

Annual Report of the All India Co-ordinated Fruit Improvement Project (Banana & Pineapple), Banana & Pineapple Research Station, Kamara for the year 1977-78.

1. Name and location of the Centre All India Co-ordinated Fruit Improvement Project (Banana & Pineapple), Banana & Pineapple Research Station, Kamara, Trichur, Kerala State.

2. Period for which the scheme is sanctioned 1974-74 to 1978-79

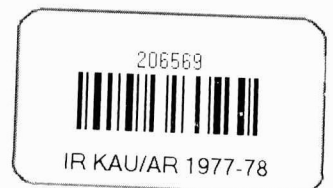
3. Staff position Table A attached

4. Budget position:-

a. Financial budget allotted during the year Rs.2,30,026.00

b. Amount spent during the period under report:

HEAD	AMOUNT SPENT IN 1977-78
I. Pay of Officers	Rs.75,371.07
II. Pay of establishment	Rs.41,087.27
III. Allowances	Rs.54,445.04
IV. Travelling Allowance	Rs. 4,175.15
V. Contingencies	
VI. Total recurring expenditure	70,000.00
VII. Non-recurring expenditure	Rs. Nil
GRAND TOTAL	Rs.2,45,078.53*



*The figures furnished are unreconciled for the months of February and March 1978)

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TABLE A
Staff Position

All India Co-ordinated Fruit Improvement Project (Banana & Pineapple, Kannara, Trichur Centre, Kerala.)

S. No.	Name of sanctioned post	No.	Name of staff member	Designation in KAU	Scale	Period	
						From	To
1	2	3	4	5	6	7	
1.	Horticulturist	1	S. Balakrishnan	Assoc. Professor of Botany (Horticulture)	Rs. 850-1450	1.4.77	31.3.78
2.	Jr. Horticulturist	1	M.R. Chidananda Pillai	Asst. Professor (Agronomy)	600-1250	1.4.77	3.4.77
			I.P. Sreedharan Nambiar	do.	do.	4.4.77	31.3.78
3.	Jr. Plant Physiologist	1	Dr. M.N. Chandrasekharan Nair	Assoc. Professor of Agrl. Botany (Plant Physiology)	850-1450	1.4.77	31.3.78
4.	Jr. Plant Pathologist	1	P.C. Jose	Assoc. Professor (Plant Pathology)	850-1450	1.4.77	31.3.78
5.	Jr. Plant Breeder	1	Dr. N. Krishnan Nair	Asst. Professor (Plant Breeding)	600-1250	26.4.77	31.3.78
6.	Jr. Entomologist-cum-Nematologist	1	K.K. Ravindran Nair	Asst. Professor (Entomology)	600-1250	1.4.77	31.3.78

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1	2	3	4	5	6	7	8
7. Sr. Research Assistants	5	K.C.Marykutty	Jr.Instructor	E.445-835	1.4.77	31.3.78	
		P.H.Latif	do.	do.	1.7.77	19.10.77	(transferred)
		P.Sukumaran Nair	do.	do.	7.7.77	15.11.77	(Expired)
		B.K.Jayachandran	do.	do.	4.10.77	13.10.77	(on leave)
		Mani T. Cherian	do.	do.	13.10.77	13.10.77	(on leave)
		T.R.Gopalakrishnan	do.	do.	22.12.77	26.12.77	(on leave)
Sr. Research Assistant		T.Radha	Jr.Instructor	do.	24.12.77	26.12.77	(on leave)
		P.A.Nazeem	do.	do.	24.12.77	26.12.77	(on leave)
		Valsamma Mathew	do.	do.	9.1.78	31.3.78	
		Lyla Mathew, K.	do.	do.	2.2.78	31.3.78	(one post is vacant)
		S.Shilaja	do.	do.	15.2.78	31.3.78	
8. Fieldman	4	N.Madhavan Nair	Appl.Demonstrator	240-445	1.4.77	20.7.77	(transferred)
		A.Nazeeruddin	do.	do.	1.4.77	16.10.77	do.
		P.K.Kalyani	do.	do.	1.4.77	31.3.78	(Two posts are vacant)
9. Laboratory Assistant	2	V.K.Sadasivan Pillai	Lab. Assistant	240-445	1.4.77	10.1.78	(transferred)
		Gracy Jacob	do.	do.	1.4.77	31.3.78	
		P.T.Nerayanan	do.	do.	7.2.78	31.3.78	
10.Clerk Typist	1	A.Ramakrishnan	Typist Gr.II	240-445	1.4.77	31.3.78	
		Ummithan					
11.Oil Engine Driver	1	K.K.Francis	Oil Engine Driver	250-385	1.4.77	7.9.77	(Transferred)
		K.A.Narayanan	do.	do.	8.9.77	31.3.78	
12.Peon/Messenger	1	V.Narayanan	Peon	196-265	1.4.77	6.2.78	(transferred now vacant)
13.Watchman	1	Beer Bahadur Singh	Watchman	do.	1.4.77	31.3.78	
14.Mali	2	V.A.ouseph	Mali	do.	24.9.77	31.3.78	(one post is vacant)

PROGRESS OF WORK DONE UNDER REPORT FROM 1.4.1977 to 31.3.1978

a. Title of the Projects:

A. B A N A N A

i. As approved in last workshop.

1. Project No.2.1.1. Varietal collection in banana - collection from various sources
2. Project No.2.2.2. Nutritional requirement of banana variety "Robusta"
3. Project No.2.2.3. Trace element studies on banana - variety "Robusta".
4. Project No.2.2.4. Water requirement studies in banana - variety 'Nendran'.
5. Project No.2.2.5. Control of weeds in banana with the aid of herbicides (variety - Robusta).
6. Project No.2.3.1. Studies on virus diseases of banana and their control.
 - Experiment No.1 To inspect banana growing areas to assess for the extent of disease and losses
 - Experiment No.3 To screen all cultivated and exotic varieties for their disease resistance (Bunchy top disease)
 - Experiment No.6 To control the spread of disease by cultural methods, therapeutic measures and by the use of insecticides
7. Project No.2.3.2 Fungal diseases of banana and their control
 - Experiment No.2 To search for suitable control measures using different fungicides against leaf spot disease of banana.
8. Project No.2.3.5 Studies on nematode parasites of banana
 - Experiment No.3 Evaluation of suitable nematicides for the control of Radopholus similis and root knot nematodes.

New trials as approved by the Director, Horticultural Research Institute, Bangalore.

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9. Frequency of application of nitrogen and potash to irrigated banana
10. Clonal variation studies in banana
11. Physiological basis of variation in yield between two varieties of banana viz. Nendran and Zanzibar.
12. Physiological deterioration of seed material in banana variety 'Nendran'
13. Induced mutagenesis through irradiation and chemical treatment.
14. Studies on the insect pests of banana.
 - i. Screening varieties against the attack of banana rhizome weevil
 - ii. Control of banana rhizome weevil by insecticidal treatments
 - iii. Control of rhizome weevil by the application of insecticides around the rhizomes.
15. Population density trial in Robusta banana
16. Ratooning trial in banana under irrigated conditions (Cavendish varieties)
17. Screening different varieties of banana
18. Physiology of Kokkan infected banana - variety Nendran against leaf spot disease

(Note: Experiment Nos.9, 11, 12 and 13 discontinued and No.18 taken up as suggested by the Project Co-ordinator (Fruits) ICA? from 1978-79 season as per PC:AICP:45/77-78 3780 dated 12.5.1977 of the Project Co-ordinator (Fruits.)

B. PINEAPPLE

- (i). As approved in last workshop.
1. Project No.3.2.1. Population density trial in pineapple variety 'Kew'.
 2. Project No.3.2.2. Nutritional studies in Pineapple variety 'Kew'.

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3. Project No.3.2.3. Effect of plant growth regulators on fruit size and maturity of pineapple 'Kew' variety
 4. Project No.3.2.4. Standardisation of time of application of growth regulators for materials raised from suckers and crowns.
 5. Project No.3.2.5. Control of weeds in pineapple with the aid of herbicides
 6. Project No.3.3.1. Survey of diseases of pineapple and assessment of damages
- (ii). New projects as approved by the Director, Horticultural Research Institute, Bangalore.
7. Studies on the effect of growth regulators in inducing flowering in 'Kew' pineapple
 8. Adaptive trial (New) in pineapple to compare the results of research with local practices.

A. BANANA

- Project No.2.1.1. (a). Varietal collection in banana

The germ plasm collection of banana was enriched by adding 14 varieties, 12 numbers from Tamil Nadu Agricultural University and two Nos. from Ponnani and Ellore of Kerala bringing the total collection to 158 varieties.

- a. Biometrical analysis of morphological characters.

During the period under report, biometrical studies on 13 morphological characters of 59 dessert types and 32 culinary types were undertaken and statistically analysed. The mean data collected are presented in tables 1 and 2. The data gave the following indications. Plant height: Significant variation among the varieties was noticed in plant height. In dessert types, the plant height varied from 129.00 to 366.67 cms. whereas in culinary types, the same was from 212.00 to 346.67 cm. Among the dessert types, pisang lilin accounted for minimum plant height while Ambalakadali for maximum. In culinary types, Trachi Vazhai accounted for minimum plant height and Mallabathesa for maximum value.

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Pseudostem girth.

Like plant height, there was significant variation among various types in respect of pseudostem girth also. In dessert types, the range was from 39.00 to 38.30 cms. where as the same in culinary types was from 62.57 to 81.00 cms. Among dessert types, Pisang lilin accounted for minimum value and Chenkadali for maximum. Among culinary types, Trachi Vazhai accounted for minimum value and Peykunnan for maximum.

Leaf production.

Both in dessert and culinary types the data showed significant variation in leaf production. The range was from 24.00 to 33.33 leaves/plant in dessert types, chirapunchi and pisang lilin accounting for maximum and minimum figures respectively. In culinary types, the range was from 27.67 to 34.67 leaves per plant, Nangunevi peyan and pachabontha batheesa accounting for maximum and minimum figures.

Bunch weight.

Significant variation existed between the varieties of both types. The dessert types produced bunches of weight range 3.33 to 19.50 kg. Pisang lilin produced bunches of smallest weight while chenkadali produced bunches of highest weight. The mean bunch weight range in culinary varieties was from 5.33 to 20.50 kg, Ennabanian accounting for lowest bunch weight and Booditha bontha batheesa for maximum bunch weight.

Weight of hands.

The statistical analysis of the data of the average weight of the hands produced in a bunch of both dessert and culinary types also was significant. For dessert types the range of mean value was from 425.00 gm. to 3284.00 gm, the maximum being for Chenkadali and minimum for pisang lilin. For culinary types the range was from 156.03 to 2369.00 gm. Kanchikela accounting for maximum value and Pachabontha batheesa for minimum value.

No. of hands/bunch.

The range in this regard was from 4.33 to 21.33 in dessert types and 5.00 to 18.33 for culinary types. There was statistical significant variation among the different types. In dessert types maximum number of hands/bunch was produced by Ayirankapoovan and minimum by Sira. In culinary types, Bluggoe, Sanpranimonthan and pachabonthabatheesa accounted for maximum production of hands whereas Booditha bontha bathese produced minimum number of hands per bunch.

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No. of fruits/bunch.

Significant variation existed between different types in this regard and the mean values ranged from 56.00 to 261.00 for dessert types and 54.67 to 275.33 for culinary types. In dessert types, maximum number of fruits/bunch was produced by Sira and minimum by Ayirankka ^{34/66}poovan whereas in culinary types Peykunnan and Samprani monthan accounted for maximum and minimum values.

Fruit production/hand.

The fruit production per hand varied significantly, the range being 10.77 to 18.60 in dessert types and 10.69 to 19.13 in culinary types. While Lacation and Kodapillakunnan gave maximum and minimum figures in this respect under dessert types, Ash monthan and Erachi vazhai gave maximum and minimum figures under culinary types. It was observed that culinary types are in general superior in fruit production than dessert types.

Weight of individual fruits.

The data on mean weight of fruits was also significant. In dessert types the range of mean values in this respect was from 26.18 to 303.67 gm whereas in culinary types the same was from 31.89 to 217.17 gms. In dessert types chenkadali accounted for maximum value and Adakkakunnan for minimum value while in culinary types Pachabontha bathesa for maximum value and Jawa for minimum value.

Fruit length.

Significant variation could be noticed in mean length of fruit in respect of both dessert and culinary types, the value range being 6.33 to 19.57 cms for dessert types and from 10.04 to 20.72 cms for culinary types. While Sira and Adakkakunnan accounted for maximum length of fruits in dessert and culinary types, Dakshinsagar and Pisang awak were inferior in this regard in dessert and culinary types.

