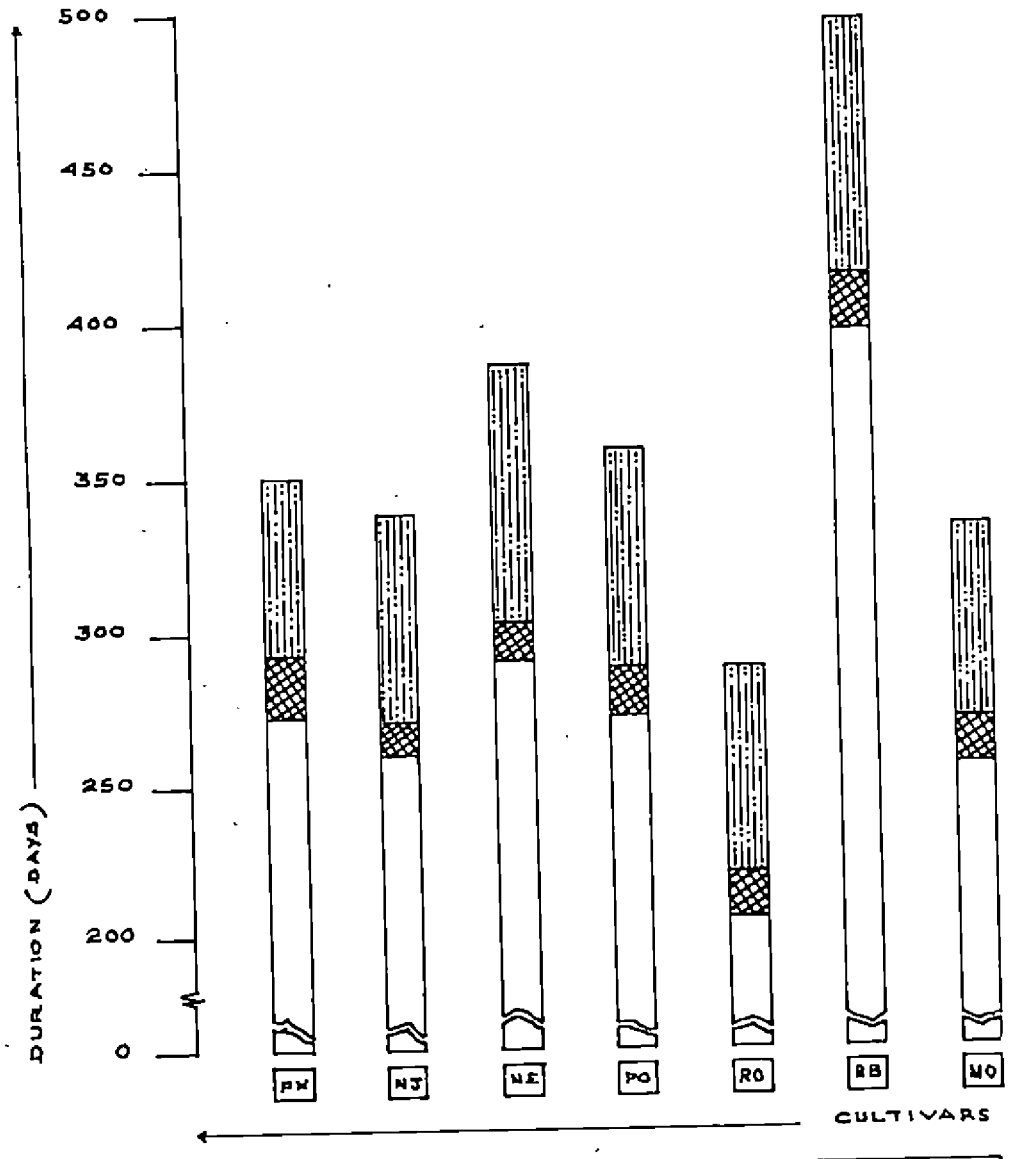
The duration for flowering of the mother plants, the duration of fruit set and the duration of maturity of the bunches were assessed and the results have been presented in Table 1.

The analysis of variance (Appendix II) showed that the cultivars exhibited highly significant differences with respect to the date of flowering. The cultivar Red Banana (T_6) took significantly longer time (395.66 days) for flowering, as compared to the others (Table 1, Fig.2) Nendran (T_3) with 291.33 days also recorded significantly

Table 1. - Duration for flowering, fruit set and harvest in the seven cultivars

Entry No.	Cultivars	Duration (days) for			Total Duration
		Flowering	Fruit set	Maturity	
1.	Palayankodan	272.66	20.58	79.08	351.74
2.	Nhalipoovan	259.66	11.83	77.00	336.66
3.	Nendran	291.33	11.41	94.33	385.66
4.	Poovan	273.00	13.00	85.75	358.75
5.	Robusta	205.00	16.75	82.66	287.66
6.	Red Banana	395.66	17.91	99.33	494.99
7.	Monthan	256.00	14.33	76.00	332.00
	$CD_{.05}$	14.285	2.152	4.021	16.465

FIG. 2 DURATION FOR FLOWERING, FRUITSET AND HARVEST IN THE SEVEN CULTIVARS



longer duration than the other cultivars, except Red Banana. Robusta (T_5) plants flowered significantly earlier (205 days) than those of the other cultivars.

The second criterion used was the duration of fruit set. The analysis of variance showed that the cultivars differed significantly with respect to the duration of fruit set (the time taken from the setting of the first hand to the setting of the last hand). Table 1 and Fig.2 indicate that the cultivar Palayankodan (T_1) took significantly longer time (20.58 days) and the cultivars Nendran (T_3), Nhalipoovan (T_2) and Poovan (T_4) which were statistically on par, significantly shorter time (11.41 days, 11.83 days and 13.00 days, respectively) as compared to the other cultivars.

The duration for bunch maturation was another criterion used for assessing the mother plant behaviour. The analysis of variance (Appendix II) showed that the entries exhibited significant differences on the time taken from shooting till harvest (bunch maturation). Table 1 and Fig.2 indicate that Red Banana (T_6) took significantly longer time for bunch maturation (99.33 days), followed by

Nendran (T_3) which took 94.33 days. Palayankodan (T_1), Nhalipoovan (T_2) and Monthan (T_7), which were statistically on par, took significantly shorter time (79.08 days, 77.00 days and 76.00 days, respectively) as compared to the other entries.

Since the seven cultivars exhibited wide variation in the total duration (planting to harvest) ranging from 287.66 days to 494.99 days (Table I), the data were examined critically. The analysis of variance (Appendix II) showed the differences among the entries to be highly significant. Red Banana (T_6) recorded the longest total duration (494.99 days) and Robusta (T_5), the shortest (287.66 days). Nendran (T_3) with a total duration of 385.66 days recorded the second longest duration (Table 1 and Fig. 2).

4.1.2. Bunch characters

The weight of the bunch, the per day yield, the number of hands per bunch and the number of fingers per hand were assessed and the results have been presented in Table 2.

Table 2. - Yield and yield components in the seven cultivars

Entry No.	Cultivars	Weight of bunch (kg)	Per day yield (g)	No. of hands per bunch	No. of fingers per hand
1.	Palayankodan	12.04	34.21	10.83	17.33
2.	Nhalipoovan	8.26	24.55	6.33	15.33
3.	Nendran	9.34	24.28	5.83	12.83
4.	Poovan	11.31	31.75	8.33	11.91
5.	Robusta	16.01	55.73	9.66	16.58
6.	Red Banana	11.68	23.61	5.66	9.66
7.	Monthan	11.26	33.91	6.33	10.00
	$CD_{.05}$	1.163	4.025	1.354	2.152

FIG. 3 WEIGHT (Kg) OF THE BUNCHES PRODUCED BY THE SEVEN CULTIVARS

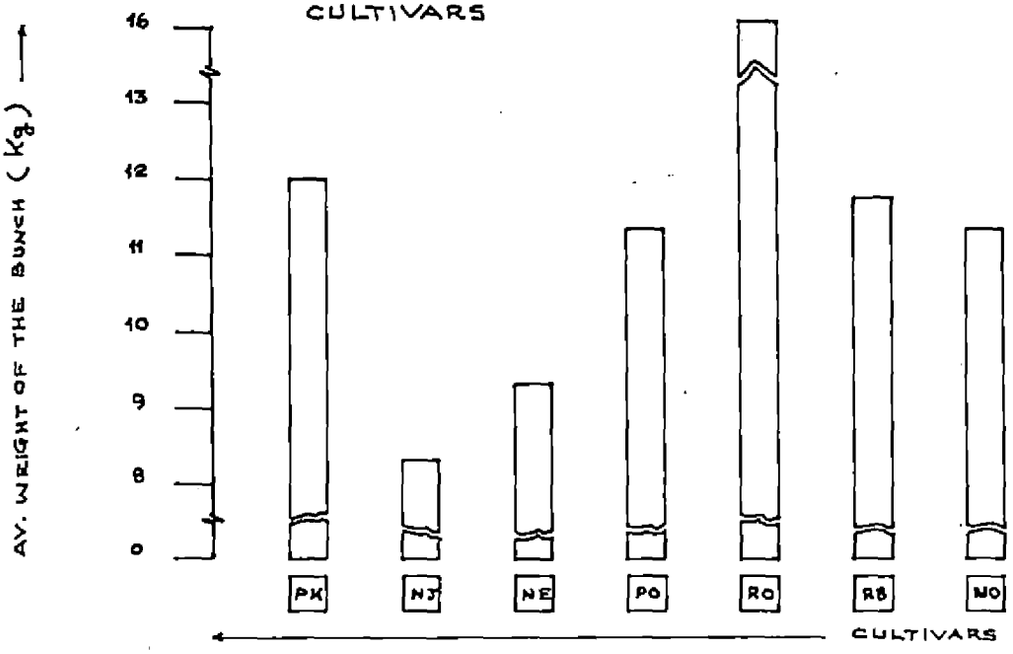
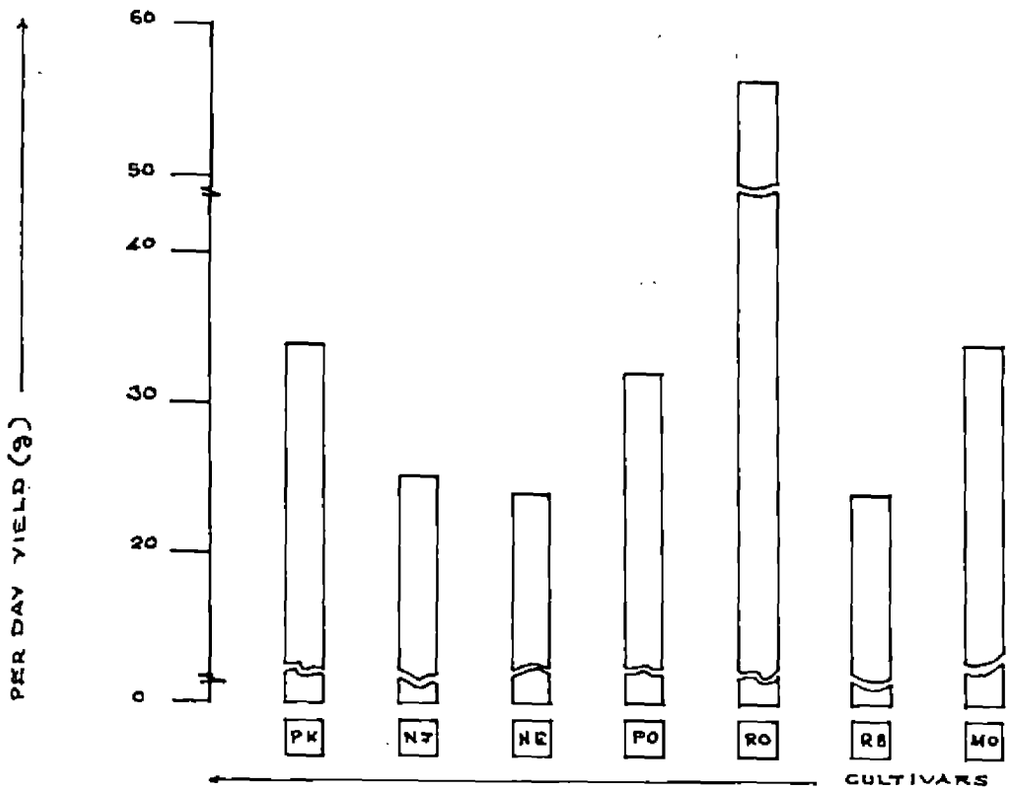


FIG. 4 PER DAY YIELD (g) OF THE SEVEN CULTIVARS



PK – PALAYANKODAN
NJ – NHALIPOOVAN
NE – NENDRAN
PO – POOVAN
RO – ROBUSTA
RB – RED BANANA
MO – MONTHAN

The analysis of variance (Appendix II) showed that the varieties exhibited highly significant differences with respect to the weight of the bunches produced. Table 2 and Fig. 3 indicate that Robusta plants (T_5) produced significantly heavier bunches (16.01 kg) as compared to the plants of the other cultivars. Nendran (T_3) and Nhalipoovan (T_2), which were statistically on par, gave significantly lighter bunches (9.34 kg and 8.26 kg, respectively).

Since the total duration (planting to harvest) varied widely (Table 1) from 287.66 days in Robusta (T_5) to 494.99 days in Red Banana (T_6), it was considered essential to compute the per day yield. The analysis of variance of the data presented in Table 2 indicated that the cultivars exhibited highly significant differences with respect to per day yield (Appendix II). Robusta (T_5) with a per day yield of 55.73 g was significantly superior to the other entries. Nhalipoovan (T_2), Nendran (T_3) and Red Banana (T_6) with per day yields of 24.55 g, 24.28 g and 23.61 g were statistically on par and significantly

FIG. 5 NUMBER OF HANDS PER BUNCH IN THE SEVEN CULTIVARS

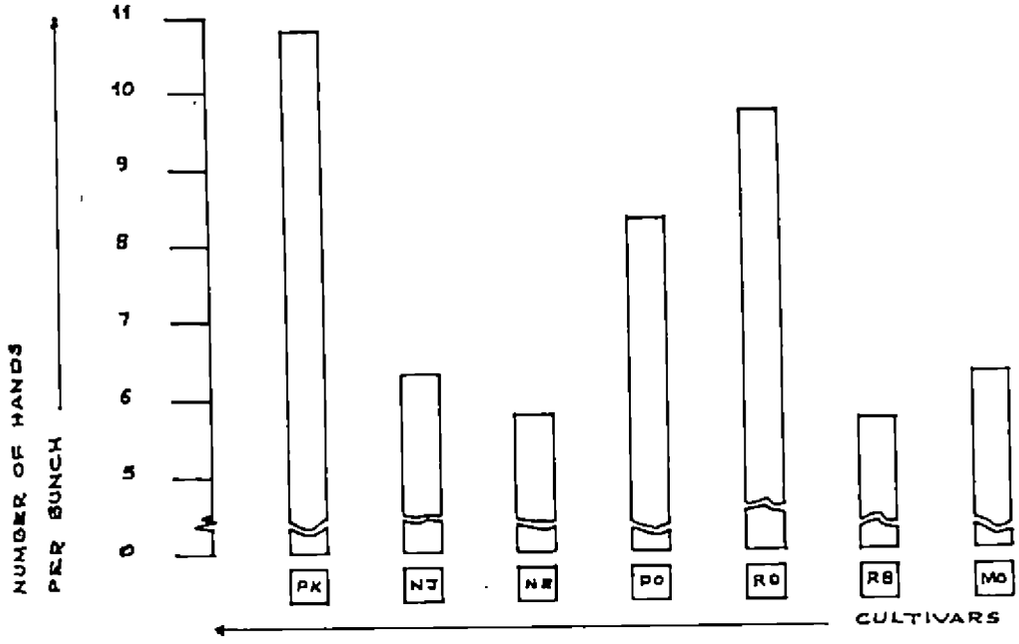
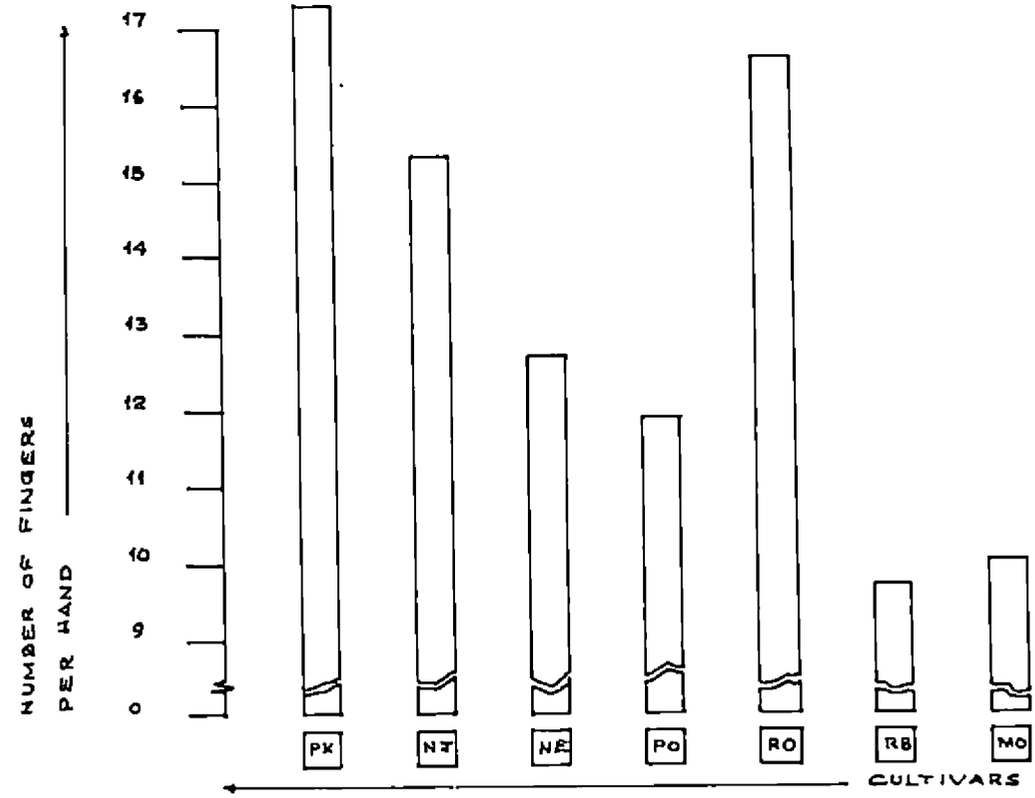


FIG. 6 NUMBER OF FINGERS PER HAND IN THE SEVEN CULTIVARS



PK - PALAYANKODAN
NJ - NJALIPOOVAN
NR - NENDRAN
PO - POOVAN
RO - ROBUSTA
RB - RED BANANA
MO - MONTHAN

inferior to the remaining cultivars in this respect (Fig.4).

The data on the number of hands per bunch were statistically analysed (Appendix II). The seven cultivars included in the study exhibited significant differences. The data (Table 2 and Fig.5) indicate that Palayankodan (T_1) and Robusta (T_5), which were statistically on par, had significantly higher number of hands (10.83 and 9.66, respectively). Nhalipoovan (T_2),Monthan (T_7), Nendran (T_3) and Red Banana (T_6), which were statistically on par, had significantly lower number of hands (6.33, 6.33, 5.83 and 5.66, respectively).

The statistical analysis of the data on the number of fingers per hand indicated highly significant differences among the cultivars. The data presented in Table 2 and Fig. 6 indicate that Palayankodan (T_1), Robusta (T_5) and Nhalipoovan (T_2), which were statistically on par, recorded significantly higher number of fingers per hand (17.33, 16.53 & 15.33, respectively) as compared to the other entries. Monthan (T_7) and Red Banana (T_6), which were also

Table 3. - Finger characters in the seven cultivars

Entry No.	Cultivars	Length of finger (cm)	Girth of finger (cm)	Weight of finger (g)
1.	Palayankodan	13.90	12.85	60.26
2.	Nhalipoovan	13.36	11.30	44.48
3.	Nendran	20.56	15.80	117.63
4.	Poovan	15.53	14.33	57.90
5.	Robusta	23.16	14.50	110.61
6.	Red Banana	19.36	15.13	163.30
7.	Monthan	22.16	14.83	132.96
	$CD_{.05}$	0.997	0.720	4.419

statistically on par, recorded significantly lower number of fingers per hand (10.00 and 9.66, respectively).

4.1.3. Finger characters

The average length, girth and weight of the fingers were assessed and the results have been presented in Table 3.

The analysis of variance with respect to the average length of the fingers (Appendix II) indicated highly significant differences among the entries . The data presented in Table 3 and Fig.7 indicate that Robusta plants (T_5) recorded significantly greater finger length (23.16 cm) as compared to the plants of the other entries. Monthan (T_7) with an average finger length of 22.16 cm and Nendran (T_3) with an average finger length of 20.56 cm were the second and the third best entries. Significantly lower finger length (13.36 cm and 13.90 cm, respectively) was recorded by Nhalipoovan (T_2) and Palayankodan (T_1), which were statistically on par.

The analysis of variance of the data on the girth of

FIG. 7 LENGTH OF THE FINGERS (Cm) IN THE SEVEN CULTIVARS

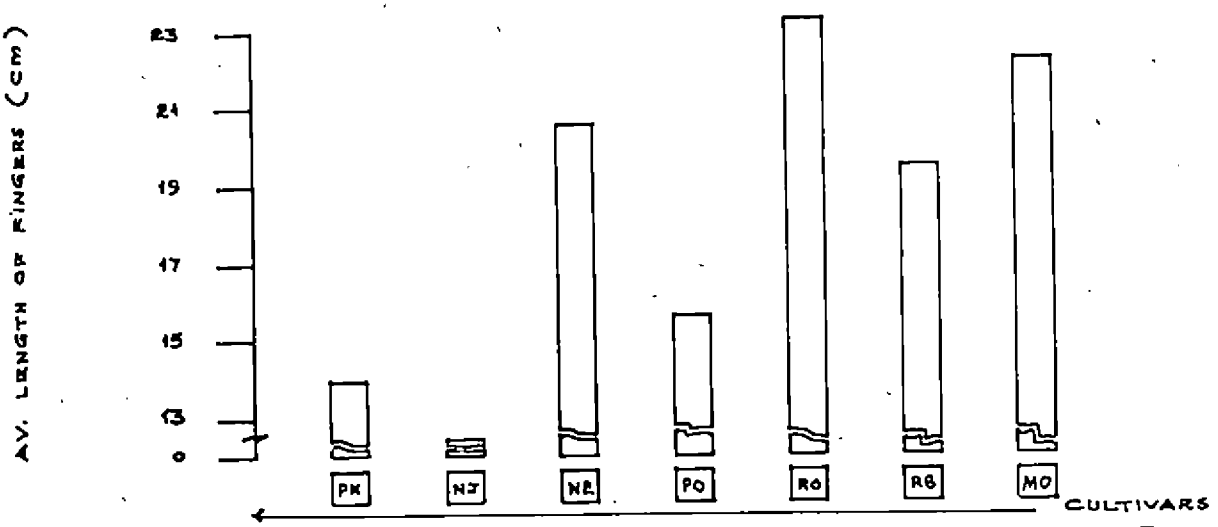


FIG. 8 GIRTH OF THE FINGERS (cm) IN THE SEVEN CULTIVARS

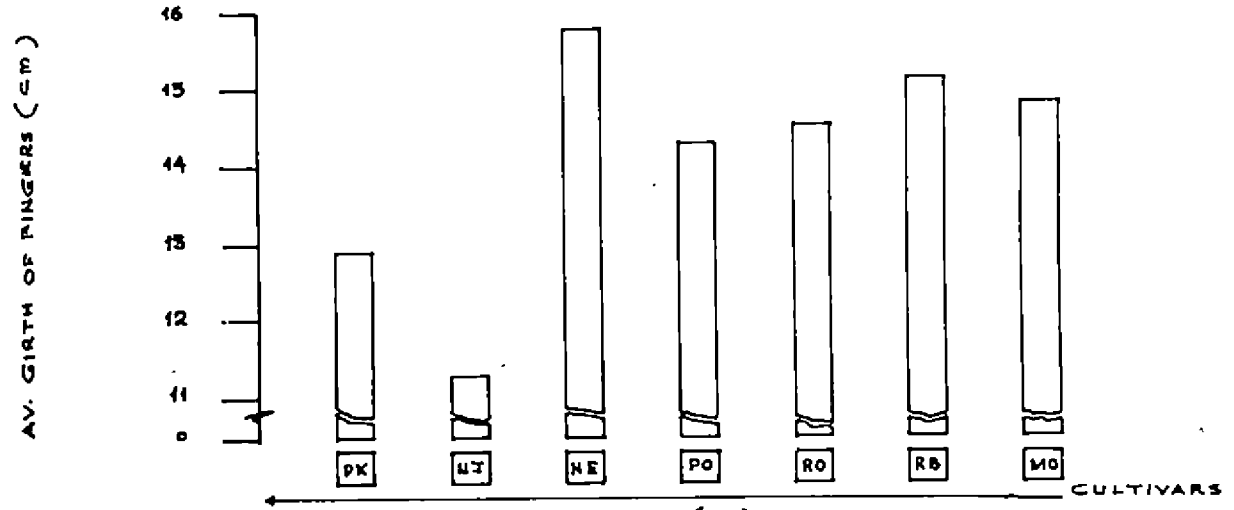
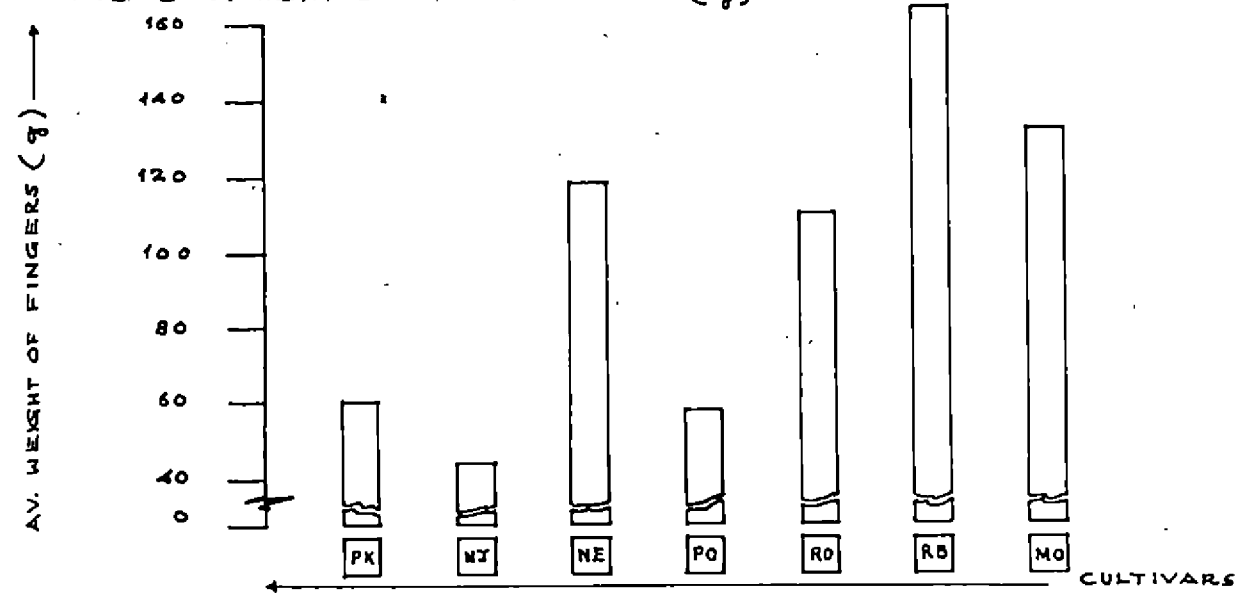


FIG. 9 WEIGHT OF THE FINGERS (g) IN THE SEVEN CULTIVARS



PK - PALAYANKODAN
NJ - NJALIPOOVAN
NE - NENDRAN
PO - POOVAN
RO - ROBUSTA
RB - RED BANANA
MO - MONTHAN

the fingers (Appendix II) indicated that the seven cultivars compared in the study significantly differed among themselves. Table 3 and Fig. 8 indicate that Nendran (T_3) and Red Banana (T_6), which were statistically on par, recorded significantly greater finger girth (15.80 cm and 15.13 cm, respectively) than the others. Palayankodan (T_1) and Nhalipoovan (T_2), which were also statistically on par, recorded significantly lower finger girth (12.85 cm and 11.30 cm) as compared to the other entries.

With respect to the average weight of the fingers also, the entries exhibited highly significant differences in the analysis of variance (Appendix II). As is indicated in the Table 3 and Fig.9, Red Banana (T_6) and Monthan (T_7) produced the heaviest (163.30 g) and the second heaviest (132.96 g) fingers as compared to the other entries. Nhalipoovan (T_2) produced significantly low average finger weight (44.48 g).

4.1.4. Sucker production

The total number of suckers, the number of sword suckers, the number of water suckers, the percentage of

Table 4. - Natural sucker production by the seven cultivars

Entry No.	Cultivars	Total No.of suckers	Sword Suckers		Water suckers	Sucker Ratio(@)	Sucker Production Index(@@)
			Number	% to total			
1.	Palayankodan	5.94	4.65	83.31	1.25	6.20	37.23
2.	Nhalipoovan	12.40	10.64	86.58	1.76	7.29	91.28
3.	Nendran	4.82	3.99	81.24	0.83	4.51	21.54
4.	Poovan	4.49	3.83	87.09	0.65	8.44	35.94
5.	Robusta	4.59	4.10	88.79	0.48	8.00	36.33
6.	Red Banana	3.70	3.29	87.01	0.41	7.77	28.11
7.	Monthan	5.06	3.74	79.98	1.32	2.84	14.48
	$CD_{.05}$	1.173	1.137	NS	0.638	NS	36.577

(@) $\left(\frac{\text{Sword suckers}}{\text{Water suckers}}\right)$

(@@) (Sucker Ratio x Total no. of suckers)

FIG. 10 SUCKER PRODUCTION BY THE SEVEN CULTIVARS DURING STAGE II (2nd TO 4th MONTH)

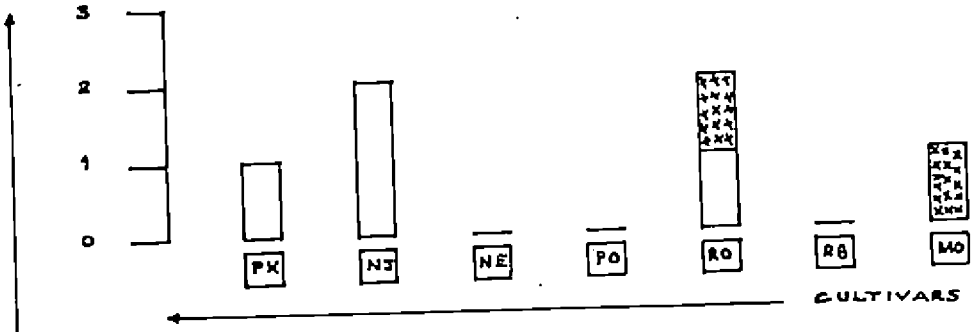


FIG. 11 SUCKER PRODUCTION BY THE SEVEN CULTIVARS DURING STAGE III (4th MONTH TO SHOOTING)

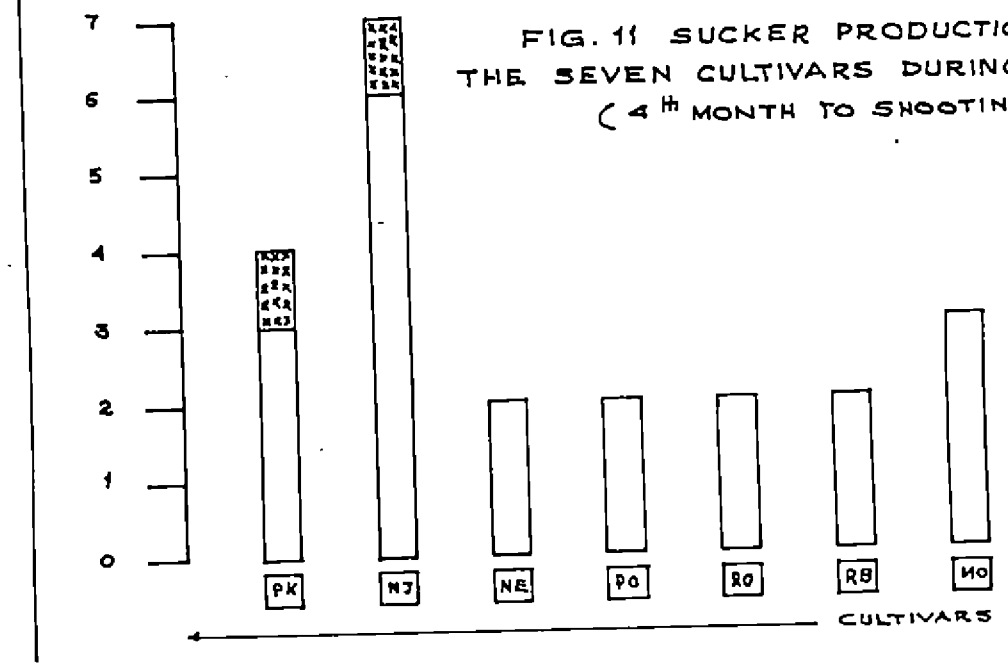
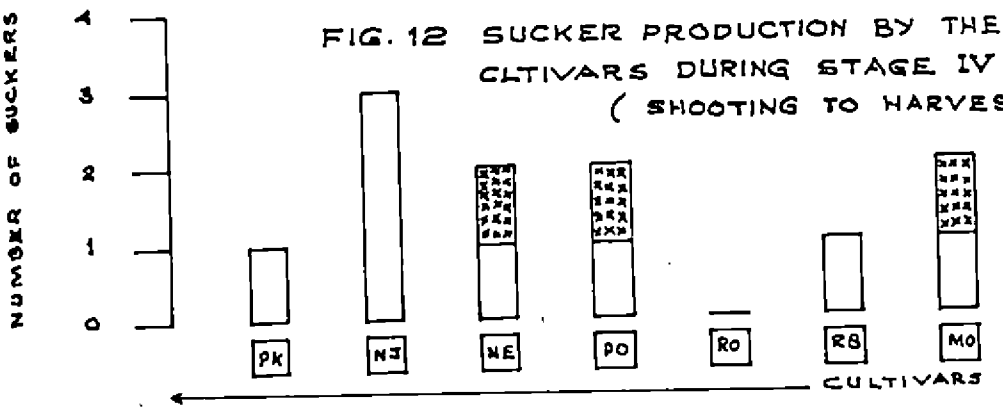


FIG. 12 SUCKER PRODUCTION BY THE SEVEN CLTIVARS DURING STAGE IV (SHOOTING TO HARVEST)



WATER SUCKERS

SWORD SUCKER

PK – PALAYANKODAN
NJ – NJALIPOOVAN
NE – NENDRAN
PO – POOVAN
RO – ROBUSTA
RB – RED BANANA
MO – MONTHAN

Natural sucker production
in 'Palayankodan'

Plate 2.- Natural sucker production in 'Nhalipoovan'

Plate 3.- Natural sucker production in 'Nendran'

Plate 4.- Natural sucker production in 'Poovan'

Plate 5.- Natural sucker production in 'Robusta'

Plate 6.- Natural sucker production in 'Red Banana'

Plate 7.- Natural sucker production in 'Monthan'

sword suckers to the total, the Sucker Ratio and the Sucker Production Index were assessed and the results have been presented in Table 4.

The statistical analysis of the data on total number of suckers (Appendix II) showed that the cultivars exhibited highly significant differences among them. The cultivar Nhalipoovan (T_2) was significantly superior to the other entries in that it gave a relatively greater number of suckers (12.40). The cultivars Nendran (T_3), Robusta (T_5), Poovan (T_4) and Red Banana (T_6), which were statistically on par, produced significantly lower number of suckers (4.82, 4.59, 4.49, 3.70, respectively) as compared to the other entries (Table 4, Figs. 10 to 12 and Plates 1 to 7).

Statistical analysis of the data on the number of sword suckers produced indicated that the entries differed significantly among themselves (Appendix II). Nhalipoovan (T_2) produced significantly greater number of sword suckers (10.64) as compared to the other entries (Table 4). Five cultivars Robusta (T_5), Nendran (T_3), Poovan (T_4), Monthan (T_7) and Red Banana (T_6), which were statistically on par, produced significantly lower number of sword suckers (4.10,

FIG. 13 SUCKER RATIO $\left(\frac{\text{SWORD SUCKERS}}{\text{WATER SUCKERS}}\right)$ IN THE SEVEN CULTIVARS

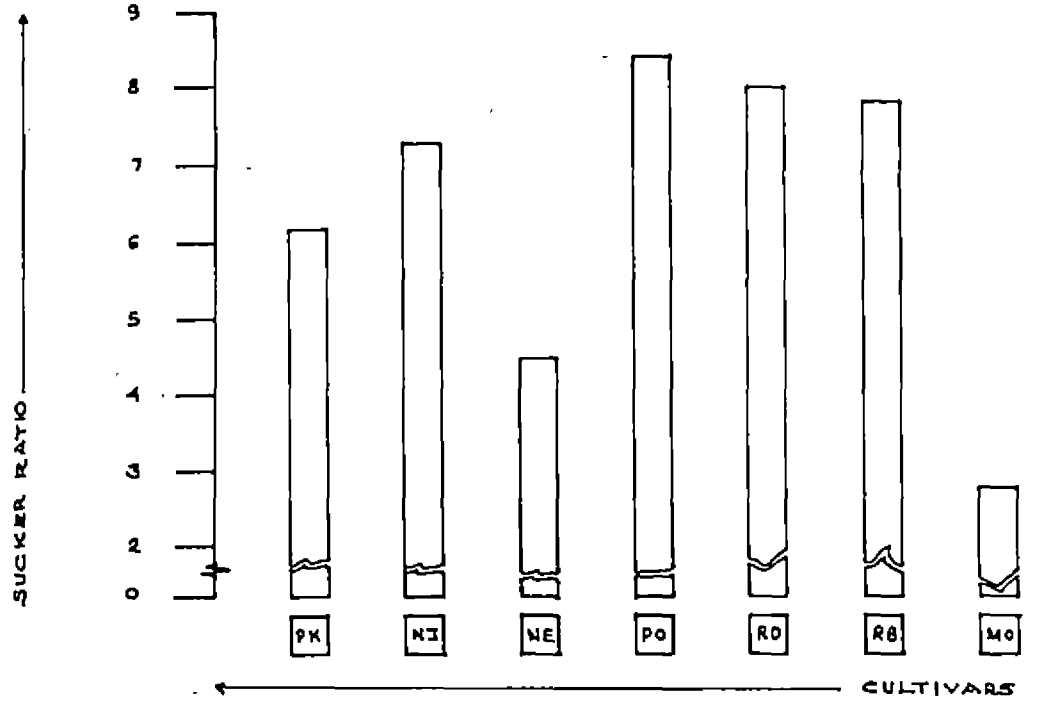
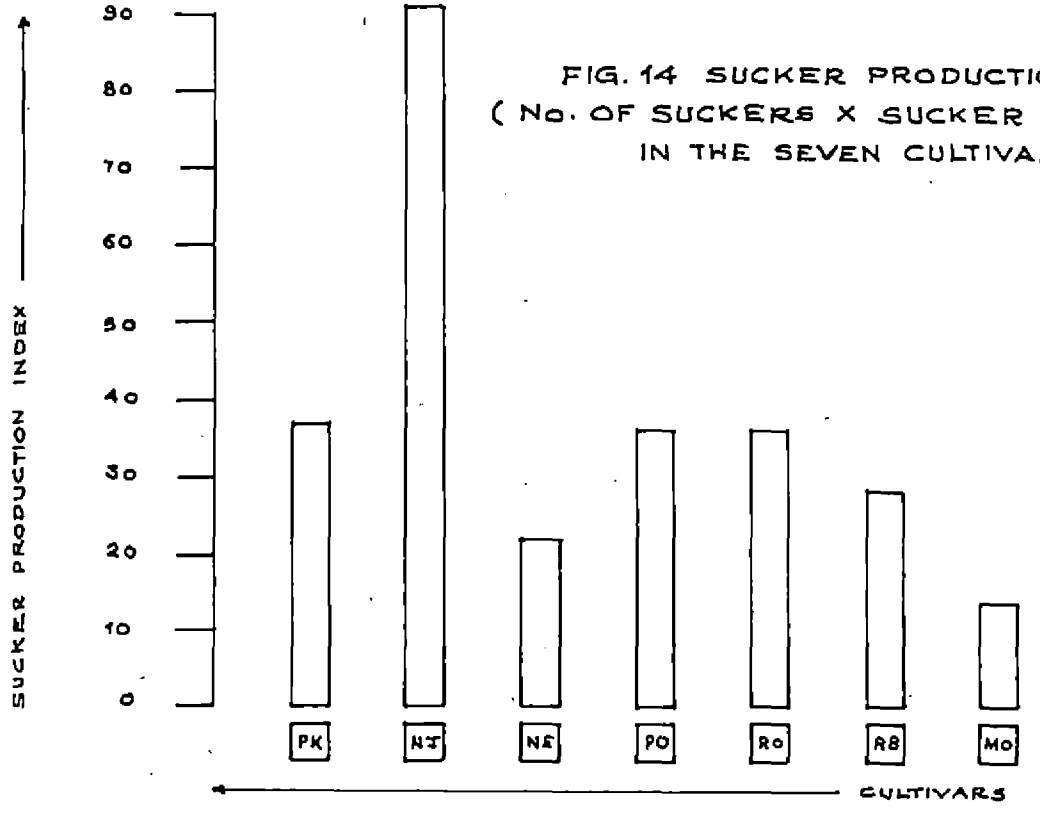


FIG. 14 SUCKER PRODUCTION INDEX
(No. OF SUCKERS X SUCKER RATIO)
IN THE SEVEN CULTIVARS



PK - PALAYANKODAN PO - POOVAN
NJ - NJALIPOOVAN RO - ROBUSTA MO - MONTHAN
NE - NENDRAN RB - REDBANANA

3.99, 3.83, 3.74, 3.29, respectively).

The seven cultivars showed significant differences with respect to production of water suckers (Appendix II). 'Nhalipoovan'(T_2) produced significantly more number of water suckers (1.76) than the other cultivars. 'Nendran'(T_3), 'Poovan'(T_4), 'Robusta'(T_5) and 'Red Banana'(T_6) were statistically on par and produced the lowest number of water suckers.

With regard to the percentage of sword suckers produced and the Sucker Ratio, the cultivars did not exhibit significant differences (Appendix II). The proportion of sword suckers (Table 4) ranged from 79.98 percent in 'Monthan' (T_7) to 88.79 percent in 'Robusta'(T_5). The Sucker Ratio (Table 4, Fig.13) ranged from 2.84 in 'Monthan'(T_7) to 8.44 in 'Poovan'(T_4).

The cultivars exhibited significant differences (Appendix II) with respect to the Sucker Production Index (number of suckers x Sucker Ratio). Table 4 and Fig. 14 indicate that 'Nhalipoovan'(T_2) with an index of 91.28 was significantly superior to the other cultivars, which recorded indices ranging from 14.48 in 'Monthan'(T_7) to 37.23 in 'Palayankodan'(T_1).

4.1.5. Sucker vigour

The vigour of the suckers produced by the different cultivars was assessed in terms of their average height and the average number of leaves at the harvest of the mother plants.

The analysis of variance of the data on the height of suckers (Appendix II) indicated highly significant differences among the cultivars. Red Banana (T_6) produced suckers which were significantly taller (111.56 cm) than those produced by the other cultivars (Table 5). Palayankodan (T_1) and Nhalipoovan (T_2) which produced 101.76 cm and 101.33 cm tall suckers were statistically on par and the second best entries. Robusta (T_5) and Poovan (T_4) with average sucker height of 71.73 cm and 67.83 cm produced suckers which were significantly shorter as compared to those produced by the other cultivars.

With respect to leaf production by the suckers, the analysis of variance (Appendix II) indicated highly significant differences among the cultivars. The suckers of Nhalipoovan (T_2) had significantly more number of leaves (5.98) as compared to those of the other cultivars (Table 5).

Table 5. - Vigour of the suckers produced by the seven cultivars

Entry No.	Cultivars	Height (cm)	No. of leaves
1.	Palayankodan	101.76	4.95
2.	Nhalipoovan	101.33	5.98
3.	Nendran	84.73	3.96
4.	Poovan	67.83	4.14
5.	Robusta	71.73	4.98
6.	Red Banana	111.56	3.93
7.	Monthan	88.29	4.37
	$CD_{.05}$	6.918	0.570

The suckers produced by Robusta (T_5) and Palayankodan (T_1) had the second highest number of leaves (4.98 and 4.95, respectively). The suckers produced by the remaining four cultivars had significantly lower number of leaves ranging from 4.37 in Monthan (T_7) to 3.93 in Red Banana (T_6).

4.2. Enhancement of sucker production in Robusta plants and its effect on the bunch weight

The second part of the study aimed at identifying a method of enhancing sucker production in Robusta and assessing its effects on the growth and productivity of the mother plants. The data on the influence of the 14 treatment combinations as compared to the control, assessed in an RBD with two replications, are presented in the following pages.

4.2.1. Growth parameters

The height of the pseudostem, its girth at the base and the number of functional leaves it supported at flowering were assessed. The results are presented in Tables 6, 7 and 8.

The analysis of variance (Appendix III) showed that

Table 6.- Height at flowering (cm) of the 'Robusta' plants under the different sucker enhancement treatments

Height of sucker removal	Treatments							
	T_1	T_2	T_3	T_4	T_5	T_6	T_7	Mean
	Ascenso's method	Barker's method	Ethrel 400 ppm	T_2-outer bark stripping	T_1-application of ammonium sulphate	Shallow planting	Package Recommendations with sucker removal	
H_1(30 cm)	257.9	200.2	182.6	217.9	223.3	212.5	224.2	216.9
H_2(60 cm)	247.3	180.2	173.4	213.8	216.1	197.1	204.6	204.9
Mean	252.6	190.2	178.0	215.8	219.7	204.8	214.4	210.9

Control (Package Recommendations) : 236.4

$CD_{.05}$ for comparing treatments : 6.5630

$CD_{.05}$ for comparing interactions : 9.2858

the treatments as compared to the control, exhibited highly significant influence on the height of the plants (pseudostem) at flowering. The treatment effects per se and the Height x Treatment interaction effects were highly significant. The effects due to the height of suckers at separation were not significant.

Table 6 indicates that T_1 (Ascenso's method), which produced 252.6 cm tall plants, was significantly superior to the rest of the treatments. T_5 (Ascenso's method without ammonium sulphate application), T_4 (Barker's method without outer bark stripping) and T_7 (Package of Practices recommendations, with sucker removal), which were statistically on par, were the second best treatments having produced 219.7 cm, 215.8 cm, and 214.4 cm tall plants, respectively. T_3 (ethrel 400 ppm) produced significantly shorter plants (178.0 cm). The control plants were 236.4 cm tall. Among the treatment combinations, H_1T_1 (Ascenso's method, 30 cm tall suckers removed) produced significantly tall plants (257.9 cm) than the rest of the combinations. The second best combination was H_2T_1 (Ascenso's method, 60 cm tall suckers removed) which recorded a plant height

Table 7.- Girth of pseudostem at flowering (cm) of the 'Robusta' plants under the different sucker enhancement treatments

Height of sucker removal	Treatments							
	T_1	T_2	T_3	T_4	T_5	T_6	T_7	Mean
	Ascenso's method	Barker's method	Ethrel 400 ppm	T_2-outer bark stripping	T_1-application of ammonium sulphate	Shallow planting	Package Recommendations with sucker removal	
H_1(30 cm)	57.1	51.5	48.9	52.9	52.7	49.8	50.2	51.9
H_2(60 cm)	53.5	48.0	49.0	50.7	51.9	48.7	50.5	50.3
Mean	55.3	49.7	48.9	51.8	52.3	49.2	50.3	51.1

Control (Package Recommendations) : 52.9

$CD_{.05}$ for comparing treatments : 2.3128

$CD_{.05}$ for comparing interactions : 3.2709

of 247.3 cm. The combinations H_1T_3 (ethrel 400 ppm, 30 cm tall suckers removed), H_2T_2 (Barker's method, 60 cm tall suckers removed) and H_2T_3(ethrel 400 ppm, 60 cm tall suckers removed), which were statistically on par, produced significantly shorter plants (182.6 cm, 180.2 cm and 173.4 cm, respectively).