Diameter of fruits.

The diameter of fruits showed significant variation among the dessert and culinary types. In dessert types maximum diameter of fruit (16.50 cms.) was exhibited by Chenkadali and minimum diameter (6.67 cm) by Adakkakunnan whereas in culinary types the maximum value (25.38 cm) was for Pachabontha batheesa and minimum (8.07 cm) for Jawa.

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Pedice! length.

Significant differences existed between the different varieties of dessert and culinary types in respect of pedicel length. The pedicel length ranges were from 47.67 to 132.33 cm for dessert types and from 48 to 149.67 cm for culinary types. Among dessert types, peykunnan gave maximum value and Nagabullalu minimum value whereas among culinary types, Booditha bontha batheesa gave maximum value and Kunnan minimum values.

Root Production.

The rate of root production per plant also varied significantly. In dessert types, maximum root production was noticed in Arbalakadali (354.33) and minimum in selection No.2 (134.00). In culinary types, pisang awak showed maximum root production (347.47) and Erachi Vazhai minimum (122.00).

b. Comparison of varieties for fruit qualities.

Thirty nine varieties of dessert type of banana were raised in R.B. design with three replications and the ripe fruits of the same were analysed for qualities viz. T.S.S., Total sugars, reducing and non-reducing sugars and acidity sugar acid ratio was also worked out (Table 3). The statistical analysis of data showed significant variations in fruit qualities of different varieties.

T.S.S.

Maximum T.S.S. was found in Chenganassery. Nendran and minimum in Valiakunnan.

Acidity.

Vennettu kunnan accounted for maximum acidity of 0.765% and Monsmari for least (0.127%).

Reducing sugars:

Valiakunnan fruits were found to contain maximum reducing sugars (17.09%) and Red banana contained the minimum (3.41%).

Non-reducing sugars:

Monsmari fruits possessed maximum percentage of 12.61 and Chenkadali possessed the minimum percentage of 1.21.

Total sugars:

Variety 'China' yielded maximum value in this regard (22.36%) and Chenkadali minimum value (5.90)

Sugar acid ratio.

Monsmari accounted for maximum value and selection No.2 for minimum value.

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Project No. and title : ICAR Code No.2.2.2
Ag 8(a) 14.3.1.

Nutritional requirements of banana.

Objectives : To find out the optimum requirement of NPK to correlate with leaf analysis

Design : 3^3 factorial confounded

No. of replications : 2

Treatments : 27

1. N at 100, 200 and 300 g/plant
2. P at 0, 40 and 80 g/plant
3. K at 0, 200 and 400 g/plant

Basal dose : 15 kg F.Y.M.

Variety : Robusta

No. of plants/plot : 12

Work done and results:

The experiment was repeated for the fourth year in succession by planting on 29.3.76. The data recorded on morphological characters (height and girth of pseudostem and number of leaves) including the data obtained during the past three years are given in Table 4. The data on yield characters such as bunch weight, number of hands and number of fingers statistically analysed including the pooled analysis of 3 years' data are presented in Table 5.

The data in Table 4 indicate that K.400 g/plant was superior for maximum height of the plants, girth of pseudostem and number of leaves/plant at flowering phase during the year 1973-74. This trend was not noticed in 1974-75 in which P 80 g/plant contributed for the maximum height of plants and K 400 g/plant for maximum girth of pseudostem. In 1975-76 also P 80 g/plant contributed for the maximum height of plants and girth of pseudostem. But in 1976-77 season, the maximum height of plants was contributed by K 200 g/plant and maximum girth of pseudostem by K 400 g/plant. In respect of number of leaves, not much differences could be noticed.

Statistical analysis of the data of bunch weight shows that in 1973-74, there was no treatment differences due to

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effect of N and P, In 1974-75 also, there was significant difference due to levels of K_2O only. In 1975-76 season response of N was not significant, but effects of P and K were statistically significant exhibiting linear response. In 1976-77, effect of K was alone significant with no response to N and P levels. The combined analysis of the data for 3 years has also indicated that effect of N was not significant whereas there was response to P and K levels.

Thus, the results of the experiments conducted for 4 years have given the indication that in respect of Robusta banana, the effect due to N at the levels tried was not significant, where as, there was response to P and K levels, the higher doses exhibiting better response. The trend of the results indicated the necessity for conducting more comprehensive trials by adjusting the PH of the soil as the pH of the soil in the station is in the range of 4.5 - 4.9.

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Project No.	: ICAR 2.2.3
Title of project	: Trace element studies in banana
Objectives	: To study the effect of trace elements on the growth and yield of banana
Treatment	: Micronutrients B, Mn, Zn, and Mo at different levels singly and in combination as given below:
B, Cu and Mn	= 0, 12.5 and 25.0 kg/ha
Zn	= 0, 25.0 kg and 50.0 kg/ha
Mo	= 0, 2.5 kg and 5.0 kg/ha
Lay out	: R.B.D.
No. of plants/plot	: 6
Replication	: 2

Work done and results

In the first year Tr.2 (Boron 12.5 kg/ha) exhibited a significant difference in bunch weight, number of hands and fingers per bunch followed by Tr.8 (Manganese 12.5 kg/ha). Except treatment 3 (Boron 25.0 kg/ha) all the other treatments produced higher bunch weight compared to control.

In the second year, no significant difference was obtained between treatments for all the characters studied viz. bunch weight, number of hands and number of fingers per bunch. However, Tr.11 (Molybdenum 5 kg/ha) recorded highest yield followed by Treatment 2 (Boron 12.5 kg/ha.)

During this year, treatment 11 (Molybdenum 5 kg/ha) followed by Tr.2 (Boron 12.5 kg) recorded highest yield among the treatments, but not higher than the control. The data were analysed statistically and it was found that there was no significant effect due to treatments (Table 6) in respect of bunch weight, number of hands or number of fingers per bunch. The experiment was discontinued during the season.

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Project No. : P.2.4

Project Title : Water requirement studies in banana

Objectives : To fix the water requirement of banana in relation to the physiological stages of crop growth.

Technical programme

Lay out : 10 x 4 R B D

Variety : Nendran

Treatments : (a). 1. Transplanting to flowering (7 months)
2. Flowering to maturity (after 7 months)

(b). Levels of irrigation
1. L1 = 20% depletion of moisture
2. L2 = 40% depletion of moisture
3. L3 = 60% depletion of moisture

(Soil moisture depletion will be assessed from soils to a depth of 60 cms calculated quantity of water will be given when the moisture level touches the stipulated level)

Number of plants per plot: 16

Work done and results:

The experiment was planted on 26-9-77 and is in progress. The biometric data on height, girth and number of leaves etc. were regularly recorded.

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Project No. : ICAR 2.2.5
 KAU AG.8(a) 14.24

Title of the project : Control of weeds in banana with the aid of herbicides - variety Robusta

Objectives : To find out suitable herbicides which would control a local spectrum of weeds in banana.

Treatments : A. Pre-emergence application

1. Diuron at 2 kg/ha at bimonthly interval.
2. Diuron at 3 kg/ha. at bimonthly interval
3. Diuron at 4 kg/ha bimonthly interval

B. Post emergence application.

4. Gramaxone 1.5 lit/ha + Diuron 2 kg/ha.
5. Gramaxone 1.5 lit/ha. + Diuron 3 kg/ha.
6. Gramaxone 1.5 lit/ha. + Diuron 4 kg/ha.
7. Gramaxone 1.5 lit/ha. + 2-4 DNa salt 1 kg/ha.
8. Gramaxone 1.5 lit/ha. + do. 2 kg/ha
9. Gramaxone 1.5 lit/ha. + do. 3 kg/ha.
10. Control

Work done and results.

The results of two years trial indicated that application of Diuron 4 kg/ha as bimonthly interval or Gramaxone 1.5 lit + Diuron 3 kg/ha or Gramaxone 1.5 lit/ha + 2.4 DNa salt 3 kg/ha as six monthly post emergence application is effective in controlling a broad spectrum of weeds without producing any deleterious effect on the crop.

An adaptive trial with above three treatments was laid out in 1976-77 and weed samples were collected on 4 different occasions. Only in the 3rd occasion, Tr.3 (Gramaxone 1.5 lit/ha + 2-4 DNa salt 3 kg/ha) was found to be superior to other treatments (Table 6 (a)).

In short there was no significant difference between treatments.

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Project No. : 2.3.1.

Title of the project : Studies on virus diseases of banana and their control

Experiment No.3. : To screen all cultivated and exotic varieties for their disease resistance (bunchy top disease of banana)

Design : R B D

Treatments : 10 varieties

Replications : 3

No. of plants per : 5
plot

The experiment was laid out during the months of September 1976

The procedure followed for inoculation was as follows:

The aphid (Pentalonia nigronervosa) reared on healthy plants were first collected and then allowed to feed in diseased plants (Bunchy Top infected plants) to acquire the virus. They were then transferred to 4-1/4 month old plants for inoculation feeding at the rate of one hundred infected aphids per plant. After inoculation feeding, the aphids, were killed by insecticidal spraying. The observations on percentage of infection of bunchy top disease as a result of artificial inoculation with infective aphids were recorded and the data are presented in table 7 - The results indicated that the varieties Vadakkankadali, Sennacherkadali and Venettukunman are tolerant to bunchy top disease when compared to other varieties.

During last year, screening trial, the variety 'Kanchikela' had not taken infection under artificial inoculation. To confirm the result, 15 Kanchikela plants were inoculated with infective aphids when the plants were 85 days old. One hundred infective aphids were used for inoculating each plant. Seven plants took up infection.

Twenty-nine Kanchikela plants were inoculated with the infective aphids when the plants were 4-1/4 months old. Only one plant was found to be infected with bunchy top disease. One hundred infective aphids were used for inoculating each plant. This inoculation trial revealed that the Kanchikela variety has got more tolerance when the plants become older.

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Experiment No.5 : To control the spread of Bunchy Top disease of banana by the use of insecticides.

The experiment was laid out in September 1976 with 11 insecticides for controlling the aphid vector (Pentalonia nigronervosa) which is responsible for the spread of Bunchy Top disease.

Design : R.B.D.
Replications : 3
Treatments : 12
No. of plants per plot : 6
Variety : Nendran

Treatments.

1. Rogor	0.05%	7. Ekatin	0.02%
2. Ekatox	0.02%	8. Thiodan	0.05%
3. Metasystox	0.02%	9. Disyston	40 kg/ha
4. Thimet	15 kg/ha	10. Sovin	0.2%
5. Dimecron	0.05%	11. Anthio	0.2%
6. Malathion	0.05%	12. Control	

Since Metacid combi was not available in the market the same was not included in this experiment.

Spraying with insecticides was carried out at fortnightly intervals, starting from one month old plants and concluding at the time of flowering. Foliar application of the insecticides were given fifteen times. Granular insecticides viz. Thimet and Disyston were applied at the time of planting and repeated at intervals of forty-five days. Six applications were given to the crop. Before each spraying aphid counts were taken at fortnightly intervals and are presented in table-3.

Statistical analysis of the data indicate that all the treatments are significantly superior to control. The aphid population were very less on plants treated with Thimet and maximum number of aphids were on control plants. Two plants were found infected with Bunchy Top disease in the plants treated with Rogor and one plant was infected with Bunchy Top in the plants treated with Anthio. There was no infection in the control plot. The yield data obtained in different treatments are furnished in Table -9. The data were analysed statistically, but there was no significant difference in yield between different treatments.

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This experiment has already been conducted for three years and hence concluded.

This experiment has revealed that both foliar application of the insecticides and the soil application of the Granular insecticides are effective in controlling the aphid population. Among these the Granular insecticides, Thimet and Disyston were highly effective in controlling the aphid (Pentalonia nigronervosa) which is responsible for the spread of Bunchy Top disease.

Project No. : 2.3.2

Title of the project : Fungal diseases of banana and their control

Experiment No.2 : To search for suitable control measures using different fungicides against leaf spot disease of banana

Design : R B D

Treatments : 7

1. Blitox 0.5%
2. Difoltan 0.3%
3. Bordeaux mixture 1%
4. Dithane Z-78 0.2%
5. Dithane M-45 0.2%
6. Power oil 1%
7. Control

Replications : 4

Variety : Dwarf Cavendish

The fungus Cercospora musae was found to be associated with the leaf spot disease of banana. The leaf spot disease is very severe during the south west monsoon period.

The experiment was planted in September 1976 with a view to find out suitable fungicide for the control of leaf spot disease of banana.