The second criterion used for assessing the vigour of the plants as influenced by the sucker enhancement treatments was the girth of the pseudostem at flowering. The data are presented in Table 7. The analysis of variance (Appendix III) indicated that although the treatments did not differ significantly from the control, they exhibited significant influence on the girth of the pseudostem of the mother plants. The Height x Treatment interaction effects were highly significant. The effects due to the height of suckers at separation did not show statistical significance.

The treatment T_1 (Ascenso's method) produced plants which were significantly superior to the others with respect to the girth of the pseudostem (55.3 cm). The treatments, T_5 (Ascenso's method without ammonium sulphate application),

T_4 (Barker's method without outer bark stripping) and T_7 (Package of Practices recommendations coupled with sucker removal), which were statistically on par (having recorded a girth of 52.3 cm, 51.8 cm and 50.3 cm, respectively), were found to be the next best set of treatments. The control plants recorded a pseudostem girth of 52.9 cm. Among the treatment combinations, H_1T_1 (Ascenso's method, 30 cm tall suckers removed) was significantly superior (57.1 cm) to the rest of the combinations. The treatment combinations H_1T_7 (Package of Practices recommendations, 30 cm tall suckers removed), H_1T_6 (shallow planting, 30 cm tall suckers removed), H_2T_3 (ethrel 400 ppm, 60 cm tall suckers removed), H_1T_3 (ethrel 400 ppm, 30 cm tall suckers removed), H_2T_6 (shallow planting, 60 cm tall suckers removed) and H_2T_2 (Barker's method, 60 cm tall suckers removed), which were statistically on par, produced plants with significantly lesser girth of pseudostem at flowering.

The third criterion used for assessing the vigour of the plants as influenced by the sucker enhancement treatments was the number of functional leaves at flowering. The data are presented in Table 8. The analysis of variance

Table 8.- Number of functional leaves borne at flowering by the 'Robusta' plants under the different sucker enhancement treatments

Height of sucker removal	Treatments							
	T_1	T_2	T_3	T_4	T_5	T_6	T_7	Mean
	Ascenso's method	Barker's method	Ethrel 400 ppm	T_2-outer bark stripping	T_1-application of ammonium sulphate	Shallow planting	Package Recommendations with sucker removal	
H_1(30 cm)	13.7	10.5	9.1	10.1	10.8	11.3	10.2	10.8
H_2(60 cm)	13.1	10.5	8.5	9.8	10.0	10.3	10.5	10.5
Mean	13.4	10.5	8.8	10.0	10.4	10.8	10.3	10.6

Control (Package Recommendations) : 12.0

$CD_{.05}$ for comparing treatments : 0.5963

$CD_{.05}$ for comparing interactions : 0.8434

(Appendix III) indicated that the treatments which did not differ significantly from the control exhibited significant influence on the number of functional leaves supported by the mother plants at flowering. The effects due to the height of the suckers at separation did not show statistical significance. The Height x Treatment interaction effects, however, were highly significant.

The treatment T_1 (Ascenso's method) which supported 13.4 functional leaves at flowering was significantly superior to the rest of the treatments. T_3 (ethrel 400 ppm) gave the lowest number of functional leaves at flowering (8.8). The control plants supported 12.0 functional leaves at flowering. Among the treatment combinations, H_1T_1 (Ascenso's method, 30 cm tall suckers removed) and H_2T_1 (Ascenso's method, 60 cm tall suckers removed) which were statistically on par (having supported 13.7 leaves and 13.1 leaves, respectively), were found to be significantly superior to the rest of the treatment combinations. The second best treatment combinations were H_1T_6 (shallow planting, removal of 30 cm tall suckers) and H_1T_5(Ascenso's method without ammonium sulphate application, 30 cm tall

suckers removed), which were also on par statistically (11.3 and 10.8 leaves, respectively). The treatment combinations H_1T_3 (ethrel 400 ppm, removal of 30 cm tall suckers) and H_2T_3 (ethrel 400 ppm, removal of 60 cm tall suckers), which were statistically on par, supported the lowest number of functional leaves at flowering.

4.2.2. Flowering behaviour

The number of days from planting of the mother plant to its flowering, the time taken (days) from setting of the first hand to that of the last hand (fruit set duration), the time taken (days) for bunch maturation and the total duration (planting to harvest) were assessed and the results have been presented in Tables 9, 10, 11 and 12.

The analysis of variance (Appendix III) showed that the treatments significantly differed from the control and influenced the duration of flowering of the mother plants. The height of the suckers at separation did not exhibit significant influence. However, the Height x Treatment interaction effects were highly significant.

Table 9 and Fig.15 indicate that T_3 (ethrel 400 ppm)

Table 9.- Duration for flowering in 'Robusta' under the different sucker enhancement treatments

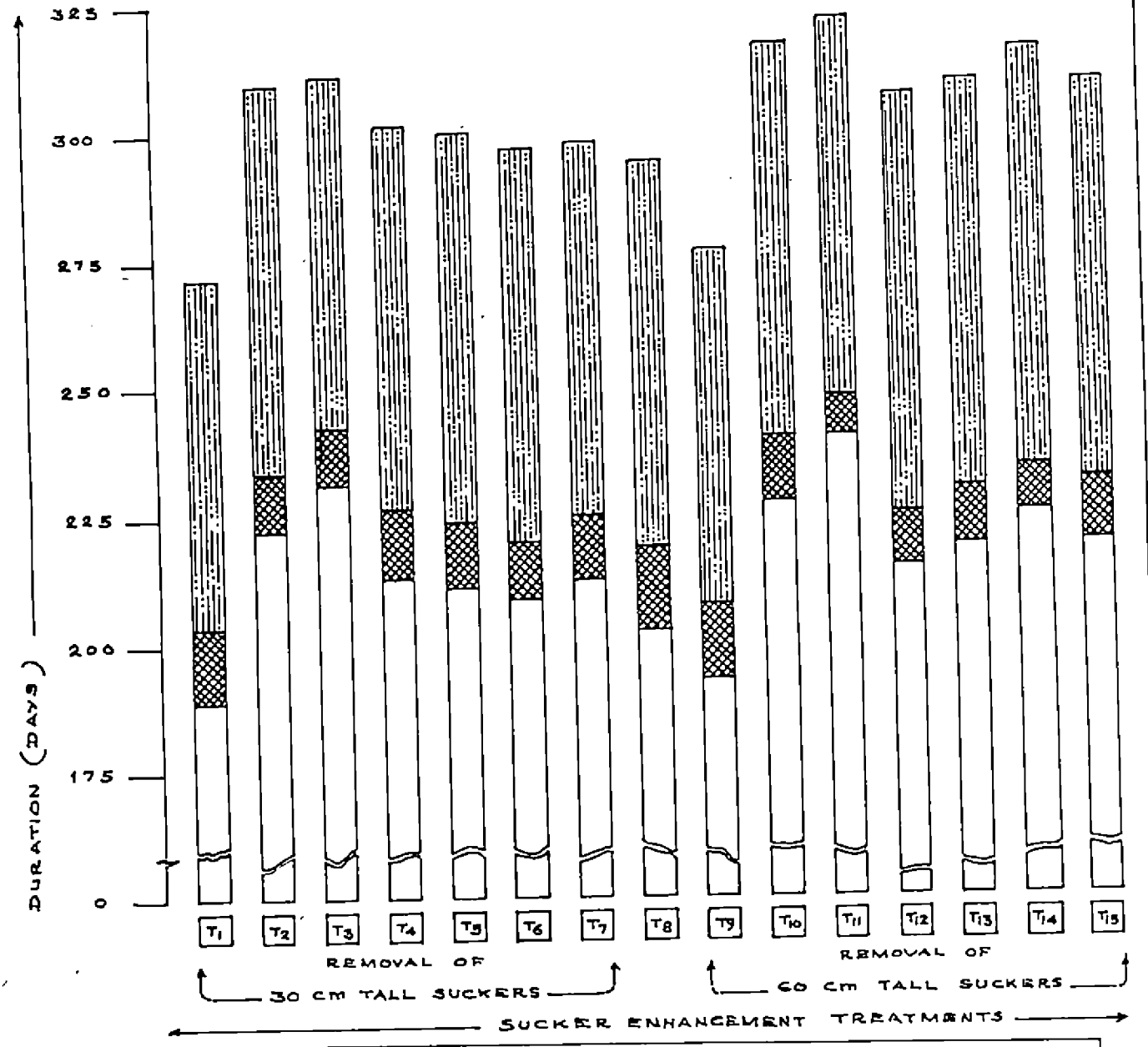
Height of sucker removal	Treatments							
	T_1	T_2	T_3	T_4	T_5	T_6	T_7	Mean
	Ascenso's method	Barker's method	Ethrel 400 ppm	T_2-outer bark stripping	T_1-application of ammonium sulphate	Shallow planting	Package Recommendations with sucker removal	
H_1 (30 cm)	188.0	222.0	232.5	213.0	211.5	210.0	212.0	212.7
H_2 (60 cm)	192.0	228.0	239.5	214.0	218.5	225.0	219.0	219.4
Mean	190.0	225.0	236.0	213.5	215.0	217.5	215.5	216.0

Control (Package Recommendations) : 202.0

$CD_{.05}$ for comparing treatments : 3.3885

$CD_{.05}$ for comparing interactions : 4.7921

FIG. 15 DURATION FOR FLOWERING, FRUITSET AND HARVEST IN ROBUSTA UNDER THE DIFFERENT SUCKER ENHANCEMENT TREATMENTS



and T_2 (Barker's method) plants took significantly longer time (236 days and 225 days, respectively) for flowering than those of the other treatments. These were significantly different from each other. T_1 (Ascenso's method) plants flowered significantly earlier (190 days) than those of the other treatments. The control plants flowered 202 days after planting. Among the treatment combinations, H_1T_1 (Ascenso's method, 30 cm tall suckers removed) and H_2T_1 (Ascenso's method, 60 cm tall suckers removed), which were statistically on par, exhibited early flowering (188 and 192 days, respectively) as compared to the other combinations. The treatment combination H_2T_3 (ethrel 400 ppm coupled with removal of 60 cm tall suckers) took significantly longer time (239.5 days) than the rest of the combinations.

The second aspect studied was the duration of fruit set. The analysis of variance (Appendix III) showed that the treatments differed significantly from the control and influenced the duration of fruit set (the time taken from the setting of the first hand to the setting of the last hand). The influence of the height of the suckers at sepa-

Table 10.- Duration of fruit set in 'Robusta' under the different sucker enhancement treatments

Height of sucker removal	Treatments							
	T_1	T_2	T_3	T_4	T_5	T_6	T_7	Mean
	Ascenso's method	Barker's method	Ethrel 400 ppm	T_2-outer bark stripping	T_1-application of ammonium sulphate	Shallow planting	Package Recommendations with sucker removal	
H_1(30 cm)	16.1	12.3	10.3	13.6	13.0	9.5	13.2	12.6
H_2(60 cm)	15.8	12.6	9.1	11.5	12.6	9.3	12.3	11.9
Mean	16.0	12.5	9.7	12.5	12.8	9.4	12.7	12.2

Control (Package Recommendations) : 16.8

$CD_{.05}$ for comparing treatments : 0.5804

$CD_{.05}$ for comparing interactions : 6.8208

ration was not significant. However, the Height x Treatment interaction effects were highly significant.

Table 10 and Fig. 15 indicate that T_1 (Ascenso's method) took significantly longer time (16.0 days) while T_6(shallow planting) and T_3(ethrel 400 ppm) completed the fruit set in significantly shorter time (9.4 and 9.7 days), as compared to the rest of the treatments. The control plants were the slowest to complete the fruit set (16.8 days). Among the treatment combinations, H_1T_1 (Ascenso's method, 30 cm tall suckers removed) and H_2T_1 (Ascenso's method, 60 cm tall suckers removed) were statistically on par and took significantly longer time to complete the fruit set (16.1 days and 15.8 days, respectively) compared to the other combinations. The treatment combinations H_2T_3 (ethrel 400 ppm, removal of 60 cm tall suckers), H_2T_6 (shallow planting, removal of 60 cm tall suckers) and H_1T_6 (shallow planting, removal of 30 cm tall suckers), which were statistically on par, took the shortest time to complete the fruit set (9.1, 9.3, 9.5 days, respectively) than the other combinations.

The analysis of variance with respect to duration

Table 11.- Duration for maturity of the 'Robusta' bunch under the different sucker enhancement treatments

Height of sucker removal	Treatments							
	T_1	T_2	T_3	T_4	T_5	T_6	T_7	Mean
	Ascenso's method	Barker's method	Ethrel 400 ppm	T_2-outer bark stripping	T_1-application of ammonium sulphate	Shallow planting	Package Recommendations with sucker removal	
H_1 (30 cm)	82.3	86.5	78.0	88.7	88.5	86.1	86.5	85.2
H_2 (60 cm)	84.5	88.2	81.0	92.6	91.0	90.5	90.5	88.3
Mean	88.4	87.3	79.5	90.6	89.7	88.3	88.5	86.7

Control (Package Recommendations) : 91.5

$CD_{.05}$ for comparing treatments : 1.8809

$CD_{.05}$ for comparing interactions : 2.6600

for bunch maturation (Appendix III) showed that the treatments significantly differed from the control and influenced the time taken from shooting till harvest (bunch maturation). The height of the suckers at separation did not exhibit significant influence with respect to this character. The Height x Treatment Interaction effects were highly significant.

Table 11 and Fig. 15 indicate that T_4 (Barker's method without outer bark stripping) and T_5 (Ascenso's method without ammonium sulphate application), which were statistically on par, took significantly longer time for bunch maturation (90.6 and 89.7 days, respectively) than the other treatments. The control plants, on the other hand, took 91.5 days for bunch maturation. The treatments T_3 (ethrel 400 ppm) and T_1(Ascenso's method) took significantly shorter duration for fruit maturation (79.5 days and 83.4 days, respectively) and they were significantly different from each other. Among the treatment combinations, H_2T_4 (Barker's method without outer bark stripping, 60 cm tall suckers removed), H_2T_5 (Ascenso's method without ammonium sulphate application, removal of 60 cm tall

suckers), H_2T_7 (Package of Practices recommendations with 60 cm tall suckers removed) and H_2T_6 (shallow planting with 60 cm tall suckers removed), which were statistically on par, took significantly longer duration than the rest of the combinations (92.6, 91.0, 90.5 and 90.5 days, respectively). The bunches produced by H_1T_3 plants (ethrel 400 ppm, 30 cm tall suckers removed) took significantly shorter time for fruit maturation (78.0 days).

The data on total duration of the plants (planting to harvest) were statistically analysed. The ANOVA (Appendix III) indicated that the treatments significantly differed from the control and influenced the total duration of the plants. The influence of the height of the suckers at separation and the Height x Treatment interaction effects on the total duration were also found to be significant.

The plants subjected to Ascenso's method (T_1) recorded the shortest (273.4 days) and those treated with ethrel 400 ppm, the longest total duration (315.5 days). The control plants maintained as per the Package of Practices recommendations recorded a total duration of 293.5

Table 12.- Total duration of the 'Robusta' plants under the different sucker enhancement treatments

Height of sucker removal	Treatments							
	T_1	T_2	T_3	T_4	T_5	T_6	T_7	Mean
	Ascenso's method	Barker's method	Ethrel 400 ppm	T_2-outer bark stripping	T_1-application of ammonium sulphate	Shallow planting	Package Recommendations with sucker removal	
H_1 (30 cm)	270.3	308.5	310.5	301.6	300.5	296.1	298.5	298.0
H_2 (60 cm)	276.5	316.2	320.5	306.6	309.5	315.5	309.5	307.7
Mean	273.4	312.3	315.5	304.1	305.0	305.8	304.0	302.8

Control (Package Recommendations) : 293.5

$CD_{.05}$ for comparing treatments : 2.6888

$CD_{.05}$ for comparing interactions : 3.8026

days (Table 12, Fig. 15). Between the two heights of sucker removal, H_1 (30 cm tall suckers removed) recorded significantly shorter total duration (298.0 days Vs 307.7 days) as against H_2 (60 cm tall suckers removed). Among the treatment combinations, H_1T_1 (Ascenso's method, removal of 30 cm tall suckers) and H_2T_1 (Ascenso's method, removal of 60 cm tall suckers) recorded the shortest and the second shortest total duration (270.3 days and 276.5 days, respectively). The longest total duration of 320.5 days was in the case of H_2T_3 plants (ethrel 400 ppm, removal of 60 cm tall suckers).

4.2.3. Yield and yield components

The weight of the bunch, the per day yield, the number of hands per bunch and the number of fingers per hand as influenced by the sucker enhancement treatments were assessed and the results are presented in Tables 13, 14, 15 and 16.

The analysis of variance (Appendix III) showed that the treatments differed significantly from the control and exhibited highly significant influence on the weight

Table 13.- Weight (kg) of the 'Robusta' bunches under the different sucker enhancement treatments

Height of sucker removal	Treatments							
	T_1	T_2	T_3	T_4	T_5	T_6	T_7	Mean
	Ascenso's method	Barker's method	Ethrel 400 ppm	T_2-outer bark stripping	T_1-application of ammonium sulphate	Shallow planting	Package Recommendations with sucker removal	
H_1 (30 cm)	20.1	12.6	8.4	14.0	13.3	8.8	12.8	12.9
H_1 (60 cm)	16.6	9.4	6.9	10.2	9.8	7.1	10.3	10.0
Mean	18.4	11.0	7.7	12.1	11.5	7.9	11.5	11.4

Control (Package Recommendations) : 21.9

$CD_{.05}$ for comparing treatments : 0.6170

$CD_{.05}$ for comparing interactions : 0.8726

Plate 8.- 'Robusta' bunch under Ascenso's method with removal of 30 cm tall suckers (H_1I_1)

Plate 9.- 'Robusta' bunch under Ascenso's method with removal of 60 cm tall suckers (H_2T_1)

Plate 10.- 'Robusta' bunch under shallow planting (T_6)

Plate 11.- 'Robusta' bunch under ethrel treatment (T_3)

Plate 12.- 'Robusta' bunch under the Package of Practices Recommendations (T_8)

of the bunches obtained from the mother plants. The height of the suckers at separation and the Height x Treatment interaction effects also exhibited significant influence on the bunch weight of the mother plants.

Table 13 and Fig. 16 indicate that T_1 (Ascenso's method) produced bunches which were significantly heavier (18.4 kg) than those of the other treatments (Plates 8 and 9). T_6 (shallow planting) and T_3 (ethrel 400 ppm), which were statistically on par, yielded significantly lighter bunches of 7.9 kg and 7.7 kg (Plates 10 and 11). The control plants in which desuckering was done as per the recommendations of the Package of Practices (Plate 12) yielded the heaviest bunches (21.9 kg). Removal of 30 cm tall suckers (H_1) proved to be significantly superior to the sucker removal at 60 cm height (H_2), having produced 12.9 kg and 10.0 kg bunches over all the treatments. Among the treatment combinations, H_1T_1 (Ascenso's method, removal of 30 cm tall suckers) with a bunch weight of 20.1 kg was significantly superior to the rest of the combinations (Plate 8). The second best combination with respect to the weight of bunches produced was H_2T_1 (Ascenso's method,

Table 14.- Per day yield of 'Robusta' plants under the different sucker enhancement treatments

Height of sucker removal	Treatments							
	T_1	T_2	T_3	T_4	T_5	T_6	T_7	Mean
	Ascenso's method	Barker's method	Ethrel 400 ppm	T_2-outer bark stripping	T_1-application of ammonium sulphate	Shallow planting	Package Recommendations with sucker removal	
H_1 (30 cm)	74.6	40.8	27.2	46.2	44.4	29.7	43.0	43.7
H_2 (60 cm)	60.0	29.7	21.6	33.5	31.8	22.5	33.3	33.2
Mean	67.3	35.3	24.4	39.8	38.1	26.1	38.2	38.4

Control (Package Recommendations) : 74.6

$CD_{.05}$ for comparing treatments : 1.9213

$CD_{.05}$ for comparing interactions : 2.7171

FIG. 16 WEIGHT (Kg) OF THE ROBUSTA BUNCHES UNDER THE DIFFERENT SUCKER ENHANCEMENT TREATMENTS

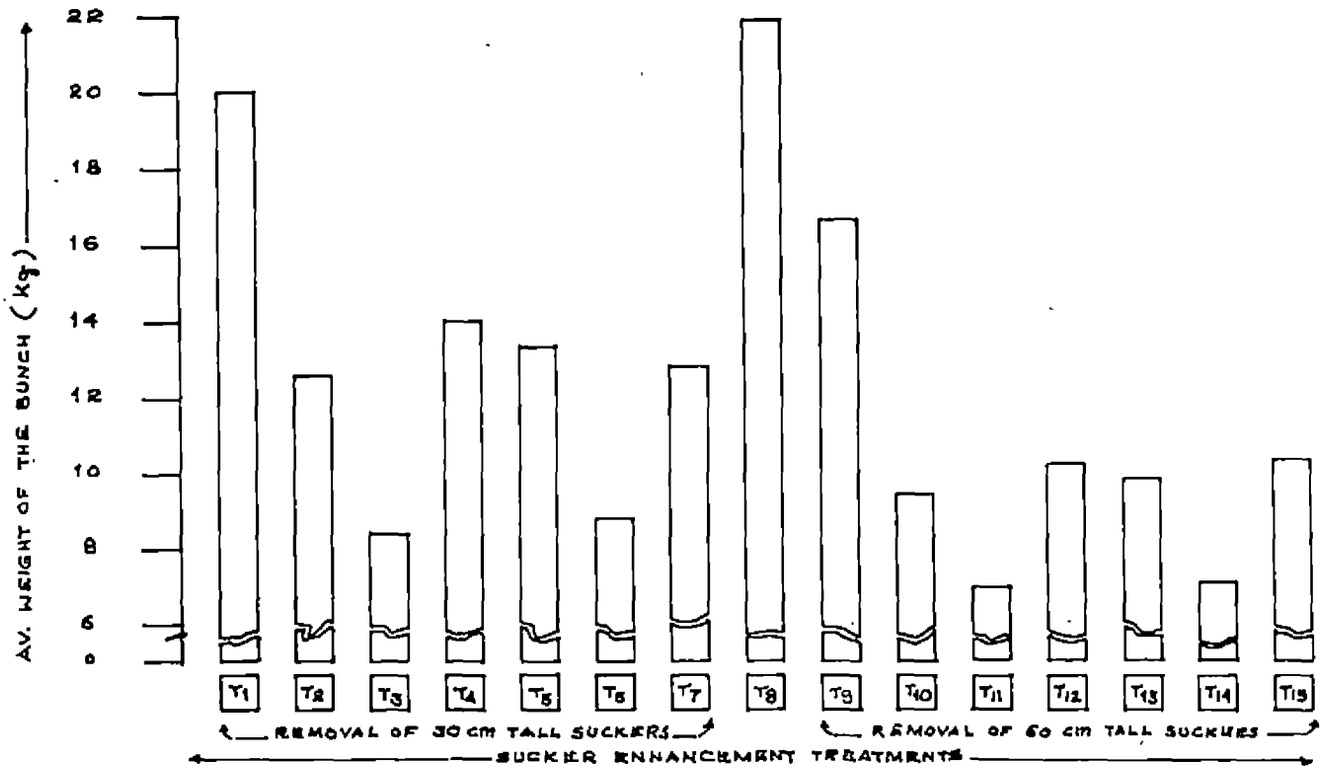
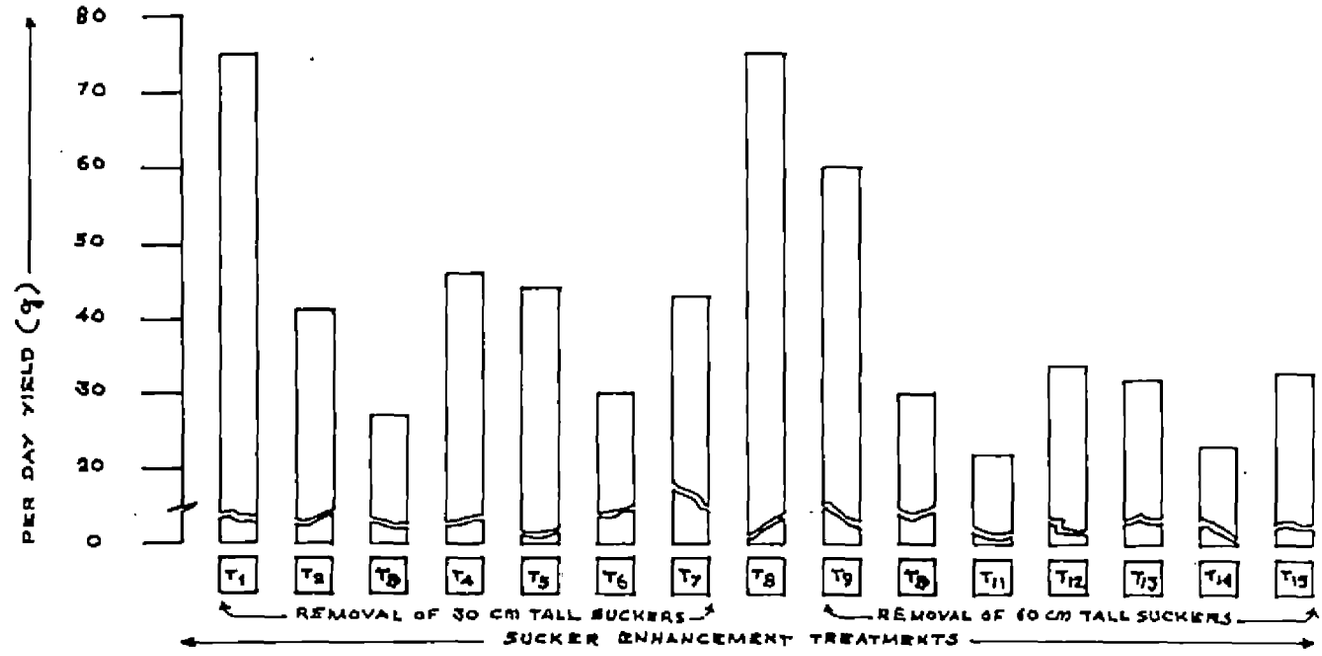


FIG. 17 PER DAY YIELD (g) OF ROBUSTA PLANTS UNDER THE DIFFERENT SUCKER ENHANCEMENT TREATMENTS



T_1 & T_9 – ASCENSO'S METHOD T_2 & T_{10} – BARKER'S METHOD T_3 & T_{11} – ETHREL 400 ppm

T_4 & T_{12} – BARKER'S METHOD MINUS OUTER BARK STRIPPING

T_5 & T_{13} – ASCENSO'S METHOD MINUS AMMONIUM SULPHATE APPLICATION

T_6 & T_{14} – SHALLOW PLANTING T_7 & T_{15} – PACKAGE OF PRACTICE RECOMMENDATIONS WITH SUCKER REMOVAL

T_8 – CONTROL

removal of 60 cm tall suckers) with a bunch weight of 16.6 kg (Plate 9). The combinations H_2T_6 (shallow planting, removal of 60 cm tall suckers) and H_2T_3 (ethrel 400 ppm, removal of 60 cm tall suckers), which were statistically on par, produced significantly inferior bunches (7.1 kg and 6.9 kg, respectively) as compared to the rest of the combinations (Plates10 and 11).

Since the total duration (planting to harvest) varied considerably among the treatments from 270.3 days to 320.5 days (Table 12), per day yield was computed and analysed to give meaningful comparison of the treatments. The ANOVA table (Appendix III) indicated that the treatments differed significantly from the control and influenced the per day yield. The height of the suckers at separation also exhibited highly significant influence on the per day yield of the mother plants. The Height x Treatment interaction effects with respect to this character also exhibited significance.

The data presented in Table 14 and Fig. 17 indicate that T_1 (Ascenso's method) with a per day yield of 67.3 g was the best treatment. T_6 (shallow planting) and T_3

(ethrel 400 ppm) plants produced the lowest per day yields of 26.1 g and 24.4 g, respectively. Sucker removal at 30 cm height produced a per day yield of 43.7 g which was significantly higher than that obtained when the suckers were removed at 60 cm (with 33.2 g). The control plants recorded a per day yield of 74.6 g. Among the treatment combinations, H_1T_1 (Ascenso's method, removal of 30 cm tall suckers) and H_2T_1 (Ascenso's method, removal of 60 cm tall suckers) were the best and the second best (with per day yields of 74.6 g and 60.0 g, respectively). These differed significantly from each other and from the other combinations. The combinations H_2T_6 (shallow planting, removal of 60 cm tall suckers) and H_2T_3 (ethrel 400 ppm, removal of 60 cm tall suckers), which were statistically on par, registered significantly low per day yields of 22.5 g and 21.6 g, respectively.

The analysis of variance with respect to the number of hands per bunch (Appendix III) indicated that the treatments significantly differed from the control and influenced the character. While the height of sucker removal did not exhibit significant effects, the Height x Treatment effects

Table 15.- No. of hands per bunch in 'Robusta' plants under the different sucker enhancement treatments

Height of sucker removal	Treatments							
	T_1	T_2	T_3	T_4	T_5	T_6	T_7	Mean
	Ascenso's method	Barker's method	Ethrel 400 ppm	T_2-outer bark stripping	T_1-application of ammonium sulphate	Shallow planting	Package Recommendations with sucker removal	
H_1 (30 cm)	8.8	6.3	5.8	7.0	6.7	5.1	6.8	6.6
H_2 (60 cm)	8.2	5.5	5.3	6.1	6.1	4.8	6.1	6.0
Mean	8.5	5.9	5.6	6.5	6.4	5.0	6.5	6.3

Control (Package Recommendations) : 8.1

$CD_{.05}$ for comparing treatments : 0.3718

$CD_{.05}$ for comparing interactions : 0.5259

FIG. 18 NUMBER OF HANDS PER BUNCH IN ROBUSTA PLANTS UNDER THE DIFFERENT SUCKER ENHANCEMENT TREATMENTS

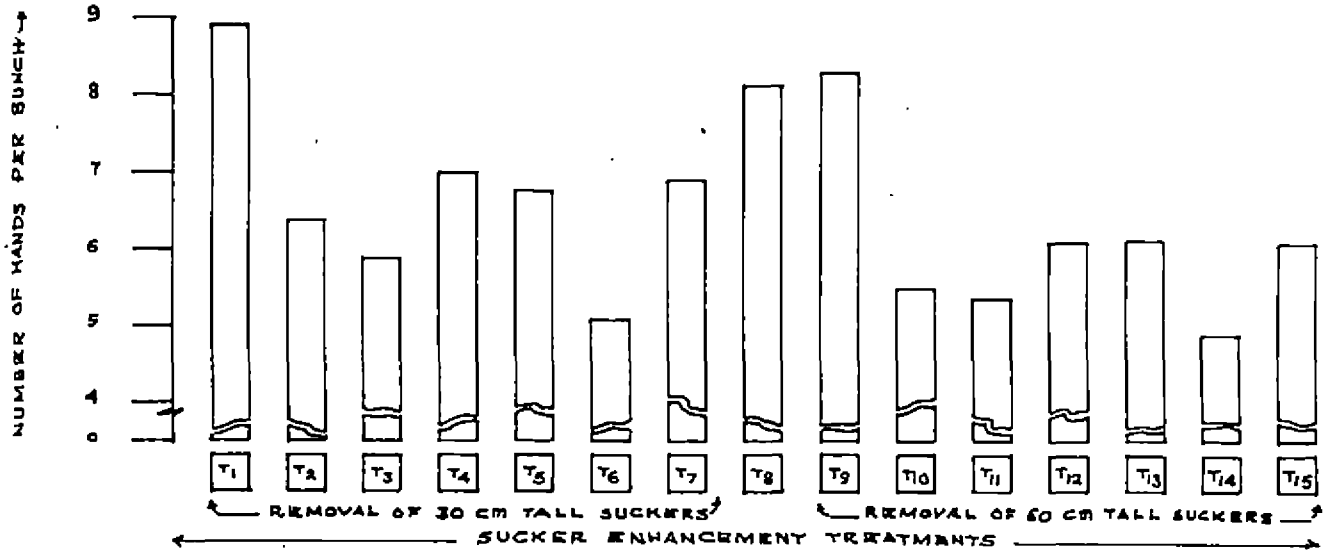
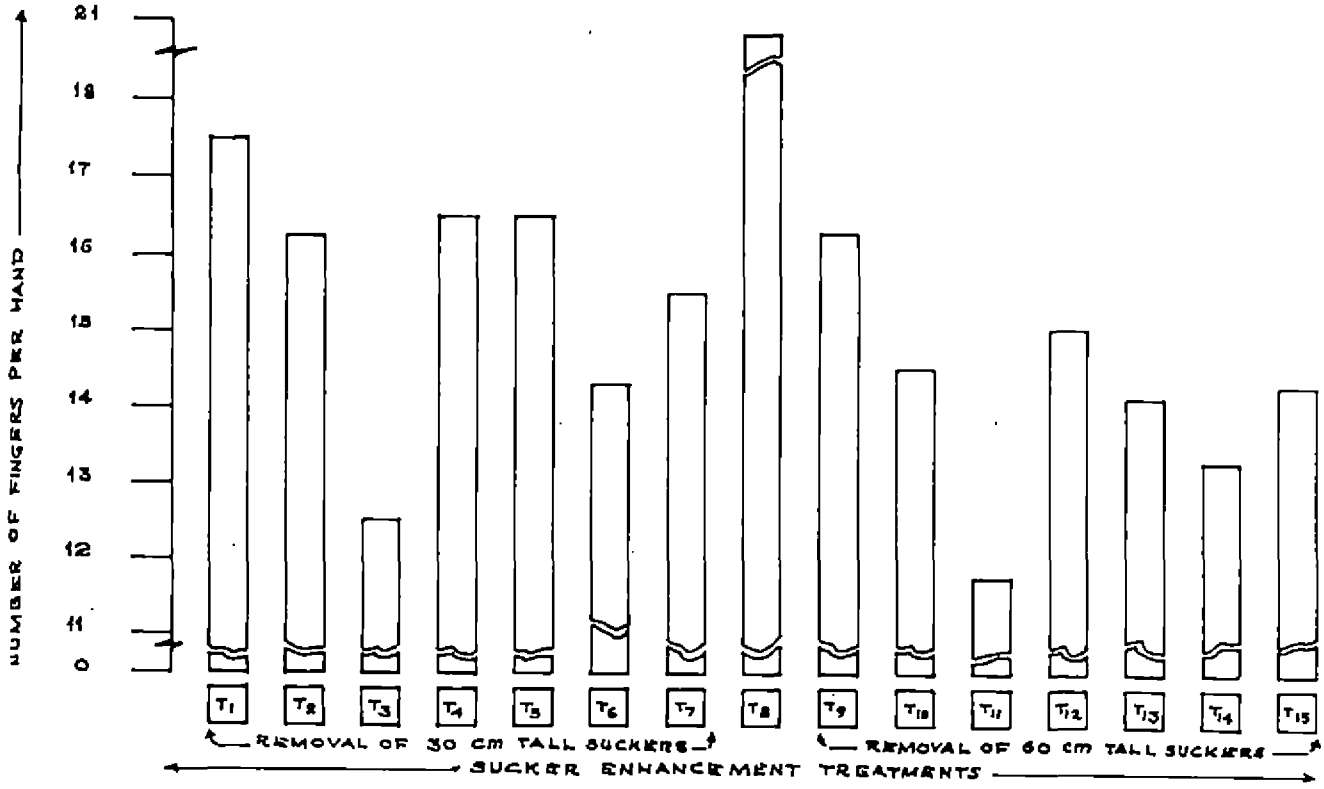


FIG. 19 NUMBER OF FINGERS PER HAND IN ROBUSTA PLANTS UNDER THE DIFFERENT SUCKER ENHANCEMENT TREATMENTS



T_1 & T_9 - ASCENSO'S METHOD T_2 & T_{10} - BARKER'S METHOD T_3 & T_{11} - ETHREL 400 ppm

T_4 & T_{12} - BARKER'S METHOD MINUS OUTER BARK STRIPPING

T_5 & T_{13} - ASCENSO'S METHOD MINUS AMMONIUM SULPHATE APPLICATION

T_6 & T_{14} - SHALLOW PLANTING

T_7 & T_{15} - PACKAGE OF PRACTICE RECOMMENDATIONS WITH SUCKER REMOVAL

T_8 - CONTROL

significantly influenced the number of hands per bunch.

The data presented in Table 15 and Fig. 18 indicate that T_1 (Ascenso's method) was significantly superior to the rest of the treatments, in that it gave the maximum number of hands per bunch (8.5). T_6 (shallow planting) produced the minimum number of hands per bunch (5.0). The control plants gave 8.1 hands per bunch.

Among the treatment combinations, H_1T_1 (Ascenso's method, removal of 30 cm tall suckers) and H_2T_1 (Ascenso's method, removal of 60 cm tall suckers), which were statistically on par, were significantly superior to the rest of the combinations (8.8 and 8.2 hands, respectively). H_2T_3 (ethrel 400 ppm, removal of 60 cm tall suckers), H_1T_6 (shallow planting, removal of 30 cm tall suckers) and H_2T_6 (shallow planting, removal of 60 cm tall suckers), which were statistically on par, gave significantly fewer hands (5.3, 5.1 and 4.8 hands, respectively) as compared to the rest of the combinations.

The number of fingers per hand was another criterion used for assessing the productivity of the plants as influenced by the treatments. The analysis of variance

Table 16.- Number of fingers per hand in 'Robusta' plants under the different sucker enhancement treatments

Height of sucker removal	Treatments							
	T_1	T_2	T_3	T_4	T_5	T_6	T_7	Mean
	Ascenso's method	Barker's method	Ethrel 400 ppm	T_2-outer bark stripping	T_1-application of ammonium sulphate	Shallow planting	Package Recommendations with sucker removal	
H_1 (30 cm)	17.5	16.2	12.5	16.5	16.5	14.2	15.5	15.5
H_2 (60 cm)	16.2	14.5	11.7	15.0	14.1	13.2	14.2	14.1
Mean	16.8	15.3	12.1	15.7	15.3	13.7	14.8	14.8

Control (Package Recommendations) : 20.7

$CD_{.05}$ for comparing treatments : 0.7293

$CD_{.05}$ for comparing interactions : 1.0314

(Appendix III) showed that the treatments differed from the control and exhibited highly significant influence on the number of fingers per hand. The Height x Treatment interaction effects were also highly significant.

The data presented in Table 16 and Fig. 19 indicate that T_1 (Ascenso's method) was significantly superior to the rest of the treatments, in that it gave the maximum number of fingers per hand (16.8). T_3 (ethrel 400 ppm) gave the lowest number of fingers per hand (12.1 fingers). The control plants gave 20.7 fingers per hand and they significantly differed from the treatment plants. Among the treatment combinations, H_1T_1 (Ascenso's method, removal of 30 cm tall suckers), H_1T_5 (Ascenso's method without ammonium sulphate application, removal of 30 cm tall suckers) and H_1T_4 (Barker's method without outer bark stripping, removal of 30 cm tall suckers), which were statistically on par, gave significantly more number of fingers per hand (17.5, 16.5 and 16.5, respectively) as compared to the other combinations. H_1T_3 (ethrel 400 ppm, removal of 30 cm tall suckers) and H_2T_3 (ethrel 400 ppm, removal of 60 cm tall suckers), which were statistically on par, were signi-

Table 17.- Length of 'Robusta' fingers (cm) under the different sucker enhancement treatments

Height of sucker removal	Treatments							
	T_1	T_2	T_3	T_4	T_5	T_6	T_7	Mean
	Ascenso's method	Barker's method	Ethrel 400 ppm	T_2-outer bark stripping	T_1-application of ammonium sulphate	Shallow planting	Package Recommendations with sucker removal	
H_1 (30 cm)	23.5	20.5	17.7	19.5	19.3	17.6	20.0	19.7
H_2 (60 cm)	22.4	18.2	17.3	19.5	20.7	17.1	19.5	19.2
Mean	22.9	19.3	17.5	19.5	20.0	17.3	19.7	19.5

Control (Package Recommendations) : 24.3

$CD_{.05}$ for comparing treatments : 0.7572

$CD_{.05}$ for comparing interactions : 1.0708

ficantly inferior to the other combinations, in that they gave fewer number of fingers per hand (12.5 and 11.7 fingers per hand, respectively).

The length, girth and weight of the fingers of each observational bunch were assessed and the results have been presented in Tables 17, 18 and 19. Analysis of variance (Appendix III) showed that the treatments were significantly different from the control and exhibited highly significant influence on each of the above characters. The height of the suckers at seperation did not exhibit any significant influence on the finger characters of the treatment plants. The Height x Treatment interaction effects were highly significant for the length, girth and weight of the fingers.

With regard to finger length, Table 17 and Fig.20 indicate that T_1 (Ascenso's method) was significantly superior (22.9 cm) to the rest of the treatments. T_3 (ethrel 400 ppm) and T_6 (shallow planting), which were statistically on par, gave significantly shorter fingers (17.5 cm and 17.3 cm, respectively). The control plants registered a finger length of 24.3 cm. Among the treatment

Table 18.- Girth of 'Robusta' fingers (cm) under the different sucker enhancement treatments

Height of sucker removal	Treatments							
	T_1	T_2	T_3	T_4	T_5	T_6	T_7	Mean
	Ascenso's method	Barker's method	Ethrel 400 ppm	T_2-outer bark stripping	T_1-application of ammonium sulphate	Shallow planting	Package Recommendations with sucker removal	
H_1 (30 cm)	13.0	12.5	11.5	12.4	12.1	12.2	12.7	12.3
H_2 (60 cm)	13.0	11.6	10.8	12.1	12.1	10.9	12.3	11.8
Mean	13.0	12.0	11.1	12.2	12.1	11.5	12.5	12.1

Control (Package Recommendations) : 14.4

$CD_{.05}$ for comparing treatments : 0.5369

$CD_{.05}$ for comparing interactions : 0.7594

FIG. 20 LENGTH OF ROBUSTA FINGERS (Cm) UNDER THE DIFFERENT SUCKER ENHANCEMENT TREATMENTS

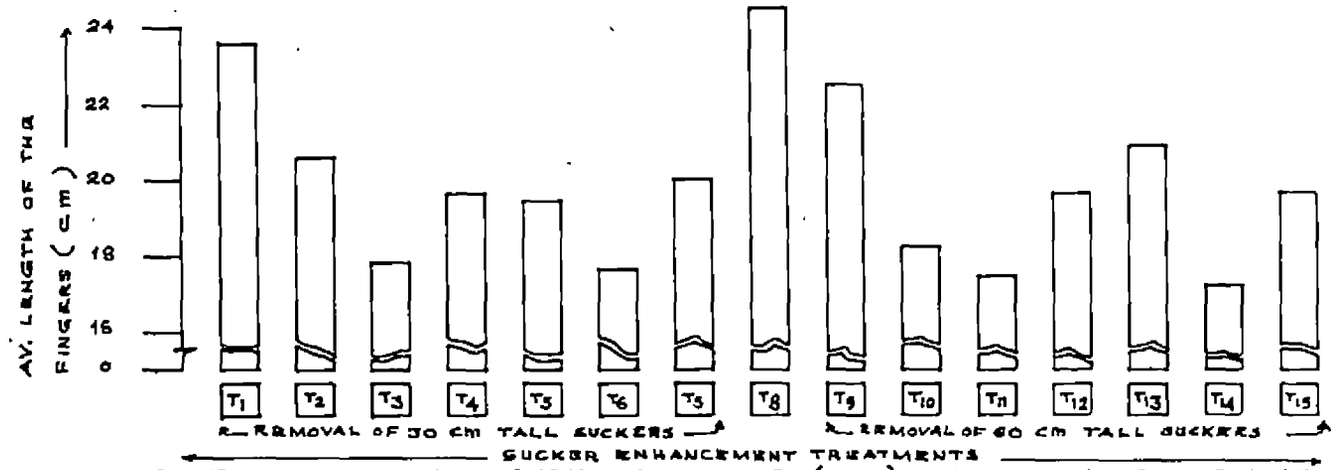


FIG. 21 GIRTH OF ROBUSTA FINGERS (Cm) UNDER THE DIFFERENT SUCKER ENHANCEMENT TREATMENTS

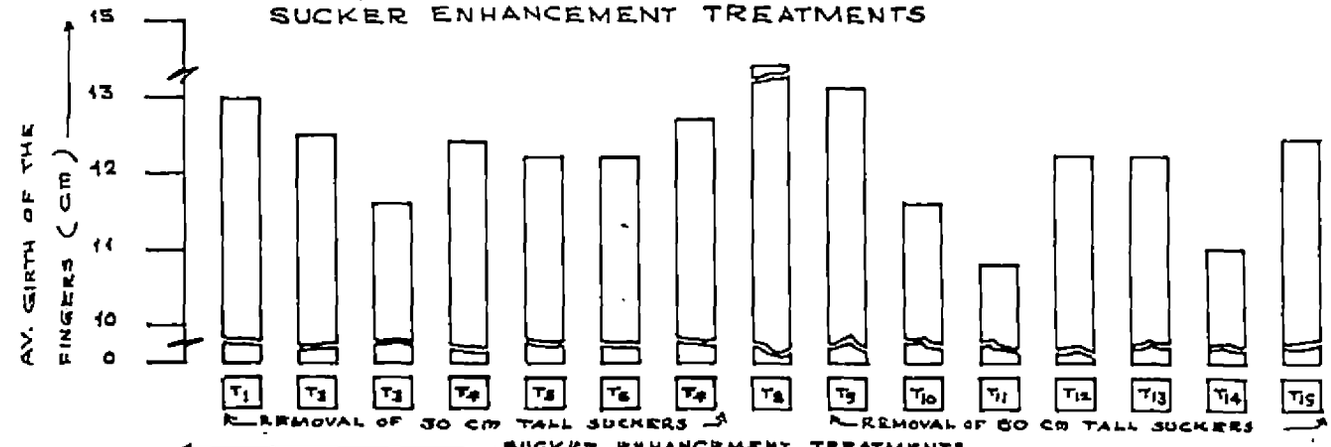
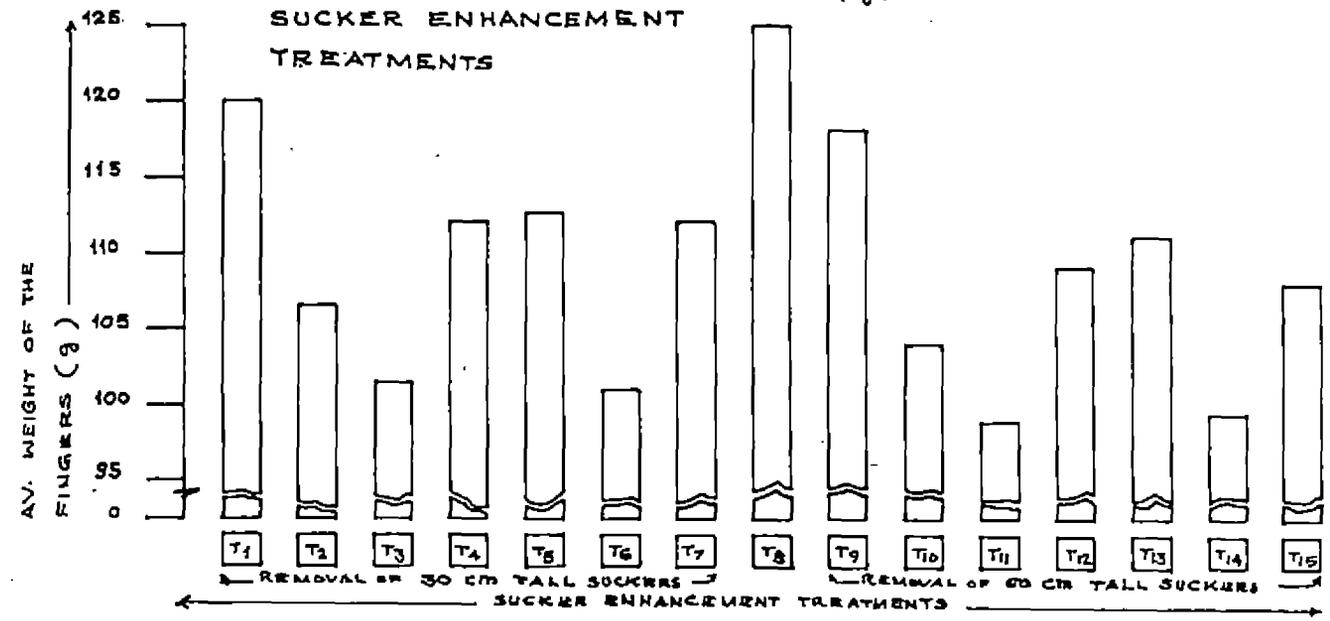


FIG. 22 WEIGHT OF ROBUSTA FINGERS (g) UNDER THE DIFFERENT SUCKER ENHANCEMENT TREATMENTS



T_1 & T_9 - ASCENSO'S METHOD T_2 & T_{10} - BARKER'S METHOD T_3 & T_{11} - ETHREL 400 ppm

T_4 & T_{12} - BARKER'S METHOD MINUS OUTER BARK STRIPPING

T_5 & T_{13} - ASCENSO'S METHOD MINUS AMMONIUM SULPHATE APPLICATION

T_6 & T_{14} - SHALLOW PLANTING T_7 & T_{15} - PACKAGE OF PRACTICE RECOMMENDATIONS WITH SUCKER REMOVAL

T_8 - CONTROL

combinations, H_1T_1 (Ascenso's method, removal of 30 cm tall suckers) and H_2T_1 (Ascenso's method, removal of 60 cm tall suckers), which were statistically on par, were significantly superior (23.5 cm and 22.4 cm, respectively) to the other combinations. H_1T_3 (ethrel 400 ppm, removal of 30 cm tall suckers), H_1T_6 (shallow planting, removal of 30 cm tall suckers), H_2T_3 (ethrel 400 ppm, removal of 60 cm tall suckers), and H_2T_6 (shallow planting, removal of 60 cm tall suckers), which were statistically on par, gave significantly shorter fingers (17.7 cm, 17.6 cm, 17.3 cm and 17.1 cm, respectively).