Spraying with different fungicides viz. (1) Blitox 0.5% (2) Difoltan 0.3% (3) Bordeaux mixture 1% (4) Dithane Z-78 0.2% (5) Dithane M-45 0.2% and power oil was commenced as soon as the initial symptom of the disease was noted. Six spraying were given to the crop at fortnightly intervals. Before the spraying, the plants were graded according to the infesting of infection. The yield data obtained are presented in Table-10.

Statistical analysis of the data revealed that there was no significant difference in yield between the treatments. However, the mean bunch weight was more from plants treated with Bordeaux mixture when compared to other treatments. The experiment was repeated during the year under report by planting on 22.10.77. The ripe banana fruits obtained from different fungicidal treatments were analysed for various qualities. The data obtained are presented in Table-11.

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The analysis indicated that the percentage of total sugar was more in all the treatments than the control. Among the treatments the percentage of total sugar was more in the fruits obtained from the plot sprayed with Bordeaux mixture. Not much of variation existed among the different treatments in respect of other qualities studied.

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Project No. : 2.3.5
 Title of the Project : Studies on the nematode parasites of banana

Objectives:

1. To survey the banana growing areas to find out the nematode parasites associated with the crop and to determine their degree of incidence.

The survey work is in progress. From the survey so far conducted, it was revealed that the following species of parasitic nematodes are present in banana root and soils.

1. Radopholus sp.
2. Pratylenchus sp.
3. Helicotylenchus sp.
4. Criconeoids sp.
5. Meloidogyne sp.

2. The object of the study is to find out the plant nematode relationship and determine their pathogenic effect on the crop.

Pot culture experiments was conducted to determine the pathogenic effect. Different levels of population of Radopholus Similis was inoculated to the plants raised in sterile soil. Periodic population of nematodes was estimated from the root samples of the plants. Biometric data on growth characters were recorded. From the data collected, it was revealed that when the population of nematodes exceeds 100 Nos. in 10 gram of roots the growth of plant was retarded.

3. Evaluation of different nematicides for the control of Radopholus similis and root knot nematodes.

Treatments : 7

1. Dasanit 2 gram of ai/plant
2. Tenik do.
3. Furadan 3 do
4. Thimet do.
5. Neem cake 400 gram/plant
6. Nemacur 2 gram of ai/plant
7. Control

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Lay out : Randomised Block Design
 No. of replication : 4
 Variety : Nendran

Work done and results.

The experiment was laid out during October 1976 for the evaluation of different nematicides for the control of parasitic nematodes of banana. Before planting soil samples were taken from each treatment, to assess the population of nematodes. First application of nematicide was done at the time of planting. The application was repeated four months after planting. Before second application, soil and root samples were collected and the nematode population assessed. Final soil and root samples were collected four months after second application. The data on population of nematodes in the soil and root samples at different stages are furnished in tables 12 and 13.

The harvest of the bunches was completed in October 1977 and the data obtained are furnished in table-14. From the counts of nematode population in the soil and root samples, it was observed that there was reduction in the number of parasites, as a result of application of nematicides.

The mean population of nematodes in 10 gram of root samples collected at different stages were statistically analysed. The result of analysis showed that there was significant difference between the population in treated plots and control plots. In control plots, the population exceeded the normal pathogenic level of 100 Nos. in 10 grams of roots.

The statistical analysis of the yield data indicated that the treatments were significantly superior to control. Maximum bunch weight was obtained in the plot treated with Nemacur followed by Tenik and Thinet.

The experiment was repeated, by planting during November 77. Application of Nematicides was done as per schedule. Soil and root samples were collected at different stages and the nematode population is being assessed.

.....contd.

Project No. : Not assigned

Title : Frequency of application of Nitrogen and Potash to irrigated banana (Var. Hendran)

Objectives : To determine the optimum time and frequency of application of N & K to Hendran banana under irrigated conditions for getting economic yields.

Duration : 3 years

Treatments : 8

1. Full N & K 30 days after planting
2. Full N & K 90 days after planting
3. Full N & K 150 days after planting
4. N & K in two equal split doses at 30 and 150 days after planting
5. N & K in 3 equal split doses at 30, 90 and 150 days after planting.
6. N & K in 4 equal split doses at 30, 70, 110 and 150 days after planting
7. N & K in 5 equal split doses at 30, 60, 90, 120 and 150 days after planting
8. N & K in 6 equal split doses at 30, 55, 80, 105, 130 and 150 days after planting.

P_2O_5 to be applied one dose on the 30th day after planting. A basal dose of 15 kg farm yard manure to be applied at the time of planting to all plants.

Dosage of nutrient

N 225 g/plant

P_2O_5 225 g/plant

K_2O 450 g/plant

Design : R.B.D.

Replication : 3

Spacing : 2 x 2 metres

No. of plants per plot : 6 (net with common border rows)

....contd.

Work done and results:

The experiment was first laid out and planted on 27.9.1976. Cultural and manurial practices were followed as per schedule. The mean data recorded on morphological characters (height, girth and number of leaves) and yield characters (bunch weight, number of hands and number of fingers) are presented in table-15.

In respect of vegetative parameters recorded, the treatment differences were significant for height and girth of plants and not for number of leaves or duration. In respect of height, treatment 5 was significantly superior to Tr.1 although it was on par with Tr.2, 7, 4, 6 and 8 which were significantly superior to Tr.3 and 1.

With regard to bunch characters, the treatment differences were significant only in respect of mean bunch weight. Tr.4 recorded maximum bunch weight followed by Tr.1 which were on par with Tr.3 and 2. The data indicated the necessity to repeat the trial under adjusted p^H condition for drawing further conclusions.

.....contd.

Project No. : Not assigned (new)

Clonal variation studies in banana

Objective : To assess the natural genetic variability existing in popular banana varieties and to select most promising clones for popularisation

Work done and results : A detailed survey was conducted in Trichur District and 538 suckers were collected. The crop was raised during 1977-78 and performance on yield and other morphological characters was studied. Wide variability was noted in duration, height, numbers of suckers produced, girth, number of leaves and total yield of the plant. The yield of the plant ranged from 3.5 to 14.5 kg. Taking average bunch weight of 11 kg as basis, the selections which gave the average bunch weight below 11 kg were rejected and the promising 80 selections were planted during this year for gathering further data.

Project No. : Not assigned
KAU Ag.8(a) 14.2.7

Title of the project : Physiological basis of variation in yield between two varieties of banana viz. Nendran and Zanzibar

Objectives : To assess the various physiological parameters such as NAR, PGR, LAR and LAI that are associated with productivity and to correlate the above parameters with the biomass and economic yield.

Technical programme:

Suckers of uniform age and size will be planted in 7 rows with 7 plants in each row including border rows with spacing of 2 M x 2 M for both varieties separately.

Three samplings were carried out. In the first sampling Nendran variety exhibited higher biomass as against Zanzibar variety while in the final sampling Zanzibar exhibited a higher biomass. NAR, LAR, PGR are being calculated.

.....contd.

Project No. : Not assigned
 KAU Ag 8 (a) 14.2.7

Title of the project : Physiological deterioration of seed material in banana - variety Nendran

Objectives : To assess the yielding potential of the rhizome of the same mother plant with continuous planting for a period of 4 years.

Technical programme:

Five suckers of uniform age and size will be planted with 2 M x 2 M spacing giving usual cultural practices as recommended in the package of practices.

The entire number of daughter suckers of the mother plant will be utilized for planting in the subsequent years upto 3rd year. In the fourth year, the number will be reduced to convenience.

Work done and results:

The suckers were planted on 30.11.1976. The suckers failed to establish. The experiment has been planted in 1977-78 season with 10 suckers and the same is in progress.

Project No. : Not assigned

Title of the project : Induced mutagenesis in some banana varieties through irradiation and chemical methods.

Objective : To cause genetic varieties in stature, duration, disease resistance, fruit quality and yield by inducing mutation through irradiation and chemical methods.

Work done and results:

Four months old suckers of Nendran variety were subjected to 1, 2, 3, 4, 5, 6, 7 and 8 KR exposures of gamma rays. The suckers were then planted in the field along with control. The suckers were allowed to produce suckers and the daughter suckers were transplanted for further performance studies.

The available suckers were very few and hence no data on morphological and yield characters were observable in the VM₂ generation. The experiment was dropped as suggested by the Project Co-ordinator (fruits), ICAR.

.....contd.

Project No. : (To be assigned)

Title of the project : Studies on the insect pests of banana and their control

Objectives : Screening of varieties against the attack of banana rhizome weevil

Work done and results:

The banana rhizome weevil is a major insect pest of the crop in Kerala. The present work is aimed at in selecting varieties resistant to the pest. The varieties used for the screening were the following:

- | | |
|--------------------|--------------------------|
| 1. Nendran | 2. Zanzibar |
| 3. Robusta | 4. Poovan |
| 5. Dwarf Cavendish | 6. Palayankodan |
| 7. Kanchikela | 8. Njalipoovan |
| 9. Grosnichel | 10. Pachabontha batheesa |

From the study, it was revealed that none of the above varieties was resistance to the pest attack. The varieties Nendran, Zanzibar, Robusta, Dwarf Cavendish and Grosnichel were more susceptible than Kanchikela, Njalipoovan, Palayankodan, Poovan and Pacha bontha batheesa.

The screening trial is in progress for the year 1977-78 with another set of 10 varieties.

.....contd.

Project No. : To be assigned
 Title : Control of banana rhizome weevil by
 insecticide treatment of suckers

Work done and results:

The object of the experiment is to find out how far external treatment of banana suckers with insecticides will help in checking infestation by rhizome weevil.

One field experiment was conducted with the following insecticides:

- | | |
|---------------------|----------------------|
| 1. Ekatin | 5. Disyston granules |
| 2. BHC suspension | 6. Furadan granules |
| 3. Sevin suspension | 7. Thimet granules |
| 4. Dimacron | 8. Solvirex |

In the case of suspensions the suckers were dipped in them for 30 minutes. The granules were spread over the suckers after dipping them in cowdung slurry and dried partially. The variety used for the study was Hendran.

From the preliminary analysis of the yield data, it was noticed that insecticidal treatment of suckers reduced the infestation of the weevil, and increased the bunch weight. The mean bunch weight of the different treatments are given below:

<u>Treatment</u>	<u>Bunch weight (kg)</u>
Disyston	10.22
BHC Suspension	10.05
Solvirex	9.92
Furadan	9.55
Sevin suspension	9.36
Dimacron	9.35
Ekatin	9.28
Control	7.77

The experiment was repeated during the year 1977-78 for confirmatory results and the same is in progress.

.....contd.

Project No. : Not assigned
Title : Control of banana rhizome weevil by
the application of insecticide around
the rhizome

Work done and results:

The object of the experiment is to find out how far the soil application of insecticide will help in checking infestation by rhizome weevil.

One field experiment was conducted with the following insecticides:

- | | |
|---------------|---------------------|
| 1. BHC 10% | 5. BHC suspension |
| 2. Aldrin | 6. Sevin Suspension |
| 3. Chlordane | 7. Carvint |
| 4. Heptachlor | 8. Control |

First application was done in the pits before planting. The second application was done 3 months after planting. The variety used for the study was Nendran.

From the preliminary analysis of the yield data obtained, it was seen that, soil application of insecticide helped in checking the infestation of rhizome weevil and increased bunch weight. The mean bunch weight of the different treatments are given below:

<u>Treatment</u>	<u>Bunch weight (kg)</u>
1. Chlordane	7.68
2. BHC 10%	7.47
3. Sevin	7.09
4. Carvint	7.06
5. Aldrin	6.93
6. BHC suspension	6.61
7. Heptachlor	6.27
8. Control	5.66

The experiment was repeated during the year 1977-78 for confirmatory results and it is in progress.

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Project No.	: Not assigned
Title of the project	: Population density trial in banana - variety Robusta
Objective	: To study the optimum spacing for variety Robusta to maximise yield per unit area
Treatments	: 4 methods of planting <ol style="list-style-type: none"> 1. Square method - 1.5 m x 1.5 m (4900 plants/ha.) 2. Triangular method - 1.0 x 2.0 m (4500 plants /ha.) 3. Single hedge method 1.0 m x 2.0 m (5000 plants/ha) 4. Double hedge method 1.0 m x 2.0 (7000 plants/ha.)
Lay out	: R.C.D.
No. of replications	: 5
Plot size	: 0.01 ha.

Work done and results:

The experiment which was planted during 1976-77 (30.9.76) was completed during the period. The data collected on vegetative parameters viz. height of the plants, girth of pseudostems and number of leaves recorded at periodical intervals are presented in Table-16. Data on productivity viz. bunch weight, yield of fruits in tons/ha. and computed figures of percentage of grade bunches are presented in Table-17.

Taking the per hectare yield, extra expenditure involved and the extra yield consequently the additional income realised, the cost benefit analysis of various treatments was worked out. The details of which are presented in Table -18.

The data on vegetative parameters (Table-16) indicated that while the Tr.2 was superior in all respects when the plants were three months old, such superiority of that treatment could not be noticed when the plants attained six months age. Tr.3 contributed for maximum height of plants and Tr.1 for the girth of pseudostems. However, in respect of number of leaves not much differences could be noticed in different periods at which

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data were collected. At flowering stage (9 months after planting) Tr.3 contributed for maximum height of plants and girth of pseudostems followed by Tr.1.

In respect of productive characters, the treatment differences were significant (Table-17) in respect of per hectare yield of fruits and percentage of grade bunches and in respect of average bunch weight. Tr.3 followed by Tr.1 contributed for maximum bunch weight even though the treatment differences were not significant. Tr.1 and Tr.3 contributed for maximum per centage of grade bunches indicating their better marketability compared to grade bunches produced in Tr.2 and Tr.4. In respect of per hectare yield of fruits in tons, it was observed that increased population/ha contributed for more production although this treatment did not contribute acceptable grade bunches.

Taking all the productive characters into consideration, treatment Tr.3 and T.1 appeared to be better and they were on par for all the characters studied. But the cost benefit analysis (Table 18) indicated that the acceptable cost benefit ratio was exhibited by Tr.1 in which a population of 4900 suckers/ha was accommodated. Under the existing system of cultivation, the population density adopted is 2319/ha providing planting distance of 2.4 M between rows and 1.8 M between plants. It appears hence necessary to conduct further trials to assess the efficacy of existing method of cultivation with the best treatments as evidenced by this trial.

During the year 1977-78, the experiment was repeated by including the local method of planting (2.4 M x 1.8 M) with 4 replications. The experiment was planted on 11.8.1977. The plants were manured as per schedule. Data on vegetative parameters viz. height of plants, girth of pseudostem and number of leaves were recorded at intervals of three months. The experiment is in progress.

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Work done and results.

The experiment was laid out in the year 1976-77 and planted on 27.9.1976. All the treatments were planted with Koklan infected suckers. The yield data showed that there was no visible effect due to application of Magnesium sulphate. The data were statistically analysed and it was found that there was no significant effect due to treatments as regards bunch weight, No. of hands and No. of fingers (Table 20)

The experiment has been repeated in 1977-78 season modifying the periodicity of the application of magnesium sulphate and the same is in progress.

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B. P I N E A P P L E

Project No. : 3.2.1
 Title of project : Population density trial in pineapple variety 'Kew'.
 Objectives : To find out the most optimum population density for 'Kew' variety of pineapple for maximising production.
 Duration : 6 years

Technical programme:

Series I - Treatments (1974 planting) : 21
 a. Spacing : 7
 b. Method of planting : 3

a. Details of spacing (in cms) S:

Sl.No.	Plant to Plant	Row to Row	Bed to Bed
1	30	60	75
2	25	60	90
3	30	45	60
4	25	60	75
5	25	45	75
6	25	45	60
7	20	40	60

b. Method of planting-P.

1. Two row bed
2. Three row bed
3. Four row bed

Lay out : Split plot design
 No. of replications : 7
 Planting material : Uniform suckers

Series II - 1976 planting:

Treatments (1976 planting) : 18
 a. Spacing : 9
 b. Method of planting : 2

....contd.

a. Details of spacing (in cms) - (S)

S.No.	Plant to plant	Row to row	Bed to Bed
1.	30	60	90
2.	25	60	90
3.	30	45	90
4.	25	45	90
5.	30	45	105
6.	25	45	105
7.	30	60	105
8.	25	60	105
9.	45	60	108 (control)

b. Method of planting (P)

1. Two row bed

2. Three row bed

Lay out : Split plot design

No. of replications : 7

Work done and results - Series I experiment (1974)

The trial to find out the most optimum population density for maximum production of pineapple was laid out on 29.7.1974. Suckers of uniform age and size having 15 to 20 leaves were used for planting. The design of the experiment was split plot with 21 treatments and seven replications. Fertilizers were applied at the rate of 8:3:12 gm of NPK per plant/year in two equal doses as soil application at the time of onset of south west and north east monsoons. Observations on the number of leaves produced/plant and leaf area index worked out one year after planting are furnished in table-21. Along with the number of suckers produced/ plant and the duration of the plant crop in days. As the natural flowering in March 1976, even after 20 months after planting, accounted only for 3.70 - 15.34% in different treatments, application of growth regulator (500 ppm ethrel) was done in January 1977 for inducing maximum flowering thereby to collect yield data. Data on weight of fruits with and without crown and crown weight were recorded. From the data, per hectare yield in tonnes with and without crowns were worked out besides the cost benefit ratio of the treatments under two row bed systems as there was no significant difference in any of the characters due to rows. The cost benefit ratios arrived at by taking into account the additional expenditure involved for various inputs and the extra yield obtained fixing the minimum most population

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density $P_1 S_1$ (45382 plants/ha.) as the base. The average fruit weight and without crown and the average crown weight are presented in table-22 along with the computed figures for per ha. yield of fruits in tonnes with and without crowns. The details of cost benefit analysis are presented in table-23.

The following results were obtained:-

Growth characters:

The data revealed that the differences in the plant vigour as expressed by the number of leaves/plant and the leaf area index were not significant due to treatments. The sucker production although was not influenced by methods of planting, different spacings significantly influenced the same, spacings S_2 and S_4 contributing for maximum and S_5 for the least production of suckers/plant. With respect to the duration of the plant crop, the treatment differences were not significant.

Yield characters

The data indicated that the average fruit weight with crowns was not affected other by the number of rows or by the spacings between rows and plants. However, treatment $P_1 S_5$ and $P_1 S_2$ produced fruits of increased weight. The fruit weight devoid of crowns showed significant difference in respect of spacings only. For this character, spacings S_4 , S_6 , S_2 and S_5 were significantly superior and were on par. Again the crown weight was not seen influenced by the number of rows but spacing significantly influenced the same, spacing S_6 contributing for the production of crowns of minimum weight and spacing S_7 for maximum weight.

The fruit yield in tonnes worked out/ha with and without crowns also showed significant influence exerted by the spacings. The per hectare yield with the crown intact was maximum in spacing S_7 followed by spacing S_6 . It was minimum in spacing S_2 . In the absence of crown also, the per hectare yield exhibited the same trend.

The cost benefit analysis showed that the treatment $P_1 S_5$ was most economical followed by treatments $P_1 S_4$ and $P_1 S_2$ for per hectare yield of fruits with crowns intact. In case of yield devoid of crowns treatment $P_1 S_4$ and $P_1 S_2$ were superior followed by $P_1 S_5$.

The studies thus have shown that leaf production, leaf area index and the duration of the plant crop of pineapple are not influenced by different population densities, whereas the sucker

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production per plant is seen affected. The average fruit weight with crown intact is not seen influenced by different population densities. But, when fruit weight without crown is taken into account, there is significant difference due to spacings obviously showing that the crown weight is influenced by the plant population, the crown weight being highest when the population density is at its maximum (spacing S₇). Higher population densities are found to be responsible for securing higher tonnage of fruits/ha. But on a practical consideration, the increased tonnage can be stated to be beneficial if only it has been found advantageous on a cost benefit ratio analysis. In this respect treatment P₁S₅ (61666 suckers/ha) P₁S₄ (59259 suckers/ha) and P₁S₂ (53333¹ suckers/ha) are superior for yield with crowns intact and treatment P₁S₄ (59259 suckers/ha), P₁S₂ (53333 suckers/ha) and P₁S₅ (61666 suckers/ha) are superior for yields without crowns. On an overall analysis it may appear that the treatment P₁S₂ (59259 suckers/ha) is most advantageous. But pineapple being a crop maintained on ratooning. The spacing between trenches is an important factor to be reckoned with for easiness in adopting various agronomic practices. The treatment P₁S₄ having the spacing of 75 cm between trenches is difficult to manage in subsequent ratoon seasons. Therefore the treatment P₁S₂ accommodating 53333 suckers/ha, allowing interspaces of 90 cms. between trenches, 60 cm between rows and 25 cm between plants is found to be optimum. Further although the maximum population densities contributed for increased tonnage the average fruit weight without crown being below the standard, may fail to attract a good price in the vegetable market.

Series II 1976 planting:

The trial was repeated in 1976-77 season adopting the modification suggested by laying out and planting on 9.9.1976 using uniform suckers. The crop was given a fertilizer schedule of 8:12 gm NPK/plant/year in two doses. During the period under report, data on vegetative growth of plants viz. number of leaves, length and width of D leaf to work out leaf area index were recorded at intervals of six months and eighteen months after planting and the same are presented in table-24.

To induce uniform flowering growth regulator (25 ppm ethrel + 2% urea + 0.04% calcium carbonate) was applied on 14.12.1977 and the percentage of flowering occurred in various treatments was recorded. The data are presented in table-24. The crop is yet to come for harvesting.

The data collected after an interval of six months after planting indicated that the various growth characteristics viz. leaf production and length and width of "D" leaf did not vary

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significantly due to rows whereas length of "D" leaf along was significantly influenced by different spacings, spacing S_9 being significantly superior to other spacings. The data collected after the interval of eighteen months after planting indicated that in respect of leaf production that the treatment P_1S_5 was superior followed by treatment P_1S_7 and P_1S_1 was inferior¹most. The leaf area index was favourable to treatment P_2S_5 followed by P_2S_2 , the inferior²most treatment being P_1S_1 . The growth regulator application produced favourable effects in all the treatments in general. The range of flowering varied from 71.73 to 96.13 in various treatments, the maximum flowering being noticed in treatment P_1S_8 followed by treatments P_1S_1 . In this respect, the treatment P_2S_4 was found to be inferior¹ recording 71.73 percent flowering.

It is expected that the crop will come to harvest in May 1978, when data on productivity and other characters will be recorded.

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Project No. : 3.2.2

Nutrition studies on pineapple

Variety : Kew

Objectives : To find out the optimum dose of urea as foliar spray in combination with soil application

Technical programme :

Series I 1974 planting

Treatments :

Total No. of treatments: 12

a. Dose of nitrogen (N): 3

b. Method of application (M): 4

a. Doses of nitrogen/plant (N)

N_1 - 8 g N/plant/year

N_2 - 12 g N/plant/year

N_3 - 16 g N/plant/year

Nitrogen will be given as 4% foliar spray. Phosphorus and potash will be given in the form of superphosphate and muriate of potash @ 4 and 12 g respectively/plant/year in soil. Phosphorus will be applied in one dose and potassium in three equal doses.

b. Method of application (M)

M_1 - 25% N as foliar + 75% N in soil

M_2 - 50% do + 50% do.

M_3 - 75% do. + 25% do.

M_4 - All nitrogen in soil

Nitrogen in soil will be given in split doses as given below:

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75% N in soil in three split doses
 50% N in soil in two split doses
 25% N in soil in one dose

All nitrogen in soil in four split doses.

Lay out	: Split plot design
Planting material	: Suckers of uniform size
Variety	: Kew
No. of replications	: 7
Plot size	: 4.20 x 2.40 M
Spacing	: 30 cm x 45 cm x 60 cm.
No. of plants per plot	: 64

Series II - 1976 planting

In the experiment laid out in 1976 certain modifications in the method of application of nutrients were made with concurrence.

Technical programme:

Same as Series I except for changes made in the method of application of nutrients both in soil and foliar.

Method of application of Nutrients.

- i. All nitrogen in soil will be given in 4 split doses at intervals of 1+2 months between applications during the period June to November.
- ii. 75% Nitrogen in soil will be given in three split doses at intervals of two months between applications during the period June to November.
- iii. 50% Nitrogen in soil will be given in two split doses at intervals of three months between application
- iv. 25% Nitrogen in soil will be given in one dose at time of planting.

Foliar application of urea.

The following will be the spraying schedule of urea

- i. 25% as foliar spray will be given in two doses in November and February
- ii. 50% N as foliar spray will be given in four doses in November, December, January and February.
- iii. 75% N as foliar spray will be given in six doses in November, December, January, February, March and April.

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Work done and results;Series I 1974 planting:

The yield data obtained consequent on the application of growth regulator (500 ppm etrel) on 25.12.1976 were analysed statistically taking into consideration, the average weight of fruit. The data are presented in Table-25. The fruits obtained from various treatments were analysed for their qualities viz. T.S.S., Acidity reducing and non-reducing sugars, total sugars and sugar acid ratio. The details of which are presented in table-25.