The data on the average girth of the fingers are presented in Table 18 and Fig. 21. T_1 (Ascenso's method) T_7 (Package of Practices recommendations with sucker removal), which were statistically on par, were significantly superior (13.0 cm and 12.5 cm, respectively) to the rest of the treatments. T_6 (shallow planting) and T_3 (ethrel 400 ppm), which were also statistically on par, gave significantly low girth of fingers (11.5 cm and 11.1 cm, respectively). The control plants registered an individual finger girth of 14.4 cm. Among the treatment

combinations, H_1T_1 (Ascenso's method, removal of 30 cm tall suckers), H_2T_1 (Ascenso's method, removal of 60 cm tall suckers), H_1T_7 (Package of Practices recommendations, removal of 30 cm tall suckers), H_1T_2 (Barker's method, removal of 30 cm tall suckers), H_1T_4 (Barker's method without outer bark stripping, removal of 30 cm tall suckers) and H_2T_7 (Package of Practices recommendations, removal of 60 cm tall suckers), which were statistically on par (13.0 cm, 13.0 cm, 12.7 cm, 12.5 cm, 12.4 cm, and 12.3 cm, respectively), were the significantly superior treatment combinations. H_1T_3 (ethrel 400 ppm, removal of 30 cm tall suckers), H_2T_6 (shallow planting, removal of 60 cm tall suckers), and H_2T_3 (ethrel 400 ppm, removal of 60 cm tall suckers), which were also statistically on par, produced fingers with significantly lesser girth (11.5 cm, 10.9 cm, and 10.8 cm, respectively).

Another criterion used for assessing the quality of the bunch as influenced by the treatments was the average weight of the fingers. The data are presented in Table 19 and Fig. 22.

T_1 (Ascenso's method) was significantly superior to

Table 19.- Weight of 'Robusta' fingers (g) under the different sucker enhancement treatments

Height of sucker removal	Treatments							
	T_1	T_2	T_3	T_4	T_5	T_6	T_7	Mean
	Ascenso's method	Barker's method	Ethrel 400 ppm	T_2-outer bark stripping	T_1-application of ammonium sulphate	Shallow planting	Package Recommendations with sucker removal	
H_1 (30 cm)	120.1	106.7	101.4	111.8	112.6	100.8	112.3	109.4
H_2 (60 cm)	118.0	104.2	99.3	109.2	111.1	99.7	108.1	107.1
Mean	119.0	105.4	100.3	110.5	111.9	100.3	110.2	108.2

Control (Package Recommendations) : 125.0

$CD_{.05}$ for comparing treatments : 1.6450

$CD_{.05}$ for comparing interactions : 2.3264

the rest of the treatments, in that it gave the maximum finger weight (119.0 g). T_3 (ethrel 400 ppm) and T_6 (shallow planting), which were statistically on par, were significantly inferior to the other treatments (100.3 g, and 100.3 g, respectively). Among the treatment combinations, H_1T_1 (Ascenso's method, removal of 30 cm tall suckers), H_2T_1 (Ascenso's method, removal of 60 cm tall suckers), H_1T_5 (Ascenso's method without ammonium sulphate application, removal of 30 cmtall suckers), H_1T_7 (Package of Practices recommendations, removal of 30 cm tall suckers), H_1T_4 (Barker's method without outer bark stripping, removal of 30 cm tall suckers) and H_2T_5 (Ascenso's method without ammonium sulphate application, removal of 60 cm tall suckers), which were statistically on par, were significantly superior (120.1 g, 118.0 g, 112.6 g, 112.3 g, 111.8 g and 111.1 g, respectively) to the other treatment combinations. The treatment combinations H_1T_3 (ethrel 400 ppm, removal of 30 cm tall suckers), H_1T_6 (shallow planting, removal of 30 cm tall suckers), H_2T_6 (shallow planting, removal of 60 cm tall suckers) and H_2T_3 (ethrel 400 ppm, removal of 60 cm tall suckers), which were also statistically on par, produced fingers having sig-

FIG. 23 SUCKER PRODUCTION BY ROBUSTA PLANTS UNDER THE DIFFERENT SUCKER ENHANCEMENT TREATMENTS DURING STAGE III (4th MONTH TO SHOOTING)

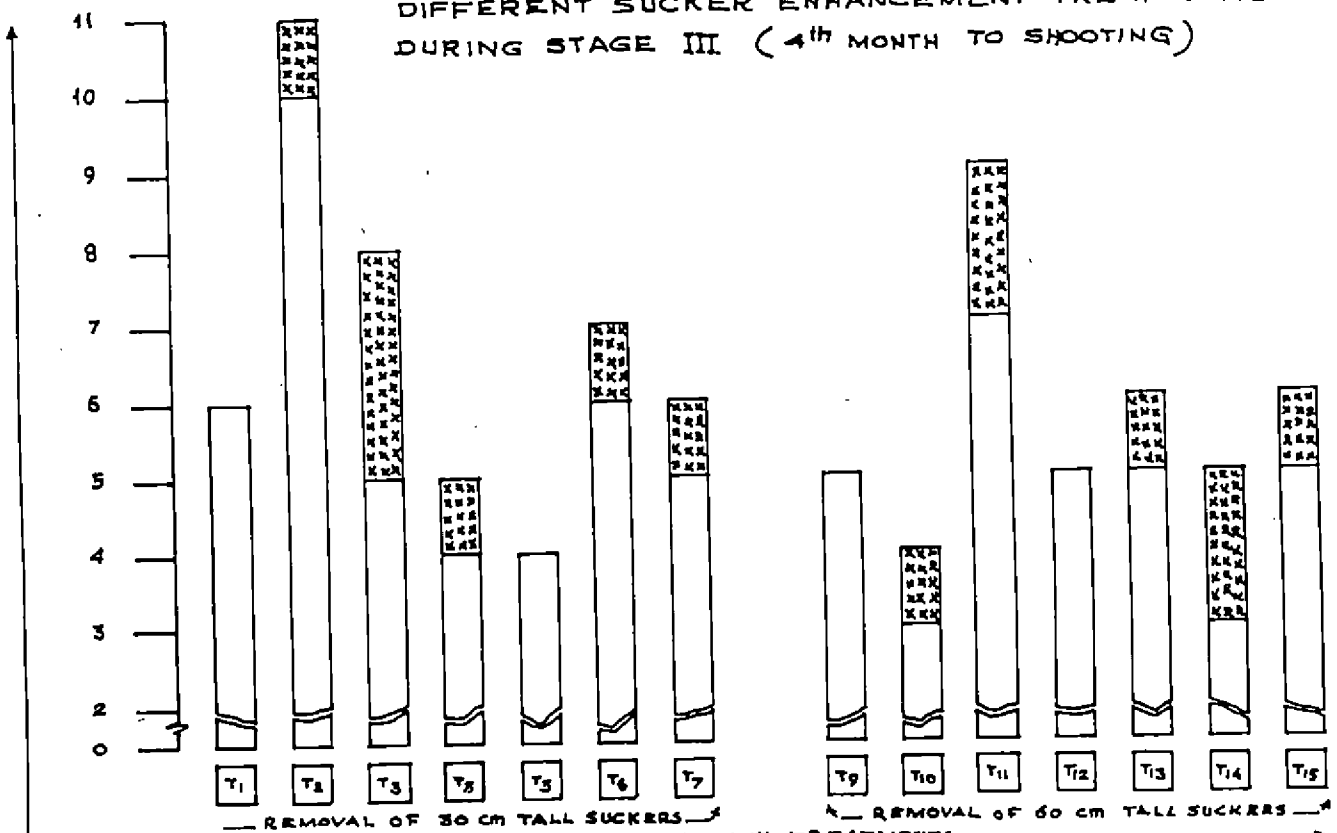
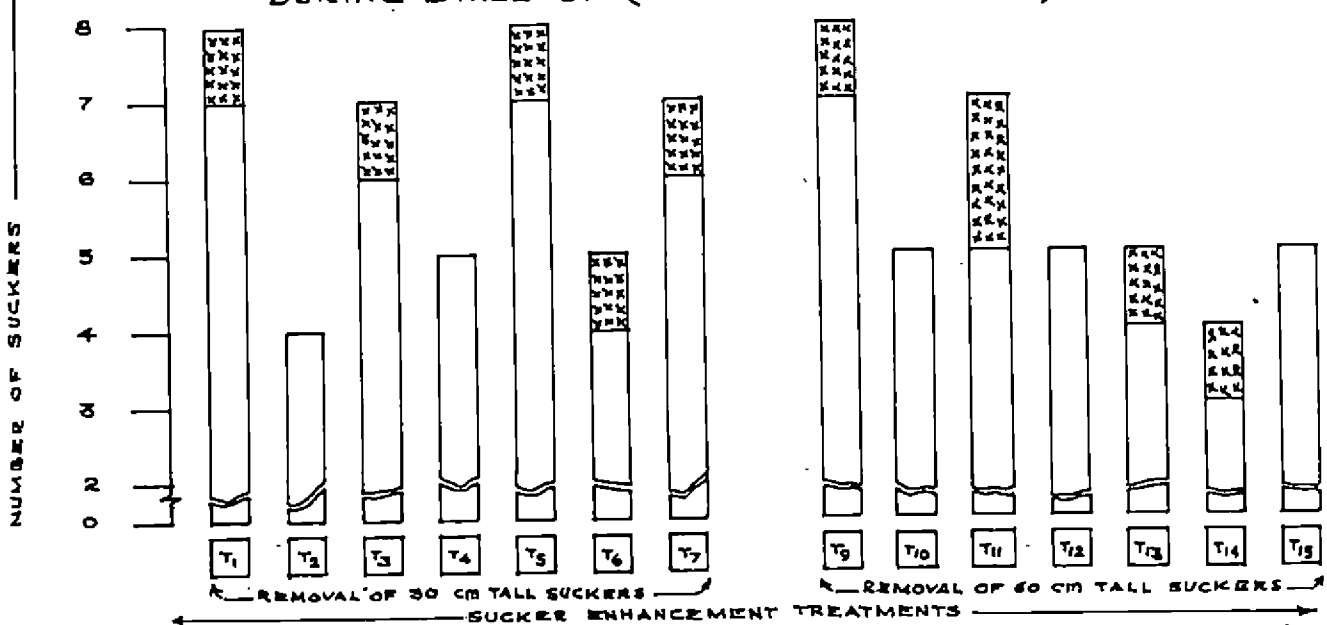


FIG. 24 SUCKER PRODUCTION BY ROBUSTA PLANTS UNDER THE DIFFERENT SUCKER ENHANCEMENT TREATMENTS DURING STAGE IV (SHOOTING TO HARVEST)



WATER SUCKER SWORD SUCKER

T_1 & T_9 - ASCENSO'S METHOD T_2 & T_{10} - BARKERS METHOD T_3 & T_{11} - ETHREL 400 ppm

T_4 & T_{12} - BARKER'S METHOD MINUS OUTER BARK STRIPPING

T_5 & T_{13} - ASCENSO'S METHOD MINUS AMMONIUM SULPHATE APPLICATION

T_6 & T_{14} - SHALLOW PLANTING T_7 & T_{15} - PACKAGE OF PRACTICE RECOMMENDATIONS WITH SUCKER REMOVAL

nificantly poor average weight (101.4 g, 100.8 g, 99.7 g and 99.3 g, respectively).

4.2.4. Sucker production

Total number of suckers produced, the number of sword suckers and water suckers, the percentage of sword suckers to the total, the Sucker Ratio and Sucker Production Index were assessed and the results have been presented in tables 20 to 25.

The ANOVA (Appendix III) indicated that the treatments differed significantly from the control and showed highly significant influence on the number of suckers produced by the mother plants. The effects due to the height of sucker removal were not significant. However, the Height x Treatment interaction effects were highly significant.

Table 20, Fig. 23 and Fig. 24 indicate that the treatments T_3 (ethrel 400 ppm), T_1 (Ascenso's method) and T_5 (Ascenso's method without application of ammonium sulphate) were significantly superior to the others with regard to the number of suckers produced (15.6, 13.6 and 11.6, respectively). Among the treatment combinations, H_1T_3 (ethrel

Table 20.- Sucker production by 'Robusta' plants under the different sucker enhancement treatments

Height of sucker removal	Treatments							
	T_1	T_2	T_3	T_4	T_5	T_6	T_7	Mean
	Ascenso's method	Barker's method	Ethrel 400 ppm	T_2-outer bark stripping	T_1-application of ammonium sulphate	Shallow planting	Package Recommendations with sucker removal	
H_1 (30 cm)	14.6	12.2	16.3	10.7	12.2	11.5	12.3	12.8
H_2 (60 cm)	12.7	9.7	14.8	10.3	11.1	9.0	9.6	11.0
Mean	13.6	11.0	15.6	10.5	11.6	10.2	11.0	11.9

Control (Package Recommendations) : 4.0

$CD_{.05}$ for comparing treatments : 0.6012

$CD_{.05}$ for comparing interactions : 0.8502

400 ppm, removal of 30 cm tall suckers) was significantly superior to the other combinations, having produced 16.3 suckers per plant. The combination H_2T_3 (ethrel 400 ppm, removal of 60 cm tall suckers) and H_1T_1 (Ascenso's method, removal of 30 cm tall suckers), which were statistically on par having produced 14.8 and 14.6 suckers, respectively per plant, were the second best in this respect. The control plants yielded only 4.0 suckers per plant because the suckers were allowed to develop only after shooting. However, the T_7 plants (maintained as per the Package of Practices recommendations, but without desuckering) yielded 11.0 suckers per mat.

With respect to the number of sword suckers produced, the ANOVA indicated that the treatments significantly differed from the control and influenced the production of sword suckers. The treatments T_1 (Ascenso's method) and T_3 (ethrel 400 ppm), which were statistically on par, were significantly superior to the others, in that they gave the maximum number of sword suckers (13.1 and 12.6, respectively). T_6 (shallow planting) gave significantly lesser number of sword suckers (8.8) compared to the other treat-

Table 21.- Production of sword suckers by 'Robusta' plants under the different sucker enhancement treatments

Height of sucker removal	Treatments							
	T_1	T_2	T_3	T_4	T_5	T_6	T_7	Mean
	Ascenso's method	Barker's method	Ethrel 400 ppm	T_2-outer bark stripping	T_1-application of ammonium sulphate	Shallow planting	Package Recommendations with sucker removal	
H_1 (30 cm)	13.8	11.6	13.5	10.2	11.3	10.7	11.7	11.9
H_2 (60 cm)	12.5	8.7	11.7	9.2	10.2	6.8	8.5	9.6
Mean	13.1	10.2	12.6	9.7	11.0	8.8	10.1	10.8

Control (Package Recommendations) : 3.7

$CD_{.05}$ for comparing treatments : 0.5765

$CD_{.05}$ for comparing interactions : 0.8153

ments (Table 21). The control plants recorded 3.7 sword suckers per mat. However, the T_7 plants (maintained as per the Package of Practices recommendations; but without desuckering) yielded 10.1 sword suckers per plant. Among the treatment combinations, H_1T_1 (Ascenso's method, removal of 30 cm tall suckers) and H_1T_3 (ethrel 400 ppm, removal of 30 cm tall suckers), which were statistically on par having produced 13.8 and 13.5 sword suckers per plant, were the significantly superior ones. H_2T_6 (shallow planting, removal of 60 cm tall suckers) with a relatively lesser number of sword suckers (6.8), was found to be significantly inferior to the other treatment combinations.

The treatments significantly differed from the control and exhibited significant influence on the number of water suckers produced by the mother plants (Appendix III). The height of suckers at separation did not exhibit significant influence. However, the Height x Treatment interactions exhibited significant effects on water sucker production by the mother plants. The data presented in Table 22 indicate that the treatment T_3 (ethrel 400 ppm) produced significantly higher number of water suckers (3.0). The

Table 22.- Production of water suckers by 'Robusta' plants under the different sucker enhancement treatments

Height of sucker removal	Treatments							
	T_1	T_2	T_3	T_4	T_5	T_6	T_7	Mean
	Ascenso's method	Barker's method	Ethrel 400 ppm	T_2-outer bark stripping	T_1-application of ammonium sulphate	Shallow planting	Package Recommendations with sucker removal	
H_1(30 cm)	0.7	0.6	2.8	0.5	0.3	0.7	0.6	0.9
H_2(60 cm)	0.2	1.0	3.1	1.1	0.8	2.1	1.1	1.3
Mean	0.5	0.8	3.0	0.8	0.6	1.4	0.8	1.1

Control (Package Recommendations) : 0.2

$CD_{.05}$ for comparing treatments : 0.5444

$CD_{.05}$ for comparing interactions : 0.7700

treatments T_2 (Barker's method) and T_1 (Ascenso's method) were among those that produced the least number of water suckers (0.8 and 0.5, respectively). The control plants recorded 0.2 water sucker per mat. Among the treatment combinations, H_2T_3 (ethrel 400 ppm, removal of 60 cm tall suckers) and H_1T_3 (ethrel 400 ppm, removal of 30 cm tall suckers), which were statistically on par, gave significantly higher counts of water suckers (3.1 and 2.8, respectively). Significantly lower counts of water suckers were recorded by nine treatment combinations.

The ability for production of quality suckers by the treatment plants was assessed in terms of the percentage of sword suckers also. The analysis of variance (Appendix III) indicated that the treatments differed from the control and exhibited significant influence on the percentage of sword suckers to the total number of suckers produced. The effects due to the height of suckers at removal were significant ($P \leq 0.05$). The Height x Treatment interaction also exhibited highly significant effects on the percentage of sword suckers.

As can be seen from the data presented in Table 23,

Table 23.- Percentage of sword suckers produced by 'Robusta' plants under the different sucker enhancement treatments

Height of sucker removal	Treatments							
	T_1	T_2	T_3	T_4	T_5	T_6	T_7	Mean
	Ascenso's method	Barker's method	Ethrel 400 ppm	T_2-outer bark stripping	T_1-application of ammonium sulphate	Shallow planting	Package Recommendations with sucker removal	
H_1 (30 cm)	94.8	95.2	82.4	95.3	96.9	93.5	94.9	93.3
H_2 (60 cm)	98.0	89.6	79.0	89.2	92.1	76.2	88.3	87.5
Mean	96.4	90.9	80.7	92.3	94.5	84.8	91.6	90.4

Control (Package Recommendations) : 83.7

$CD_{.05}$ for comparing treatments : 4.3381

$CD_{.05}$ for comparing interactions : 6.1351

the treatments T_1 (Ascenso's method), T_5 (Ascenso's method without ammonium sulphate application) and T_4 (Barker's method without outer bark stripping), which were statistically on par, gave significantly higher percentage of sword suckers (96.4, 94.5 and 92.3, respectively). T_3 (ethrel 400 ppm) produced significantly lower percentage of sword suckers (80.7). Of the suckers produced by the control plants, 83.7 per cent were sword suckers. The treatment combinations H_2T_1 (Ascenso's method, removal of 60 cm tall suckers), H_1T_5 (Ascenso's method without ammonium sulphate application, removal of 30 cm tall suckers), H_1T_4 (Barker's method without outer-bark stripping, removal of 30 cm tall suckers) and H_1T_2 (Barker's method, removal of 30 cm tall suckers) were among the eight which recorded maximum percentage of sword suckers (98.0, 96.9, 95.3 and 95.2, respectively). The combinations H_2T_3 (ethrel 400 ppm, removal of 60 cm tall suckers) and H_2T_6 (shallow planting, removal of 60 cm tall suckers), which were statistically on par, gave significantly lower percentage of sword suckers (79.0 and 76.2, respectively).