The data revealed that in respect of average fruit weight with crowns, the effects due to nitrogen levels was not significant where as method of application of nitrogen differed significantly, M_1M_4 and M_2 method of applications being superior to M_3 method of application. Both nitrogen levels and methods of application had no influence on TSS and acidity of the fruits. The reducing sugars, non-reducing sugars, total sugar and sugar acid ratio were found to vary significantly due to nitrogen levels and methods of application. In respect of reducing sugars different levels of nitrogen differed significantly, N_1 contributing for maximum followed by N_2 and N_3 . Among different methods of application, M_4 being significantly superior to M_1 , M_3 and M_2 which were on par. In respect of non-reducing sugars, total sugars and sugar acid ratio, among the different levels of nitrogen N_2 was significantly superior to N_1 and N_3 , among the four methods of applications M_4 was significantly superior followed by M_3 . The data thus have shown that in respect of yield there was no significant difference between different levels of nitrogen tried but soil application (M) of nutrients was superior to other methods tried. Although lower most dosage of 8 g N/plant/year (N_1) contributed for higher reducing sugar in fruits, in respect of other qualities of fruits viz. non-reducing sugars, total sugars and sugar acid ratio. The Nitrogen level 12 g/plant/year (N_2) was found to be significantly superior followed by 8 g N/plant/year (N_1), the highest dosage tried viz. 16 g N/plant/year (N_3) contributing far lesser qualities of fruits. In respect of methods of application, soil application (M_4) was significantly superior for all the characters studied viz. yield and qualities of fruits.

Series II 1976 planting:

During 1976-77 the experiment was repeated adopting the modifications of the technical programmes by planting on 10.7.1976 in split plot design with 12 treatments and seven replications.

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The period under report application of fertilizers as per schedule was completed. To induce uniform flowering and to enable for the collection of yield data growth regulators (25 ppm ethrel + 2% urea + 0.04% calcium carbonate) was applied on 16.12.1977. The data in vegetative growth characteristics viz. numbered leaves and leaf area index were recorded at intervals of six and eighteen months after planting. The extent of flowering as percentage due to the application of growth regulator was also recorded. The data are furnished in table-26.

The data indicated that in respect of leaf production at interval of six months after planting treatments M_1M_1 followed by treatments N_3M_1 and N_3M_4 are superior and treatment N_3M_3 is inferiormost. Of leaf area index for the above period treatment N_1M_1 followed by treatment N_3M_4 is superior and treatment N_2M_3 is inferiormost. With regard to leaf production after a period of 18 months after planting, the trend of results was in favour of treatment N_3M_4 , N_1M_4 and N_1M_1 . With regard to leaf area index for the period treatment N_3M_4 is found to be superior followed by treatment N_1M_4 . Thus the data on growth characters are found in favour to soil application of nitrogen in general. In respect of flowering due to growth regulator application, although this trend is favourable to soil application in respect of N_1 and N_3 levels of nitrogen, in respect of N_2 levels of nitrogen treatment N_2M_1 is superior. It was noticed that for all the nitrogen levels, M_3 method of application was inferior in this respect.

The harvesting of the crop has not yet been commenced for drawing conclusions in respect of yield and qualities of fruits.

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- Project No. : 3.2.3
- Effect of plant growth regulators on fruit size and maturity of pineapple variety 'Kew'.
- Objectives : To find out the best concentration of planofix and stage of application of the same in increasing fruit size and delay in maturity of the fruits
- Duration : 6 years.
- Treatments
- a. Concentration of planofix
 - i. 100 ppm
 - ii. 200 ppm
 - iii. 300 ppm
 - b. Stage of application
 - i. One month after flowering
 - ii. Two months after flowering
 - iii. Three months after flowering

Uniform flowering of plants will be induced by the application of growth regulator.

- Type of planting material : Uniform suckers
- Variety : Kew
- Lay out : Randomised Block design
- No. of replications : 3
- Plot size : 7.50 x 2.10 metres
- Spacing : 30 cm x 60 cm x 90 cm
- No. of plants/plot : 70

The experiment was laid out statistically in 1976-77 season by planting in June 1974. During the period under report growth regulator application to induce uniform flowering was done on 22.12.77 about 16 months after planting. Data on the extent of flowering as percentage were collected. Application of planofix of different concentration at the stage of one month after flowering was done on 5.3.1978 after recording the basic data. The other treatments are yet to be done and hence the experiment is in progress. The extent of flowering in various treatments ranged from 56.6 to 78%.

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Project No.	: 7.2.4
	Standardisation of time of application of growth regulator (ethrel) for materials raised from suckers and crown.
Objectives	: To find out the best stage of application of growth regulators for getting optimum fruit weight.
Duration	: 3 years
Treatments:	
1. Suckers	: Application of growth regulators in suckers at 14, 15, 16, 17 and 18 months after planting with control (water application)
2. Crown	: Application of growth regulators on crowns at 16, 17, 18, 19 and 20 months after planting with control (water application)
Growth regulator to be used:	100 ppm ethrel + 2% urea + 0.04% CaCO ₃ .
Lay out	R.B.D.
No. of replications	: 4
Spacing	: 30 cm x 60 cm x 90 cm
No. of plants/treatment	: 70

Work done and results.

The observational trial conducted during 1974-76 had indicated that 500 ppm ethrel was effective in inducing good percentage of flowering (73.82 to 95.71%) in crowns at age 16, 17, 18, 19 and 20 months, the maximum percentage of flowering being produced in 17 and 18 months old crowns. The control plot had recorded only a flowering of 2.48%, while the average weight of fruits obtained was 1.222 kg from suckers, the same was only 0.962 kg from crowns.

For getting more results the experiment was repeated in R.B. design by planting on 16.6.1976 the growth regulator (100 ppm ethrel + 2% urea + 0.04% CaCO₃) was applied during the period under report in all the treatment comprising of suckers and crowns of different ages. Data on vegetative growth of plants viz. No. of leaves and leaf area index at the time of application of growth regulator and also the extent of flowering at periodic intervals due to growth regulator application were recorded. The data are presented in tables-27 and 28.

.....contd.

The data revealed the following:

i. In respect of mean leaf numbers per plant, the average leaf production varied from 37.30 to 46.82 per plant in respect of suckers and from 30.07 to 39.32 per plant in respect of crowns of different age groups.

ii. The response of suckers was good towards the application of growth regulators for all ages starting from 14th month, the extent of flowering ranging from 82.5 to 96.1 per cent.

iii. In control plot, the plants started flowering under natural conditions only when they attained the age of 19 months only. They recorded a percentage of flowering of 88.9 percent which has been obtained due to very favourable weather during the year consequent of well distributed rainfall during north east monsoon period. Under other circumstances, the extent of flowering under natural conditions would have been much less (20-30 per cent)

iv. The crowns also responded well to growth regulator application for all the ages tried, the extent of flowering varying from 81.8 to 89 percent even though final data are yet to be received.

v. In control plot of crowns, flowering was noticed when the plants attained 19-1/2 months of age after planting and the extent of flowering during that time was only a meagre figure of 17.9 per cent. Eventhough flowering continued under natural conditions in control plot, the extent of flowering was low (23.6 per cent). Again, the unusual favourable weather conditions prevailed during the period had helped in this regard.

The experiment is being continued to gather further details on flowering and yield for drawing conclusions.

.....contd.

- Project No. : 3.2.5 - Control of weeds in pineapple with herbicides
- Objectives : 1. Survey of weed flora
2. To find out the suitable herbicides which would control a broad spectrum of weeds.
3. To study the effect of herbicides on quality and yield and
4. Economics of weed control with herbicides.
- Treatments : 4
- Diuron 1.5, 2.0, 2.5 and 3.0 kg/ha
 Bromacil 1.5, 2.0, 2.5 and 3.0 kg/ha
 Diuron 1.5 kg/ha + Bromacil 1.5 kg/ha
 Diuron 1.5 kg/ha + Bromacil 2.0 kg/ha
 Diuron 2.0 kg/ha + Bromacil 1.5 kg/ha
 Diuron 2.0 kg/ha + Bromacil 2.0 kg/ha
 Hand weeded control and
 unweeded control
- Method of application : First application as pre-emergent spray, second application after 4 months at half dosage.
- Lay out : R.B.D.
- Replications : 3
- Plot size : 0.10 M x 2.10 M
- No. of plants/plot : 70
- Spacing of plants : 30 cm x 60 cm x 90 cm

Work done and results:

The experiment which was started in 1974-75 season was concluded. The data collected indicated that application of diuron at 3 kg/ha was most effective in controlling a broad spectrum of weeds in pineapple plantation besides most economical. It also attributed for higher yield without impairing the quality of fruits.

The experiment of 1976-77 season planted on 10.10.1976 is in progress. During the period under report, data on dry weight of weeds/square metre area were collected at periodical intervals. Growth regulator (combination treatment of 25 ppm ethrel + 2% urea + 0.04% CaCO₃) was applied in all treatments to induce uniform flowering. The harvesting is yet to be commenced.

.....contd.

Project No. : 3.3.1
Survey and assessment of diseases of
pineapple

A mild incidence of leaf blight disease was noticed in
pineapple plants in some of the gardens. The fungus was isolated
and identified as *Drechslera hawaiiensis*. Symptomatology of the
disease was studied.

Project No. : Not assigned
Studies on the effect of growth regulators
in inducing flowering in 'Kew' pineapple

Objectives : To standardize the concentration and time
of application of growth regulators for
inducing flowering in pineapple 'Kew'
variety under Kerala condition

Duration : 4 years

Treatments : 64

a. No. of concentrations: 8

1. Ethrel 100 ppm
2. Ethrel 250 ppm
3. Ethrel 500 ppm
4. Ethrel 750 ppm
5. Ethrel 1000 ppm
6. Ethrel 100 ppm + Urea 2% + CaCo₃ 0.04%
7. 25 ppm ethrel + 2% urea + 0.04% CaCo₃
8. Control (water)

b. Age (stage) of plants : 3

1. Application at 11 months after planting
2. ,, 12 ,, ,,
3. ,, 13 ,, ,,
4. ,, 14 ,, ,,
5. ,, 15 ,, ,,
6. ,, 16 ,, ,,
7. ,, 17 ,, ,,
8. ,, 18 ,, ,,

Lay out : R.B.D.

No. of replications : 2

.....contd.

Work done and results:

The observational trial conducted during 1974-76 period had indicated that ethrel at concentrations of 500 and 1000 ppm were most effective in inducing flowering in pineapple in suckers of age 14-1/2 to 16 months in plant crop season.

Further observational trials conducted in 1976-77 season during the month November to February adopting 6 treatments viz. three concentrations of ethrel at 100, 500 and 1000 ppm one concentration of Acimone (M.L. based product) at 10 ppm and two combination treatments viz. 25 ppm ethrel + 2% urea + 0.04% calcium carbonate and 100 ppm ethrel + 2% urea + 0.04% CaCO₃, on 100 plants of plant crop of 16 months old (40-42 leaves) per treatment and ratoon crop of 11-12 months old (20-30 leaves) yielded the following results.

In both plant and ratoon crops, 1000 ppm ethrel treatments of 25 ppm and 100 ppm ethrel in combination with 2% urea and 0.04% CaCO₃ and 500 ppm ethrel contributed for maximum per centage of flowering in all the months tried viz. November, December, January and February (table-29). There was not much variation in the extent of flowering between the two treatments ethrel 500 ppm and 1000 ppm. But ethrel in combination with urea and calcium carbonate gave excellent results. Acimone was found to be least effective.

Of the 8 characters (viz. mean No. of leaves/plant, mean length and width of "D" leaf at the time of growth regulator application, mean fruit weight with and without crown, crown weight, No. of crowns and L/B ratio), studied, treatment differences were significant only in respect of mean weight of fruits without crown and L/B ratio (Table 30). The highest value for fruit weight was recorded by Tr.6 (Acimone 10 ppm) followed by Tr.4 (ethrel 100 ppm + 2% urea + 0.04% CaCO₃). With reference to L/B ratio of fruits, treatments 4 (100 ppm ethrel + 2% urea + 0.04% CaCO₃) were found superior in the order stated. The mean weight of crown was high in plants subjected to Acimone application. In almost all the cases, the fruits possessed multiple crowns, the maximum number being in plants treated with ethrel combinations.

The cost of application of the three best treatments worked out indicated that the combination treatment 25 ppm ethrel + 2% urea + 0.04% CaCO₃, was the cheapest involving a cost of 1.2 paise per plant, the next best being the combination treatment of 100 ppm ethrel + 2% urea + 0.04% CaCO₃ involving an expenditure of 1.53 paise per plant as against the expenditure of 3.11 paise/plants of application of 500 ppm ethrel was resorted to. The combination treatments of ethrel, urea and CaCO₃ were effective in both plant crop and ratoon crop.

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Yet another set of observational trials to evaluate the efficacy of different chemicals and growth regulators in inducing flowering during the different months of the year was taken up in 1976-77. Three doses of Ethrel 100 ppm, 500 ppm and 1000 ppm; planofix 20 ppm, 30 ppm and 50 ppm coarsely ground powder of calcium carbide; Acimone 10 ppm and a combination of ethrel 100 ppm, 2% urea and 0.04% CaCO₃ were applied in suckers of the plant crop as well as in one year old ratoon crop of 'Kew' variety of pineapple. Twenty-five plants were randomly selected for each treatment in each month. Growth regulators were applied in every month from May 1976 to February 1977. The percentage of flowering was recorded for each treatment in each month. To assess the seasonal performance of the treatments, the techniques suggested by Finlay and Wilkinson (1963) and those by Eberhart and Russel (1966) were followed. The data on the percentage of flowering in different month and the regression co-efficients and mean percentage of flowering for different treatments are presented in tables 31 and 32.

The data revealed the following:

In general, maximum percentage of flowering was observed during October, November and December months indicating that the growth regulators exert their maximum influence just prior to the natural flowering in pineapple.

Among various treatments tried, ethrel at 1000 ppm and combination treatment of ethrel, urea and CaCO₃ induced reasonably high percentage of flowering in off season of June-July, besides giving maximum flowering during the period of October to January while the other treatments were not so effective. Treatments which had regression co-efficient greater than unity showed higher percentage of flowering indicating that ethrel alone and its combination with urea and CaCO₃ performed well in every month. From the economic point of view, ethrel in combination with urea and CaCO₃ was cheap.

In order to gather more details and to get conclusive results, a new experiment as per aforesaid technical programme was statistically laid out on 24.6.1976 using uniform suckers. During the period under report, besides attending to maintenance of crop, growth regulator application was completed in all the treatments as per schedule. Data on vegetative growth of plants viz. No. of leaves, length and width of "D" leaf at the time of application of growth regulator and extent of flowering after 90 days after application of growth regulator were recorded which are presented in tables 33, 34 and 35.

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The data on extent of flowering furnished in table indicate that all the types of growth regulators in different concentrations were ineffective in inducing flowering in plants of age 11 and 12 months even though the combination treatments of ethrel, urea and calcium carbonate are slightly better compared to other treatments. The response of plants to growth regulator applications improved when the plants attained the age of 13 months. Upto 16th month of age of suckers, combination treatments of ethrel, urea and calcium carbonate and ethrel alone at higher concentrations were found very effective. After the plants attained the age of 17 months, all the treatments proved better and due to favourable weather conditions which prevailed during the north east monsoon period, the extent of flowering in control plots was also high compared to previous years (75% for 17th month and 73.5% for 18th month).

The harvesting of the crop is in progress and the efficacy of the treatments can be judged after collection of data on yield in 1978-79 season.

Project No. : ICAR not assigned

Project title : Adaptive trial (New)

Objectives : To compare the results of research so far obtained with local practices and to assess their merits and demerits and to serve as a demonstration plot for improved technologies.

Duration : 3 years

Technical programme:

Treatments : 2

Tr.1 improved practices.

- a. Low depth of trench (25 cm)
- b. High density of planting (30 cm x 60 cm x 90 cm = 43036 plants/ha)
- c. Application for herbicide - Diuron @ 3 kg/ha.
first spraying immediately after planting as pre-emergence and second spraying at half dose four months after first spraying.

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- d. Fertilizer dose - 8 g, 4 g, 12 g, NPK per plant per year in two split doses, one at the time of planting and another 4 months after planting.
- e. Induction of flowering using growth regulator viz. 25 ppm ethrel + 2% urea + 0.04% CaCO₃ when the plants are about 16-17 months old.

Tr.2 - Local practices.

- a. Deep trenches (45 cm)
- b. Low density of planting (45 cm x 60 cm x 180 cm)
- c. Hand weeding - three times a year
- f. Fertilizer dose - 8 g, 8 g, 16 g NPK per plant per year in two split doses as fertilizer mixture
- g. No artificial induction of flowering

Lay out : Observational

Details of layout

DETAILS	Tr.1 IMPROVED PRACTICES	Tr.2 LOCAL PRACTICES
1. Area of treatment	340 sq. mts	828 sq. mts
2. No. of trenches	26	16
3. No. of plants/trench	160	96
4. Total No. of plants	4160	1536
5. No. of plants/ha	43560	16000

The trial was started on 26.6.1976. Manuring, weeding, herbicide applications etc. were done according to schedule. Data on vegetative growth of plants at intervals of 6 months and 16 months after planting, extent of weed growth at periodical intervals, extent of flowering due to growth regulator application in Tr.1 and under natural conditions in Tr.2 at periodical intervals and yield were recorded. The cost of cultivation and estimated yield with cost benefit analysis were also worked out. The data collected are presented in tables 36, 37 and 38.

The data revealed the following:

- i. In respect of mean leaf production and leaf area index, the improved practices was superior to Tr.2 - local practices for data of both six months and 16 months after planting.

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20.6.569

- ii. The growth regulator application in Tr.1 - improved practices was highly beneficial and the same accounted for 96.83 per cent flowering in plants as against 67.20 per cent in Tr.2 - local practices.
- iii. In plots under Tr.2 (local practices) satisfactory flowering occurred (61.83%) only after the plants had attained 19 months of age, the flowering being very much staggered making harvesting expensive. Even the extent of flowering of 67.20% under natural conditions is peculiar this year due to favourable weather conditions prevailed during north east monsoon season. Under normal circumstances, the percentage of flowering under natural conditions would have been much less (30-40%).
- iv. The weed growth in plots under Tr.1 - improved practices was low compared to Tr.2 - local practices wherein hand weeding was resorted to. The dry weight of weeds recorded per square metre area at intervals are furnished below:

Treatment	Dry weight of weeds/sq.metre at different periods		
	Sept.76	Jan.77	Sept.77
Tr.1 Improved practices	0.138	2.97	64.70
Tr.2 Local practices	4.800	9.51	383.70

- v. The total cost of cultivation of the plots under Tr.1 (improved practices) worked out to Rs.4124.98 as against Rs.2301.15 for plots under Tr.2 (local practices), the extra cost of cultivation for Tr.1 compared to Tr.2 working out to Rs.1823.83.
- vi. While the average fruit weight with crown was (1.92 Kg) in Tr.2 (local practices), the same was only 1.50 kg in Tr.1 (improved practices). The low fruit weight in Tr.1 was attributable to the higher density of population used.
- vii. The data on plot yield and computed cost figures for plot yield indicated that the cultivation of plots under Tr.1 improved methods was profitable, giving a profit of Rs.827.52 for the plot in spite of extra expenditure involved, whereas the cultivation of plots under Tr.2 - local practices was on loss leading to a loss of Rs.609-657 in the second year. This aspect clearly shows the imperative necessity to take ratoon crops in pineapple under local system of cultivation for profits.

Since complete harvesting of fruits has not yet been over, the experiment is continued to gather further data on crown weight, L/B ratio, canning ratio and other fruit qualities.

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UP TO DATE PROGRESS OF WORK DONE
UNDER

ALL INDIA CO-ORDINATED FRUIT IMPROVEMENT PROJECT

From 1.1.1973 to 31.3.1978

C. Upto data progress work done from January 1973 onwards to-date.

A. B A N A N A

1. Project No. : 2.1.1.

Varietal collection of banana

a. Collection from various sources.

The germ plasm collection which considered of 123 varieties in the year 1973-74 was enriched by bringing the total number of varieties to 158 by 1977-78. Earlier the varieties were catalogued according to duration and yield as three maturity groups. From variety point of view they were classified as Nendran varieties, Dwarf varieties, tall varieties and culinary varieties. They were also classified genomically based on taxonomic scoring. The promising varieties were selected for multiplication and distribution. Biometrical analysis of 13 morphological characters of 59 dessert types and 32 culinary types was completed. Comparison of 39 varieties of dessert types for different fruit qualities namely viz. T.S.S., Total sugars, reducing and non-reducing sugars, Acidity and sugar acid ratio was done.

B. To test selected clones that have shown promise in certain areas.

Since 1973-74, field experiments to assess the field performance of four mutants of Dwarf cavendish banana namely Giant Governor, Robusta, Peddapacha arati and Monsnari were in progress. The results revealed that the cultivar Monsnari, was more productive followed by Giant Governor. Monsnari produced bunches of higher weight with larger fruits. Its ripe fruits possessed higher sugar content and lesser acidity compared to the ripe fruits of other cultivars.

2. Project No. : 2.2.2.

Nutritional requirement of banana variety Robusta.

The experiment was in progress from 1973-74. The results of the experiment conducted for a period of four years indicated that in respect of Robusta banana under Trichur conditions, the effects due to nitrogen at the level tried were not significant. There was linear response to P and K levels, the higher dosages exhibiting better response. The trend of the results indicated the necessity for conducting more comprehensive trials by adjusting the pH of the soil as the pH of the soil of the station is in the range of 4.5 - 4.9 or in suitable other locations.

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Project No. : 2.2.3
Trace element studies on banana
Variety Robusta

The results of trials of different years were erratic.

Project No. : 2.2.4
Water requirement studies in banana

The experiment was first laid out in 1977-78 season and is in progress.

Project No. : 2.2.4
Control of weeds in banana with the acid of herbicides (variety-Robusta)

The experiment was in progress since 1974-75. Survey of weed flora of the locality indicated the presence of 36 different types of weeds of which 13 types were of major importance. Statistical analysis of data of dry weight of weeds/square metre recorded at different intervals showed that in all the years, the combination treatment of Gramaxone 1.5 lit/ha. and Diuron 3 kg/ha as post emergence application at six months intervals is effective in controlling weeds in banana fields under Trichur conditions. The herbicide application did not produce any deleterious effects on plants and did not affect the yield.

Project No. : 2.3.1.
Studies on virus diseases of banana and their control

Experiment No.3.

Earlier trials with 30 varieties of banana indicated that the percentage of infection was comparatively low in varieties Bodles Alta fort, Pisang awak, Boodi Bontha batheesa, Karpooravally and Kanchikela. Later trials showed that Kanchikela possessed better tolerance when the plants became older i.e. about 4-1/4 months old. Experiments conducted in 1977-78 season indicated that the varieties Vadakkankadali, Sennachenkadali and Venettukumman were comparatively tolerant. Further trials are in progress.

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Project No. : Not assigned
 Frequency of application of nitrogen and potash to irrigated banana (variety Nendran).

The trial which was conducted in 1976-77 season indicated that in respect of vegetative parameters, the treatment differences were significant for height and girth of plants and not for leaf production. In respect of bunch characters, treatments 4 (N & K in two equal split doses at 30 and 150 days after planting) was superior although it was on a par with treatments 1, 3 and 2. These results indicated the necessity to repeat the trial under adjusted pH condition of the soil preferably in a new location. This experiment was hence discontinued in 1977-78 season as suggested by the Project Co-ordinator (Fruits).

Project No. : Not assigned
 Clonal variation studies in banana.

The experiment was first started in 1976-77 season. By conducting detailed survey in Trichur District, 538 single plant selections were made and planted during 1977-78 to study their performance. Based on average bunch weight (taking the average bunch weight as 11 kg) 80 selections were retained for further planting and study.

Project No. : Not assigned

Physiological basis of variation in yield between two varieties of banana viz. Nendran and Zanzibar.

This trial was newly taken up in 1976-77 season

Project No. : Not assigned

Physiological deterioration of seed material in banana - variety Nendran.

This trial was newly taken up in 1977-78 season.

Project No. : Not assigned

Induced mutagenesis in some banana varieties through irradiation and chemical methods.

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Experiment No.5.

The experiment was conducted for three years in succession from 1974-75. The results have revealed that both foliar and soil application of insecticides were effective in controlling the aphid population. Among the granular insecticides tried, Thimet and Disyston were very highly effective in controlling the insect vector Pentalonia nigronervosa.

Project No. : 2.3.2
Fungal diseases of banana and their control.

Earlier trials conducted in 1974-75 and 1975-76 showed that treatment differences were not significant in respect of yield eventhough the mean bunch weight obtained from the plots under Tr. Bordeaux mixture was more. The trial of 1976-77 also showed the same trend. The analysis of ripe fruits for different qualities indicated that the total sugar content was high in all treatment plots compared to control; maximum total sugar being noticed in ripe fruits under Tr. Bordeaux mixture. In respect of other qualities of fruits, the differences between various treatments were negligible.