The analysis of variance with respect to the Sucker

Table 24.- Sucker Ratio $\left(\frac{\text{Sword suckers}}{\text{Water suckers}}\right)$ in 'Robusta' plants under the different sucker enhancement treatments

Height of sucker removal	Treatments							
	T_1	T_2	T_3	T_4	T_5	T_6	T_7	Mean
	Ascenso's method	Barker's method	Ethrel 400 ppm	T_2-outer bark stripping	T_1-application of ammonium sulphate	Shallow planting	Package Recommendations with sucker removal	
H_1(30 cm)	18.5	19.6	4.9	20.5	35.7	16.1	19.6	19.3
H_2(60 cm)	50.0	9.4	3.8	9.2	11.9	3.4	8.5	13.7
Mean	34.2	14.5	4.3	14.8	23.8	9.7	14.1	16.5

Control (Package Recommendations) : 5.5

$CD_{.05}$ for comparing treatments : 7.4330

$CD_{.05}$ for comparing interactions : 10.5119

FIG. 25 SUCKER RATIO $\left(\frac{\text{SWORD SUCKER}}{\text{WATER SUCKER}}\right)$ IN ROBUSTA PLANTS UNDER THE DIFFERENT SUCKER ENHANCEMENT TREATMENTS

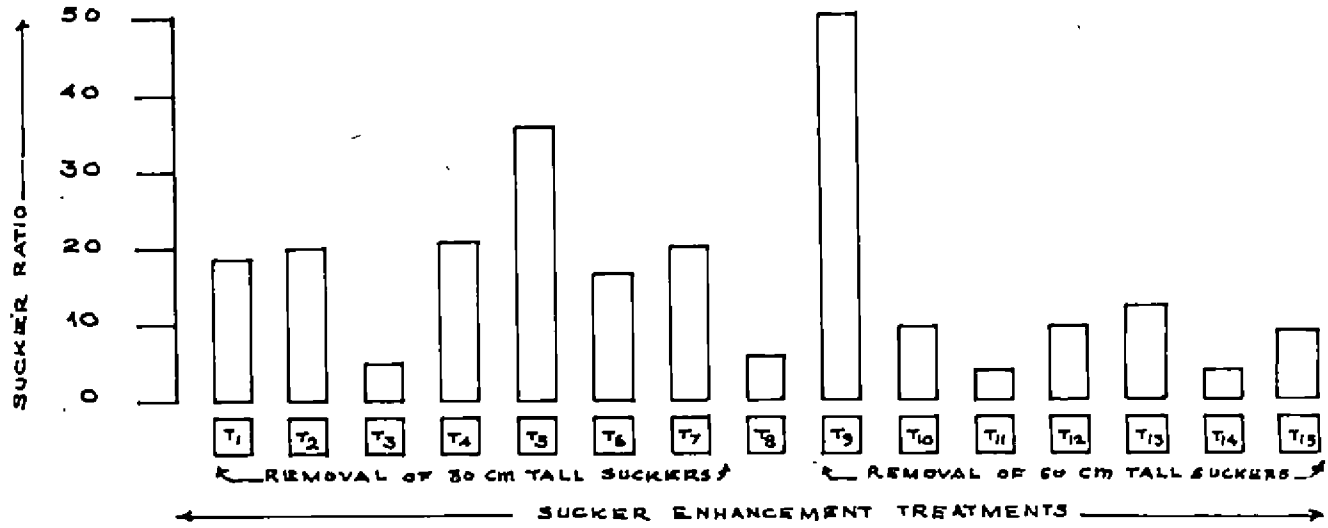
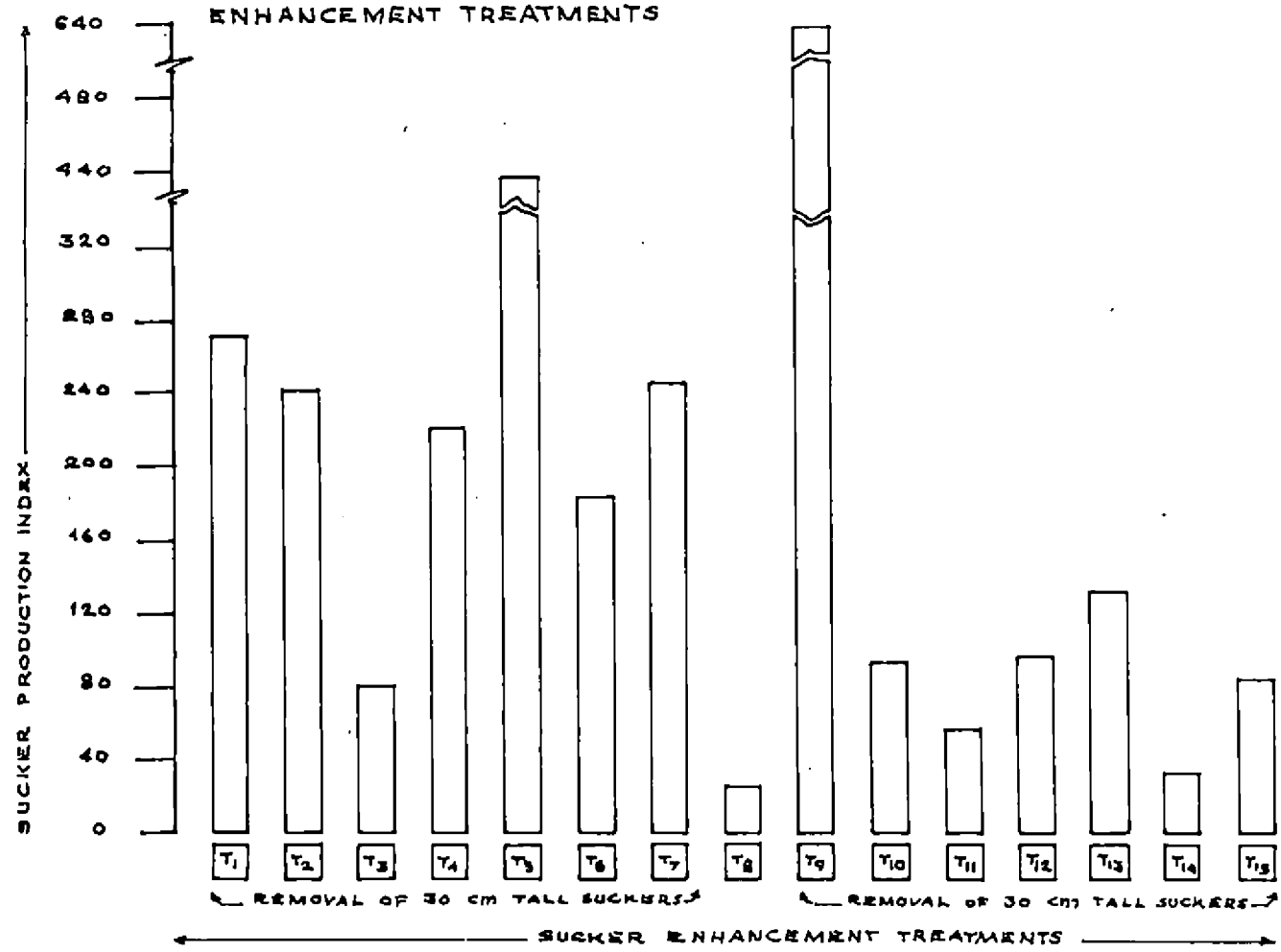


FIG. 26 SUCKER PRODUCTION INDEX (No. OF SUCKERS X SUCKER RATIO) IN ROBUSTA PLANTS UNDER THE DIFFERENT SUCKER ENHANCEMENT TREATMENTS



T_1 & T_9 – ASCENSO'S METHOD T_2 & T_{10} – BARKER'S METHOD T_3 & T_{11} – ETHREL 400 ppm
T_4 & T_{12} – BARKER'S METHOD MINUS OUTER BARK STRIPPING
T_5 & T_{13} – ASCENSO'S METHOD MINUS AMMONIUM SULPHATE APPLICATION
T_6 & T_{14} – SHALLOW PLANTING T_7 & T_{15} – PACKAGE OF PRACTICE RECOMMENDATIONS WITH SUCKER REMOVAL
T_8 — CONTROL

Ratio (number of sword suckers/number of water suckers) presented in Appendix III indicated that the treatments differed significantly from the control and influenced the character. The height of the suckers at removal exhibited significant influence ($P \leq 0.05$) on the ratio of sword suckers to water suckers. The Height x Treatment interaction effects were also highly significant.

Table 24 and Fig.25 indicate T_1 (Ascenso's method) to be significantly superior to the other treatments, with a ratio of 34.2. The treatment T_5 (Ascenso's method without ammonium sulphate application) with a ratio of 23.8 was the second best. The treatments T_6 (shallow planting) and T_3 (ethrel 400 ppm), which were statistically on par, gave significantly lower sucker ratios (9.7 and 4.3, respectively). The control plants gave a ratio of 5.5 only. Among the treatment combinations, H_2T_1 (Ascenso's method, removal of 60 cm tall suckers) was significantly superior to the others, in that it gave the best Sucker Ratio (50.0). The treatment combination H_1T_5 (Ascenso's method without ammonium sulphate application, removal of 30 cm tall suckers) with a Sucker Ratio of 35.7 was the second best.

Table 25.- Sucker Production Index in 'Robusta' plants under the different sucker enhancement treatments

Height of sucker removal	Treatments							
	T_1	T_2	T_3	T_4	T_5	T_6	T_7	Mean
	Ascenso's method	Barker's method	Ethrel 400 ppm	T_2-outer bark stripping	T_1-application of ammonium sulphate	Shallow planting	Package Recommendations with sucker removal	
H_1 (30 cm)	270.7	241.2	81.1	220.5	437.9	184.1	243.9	239.9
H_2 (60 cm)	637.7	93.0	56.3	94.8	132.8	30.7	82.2	161.1
Mean	454.2	167.1	68.7	157.7	285.3	107.4	163.0	200.5

Control (Package Recommendations) : 24.0

$CD_{.05}$ for comparing treatments : 89.3044

$CD_{.05}$ for comparing interactions : 126.2955

Seven treatment combinations which recorded low Sucker Ratios of 11.9 to 3.4 were statistically on par and included H_1T_3 (ethrel 400 ppm, removal of 30 cm tall suckers), H_2T_3 (ethrel 400 ppm, removal of 60 cm tall suckers) and H_2T_6 (shallow planting, removal of 60 cm tall suckers).

The Sucker Production Index (number of suckers produced x Sucker Ratio) was computed to give an overall rating of the treatments with respect to production of quality suckers. The analysis of variance presented in Appendix III indicated that the treatments significantly differed from the control and influenced the Sucker Production Index. While the height of suckers at separation did not exhibit statistical significance, the Height x Treatment interaction effects were highly significant.

The data presented in Table 25 and Fig. 26 indicate that T_1 (Ascenso's method) yielded a significantly high Sucker Production Index of 454.2 as compared to the other treatments. T_5 (Ascenso's method without ammonium sulphate application) recorded the second highest Sucker Production Index of 285.3. T_4 (Barker's method without outer bark stripping), T_6 (shallow planting) and T_3 (ethrel 400 ppm),

which were statistically on par, registered significantly lower indices (157.7, 107.4 and 68.7, respectively). The control plants gave a Sucker Production Index of only 24.0. Among the treatment combinations, H_2T_1 (Ascenso's method, removal of 60 cm tall suckers) gave the best index of 637.7, followed by H_1T_5 (Ascenso's method without application of ammonium sulphate, removal of 30 cm tall suckers) with an index of 437.9. Seven treatment combinations, which were statistically on par, gave low indices ranging from 132.8 to 30.7. These treatment combinations included H_2T_7 (Package of Practices recommendations, removal of 60 cm tall suckers), H_1T_3 (ethrel 400 ppm, removal of 30 cm tall suckers), H_2T_3 (ethrel 400 ppm, removal of 60 cm tall suckers) and H_2T_6 (shallow planting, removal of 60 cm tall suckers) with indices of 82.2, 81.1, 56.3 and 30.7 respectively.

4.2.5. Sucker vigour

The vigour of the suckers produced by the plants subjected to the different sucker enhancement treatments was assessed in terms of the leaves they supported at the time of seperation, their weight and the girth of their

Table 26.- Number of leaves borne by the suckers under the different sucker enhancement treatments

Height of sucker removal	Treatments							
	T_1	T_2	T_3	T_4	T_5	T_6	T_7	Mean
	Ascenso's method	Barker's method	Ethrel 400 ppm	T_2-outer bark stripping	T_1-application of ammonium sulphate	Shallow planting	Package Recommendations with sucker removal	
H_1(30 cm)	2.0	1.1	1.4	1.5	1.7	1.3	1.5	1.5
H_2(60 cm)	2.4	2.6	3.0	2.9	2.7	1.9	2.6	2.6
Mean	2.2	1.8	2.2	2.2	2.2	1.6	2.0	2.0

Control (Package Recommendations): Not available since desuckering was practiced

$CD_{.05}$ for comparing treatments : 0.4972

$CD_{.05}$ for comparing interactions : 0.7031

pseudostem at the collar. The data on these aspects are presented in Tables 26, 27 and 28.

The analysis of variance of the data indicated that the treatments significantly differed from the control and influenced the number of fully expanded leaves the suckers had at the time of their seperation (Appendix III). Although the height of the suckers at seperation did not exert significant influence, the Height x Treatment interaction effects were found to be significant.

The suckers produced by the plants subjected to the different treatments, except Treatment 6 (shallow planting), had 1.8 to 2.2 fully expanded leaves at seperation (Table 26). Statistically, these were on par. The Treatment 6 (shallow planting) was significantly inferior in this respect, with only 1.6 fully expanded leaves at seperation. Among the treatment combinations, all those involving H_2 (60 cm tall suckers removed), except the combination H_2T_6 (shallow planting, sucker removal at 60 cm height) were significantly superior to those involving H_1 (30 cm tall suckers removed).

Table 27.- Weight of suckers (kg) under the different sucker enhancement treatments

Height of sucker removal	Treatments							
	T_1	T_2	T_3	T_4	T_5	T_6	T_7	Mean
	Ascenso's method	Barker's method	Ethrel 400 ppm	T_2-outer bark stripping	T_1-application of ammonium sulphate	Shallow planting	Package Recommendations with sucker removal	
H_1(30 cm)	1.7	0.8	1.9	1.1	1.2	0.8	1.0	1.2
H_2(60 cm)	4.7	3.3	4.3	3.7	3.6	2.6	3.0	3.6
Mean	3.2	2.0	3.1	3.1	2.4	1.7	2.0	2.3

Control (Package Recommendations) : Not available since desuckering was practiced

$CD_{.05}$ for comparing treatments : 0.1824

$CD_{.05}$ for comparing interactions: 0.2580

The second criterion used for assessing the vigour of the suckers separated was their weight at seperation. The analysis of variance of the data (Appendix III) indicated that the treatments significantly differed from the control and influenced the weight of the suckers at seperation. The height of suckers at removal and the Height x Treatment interaction effects were also significant.

The data presented in Table 27 indicate that the treatments T_1 (Ascenso's method), T_4 (Barker's method without outer bark stripping) and T_3 (ethrel 400 ppm), which were statistically on par, were superior to the remaining treatments, having produced 3.2 kg, 3.1 kg and 3.1 kg suckers. Shallow planting (T_6) yielded significantly inferior (lighter) suckers. Between the two heights of sucker removal, H_2 (60 cm tall suckers removed) was significantly superior to H_1 (30 cm tall suckers removed). Among the treatment combinations, those involving H_2 (60 cm tall suckers removed) were better than those involving H_1 (30 cm tall suckers removed). The combinations H_2T_1 (Ascenso's method, 60 cm tall suckers removed) and H_2T_3 (ethrel 400 ppm, 60 cm tall

Table 28.- Girth of the pseudostem (cm) at the base of suckers under the different sucker enhancement treatments

Height of sucker removal	Treatments							
	T_1	T_2	T_3	T_4	T_5	T_6	T_7	Mean
	Ascenso's method	Barker's method	Ethrel 400 ppm	T_2-outer bark stripping	T_1-application of ammonium sulphate	Shallow planting	Package Recommendations with sucker removal	
H_1(30 cm)	9.7	8.0	13.0	9.0	8.3	8.3	8.7	9.3
H_2(60 cm)	41.6	30.5	32.5	33.9	32.0	29.8	32.8	33.4
Mean	25.7	19.2	22.7	21.1	20.5	19.1	20.7	21.3

Control (Package Recommendations) :Not available since desuckering was practiced

$CD_{.05}$ for comparing treatments : 1.1637

$CD_{.05}$ for comparing interactions : 1.6450

suckers removed) were the best and the second best.

Girth of the pseudostem at the collar was also used for assessing the vigour of the suckers. The ANOVA of the data (Appendix III) indicated that the sucker enhancement treatments significantly differed from the control and influenced the girth of the pseudostem. The height of the suckers at removal and the Height x Treatment interaction effects were also found to be significant.

The data presented in Table 28 indicated T_1 (Ascenso's method) which produced a pseudostem girth of the 25.7 cm to be significantly superior to the others. T_3 (ethrel 400 ppm) was found to be the second best, with 22.7 cm girth. Shallow planting (T_6) with a girth of 19.1 cm and Barker's method (T_2) with a girth of 19.2 cm were statistically on par and inferior to the others. Between the two heights of sucker removal, H_2 (60 cm tall suckers removed) which produced a girth of 33.4 cm was significantly superior to H_1 (30 cm tall suckers removed). Among the treatment combinations, those involving H_2 (60 cm tall suckers removed) were significantly superior to those involving H_1

Table 29.- Correlation coefficients between the characters studied in Robusta

	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}	X_{12}	X_{13}	X_{14}	X_{15}	X_{16}
X_1	1	0.90**	-0.15	-0.0006	-0.15	0.16	-0.26**	-0.63**	-0.08	-0.28**	-0.23*	0.02	-0.45**	-0.28**	-0.33**	-0.29**
X_2		1	0.06	0.22*	0.12	-0.01	-0.11	-0.54**	-0.17	0.08	-0.03	0.23*	-0.19*	-0.12	-0.11	-0.08
X_3			1	0.76**	0.60**	-0.92**	0.72**	0.13	-0.73**	0.82**	0.85**	0.58**	0.67**	0.74**	0.64**	0.78**
X_4				1	0.64**	-0.60**	0.72**	0.15	-0.47**	0.74**	0.75**	0.70**	0.65**	0.72**	0.61**	0.68**
X_5					1	-0.51**	0.61**	0.21*	-0.48**	0.62**	0.71**	0.67**	0.64**	0.64**	0.63**	0.54**
X_6						1	-0.62**	-0.05	0.94**	-0.75**	-0.80**	-0.45**	-0.57**	-0.65**	-0.49**	-0.70**
X_7							1	0.22*	-0.04	0.87**	0.04	0.76**	0.81**	0.86**	0.76**	0.84**
X_8								1	0.25**	0.10	0.06	0.11	0.33**	0.23*	0.33**	0.22**
X_9									1	-0.56**	-0.63**	-0.30**	-0.32**	-0.44**	-0.29**	-0.45**
X_{10}										1	0.97**	0.74**	0.87**	0.89**	0.78**	0.91**
X_{11}											1	0.74**	0.83**	0.83**	0.75**	0.89**
X_{12}												1	0.74**	0.79**	0.71**	0.76**
X_{13}													1	0.82**	0.81**	0.85**
X_{14}														1	0.79**	0.91**
X_{15}															1	0.78**
X_{16}																1

* Significant at 5% level of probability

** Significant at 1% level of probability

X_1 = Number of suckers
X_2 = Number of sword suckers
X_3 = Height of the mother plant at flowering
X_4 = Girth of the pseudostem at flowering
X_5 = Functional leaves borne by the mother plant at flowering
X_6 = Duration for flowering
X_7 = Duration for fruit set
X_8 = Duration for fruit maturity
X_9 = Total duration
X_{10} = Bunch weight
X_{11} = Per day yield
X_{12} = Number of hands per bunch
X_{13} = Number of fingers per hand
X_{14} = Length of finger
X_{15} = Girth of finger
X_{16} = Weight of finger

(30 cm tall suckers removed). The combination H_2T_1 (Ascenso's method, 60 cm tall suckers removed) which produced a pseudostem girth of 41.6 cm was the best. The combinations of H_2 (60 cm tall suckers removed) with T_2 (Barker's method) and T_6 (shallow planting) were statistically on par; but the poorest among those involving H_2.

4.2.6. Correlation studies

In order to assess the effect of the treatments on the productivity of the mother plants, simple correlations were worked out between the various parameters studied. The correlation coefficients have been presented in Table 29.

The total number of suckers did not show significant relationship with the three parameters of mother plant vigour, namely, the height of the pseudostem ($r = -0.15$), girth of the pseudostem ($r = -0.0006$) and the number of functional leaves present at the time flowering ($r = -0.15$). However, the number of sword suckers exhibited significant correlation ($r = 0.22^{*}$) with the girth of the pseudostem at flowering. The correlation between the total number of

suckers and the number of sword suckers was positive and highly significant ($r = 0.90^{**}$).

Association between the vigour of the plants and their productivity was examined through the correlations between the three indices of plant vigour (the height and girth of the pseudostem, and the number of functional leaves) on the one hand, and the flowering characters, the yield (bunch weight) and the yield components (number of hands, number of fingers per hand, length, girth and weight of the fingers) on the other. The matrix of 'r' values presented in Table 29 indicates that the height and girth of the pseudostem and the number of functional leaves at flowering exhibited highly significant and negative correlation ($r = -0.92^{**}$, -0.60^{**}, -0.51^{**}, respectively) with flowering duration and highly significant positive correlation ($r = 0.72^{**}$, 0.72^{**}, 0.61^{**}, respectively)with the duration of fruit set. With regard to the duration for fruit maturity, the number of functional leaves at flowering alone exhibited significant correlation ($r = 0.21^{*}$) The three indices exhibited negative and significant correlation with the total duration of the treatment plants

(r being, -0.73^{**}, -0.47^{**} and -0.48^{**}, respectively). Table 29 also indicates that the height and girth of the pseudostem and the number of functional leaves exhibited highly significant and positive correlation ($r = 0.82^{**}$, 0.74^{**}, 0.62^{**}, respectively) with the yield per se (bunch weight) and the components of yield (number of hands, number of fingers per hand; length, girth and weight of the fingers). With per day yield also, the three indices of plant vigour exhibited highly significant and positive correlations ($r = 0.85^{**}$, 0.75^{**}, 0.71^{**}, respectively).

Positive and highly significant correlations were obtained between the components of yield (number of hands, number of fingers, length, girth and weight of the fingers) and the yield per se (bunch weight), the 'r' values being 0.74^{**}, 0.87^{**}, 0.89^{**}, 0.78^{**} and 0.91^{**}, respectively. With per day yield, the corresponding values of the correlation coefficient were 0.74^{**}, 0.83^{**}, 0.83^{**}, 0.75^{**} and 0.89^{**}, respectively). The duration of flowering exhibited highly significant and negative correlation with the weight of the bunch ($r = -0.75^{**}$), while the duration of fruit set was positively correlated ($r = 0.87^{**}$). The

corresponding values with respect to per day yield were $r = -0.80^{**}$ and $r = 0.04$, respectively.

The number of suckers produced did not exhibit significant correlation with either the duration for flowering or the total duration; but was negatively and significantly correlated with the duration for fruit set ($r = -0.26^{**}$). Both the number of suckers and the number of sword suckers exhibited highly significant and negative correlation with the duration for fruit maturity ($r = -0.63^{**}$ and -0.54^{**}, respectively).

The data also indicate highly significant negative correlations between the sucker number on the one hand and the yield (bunch weight) and yield components of the mother plant (number, length, girth and weight of fingers) on the other ($r = -0.28^{**}$, -0.45^{**}, -0.28^{**}, -0.33^{**} and -0.29^{**}, respectively). The correlation between the number of suckers produced and the per day yield was also negative and significant ($r = -0.23^{*}$).

Among the other associations examined, the correlations between duration of flowering on the one hand and length, girth and weight of the fruits on the other were found to be negative and highly significant ($r = -0.65^{**}$,

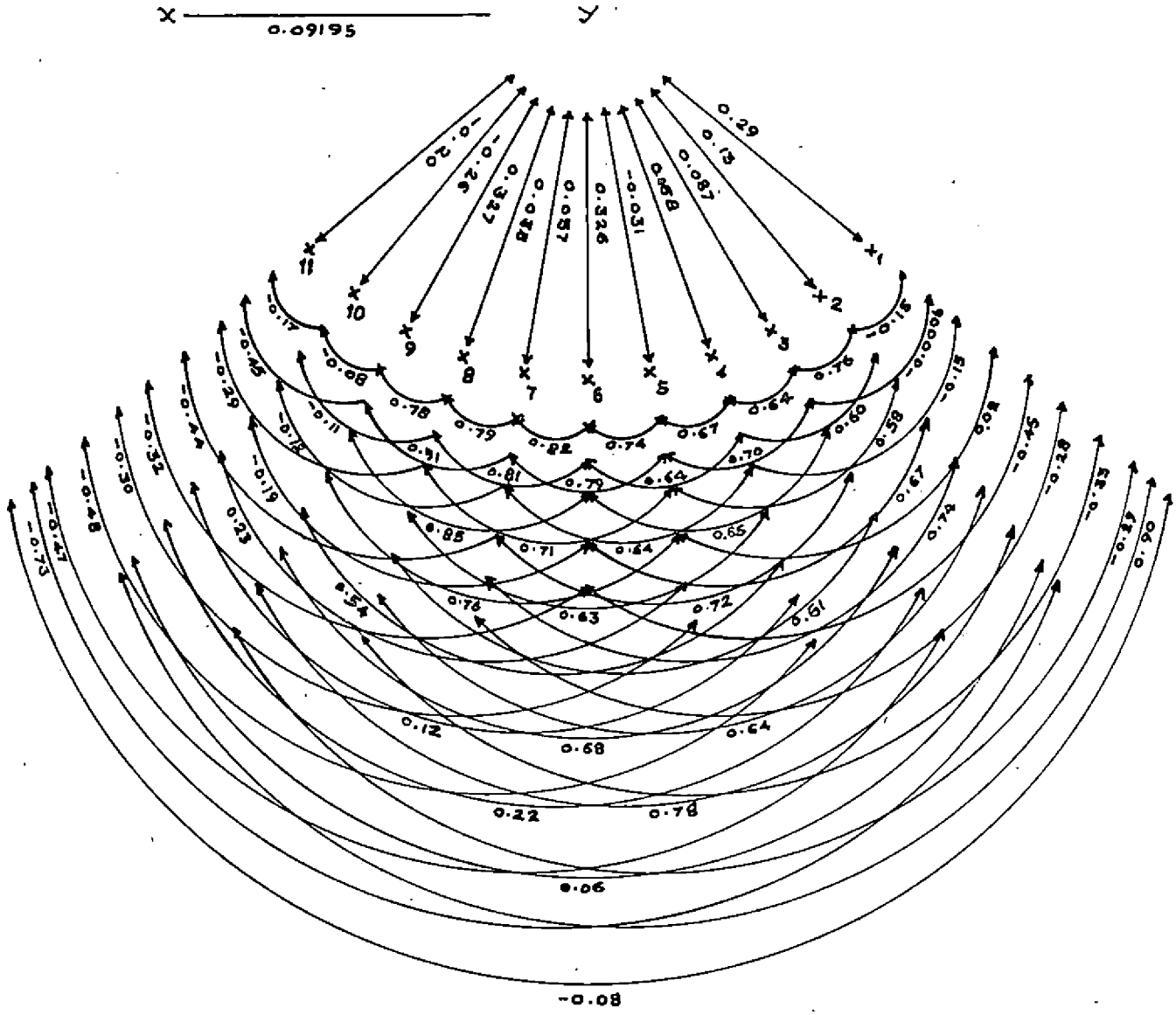
Table 30.- Direct and indirect path effects of component traits on per day yield in Robusta

	No. of suckers produced	No. of sword suckers produced	Total duration of the mother plant	Height of the mother plant at flowering	Girth of pseudo-stem at flower-ing	No. of functional leaves at flowering	No. of hands per bunch	No. of fingers per hand	Length of finger	Girth of finger	Weight of finger	Total corre-lation
No. of suckers produced	0.29	-0.23	0.017	-0.021	-0.000052	-0.0096	-0.00025	-0.15	-0.019	-0.012	-0.097	-0.23*
No. of sword suckers produced	0.26	-0.26	0.035	0.0086	0.020	0.0081	-0.0074	-0.062	-0.0068	-0.0038	-0.028	-0.036
Total dura-tion of the mother plant	-0.024	0.044	-0.20	-0.096	-0.041	-0.033	0.0094	-0.11	-0.025	-0.010	-0.15	-0.63**
Height of the mother plant at flowering	-0.046	-0.017	0.15	0.13	0.067	0.047	-0.018	0.22	0.041	0.023	0.25	0.85**
Girth of pseudostem at flowering	-0.00017	-0.059	0.096	0.100	0.087	0.048	-0.023	0.21	0.040	0.021	0.22	0.75**
No. of func-tional leaves at flowering	-0.041	-0.031	0.098	0.091	0.062	0.068	-0.023	0.23	0.038	0.023	0.20	0.71**
No. of hands per bunch	0.0024	-0.062	0.061	0.077	0.064	0.050	-0.031	0.25	0.043	0.026	0.26	0.74**
No. of fingers per hand	-0.13	0.049	0.065	0.088	0.057	0.047	-0.023	0.326	0.045	0.028	0.28	0.83**
Length of finger	-0.095	0.031	0.090	0.094	0.061	0.045	-0.023	0.26	0.057	0.023	0.29	0.83**
Girth of finger	-0.097	0.029	0.060	0.084	0.053	0.045	-0.023	0.27	0.038	0.035	0.26	0.75**
Weight of finger	-0.085	0.022	0.093	0.10	0.058	0.042	-0.024	0.28	0.050	0.027	0.327	0.89**

* Significant at 5% level of probability

** Significant at 1% level of probability

FIG. 27 PATH DIAGRAM SHOWING THE DIRECT AND INDIRECT PATH EFFECTS OF COMPONENT TRAITS ON PER DAY YIELD IN "ROBUSTA"



DIRECT EFFECTS. INTER CORRELATIONS. X - RESIDUAL EFFECTS.