Project No. : 2.3.5
Studies on nematode parasites of banana

i. The survey work is in progress. From the work so far conducted, it was revealed that 5 species of parasitic nematodes are present in banana roots and soils.

ii. Pot culture experiments showed that when the population of nematodes exceeded one hundred numbers in 10 gm of roots, the growth of the plants got retarded.

iii. Earlier trials conducted in 1974-75 and 1975-76 seasons had indicated that the extent of nematodes population in soil and root samples got reduced due to nematicide application. There was no significant differences in yield due to treatments. But the trial of 1976-77 season showed that the treatment differences were significant in respect of yield and all nematicidal treatments were superior to control. The plot treated with Nemacur gave maximum yield followed by Temik and Thimet.

The following new trials were undertaken with the concurrence of the Director, Horticultural Research Institute, Bangalore in 1976-77 and later many of them discontinued as suggested by the Project Co-ordinator (fruits), ICAR.

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The trial was commenced in 1976-77 season. As the number of daughter suckers produced by the irradiated mother plants was very few, no tangible data on morphological and productive aspects could be collected in VM2 generation. The experiment was also dropped as suggested by the Project Co-ordinator (fruits)

Project No. : Not assigned

Studies on the insect pests of banana and their control

The trial conducted in 1976-77 showed that none of the 10 varieties screened were resistant to pest attack. However, varieties such as Nendran, Zanzibar, Robusta, Dwarf cavendish and GrosMichel were more susceptible than Kanchikela, Njalipoovan, Talayankodan, Poovan and Pacha bontha batheesa. The trial is continued with another set of 10 varieties.

ii. Control of banana rhizome weevil by insecticide treatment of suckers.

The results of the trial of 1976-77 indicated that the insecticidal treatment of suckers reduced the incidence of pest besides increasing the bunch weight. The trial is continued.

iii. Control of banana rhizome weevil by the application of insecticides around the rhizomes.

The experiment was conducted for the first time in 1976-77 season. From the preliminary analysis of yield data, it was noticed that the insecticidal application besides checking the infestation of rhizome weevil, helped in increasing the bunch weight. The experiment is continued.

Project No. : Not assigned.

Population density trial in banana variety 'Robusta'.

The trial planted in 1976-77 season yielded the following results.

i. Tr.3 (single hedge method having 5000 plants/ha) and Tr.1 (square method accommodating 4900 plants/ha), accounted for maximum height and girth of plants at flowering phase but no significant difference between treatments was perceptible in respect of leaf production.

ii. In respect of average bunch weight the treatment differences were not significant.

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iii. Treatment differences were significant for per hectare yield of fruits and percentage of grade bunches, Tr.3 and Tr1. being superior for percentage of grade bunches.

iv. The increased population per ha. contributed for higher overall productivity but only at the expense of grade bunches.

v. Best cost benefit ratio was obtained for Tr.1 accommodating 49000 plants/ha. Based on the indications, the experiment was repeated during 1977-78 season by including one more method of planting viz. local method where 2310 plants/ha are accommodated giving a spacing of 2.4 mts. between rows and 1.8 mts between plants. The study is in progress.

Project No. : Not assigned

Ratooning trial in banana Dwarf cavendish varieties

The study which was conducted only in one season in 1976-77 indicated that varieties Monsmari and Giant Governor were more productive under ratooning than Robusta and Peddapacharati. But the average bunch weight obtained in all the varieties was unsatisfactory compared to the productivity of plant crop. So the experiment was concluded.

Project No. : Not assigned

Screening of different varieties against leaf spot disease.

Study undertaken in 1976-77 season to assess the comparative resistance of 143 varieties of banana against leaf spot disease showed that varieties Red banana, Chenkadali, Sennachankadali, Pisang lilin, Faka, Tomgate, Madakkalunnan and Thiruvanandapuram were more tolerant compared to other varieties.

B. PINEAPPLE

Project No. : 3.2.1
Population Density trial in
Pineapple variety 'Kew'.

The first series of experiment was started in 1974 and was concluded in 1977. The data on growth characters revealed that the differences in plant vigour as expressed by the number of leaves/plant and leaf area index were not significant due to different treatments. Sucker production was seen influenced by different spacings and not by method of planting. No significant difference existed for duration of crops under different treatments.

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The data on yield characters revealed that the average fruit weight with crown was not influenced by treatments but fruit weight without crown was seen influenced by spacings only; Spacing S4, S6, S2 and S5 being superior. Crown weight was not seen influenced by the method of planting, but spacing influenced the same, maximum population densities attributing for maximum weight of crowns. Significant differences due to spacings existed in respect of per hectare yield of fruits with and without crowns. Maximum population densities contributed for maximum per hectare yield. The cost benefit analysis showed that the treatment P1S5 was the most economical one followed by treatments P1S4 and P1S2 for per hectare yield with crown intact and treatments P1S4, P1S2 and P1S5 for per hectare yield devoid of crowns. On an overall analysis, it appeared that the treatment P1S4 accommodating 59, 259 suckers/ha was most advantageous. This treatment had the spacing 75 cm between trenches which was found to be inadequate if ratooning of the crop is resorted to- In view of the fact that ratooning is practiced in Kerala, the treatment P1S2 accommodating 53,333 suckers/ha. allowing interspaces of 90 cm between trenches, 60 cm between rows and 25 cm between plants was recommended for the time being in package of practices for adoption. The series II experiment started in 1976 is continued.

Project No. : 3.2.2.

Nutritional studies in pineapple variety 'Kew'.

The series I experiment started in 1974 was completed. The results showed that in respect of average fruit weight with crowns, the effects due to Nitrogen levels were not significant whereas method of application of Nitrogen influenced the same, M1, M4 and M2 methods being superior to M3 method of application. Both N levels and method of N application did not influence TSS and acidity of the fruits. Reducing sugar, non-reducing sugar, total sugars and sugar acid ratio were found to vary significantly due to nitrogen levels and methods of application. M1M4 contributed for maximum reducing sugars in fruits; whereas in respect of other qualities N₂M₄ was superior. Thus the experiment had shown that 8 gm nitrogen per plant per year applied all in soil was superior for yield helping in improving the status of reducing sugars in fruits. For betterment of other qualities, 12 gm nitrogen/plant/year was superior. The dosage of 16 gm Nitrogen/plant/year was found to impair the qualities of fruits.

The series II experiment started in 1976-77 is continued and collection of data is in progress.

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Project No. : 2.2.3. Effect of plant growth regulators of fruit size and maturity of pineapple 'Kew' variety.

The first series of experiment planted in 1974 was completed as an observational trial. The data collected on growth features, maturity, mean fruit weight, quality of fruits etc. indicated that in general the trend was in favour of spraying 100 ppm Planofix on fruits one month after the visible signs of the inflorescence.

In 1976-77 season another trial was laid out statistically which is yet to yield results and hence continued.

Project No. : 3.2.4 - Standardisation of time of application of growth regulators (ethrel) for materials RAISED from suckers and crowns.

The observational trial conducted during 1974-76 had indicated that 500 ppm ethrel was effective in inducing good percentage of flowering (73.82 to 89.71) in crowns of ages 16, 17, 18, 19 and 20 months, the maximum effect being in crowns of 17 to 20 months. The average fruit weight obtained from suckers was found to be more compared to the fruits of crowns. The trial was repeated by planting in 1976 season in BB design. Data on vegetative parameters, extent of flowering and productivity are being collected. The data so far collected indicated that suckers respond well to the application of the growth regulator from 14th month of age. In control plot, flowering occurred only when the plants attained the age of 19 months. In crowns also, all age groups responded well to growth regulator application. However, final data on yield are yet to be received.

Project No. : 3.2.5 - Control of weeds in pineapple with herbicides.

The series I trial conducted in 1974-76, showed that among various treatments, diuron @ 3 kg/ha. applied as pre-emergence and repeated at half dose five months after the first application was very effective in controlling a broad spectrum of weeds in pineapple plot. In respect of yield also, this treatment excelled the others giving increased yield thereby more profit. Under prevailing wage rates, herbicide application was found to be more economical. The survey of weed flora indicated the existence of 41 types of weeds in the locality of which 20 were of major importance. The series I trial started in 1976 is in progress.

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Project No. 3.3.1 - Survey and assessment of diseases in pineapple.

The observations recorded in 1977-78 season indicated the presence of a mild infection of leaf blight disease in pineapple. The fungus was isolated and identified as prechslera hawaisensis. The symptomatology of the disease was studied.

Project No. : Not assigned

Studies on the effect of growth regulators in inducing flowering in 'Kew' Pineapple.

The first observational trial conducted in 1974-76 season indicated that ethrel at 500 ppm and 1000 ppm concentrations were most effective in inducing maximum flowering in pineapple suckers of age 14-1/2 to 16 months in plant crop season.

The second series of observational trial conducted in 1976-77 season during the months from November to May using different growth regulators at different concentrations on plant crop of 16 months old and ratoon crop of 11-12 months old showed that concentrations of ethrel alone at 1000 ppm and 500 ppm and combination treatment of ethrel at 100 or 25 ppm with 2% urea and 0.04% calcium carbonate contributed for maximum extent of flowering in all the months. Ethrel in combination with urea and CaCO₃ was exceptionally good. Acimone was found to be least effective. Of the eight characters studied, treatment differences were significant only in respect of mean weight of fruits without crowns and L/B ratio. The highest value for fruit weight was recorded by Tr.6 (Acimone 10 ppm) followed by Tr.4 (ethrel 100 ppm + 2% urea + 0.04% CaCO₃) with reference to L/B ratio of fruits, Tr.4 and Tr.6 were again superior. The mean weight of crown was high in plants subjected to Acimone treatment. In all most all the cases, the fruits possessed multiple crowns, the maximum number being in plants treated with ethrel combination. The cost involved for the application of the three best treatments revealed that the treatment 25 ppm ethrel + 2% urea + 0.04% CaCO₃ was the cheapest involving the cost of 1.2 paise/plant, the next best being combination treatment of 100 ppm ethrel involving an expenditure of 1.53 paise/plant as against the expenditure of 3.11 paise/plant in case of treatment 500 ppm ethrel. Besides, the combination treatments of ethrel were effective in both plant crop and ratoon crop.

The third series of observational trial to evaluate the efficacy of different chemicals and growth regulators in inducing flowering in pineapple during the different months of the year commencing from May 1976 to February 1977 was taken up using three doses of ethrel (100 ppm, 500 ppm and 1000 ppm), three doses

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of planofix (20 ppm, 30 ppm and 50 ppm), coarsely ground calcium carbide and ice water, Acinone at 10 ppm and the combination of 100 ppm ethrel with 2% urea and 0.04% calcium carbonate. The trial was conducted both on suckers of plant crop and ratoon crop. The percentage of flowering was recorded at periodical intervals and the seasonal performance was assessed adopting the techniques suggested by Finlay and Wilkinson (1963) and Eberhart and Bussel (1966). The data revealed that in general, maximum percentage of flowering could be observed in the applications made in October, November and December indicating the maximum efficacy of growth regulators just prior to the anticipated natural flowering. Among the various treatments tried, combination treatment of ethrel, urea and CaCO_3 was found to be reasonably good in the off season of June-July also. From the economic point of view also, this treatment was found to be cheaper.

In order to gather more details and to get conclusive results, a new statistically laid out experiment was started in 1976 season which is in progress. The data so far collected indicated that the growth regulator application was effective only when the plants attained the age of 13 months.

Project No. : Not assigned

Adaptive trial to compare the results of research so far obtained with local practices.

This trial was started for the first time in 1976 season and it is in progress. Observations on vegetative growth of plants, weed growth, flowering and yield (assessed) were recorded. The cost of cultivation and estimated yield with cost benefit analysis were also worked out. The observations revealed that the plants under Tr.1 (improved practices) were more vigorous in vegetative growth from the beginning. The growth regulator application was highly beneficial producing 96.83% flowering in plants under Tr.1 (improved practices) as against 67.20% in Tr.2 (local practices). Even the extent of flowering 67.20% in Tr.2 should be considered in usual as the same had occurred due to very favourable weather existed during the North east monsoon period of the year, as under normal circumstances flowering under natural conditions to a tune of 30 to 40% alone can be expected. It was also noticed that the flowering in Tr.2 started only when the plants attained age 19 months that to in protracted nature. The weedicide application in Tr.1 was also beneficial in controlling a broad spectrum of weeds. The additional cost of cultivation for Tr.1 compared to Tr.2 worked out to Rs.1823.83. While the average fruit weight with crown was 1.92 kg in Tr.2, the same was only 1.50 kg in Tr.1. The low fruit weight in

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Tr.1 was attributable to high density of population. The computed cost figures for plot yields of the two treatments indicated that while Tr.1 attributed for a profit of ₦.827.52 within two years of planting, Tr.2 ended in a loss of ₦.609.57. This aspect clearly showed the imperative necessity for taking ratoon crops in pineapple under local system of cultivation. The experiment is being continued for gathering further details.