Y - PER DAY YIELD. X_1 - NO: OF SUCKERS PRODUCED.

X_2 - HEIGHT OF THE MOTHER PLANT AT FLOWERING. X_3 GIRTH OF THE PSEUDOSTEM AT FLOWERING.

X_4 - NO: OF FUNCTIONAL LEAVES AT FLOWERING. X_5 - NO: OF HANDS PER BUNCH.

X_6 - NO: OF FINGERS PER HAND. X_7 - AVERAGE LENGTH OF AN INDIVIDUAL FINGER.

X_8 - AV: GIRTH OF AN INDIVIDUAL FINGER X_9 - AV: WEIGHT OF AN INDIVIDUAL FINGER.

X_{10} - NO: OF SWORD SUCKERS PRODUCED X_{11} - TOTAL DURATION OF THE MOTHER PLANT.

-0.49^{**}, -0.70^{**}, respectively). The data also revealed highly significant positive correlations between the number of fruits and the duration for fruit set ($r = 0.81^{**}$), between the length and the girth of fruit ($r = 0.79^{**}$), between the length and the weight of fruit ($r = 0.91^{**}$), between the girth and the weight of fruit ($r = 0.78^{**}$), and between the bunch weight and the per day yield ($r = 0.97^{**}$).

4.2.7. Direct/indirect effects of the factors on the yield

Path coefficient analysis was done to assess the direct and indirect effects of the number of suckers, the number of sword suckers, the total duration, the height at flowering, the girth of the pseudostem at flowering, the number of functional leaves at flowering, the number of hands per bunch, the number of fingers per hand, and the length, girth and weight of the fingers on the per day yield.

The 11 factors studied accounted for 90.81 per cent of the variation in per day yield (Table 30 and Fig.27). The average weight of fingers had the maximum direct effect (0.327) on the per day yield, followed by the number of fingers (0.326) and the number of suckers produced (0.29).

The number of sword suckers produced had a direct effect of -0.26. The total duration of the mother plant also exhibited a negative direct effect of -0.20 on the per day yield.

The number of suckers produced recorded a negative indirect effect of -0.23 on the per day yield through the number of sword suckers, followed by an indirect effect of -0.15 through the number of fingers per hand. The height of the pseudostem at flowering had an indirect effect of 0.25 through the weight of an individual finger and 0.22 through the number of fingers per hand. The girth of the pseudostem at flowering had an indirect effect of 0.22 through the weight of an individual finger and 0.21 through the number of fingers per hand. The number of functional leaves at flowering had an indirect effect of 0.23 and 0.20, through the number of fingers per hand and the weight of an individual finger, respectively. The number of hands per bunch had an indirect effect of 0.26 through the weight of an individual finger and 0.25 through the number of fingers per hand. The number of fingers per hand had an indirect effect of 0.28 through the weight of an individual finger.

The average length of an individual finger recorded indirect effects of 0.29 and 0.26 through the weight of an individual finger and the number of fingers per hand. The girth of an individual finger had indirect effects of 0.27 and 0.26 through the number of fingers per hand and the weight of an individual finger, respectively. The weight of an individual finger had an indirect effect of 0.28 through the number of fingers per hand.

Discussion

5. DISCUSSION

5.1 The banana growers persistently demand supply of large number of quality planting material, particularly when new cultivars are released for cultivation in their area. The source of planting material in banana is limited to its suckers. Owing to the differential performance of the two types of suckers (the sword suckers and the water suckers), cultivators in most of the banana growing tracts have been advised to raise their crop only from the sword suckers (Gregory, 1952; Oppenheimer and Gottreich, 1954; Nayar, 1962; Simmonds, 1966; Chattopadhyay et al., 1980). This restriction further limits the availability of quality planting material. More over, the sword suckers are reported to be poor in suckering (Kaikari and Amankwah, 1977), although they emerge early, give the largest leaf area and produce the most vigorous plants. Methods of rapid multiplication, such as the use of corm bits (Berril, 1960; Nayar, 1962; Simmonds, 1966), raising of nurseries (Wright, 1951), etc. are available; but their utility is limited to occasions when new genotypes and desirable mutants are isolated. Tissue culture methods, although demonstrated

to have potential in banana (Doreswamy, 1983; Jarret, et al., 1985), are yet to reach a commercial take-off stage.

5.2. Under the circumstances, several investigators have made attempts to increase sucker production, particularly in the shy-suckering varieties (Wright, 1951; Gregory, 1952; Barker, 1959; Osborne, 1963; Ascenso, 1967; Sathyanarayana et al., 1980; Ravichandran, 1983). Surprisingly, the effect of the sucker enhancement treatments on the performance of the mother plants has not been assessed in detail by these investigators, except Ravichandran (1983). Without such information, the methods can only have limited utility. It is in this context that the present investigations were made, not only to standardize methods for increasing sucker production; but also to examine their effects on the growth, flowering behaviour and productivity of the mother plants. The investigations consisted of two parts, the first, an assessment of the natural sucker production in seven of the important cultivars of the State and the second, efforts to standardise a method that would generate a large number of sword suckers without deleterious effects on the mother plants.

5.3. The seven cultivars chosen were evaluated in a RBD with three replications. Their flowering behaviour and productivity were assessed, besides their sucker production capability.

5.3.1 The seven cultivars exhibited wide variation in the total duration, ranging from 287.66 days for 'Robusta' to 494.99 days for 'Red Banana' (Table 1). The differences among the cultivars were statistically significant. The time taken from planting to flowering (vegetative phase) and from flowering to harvest (reproductive phase) were separately examined. In both the cases, 'Red Banana' (T_6) recorded longer duration as compared to the other cultivars (395.66 and 99.33 days, respectively). 'Robusta' (T_5) which flowered the earliest, took significantly more time (82.66 days) than 'Monthan' (T_7) which matured the fastest with 76.00 days. With respect to the duration for fruit set, 'Palayankodan' (T_1) recorded significantly longer duration (20.58 days) than the other cultivars. The cultivars 'Red Banana' (T_6) and 'Robusta' (T_5), which were statistically on par, recorded lesser duration (17.91 days, 16.75 days, respectively) than 'Palayankodan' (T_1). In 'Poovan' (T_4),

'Nhalipoovan' (T_2) and 'Nendran' (T_3), the fruit set was completed in a shorter spell of time (11 to 13 days).

5.3.2. The data presented in Table 2 revealed that 'Palayankodan' (T_1) and 'Robusta' (T_3) had the highest number of fingers per bunch (10.83 hands x 17.33 fingers per hand and 9.66 hands x 16.58 fingers per hand, respectively). Therefore, it can be logically assumed that these cultivars would take more number of days to complete the fruit set, as compared to the others. However, while 'Palayankodan' took the longest time justifying the above assumption, 'Robusta' took significantly lesser time than 'Palayankodan'. 'Red Banana' (T_6) which recorded the least number of hands per bunch (5.66 hands x 9.66 fingers per hand) can be expected to complete the fruit set faster. But the cultivar took the second longest duration (along with 'Robusta', T_5) for completing the fruit set (17.91 days). This can be explained as due to the varietal character. The possibility that a very long duration variety like 'Red Banana' has "genetic slowness" built in it cannot be ruled out.

5.3.3. In the analyses of yield and yield contributing characters, 'Robusta' (T_5) recorded the highest bunch weight

(of over 16 kg) and 'Nhalipoovan' (T_2), the lowest (8.26 kg) along with 'Nendran' (T_3) (9.34 kg). The remaining four cultivars which included 'Palayankodan' (T_1) and 'Red Banana' (T_3) recorded intermediate bunch weight. The analysis of characters contributing towards yield revealed that 'Robusta' (T_5) had significantly larger number of hands (9.66), except 'Palayankodan' (T_1, 10.83). With respect to the number of fingers per hand, 'Robusta' (T_5, 16.58) along with 'Palayankodan' (T_1, 17.33) and 'Nhalipoovan' (T_2, 15.33) topped the list. The 'Robusta' fruits were significantly longer (23.16 cm) than those of the other cultivars (Table 3). It is but natural under the circumstances, that 'Robusta' (T_5) produced the heaviest bunches. 'Palayankodan' (T_1), which along with 'Red Banana' (T_3), 'Poovan' (T_4), and 'Monthan' (T_7) produced the second heaviest bunches, (12.04 kg, 11.68 kg, 11.31 kg and 11.26 kg, respectively) recorded maximum number of hands ('Robusta' being statistically on par) and maximum number of fingers per hand. The small size of 'Palayankodan' (T_1) fruits in terms of their length (13.90 cm) and girth (12.85 cm) brought down the average weight of its bunches, in spite of the cultivar recording the maximum number of

fingers per bunch (10.83 hands x 17.33 fingers per hand). In the case of 'Red Banana' (T_5), which was among the cultivars which recorded the lowest number of hands and the lowest number of fingers per hand, the average size of the fruits was fairly large and the fruits weighed the heaviest (19.36 cm long with 15.13 cm girth and 163.3 g weight). These factors pushed up the average weight of the 'Red Banana' (T_6) bunches, although they had the minimum number of fingers (5.66 hands x 9.66 fingers per hand).

5.3.4. Since the cultivars exhibited wide variation with respect to the total duration, it was considered essential to examine their per day productivity in order to have a meaningful comparison. 'Robusta' (T_5) which produced the heaviest bunches (16.01 kg) within the shortest total duration (287.66 days) gave the per day yield of 55.73 g. which was significantly higher than that recorded by the other cultivars. 'Red Banana' (T_6) which produced 11.68 kg bunches (second heaviest along with those of 'Palayankodan' 'Poovan' and 'Monthan') recorded the lowest per day yield of 23.61 g, mainly because of its significantly longer duration (494.99 days). 'Palayankodan' (T_1), which recorded a per day yield

of 34.21 g and which was statistically on par with 'Poovan' (T_4, 31.75 g) and 'Monthan' (T_7, 33.91 g), produced not only the second heaviest bunch; but also recorded the largest number of fingers (10.83 hands x 17.33 fingers per hand) and intermediate duration.

5.3.5. The various aspects of natural sucker production by the cultivars were also investigated upon. As has been pointed out by Osborne (1963), the rate of sucker production and the total number of suckers produced are of significance in determining the commercial acceptability of any banana clone. The number of suckers produced by 'Nhalipoovan' (T_2) was significantly higher (12.40) than that by the other cultivars. Among the suckers produced by 'Nhalipoovan' (T_2), a high proportion (10.64 out of 12.40) was sword suckers (Table 4). Although the cultivar produced significantly higher number of water suckers than the others, the Sucker Production Index (which was computed to get the overall rating of the cultivars with respect to their ability to produce commercially acceptable suckers) was significantly higher (91.28) in 'Nhalipoovan' than in the other cultivars (14.48 in 'Monthan' to 37.23 in 'Palayankodan'). In the case of 'Red Banana' (T_6),

which produced a high proportion of sword suckers (87.01 per cent) and a fairly high Sucker Ratio (7.77), a rather low Sucker Production Index of 28.11 was recorded, because of the lowest number of suckers it produced.

5.3.6. According to Osborne (1963), the suckering qualities of the banana clones are important in arriving at the system of management that is adopted. Simmonds (1966) reported that although differences exist between the clones in their capacity to produce suckers, data on natural sucker production by the different clones are lacking. It is thus imperative that any attempt to standardise sucker enhancement treatments be preceeded by an assessment of the natural sucker production by the clones included. The studies conducted by Balakrishnan (1980), Ravichandran (1983) and others, have generated data on these aspects with reference to some clones of importance. Genome-wise, the seven cultivars included in the present studies were hybrid derivatives, except 'Robusta' and 'Red Banana' which were acuminata derivatives. Ploidy-wise, the seven clones compared were triploids (AAA, AAB and ABB), except the diploid 'Nhalipoovan' (AB). The two acuminata derivatives exhibited poor suckering

ability (4.59 and 3.70 suckers per mat) as compared to the hybrid derivatives (4.49 to 12.40 suckers per mat). More number of suckers in the balbisiana derivatives and less number in the derivatives of acuminata has been recorded (Venkataramani, 1946; Simmonds, 1962; Chakrabarty, 1977). On the contrary, Alagiamanavalan (1979) obtained profuse suckering in acuminata cultivars. Balakrishnan (1980) reported that pure acuminata cultivars (AA, AAA genomes) produced comparatively more number of suckers than the hybrid derivatives, although 'Monthan' (ABB) produced more suckers than 'Robusta' (AAA). This investigator obtained higher suckering in the hybrid cultivars (an average of 6.54 suckers per plant in the five hybrid cultivars against an average of 4.14 suckers in the two acuminata cultivars), as observed by Balakrishnan (1980). Besides recording findings of similar nature, Ravichandran (1983) observed that as the proportion of 'B' genome increased, there was a proportionate increase in the production of water suckers. In the present studies also, the five cultivars with 'B' genome (AB, AAB, ABB) recorded an average of 1.16 water sucker per plant as against 0.44 water sucker per plant recorded by the two 'AAA' cultivars.

It has been reported that suckering ability and ploidy of the clones hold negetive relationship (Gregory, 1954; Balakrishnan, 1980). In the present studies, the diploid 'Nhalipoovan' produced 12.40 suckers per plant as against an average of 4.76 suckers per plant in the six triploids, confirming the above observation.

5.3.7. The present investigations also assessed the vigour of the suckers produced by the seven cultivars in terms of the height and the number of leaves the suckers had at the harvest of the mother plant. The suckers produced by 'Red Banana' (T_6) were significantly taller (111.56 cm) than those of the other cultivars. 'Palayankodan' (T_1) and 'Nhalipoovan' (T_2) produced the second tallest suckers (101.76 cm and 101.33 cm, respectively). The suckers produced by 'Nhalipoovan' (T_2) had significantly more number of leaves (5.98) than those of the other cultivars. 'Robusta' (T_5) and 'Palayankodan' (T_1) were statistically on par in this respect, having produced suckers with 4.98 and 4.95 leaves. In terms of the two parameters, the suckers produced by 'Nhalipoovan' (T_2), 'Robusta' (T_5) and 'Palayankodan' (T_1) seemed more vigorous than those produced by the other cultivars.

5.4. The second part of the study aimed at standardising a treatment or a treatment combination that would increase the production of quality suckers in 'Robusta' (T_5), one of the cultivars which usually produce a significantly lower number of suckers (4.59 as against 12.40 by 'Nhalipoovan' in the present studies). A treatment/treatment combination that would increase the sucker production and exhibit least deleterious effects on the growth, flowering and productivity of the mother plants was sought for.

5.4.1. The growth and vigour of the mother plants, as influenced by the treatments, were assessed in terms of the height, girth and number of functional leaves at flowering (Tables 6 to 8). Ascenso's method (T_1) produced the tallest (252.6 cm) and thickest (55.3 cm) plants with the largest number of leaves (13.4), whereas ethrel 400 ppm (T_3) yielded the shortest (178.0 cm) and thinnest (48.9 cm) plants with the least number of leaves (8.8). In his comparative evaluation of the different treatments, Ravichandran (1983) also obtained vigorous plants on subjecting them to Ascenso's method. Further, he observed that ethrel-treated plants recorded reduced plant vigour. The two sets of sucker removal

treatments (removal of 30 cm tall and 60 cm tall suckers) did not significantly influence the growth of the mother plants. The Height x Treatment interactions, however, exhibited highly significant influence on the vigour of the mother plants. Ascenso's method at both the sucker removal treatments (H_1T_1 and H_2T_1) was clearly the best treatment. Between the two sucker removal treatments, removal of 30 cm tall suckers produced under Ascenso's method was the best, except with respect to the number of functional leaves in which case, the combinations H_1T_1 and H_2T_1 were statistically on par (13.7 and 13.1 leaves, respectively). The combinations involving application of ethrel 400 ppm and the two sucker removal treatments (H_1T_3 and H_2T_3) were significantly inferior to the rest of the combinations.

5.4.2. The flowering behaviour of the mother plants was assessed (Tables 9 to 11) in terms of the duration for flowering (planting to shooting), the duration for fruit set (setting of the first hand to the setting of the last hand) and the duration for maturation of the bunches (duration from shooting till harvest). Ascenso's method (T_1) induced

the mother plants to flower significantly earlier (190 days) than the other treatments (213.5 days to 236 days). Barker's method (T_2) and spraying of ethrel 400 ppm (T_3) induced the plants to flower late (225 days and 236 days, respectively). Tendency of ethrel treated plants to exhibit delayed flowering has been observed earlier by several workers (Anbazhagan, 1978; Annadurai and Shanmugavelu, 1978; Ravichandran, 1983). With respect to the duration for fruit set, which mainly depends on the number of hands produced, Ascenso's method (T_1) exhibited the longest duration (16 days). An examination of the data on total number of fingers per bunch would reveal that the plants subjected to Ascenso's treatment (T_1) had significantly more number of fingers per bunch (8.5 hands x 16.8 finger per hand) than those of the other treatments. Such bunches would take more time to complete the fruit set than the bunches with less number of fruits. Another significant observation is the behaviour of the ethrel treated (T_3) plants which flowered late (236 days); but completed the fruit set in a comparatively shorter time (9.7 days). The ethrel treated plants had the least number of fingers per bunch (5.6 hands x 12.1 fingers per hand) and as such,

can be expected to complete the fruit set faster. With respect to the duration from shooting till harvest, the ethrel treated plants (T_3) and the plants subjected to Ascenso's treatment (T_1) were the best and the second best in terms of earliness (79.5 days and 83.4 days, respectively). The plants subjected to Barker's treatment without stripping of the outer leaf sheaths (T_4) took significantly longer time (90.6 days) to come to harvest. Ravichandran (1983) also found Ascenso's method to induce faster maturity of the bunches. Data on the total duration (duration from planting till harvest) presented in Table 12 clearly indicated the superiority of Ascenso's method (T_1) which, incidentely, was the second best with respect to the duration for fruit maturity (the best with respect to the duration for fruit maturity being ethrel 400 ppm). The ethrel treated plants (T_3) took significantly longer time (315.5 days). Delay in flowering has been found associated with ethrel application (Anbazhagan, 1978; Annadurai and Shanmughavelu, 1978; Ravichandran, 1983) and such delay is bound to reflect on the total duration also.

The plants maintained under the Package of Practice

recommendations; but with sucker removal (T_7) were intermediate with respect to the four parameters analysed to study the flowering behaviour of the treatment plants.

5.4.3. The most important objective of the study was to identify a treatment or treatment combination that would not only enhance sucker production; but also would cause the least possible damage to the mother plant receiving the treatments. To assess the ability of the treatments to increase sucker production, the total number of suckers induced, the number and proportion of sword suckers and water suckers, and the overall ability to produce commercially acceptable suckers (Sucker Production Index) were evaluated (Tables 20 to 25). With respect to the total number of suckers induced, T_3 (ethrel 400 ppm) was the best treatment, having produced 15.6 suckers per mat. Ascenso's method (T_1) and Ascenso's method without the application of ammonium sulphate (T_5) were the second and the third best treatments, having induced 13.6 and 11.6 suckers per mat, respectively. Plants set shallow (T_6) and those subjected to Barker's treatment without outer bark stripping (T_4) were significantly the inferior treat-

ments. Ravichandran (1983) who compared several sucker enhancement treatments found that ethrel 400 ppm was better than the other treatments with respect to the total number of suckers induced. In his studies, ethrel 400 ppm gave 19.7 suckers per mat while Ascenso's method gave a mean multiplication rate of only 16.9:1. The results of the present investigations and those of Ravichandran (1983) are in agreement, although the actual number of suckers produced showed variation between the locations. These variations can be ascribed as due to the agro-climatic differences.

Production of sword suckers is the most important aspect. Ascenso's method (T_1) and ethrel 400 ppm (T_3) were the best (13.1 and 12.6, respectively) in this respect. Barker's method (T_2) was one among the three treatments which were significantly inferior to the other treatments, except shallow planting (T_6). Shallow planting (T_6) produced significantly lower number of sword suckers (3.8) than all the other treatments. Ascenso's method (T_1) produced the least number (0.5 per plant) of water suckers per plant. Ethrel 400 ppm (T_3) was found to be the worst treatment, having produced 3.0 water suckers per plant.

The data on the percentage of sword suckers also indicated the superiority of Ascenso's method (T_1) (96.4). Ethrel 400 ppm (T_3), which was one of the best two treatments with respect to the production of sword suckers, recorded the lowest percentage of sword suckers (80.7) since it produced maximum number of water suckers (3.0). Shallow planting (T_6) which produced significantly lower number of sword suckers recorded the second lowest percentage (84.8) of sword suckers. In order to have an overall rating of the treatments with respect to production of commercially acceptable suckers (sword suckers), the Sucker Ratio (sword suckers/water suckers) and the Sucker Production Index (total number of suckers produced x Sucker Ratio) were computed. In both the cases, Ascenso's method (T_1) with a Sucker Ratio of 34.2 and a Sucker Production Index of 454.2 was found to be the best. Ascenso's method without the application of ammonium sulphate (T_5) was the second best treatment, having recorded a Sucker Ratio of 23.8 and a Sucker Production Index of 285.3. Ethrel 400 ppm (T_3) was significantly inferior, having recorded a Sucker Ratio of 4.3 and a Sucker Production Index of 68.7. Considering

the sucker inducing ability and the ability to yield maximum number of commercially acceptable suckers, Ascenso's method can be rated as the best. The method was the second best with respect to the total number of suckers; but the best with respect to the production of sword suckers, the Sucker Ratio and the Sucker Production Index. Ethrel 400 ppm, although was the best with respect to number of suckers produced, is not acceptable since the production of water suckers was high which brought down the Sucker Production Index. Ravichandran (1983) also found ethrel to stimulate the production of water suckers.

The height of the suckers at removal significantly influenced ($P \leq 0.05$) the percentage of sword suckers and the Sucker Ratio. With respect to the other criteria, the differences due to the height of the suckers at removal were not statistically significant.

Among the treatment combinations, H_1T_3 (ethrel 400 ppm with removal of 30 cm tall suckers) produced significantly more number of suckers (16.3), followed by H_2T_3 (ethrel 400 ppm with removal of 60 cm tall suckers) and H_1T_1 (Ascenso's

method with removal of 30 cm tall suckers) with 14.8 and 14.6 suckers per plant, respectively. However, when production of sword suckers was considered, the combination H_1T_1 (Ascenso's method with sucker removal at a height of 30 cm) was the best (13.8 sword suckers out of 14.6). The combination H_2T_1 (Ascenso's method with sucker removal at a height of 60 cm) was one of the four which ranked second in terms of sword suckers produced (12.5 sword suckers out of 12.7). In this respect also, the combinations involving T_7 (Package of Practice recommendations but with sucker removal) proved to be inferior. Ethrel treatment (T_3) in combination with sucker removal either at 30 cm height or 60 cm height (H_1T_3 and H_2T_3, respectively) produced significantly larger number of water suckers (2.8 and 3.1 respectively), thus indicating the inferiority of ethrel treatment.

In order to obtain the overall picture regarding the production of suckers by the plants subjected to the different treatment combinations, the percentage of sword suckers to the total number of suckers produced, the Sucker Ratio (number of sword suckers/number of water suckers) and the Sucker Produc-

tion Index (total number of suckers x Sucker Ratio) were computed. With respect to the first two, the influence of the height of the suckers at removal was significant. Eight of the 14 treatment combinations recorded over 90 per cent sword suckers. Among these combinations, H_2T_1 (Ascenso's method with removal of 60 cm tall suckers) and H_1T_5(Ascenso's method without ammonium sulphate application, removal of 30 cm tall suckers), which were statistically on par, recorded the highest values (98.08 per cent and 96.94 per cent, respectively). The percentage of sword suckers produced indicates only the proportion of sword suckers in the total suckers produced, whether the total number is nine as in the case of H_2T_6 (shallow planting, removal of 60 cm tall suckers) or 16.37 as in the case of H_1T_3 (ethrel 400 ppm, removal of 30 cm tall suckers). As such, this criterion did not lead the investigator to a meaningful conclusion. The Sucker Ratio indicated the number of sword suckers against the number of water suckers. The statistical analysis indicated that in respect of this criterion also, the difference due to the height of the suckers at removal were significant ($P \leq 0.05$). The analysis further revealed

method without the application of ammonium sulphate, removal of 60 cm tall suckers). The exercise indicated that computation of Sucker Production Index can be useful in making an overall comparison of the different treatments or treatment combinations, with respect to the production of commercially acceptable suckers. It is interesting that with respect to these criteria. Ascenso's method with or without the application of ammonium sulphate, with removal of 30 cm or 60 cam tall suckers performed the best.

5.4.4. The vigour of the suckers removed periodically from the treatment plants was assessed in terms of the number of leaves and the weight of the suckers. With respect to the number of leaves, all the treatments except shallow planting (T_6) were statistically on par. This criterion, thus, could not effectively unravel the treatment effects. The weight of the suckers exhibited larger variation from 1.7 kg in T_6 (shallow planting) to 3.2 kg in T_1 (Ascenso's method). Ascenso's method (T_1), Barker's method without stripping the outer leaf sheaths (T_4) and ethrel 400 ppm (T_3) were statistically on par and the best treatments.

tion Index (total number of suckers x Sucker Ratio) were computed. With respect to the first two, the influence of the height of the suckers at removal was significant. Eight of the 14 treatment combinations recorded over 90 per cent sword suckers. Among these combinations, H_2T_1 (Ascenso's method with removal of 60 cm tall suckers) and H_1T_5 (Ascenso's method without ammonium sulphate application, removal of 30 cm tall suckers), which were statistically on par, recorded the highest values (98.08 per cent and 96.94 per cent, respectively). The percentage of sword suckers produced indicates only the proportion of sword suckers in the total suckers produced, whether the total number is nine as in the case of H_2T_6 (shallow planting, removal of 60 cm tall suckers) or 16.37 as in the case of H_1T_3 (ethrel 400 ppm, removal of 30 cm tall suckers). As such, this criterion did not lead the investigator to a meaningful conclusion. The Sucker Ratio indicated the number of sword suckers against the number of water suckers. The statistical analysis indicated that in respect of this criterion also, the difference due to the height of the suckers at removal were significant ($P \leq 0.05$). The analysis further revealed

that the arrays of treatment combinations were exactly the same in both the instances (percentage of sword suckers and the Sucker Ratio). In the case of Sucker Ratio, the combinations H_2T_1 (Ascenso's method with removal of 60 cm tall suckers) and H_1T_5 (Ascenso's method without ammonium sulphate application, removal of 30 cm tall suckers) were the best and the second best, having recorded ratios of 50.0 and 35.7, respectively and having significantly differed from the rest of the treatment combinations.

Since the percentage of sword suckers and the Sucker Ratio did not enable meaningful evaluation of the treatment combinations, the Sucker Production Indices (total number of suckers x Sucker Ratio) were computed. Statistical analysis of the data indicated the combinations H_2T_1 (Ascenso's method with removal of 60 cm tall suckers) and H_1T_5(Ascenso's method without the application of ammonium sulphate, removal of 30 cm tall suckers) to be the best and the second best, having recorded indices of 637.7 and 437.9, respectively. The least beneficial treatment combinations recorded Sucker Production Indices ranging from 30.7 in H_2T_6 (Shallow planting with removal of 60 cm tall suckers) to 132.8 in H_2T_5 (Ascenso's

method without the application of ammonium sulphate, removal of 60 cm tall suckers). The exercise indicated that computation of Sucker Production Index can be useful in making an overall comparison of the different treatments or treatment combinations, with respect to the production of commercially acceptable suckers. It is interesting that with respect to these criteria. Ascenso's method with or without the application of ammonium sulphate, with removal of 30 cm or 60 cam tall suckers performed the best.

5.4.4. The vigour of the suckers removed periodically from the treatment plants was assessed in terms of the number of leaves and the weight of the suckers. With respect to the number of leaves, all the treatments except shallow planting (T_6) were statistically on par. This criterion, thus, could not effectively unravel the treatment effects. The weight of the suckers exhibited larger variation from 1.7 kg in T_6 (shallow planting) to 3.2 kg in T_1 (Ascenso's method). Ascenso's method (T_1), Barker's method without stripping the outer leaf sheaths (T_4) and ethrel 400 ppm (T_3) were statistically on par and the best treatments.

The influence of the height of the suckers at removal on the weight of the suckers was statistically significant ($P \leq 0.1$). Removal of suckers at 60 cm height was found to be better than their removal at 30 cm height, with respect to the weight of the suckers. The strong positive correlation between the height of suckers at removal and their weight can normally be expected.

With respect to the combinations involving the seven treatments and the two heights of sucker removal also, the data on the number of leaves per sucker did not yield useful information. However, the data on the weight of the suckers at removal indicated Ascenso's method (T_1) to be the best when 60 cm tall suckers were removed ($H_2T_1 = 4.7$ kg).

The significant interaction between the height of the suckers at removal and the treatments has brought all the treatment combinations involving H_1 in the lower part of the array, as can be expected.

Observations on the number of leaves and the weight of the suckers at sucker removal indicate only the temporary advantage the suckers may have. Further studies are required to assess the growth, flowering behaviour and productivity of

the suckers separated at 30 cm and 60 cm heights. As the 30 cm tall suckers are bound to be weaker than the 60 cm tall ones, they may have to be upgraded (Ndubizu and Obiefuna, 1982) before being planted out. Comparative evaluation of 30 cm tall (upgraded) suckers, 60 cm tall suckers and three-to four-month old suckers (now recommended) is another study required.

5.4.5. The seven treatments, although intended as sucker enhancement treatments, were evaluated with respect to their effect on the bunch characters of the mother plants. The number of hands per bunch, the number of fingers per hand as well as the length, girth and weight of the fingers were the yield contributing characters assessed (Tables 15 to 19). With respect to these yield contributing characters, Ascenso's method (T_1) exhibited highly significant and beneficial effects. The plants under Ascenso's treatment (T_1) were uniformly the best, with respect to the average bunch weight and the per day yield also (18.4 kg, and 67.3 g, respectively). Ethrel treatment (T_3) and shallow planting (T_6) were the significantly poor treatments with respect to the bunch weight and the per day yield (Tables 13 and 14).

While the treatments exhibited highly significant influence on all the bunch characters, the height of the suckers at removal exhibited significant effects only with respect to the yield (bunch weight) and the per day yield. In both the cases, removal of 30 cm tall suckers was significantly better than removal of 60 cm tall suckers. Wright (1951) had reported that removal of very small suckers (peepers) increased the yield of suckers in 'Lacatan' banana. Gregory (1952) also obtained higher yields of planting material on removal of peepers. De Langhe (1961) had advocated periodical harvesting of 20 cm to 30 cm tall suckers, mainly because of the increased yield of suckers. However, the effect of removal of peepers/young suckers on the productivity of the mother plants has not been studied by these workers.

In the analysis of Height x Treatment interaction effects, the treatment combinations H_1T_1 and H_2T_1 (Ascenso's method with sucker removal at 30 cm and 60 cm) proved uniformly the best two. The superiority of Ascenso's method (T_1) with respect to the yield contributing characters, the bunch weight and the per day yield, and the fact that H_1 was

significantly better than H_2 at least with respect to the bunch weight and the per day yield, justify the treatment combination H_1T_1 being the best. Among the poor combinations were those involving shallow planting (T_6) and ethrel spraying (T_3) on the one hand and removal of 60 cm tall suckers (H_2) on the other. With respect to the finger characters (length, girth and weight of the fingers), weight of the bunch and the per day yield, the combinations H_2T_3 and H_2T_6 were significantly inferior to the other combinations. The comparison of the different treatments made earlier indicated the treatments T_3 and T_6 (ethrel 400 ppm and shallow planting) to be uniformly poor with respect to the yield contributing characters, the bunch weight and the per day yield. Further, it may be recalled that between the two heights of sucker removal, removal of 60 cm tall suckers was significantly inferior to removing them at 30 cm height (except for the weight of the suckers). As such, the combinations involving the treatments T_3 (ethrel 400 ppm) and T_6 (shallow planting) with the height of sucker removal H_2 (60 cm) can be expected to show poor performance.

5.5. In order to assess the effect of the treatments on the productivity of the mother plants, simple correlations were worked out between the various parameters studied (Table 29). The total number of suckers did not exhibit significant relationship with the vigour of the mother plants, the duration for their flowering and their total duration. With the duration for fruit set, the total number of suckers exhibited significant negative correlation. The total number of suckers and the number of sword suckers exhibited significant negative correlation with the duration for fruit maturity. The data also indicated significant negative correlations between the sucker number on the one hand and the yield (bunch weight), the per day yield and the yield components on the other.

A study of simple correlations may not acurately reveal the causal scheme of relationships. Path co-efficient analysis (Wright, 1923) was, therefore, carried out to unravel the causal schemes of relationships. The efficiency of the path analysis can be judged from the fact that the eleven parameters studied accounted for 90.81 per cent of variation in per day yield.

It is interesting that the number of suckers produced had a positive direct effect of 0.29, even though the correlation analysis indicated significant negative correlation with the per day yield. The weight of finger had the maximum direct effect (0.327), followed by the number of fingers per hand (0.326). The number of suckers produced recorded a negative indirect effect of -0.23 on the per day yield through the number of sword suckers. It can, therefore, be deduced that the sucker enhancement treatments may not lower the per day yield, provided they do not affect the average weight of finger and the number of fingers per hand. These criteria are to be specifically assessed before a sucker enhancement treatment is declared as useful.

5.6. The investigations have clearly indicated that Ascenso's method with sucker removal at 30 cm height can bring about enhanced production of sword suckers and give economic yields in 'Robusta'. As the method involves only earthing up and application of additional nitrogen (720 g ammonium sulphate per plant per year in four equal dressings), the cost per

sucker produced is not likely to be high. Detailed economic analysis is warranted with respect to the cost of sucker production *per se*, the cost of upgradation of the suckers removed, the likely effect on the income of the farmers (from the sale of the suckers and bunches), etc. The applicability of the method to the other shy-suckering cultivars also require studies.

Summary

6. SUMMARY

6.1. Studies were carried out at the College of Agriculture, Vellayani during 1983-85 to assess the natural sucker production in seven of the important cultivars of the State and to standardise a method that would generate a large number of sword suckers (in 'Robusta') without deleterious effects on the mother plants.

6.2. 'Nhalipoovan' produced significantly more number of suckers (12.40 per mat against 3.70 to 5.94) than the other cultivars ('Palayankodan', 'Nendran', 'Poovan', 'Robusta', 'Red Banana' and 'Monthan'). The Sucker Production Index (which was computed to obtain the overall rating of the cultivars with respect to their ability to produce commercially acceptable suckers) was significantly high in 'Nhalipoovan' (91.28) than in the other cultivars (14.48 to 37.23).

6.3. The studies indicated that computation of Sucker Production Index (number of suckers produced x number of sword suckers/number of water suckers) is useful in making an overall comparison of the different cultivars or the different treatments/treatment combinations with respect to their ability to produce commerciably acceptable (sword) suckers.

6.4. An attempt was made to standardise a treatment that would increase the production of quality suckers in 'Robusta', one of the cultivars which produced a significantly low number of suckers (4.59 against 12.40 by 'Nhalipoovan') in the present studies. A treatment/treatment combination that would not only increase the sucker production; but also exhibit least deleterious effects on the growth, flowering and yield of the mother plants was sought for.

6.5. Ethrel 400 ppm produced the maximum number of suckers (15.6 per mat); but the treatment exhibited harmful effects on the mother plant such as delaying the flowering, increasing the total duration, affecting the yield and yield components (bunch weight, per day yield, number of fingers and weight of fingers), besides producing significantly large number of water suckers to lower the Sucker Production Index. Ascenso's method recorded the second largest number of suckers, the largest number of sword suckers and the highest Sucker Production Index (13.6, 13.1, 454.2, respectively).

Of the two sucker removal treatments, removal of the suckers at 30 cm height was found to be better than sucker removal at 60 cm height.

Among the treatment combinations, Ascenso's method at both the sucker removal treatments (H_1T_1 and H_2T_1) was clearly the best in terms of quality and quantity of sucker produced.

6.6. With respect to growth, flowering and yield of the mother plants, Ascenso's method and its combinations with the two heights of sucker removal, exhibited beneficial influence.

6.7. Ascenso's method combined with removal of 30 cm tall suckers (H_1T_1) produced the tallest and thickest plants (257.9 cm, 57.1 cm, respectively) with the largest number of leaves (13.7). Such plants exhibited the earliest shooting and fairly shorter period for the maturity of the bunches. With respect to the yield and yield components, the combination recorded the maximum number of fingers, the largest fingers, the heaviest bunches and the maximum per day yield. The combination H_2T_1 (Ascenso's method with removal of 60 cm tall suckers) ranked the second best.

6.8. In the correlation analysis, significant negative correlations were observed between the sucker number on the one hand and the yield (bunch weight), the per day yield and the yield components on the other.

6.9. The path analysis indicated that the weight of the fingers (which recorded the maximum direct effect 0.327) and the number of fingers per hand (which recorded the second maximum direct effect of 0.326) are to be specifically assessed before a sucker enhancement treatment is declared as useful.

6.10. Detailed economic analyses are warrented with respect to the cost of production of suckers by Ascenso's method, the cost of upgradation of the 30 cm tall suckers after their removal from the parental mat and the likely reduction/increase in income of the farmers.

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Appendices

APPENDIX I

Weather data* during the period of the experiments

Month	Temperature (°C)				Relative humidity(%)			Rainfall (mm)
	Maximum		Minimum					
	Maximum	Average	Minimum	Average	0830 IST	1730 IST	Average	
October 1984	32.3	29.8	20.1	22.9	83	76	79.5	205.1
November 1984	33.1	30.8	22.1	23.3	86	78	82.0	71.8
December 1984	33.8	31.8	19.5	22.1	72	66	69.0	2.7
January 1985	33.7	31.6	21.0	22.6	80	67	73.5	91.7
February 1985	34.9	32.2	20.8	23.3	81	67	74.0	40.2
March 1985	37.1	33.4	22.6	24.9	77	66	71.5	13.6
April 1985	35.3	33.5	23.5	25.4	78	71	74.5	87.4
May 1985	35.3	32.2	22.4	24.9	83	79	81.0	223.3
June 1985	31.0	28.7	21.4	22.8	93	85	89.0	424.3
July 1985	31.0	29.8	21.4	22.9	88	77	82.5	82.5
August 1985	31.7	30.1	21.4	23.3	86	76	81.0	61.8
September '85	33.1	30.9	21.9	23.6	84	74	79.0	96.8
October 1985	31.8	30.4	21.8	23.6	87	77	82.0	162.7
November 1985	32.6	30.1	20.1	22.7	83	75	79.0	170.4
December 1985	34.7	31.7	21.1	22.9	76	68	72.0	39.5
January 1986	31.4	32.3	20.6	22.8	73	63	68.0	2.2
February 1986	33.2	32.2	21.0	22.6	76	62	69.0	28.8
March 1986	35.5	33.3	21.9	24.2	76	67	71.5	12.1

* Source: The Director, Meteorological Centre, Observatory Hills, Trivandrum.

APPENDIX II

Evaluation of the seven cultivars
ANOVA (abstract)

(Mean Sum of Squares)

Characters	Replication (df=2)	Treatment (df=6)	Error (df=12)
1. Duration of flowering	18.50	10109.06**	64.46
2. Duration for fruit set	1.19	34.97**	1.46
3. Duration for fruit maturity	7.80	239.23**	5.10
4. Total duration	13.00	12702.96**	67.91
5. Weight of bunch	0.01	17.93**	0.42
6. Per day yield	0.19	377.31**	5.12
7. Number of heads per bunch	0.10	12.66**	0.57
8. Number of fingers per hand	1.71	28.67**	1.46
9. Average length of finger	1.04	48.13**	0.31
10. Average girth of finger	0.77	7.05**	0.16
11. Average weight of finger	28.85	5963.54**	6.17
12. Number of suckers produced	0.68	27.07**	0.34
13. Number of sword suckers produced	0.64	21.08**	0.34
14. % of sword suckers produced	2.42	33.73	51.88
15. Number of water suckers produced	0.14	0.60**	0.10
16. Sucker Ratio	17.16	12.83	10.38
17. Sucker Production Index	620.01	1883.92**	422.67
18. Height of suckers	9.00	793.30**	15.12
19. Number of leaves produced by suckers	0.067	1.65**	0.10

** Significant at 1% level of probability

APPENDIX III

Evaluation of the sucker enhancement treatments
ANOVA (abstract)

(Mean Sum of Squares)

Character	Replication (df=1)	Height (df=1)	Treatment (df=6)	Treatment Vs Control (df=1)	Height Vs Treatment (df=6)	Error (df=14)
1. Height of mother plant	44.50	7.12^{NS}	1593.68**	1219.75**	838.89**	18.72
2. Girth of pseudostem at flowering	0.054	1.10^{NS}	13.42**	6.21^{NS}	12.06**	2.32
3. Number of functional leaves at flowering	0.18	0.10^{NS}	4.45**	3.85**	3.77**	0.15
4. Duration of flowering	16.12	9.12^{NS}	475.45**	651.75**	324.64**	4.99
5. Total duration	29.00	665.5**	754.79**	164.75**	22.41**	3.14
6. Duration for fruit set	0.91	0.080^{NS}	9.48**	39.62**	11.033**	0.14
7. Duration for fruit maturity	1.31	0.37^{NS}	41.87**	41.32**	32.84**	1.53
8. Weight of bunch	0.0024	0.80*	36.99**	202.34**	23.20**	0.16
9. Per day yield	0.56	21.93**	569.50**	2409.48**	366.56**	1.60
10. Number of hands per bunch	0.25	0.035^{NS}	3.25**	5.71**	2.26**	0.06
11. Number of fingers per hand	0.16	0.27^{NS}	6.54**	64.62**	5.37**	0.23
12. Average length of finger	1.54	0.46^{NS}	10.72**	39.78**	5.05**	0.24
13. Average girth of finger	0.00	0.29^{NS}	1.37**	10.30**	0.55**	0.12
14. Average weight of finger	2.87	2.00^{NS}	95.58**	523.43**	92.48**	1.17

APPENDIX III (Contd.)

(Mean Sum of Squares)

Character	Replication (df=1)	Height (df=1)	Treatment (df=6)	Treatment Vs Control (df=1)	Height Vs Treatment (df=6)	Error (df=14)
15. Total number of suckers produced	0.018	0.50	9.14**	118.66**	10.78**	0.15
16. Number of sword suckers produced	0.43	0.005NS	12.10**	93.43**	4.97**	0.14
17. Percentage of sword suckers	77.03	42.92*	124.28**	85.20**	68.64**	8.18
18. Number of water suckers produced	0.60	0.37NS	1.62**	1.51**	1.85**	0.12
19. Sucker Ratio	174.38	123.56**	457.81**	227.17**	249.59**	24.01
20. Sucker Production Index	25596.88	13091.75NS	79728.05**	58170.79**	38697.85**	3466.74
21. Average weight of suckers at separation	0.027	1.20**	5.15**	11.07**	2.52**	0.014
22. Number of leaves on the suckers at seperation	0.012	0.044NS	1.46**	2.11**	0.39*	0.10
23. Girth of pseudostem at seperation (sucker)	0.27	136.84**	531.62**	844.05**	163.58**	0.58

* Significant at 5% level of probability

** Significant at 1% level of probability

APPENDIX IV

The cultivars studied and their synonyms

Entry No.	Cultivar	Synonym
T_1	Palayankodan	Poovan (Tamil Nadu), Karpura Chakkarakeli (Andhra Pradesh), Lal Velchi (Maharashtra), Fill Basket and Mysore (Trinidad)
T_2	Nhalipoovan	Ney poovan (Tamil Nadu), Sonery (Maharastra), Nitka Bab (North Kanara), Rasakadali (Kerala)
T_3	Nendran	Ethakai (Kerala), Rajeli (Maharashtra), Kochi Kelel (Sri Lanka), Plantain (Trinidad)
T_4	Poovan	Rasthali (Tamil Nadu), Mutheli (Maharashtra), Malbhog (Bihar), Amruthapani (Andhra Pradesh), Rasa Bale (Karnataka), Silk fig (Trinidad)
T_5	Robusta	Bombay Green and Harichal (Maharashtra), Robusta (Tamil Nadu), Pedda Pacha Arati (Andhra Pradesh), Pisang buai (Malaya), Tall Mons Mari (Queensland)
T_6	Red Banana	Lal Kela (Maharastra), Chenkadali and Sevvazhai (Tamil Nadu), Anupan (Bihar), Red Banana (Trinidad)
T_7	Monthan	Bontha (Andhra Pradesh), Kanch Kela (West Bengal), Madhuranga Bale (Karnataka), Bluggoe (Trinidad), Pisang Nanka (Malaya), Klue hakmuk (Thailand)

ENHANCING SUCKER PRODUCTION IN BANANA AND ITS EFFECT ON THE BUNCH WEIGHT OF THE MOTHER PLANT

BY
LEKHA SREEDHAR R.

ABSTRACT OF THESIS
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requirements for the degree of

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COLLEGE OF AGRICULTURE
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ABSTRACT

Natural sucker production in seven of the important cultivars of the State was assessed at the College of Agriculture, Vellayani during 1983-85. Attempts were also made to standardise a treatment/treatment combination that would generate a large number of commerciably acceptable suckers in 'Robusta' without much deleterious effects on the mother plants.

Among the seven cultivars, 'Nhalipoovan' produced significantly larger number of suckers per mat (12.40 against 3.72 to 5.94). The natural sucker production in 'Robusta' was found to be fairly low (4.59 per mat against 12.40 per mat in 'Nhalipoovan').

The studies indicated that computation of Sucker Production Index(total number of suckers x $\frac{\text{number of sword suckers}}{\text{number of water suckers}}$) is useful in assessing the ability of the cultivars/treatments/treatment combinations to produce commercially acceptable suckers (sword suckers).

Among the various treatments tried, Ascenso's method proved itself to be the best, having recorded the second

largest number of suckers (13.6 per mat), the largest number of sword suckers (13.1 per mat) and the highest Sucker Production Index (454.2). This treatment registered the least harmful effects on the growth, flowering and productivity of the mother plants.

Between the two heights of sucker removal, removal of suckers at 30 cm height was found to be better than removal of suckers at 60 cm height in as much as the former stimulated sucker production without harmful influence on the mother plants.

Among the treatment combinations, the combinations involving Ascenso's method and the two heights of sucker removal (30 cm and 60 cm) not only produced the largest number of commerciably acceptable suckers; but also exhibited the least harmful effects on the mother plants.