Significant findings obtained at the centre under All India Co-ordinated Fruit Improvement Project.

A. B A N A N A

1. The varietal collection consisted of 158 varieties of banana. Observations revealed that Monthan group is comparatively drought resistant and highly suited for cultivation under rainfed conditions in Kerala for culinary purposes. Based on the studies the following varieties were found promising.

A. DESSERT TYPES:

1. Dwarf
 - i. Monsmari
 - ii. Giant Governor
 - iii. Robusta
 - iv. Dwarf Cavendish

2. Tall
 - i. Grosnichel
 - ii. Chenkadali
 - iii. Poovan
 - iv. Palayankodan
 - v. Njalipoovan
 - vi. Amritsagar
 - vii. Karpooravalli
 - viii. Poonkalli

3. Nendran group
 - i. Nedunendran
 - ii. Zanzibar

B. CULINARY VARIETIES:

- i. Monthan
- ii. Batheesa
- iii. Kanchikela
- iv. Nendrapadathy

Biometrical analysis of morphological characters and fruit qualities is in progress.

2. Among the various available mutants of cavendish banana at this station, the variety Monsmari produced bunches of better weight. Its fruits were of larger size and contained higher sugar and lesser acidity. Multilocational trials have been laid out to assess its performance in different localities.
3. The trials on the study of nutritional requirements of banana

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conducted for four years, indicated that the effect due to nitrogen at the levels tried was not significant, but the yield response was significant to phosphorus and potassium levels, the optimum being outside the levels tried for the soil existing in the Banana Research Station, Kannara. The fertility status of the soil is nitrogen high P_{25} and K_{20} medium and pH in the range of 4.5 - 4.9. The trend of the results indicated the necessity for conducting more comprehensive trials under adjusted pH conditions preferably in a new location.

4. The response of banana crop to micronutrient application in soil was erratic.
5. The survey of weed flora of banana plantation indicated the presence of 36 types of weeds of which 13 were of major importance. Weedicide application was found to be very effective in controlling a broad spectrum of weeds. Among the various herbicides tried, post emergence application of a combination of gramaxone 1.5 lit. and Diuron 3 kg/ha. at six monthly intervals was found to be the best, next best treatment being the combination treatment of gramaxone 1.5 lit. and 2,4, DNa salt one kg per hectare. Among the above two treatments application of gramaxone 1.5 lit + 2,4, DNa salt 3 kg/ha. was found to be more economical. The herbicide application did not adversely affect either the growth of plant or productivity.
6. The studies undertaken on the incidence of diseases in banana and their control have yielded the following results.

On banana three diseases viz. Bunchy top, leaf spot and Kokkan are most important in Kerala. The survey on the incidence of bunchy top disease in various districts of Kerala revealed that the maximum percentage of infection was in Nendran, Red banana, Poovan, Palayankodan and Robusta.

The screening of varieties of banana so far conducted against bunchy top disease by artificial inoculations showed that the varieties Bodles Alta Fort, Pisang awak, Boodithabontha batheesa, Karpooravally, Kanchikela, Vadakkan kadali, Senna chenkadali and Vennettu kunnan were comparatively tolerant to bunchy top disease when compared to other varieties tried. It was interesting to note that older plants (4-1/4 months) of Kanchikela exhibited better tolerance to disease.

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Both soil and foliar applications of insecticides were effective in controlling the insect vector (Pentalonia nigronervosa) of bunchy top disease thereby bringing reduction in the disease incidence. Among the granular insecticides tried Thimet and Disyston were very highly effective.

The leaf spot disease of banana was found associated with two fungi viz. Cercospora musae, and cordona musae. Spraying with bordeaux mixture 1% was found to be very effective. This treatment contributed for higher mean bunch weight. The analysis of the ripe fruits for various qualities indicated that the percentage of total sugar was more in all the treatments compared to control, the best treatment being spraying with Bordeaux mixture.

7. The survey on the incidence of parasitic nematodes in banana indicated the presence of the following five species of parasitic nematodes.

1. Radopholus sp.
2. Pratylenchus sp.
3. Helicotylenchus sp.
4. Criconemoids sp.
5. Meloidogyne sp.

Pot culture experiments conducted to assess the pathogenic effects using different levels of population of Radopholus similis indicated that the plant growth got retarded when the population of nematode exceeded the level of 100 numbers in 10 gm. of roots.

The evaluation of different nematicides for the control of parasitic nematodes of banana indicated that there was reduction in the number of parasites due to application of nematicides, significant difference in population being noticed between treated and control plots. In control plot the population exceeded the normal pathogenic level. Maximum bunch weight was obtained from the plots treated with Nemacur, Thimet and Themik.

8. The trial conducted to determine the optimum time and frequency of application of nitrogen and potash to nendran banana under irrigated conditions indicated that in respect to mean bunch weight, Tr.4 (N and K) in two equal split doses at 30 and 150 days after planting) was superior.

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9. The screening of varieties against the attack of banana rhizome weevil revealed that none of the varieties tested was resistant to pest attack. The varieties Nendran, Zanzibar, Robusta, Dwarf Cavendish and Gros-michel were more susceptible than Kanchikola, Njalipoovan, Palayankodan, Poovan and Pachabontha batheesa. Insecticidal treatments of suckers and application of insecticides around the rhizomes helped to reduce the infestation of the weevil and increased the bunch weight.
10. The population density trial in banana variety Robusta indicated based on cost benefit analysis that a population of 4900 suckers/ha was acceptable, but further trials comparing the local practice of accommodating 2310 suckers/ha with the above however appears necessary.
11. In the ratooning trial of Dwarf cavendish varieties of banana under irrigated conditions, Monsmari and Giant Governor exhibited the superiority in production. But in as much as the average bunch weight obtained was unsatisfactory in the ratooned crop when compared to plant crop, it was felt that these varieties did not deserve ratooning.
12. The work on screening of 143 varieties of banana against leaf spot disease showed that Red banana, Chenkadali, Senna chenkadali, Pisang lilin, Pakka, Tongate, Adakkakunnan and Thiruvananthapuram were more tolerant than other varieties.

B. PINEAPPLE

1. Planting of higher population of suckers in unit area helped to increase yield of pineapple considerably. Of the various treatments P1S5 (61666 suckers/ha), P1S4 (59259 suckers/ha) and P1S2 (53333 suckers/ha) were found superior for yield. On an overall analysis it appeared that the treatment P1S4 (59259 suckers/ha) was most advantageous. But in this treatment the spacing between trenches being 75 cms, difficulty arose in the maintenance of the crop in the subsequent ratoon seasons. Therefore, the treatment P1S2 (53333 suckers/ha) allowing inter-spaces of 90 cms between trenches, 60 cm. between rows and 25 cms between plants was found to be more beneficial as against the conventional cultivation practice of planting suckers adopting a spacing of 45 cm x 60 cm x 180 cm (15000 suckers/ha.)

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2. Soil application of nitrogen fertilizer was found to be better than foliar + soil application for pineapple. Nitrogen levels and method of N application did not influence TSS and acidity of fruits. The lowermost dosage of 8 gms N/plant/year contributed for higher reducing sugars in fruits. In respect of other qualities of fruits viz. non-reducing sugars, total sugars and sugar acid ratio Nitrogen level of 12 gm/plant per year was superior. Soil application of N was significantly superior for all the characters studied.
3. Survey of weed flora of pineapple plantation indicated the presence of 41 types and varieties of weeds of which 20 types were of major importance. Application of herbicides was found to be very effective in controlling a broad spectrum of weeds in pineapple plantation. Among the treatments tried, Diuron 3 kg per hectare applied as pre-emergence and repeated at half dose five months after first application was found to be not only superior, but also was more economical than hand weeding under the prevailing wage rates. This treatment helped in increased production of fruits by 15% thereby ensuring higher profit. The herbicide treatment was not detrimental to the plants or to the quality of fruits.
4. A mild incidence of leaf blight disease was noticed in pineapple and the causative fungus was identified as Drechslera hawaiiensis.
5. The first series of observational trial conducted in 1974-76 season indicated that Ethrel at 500 ppm and 1000 ppm concentrations were most effective in inducing maximum flowering in pineapple suckers of age 14-1/2 to 16 months in plant crop season. The second series of observational trial conducted in 1976-77 season during the month from November to May using different growth regulators at different concentrations on the plant crop of 16 months old and ratoon crop of 11-12 months old indicated that besides ethrel alone at 1000 ppm and 500 ppm dosages, combination treatments of Ethrel at 100 ppm and 25 ppm with 2% urea and 0.04% of calcium carbonate were very effective, combination treatments being exceptionally good for both plant crop and ratoon crop. The treatment 25 ppm ethrel + 2% urea + 0.04% calcium carbonate was the cheapest involving a cost of 1.2 paise/plant. The third series of observational trial to evaluate the efficacy of different growth regulators in inducing flowering during the different months of the year commencing from May 1976 to January 1977 indicated that maximum percentage of flowering was observable in the applications made in the months of October, November and December, just prior to anticipated natural flowering period of pineapple. Among the

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various treatments, combination treatment of ethrel, urea and calcium carbonate was found to be reasonably good in the offseason of June-July provided rains did not advance or precede application atleast a day.

6. The adaptive trial laid out to compare the results of research so far obtained with local practices proved the advantages of adopting high density planting, herbicide application and growth regulator application. While the improved practices ensured profit within two years of planting based on computed figures for yield, the local practice ended in loss showing the imperative necessity for adhering to ratooning under local practice of cultivation.

RESULTS FIT TO BE PASSED ON TO
EXTENSION

7. Results fit to be passed on to Extension

A. BANANA

1. The studies undertaken in germ plasma collection of banana have shown that four dwarf varieties, eight tall varieties, two Neendran varieties and four culinary varieties are most promising and deserve further multiplication and popularisation.
2. Under Kerala conditions, Monsnari variety, a cultivar of dwarf cavendish banana is highly productive producing bigger fruits possessing higher sugar content and lesser acidity. This cultivar from Queensland has significance as an export banana in eastern Australia and Martinique. This variety has been put under multilocation trials.
3. For controlling weeds in banana plantation a post emergence application of a combination of Gramaxone 1.5 litres/ha and Diuron 3 kg/ha at six monthly intervals or a combination of Gramaxone 1.5 litres/ha and 2, 4 DNa salt 3 kg/ha were found to be very effective under Trichur conditions. The latter treatment is found to be cheaper although it is second best.
4. Application of granular insecticides viz. Thimet and Disyston were found highly effective in reducing the aphid population which is responsible for the spread of bunchy top disease in banana.
5. Nematicur, Themik and Thimet were found to be very effective nematicide in banana plantation
6. Ratooning of Dwarf cavendish varieties of banana under irrigated conditions was found to be not economical considering the yield obtained in plant crop season.

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B. PINEAPPLE

1. A population density of 53333 suckers/ha with spacing of 25 cms between plants, 60 cm between rows and 90 cm between trenches was found to give increased yield in pineapple with acceptable cost benefit ratio. Depth of trenches had no significant effect on yield.
2. Application of herbicide, Diuron @ 3 kg/ha as pre-emergence spray and repeated half dose five months after first application was found to control a broad spectrum of weeds in pineapple plantation. The treatment was not only more economical than hand weeding under Kerala conditions but also helped in increasing the yield without producing any deleterious effects.
3. Application of Ethrel at 25 ppm in combination with 2% urea and 0.04% calcium carbonate was found to be very effective in inducing maximum flowering in pineapple both in plant crop and ratoon crop seasons. This treatment was cheapest involving an expenditure of 1.2 paise/plant. Although maximum benefit due to growth regulator application was observable at the period of anticipated natural flowering in pineapple, this treatment was reasonably good during the offseason of July provided hazards due to rains do not occur.
4. The treatments included under improved practices in adaptive trial are fit to be passed on to the cultivators as evidenced by the results.

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B. LIST OF PUBLICATIONS

The following articles were published/await publication.

A. SCIENTIFIC ARTICLES:

a. Banana

1. Studies on the performance of some mutants of cavendish banana (Agri. Res. J. Kerala)
2. Response of Nendran banana to different levels of N, P and K (Agri. Res. J. Kerala, 1977, 15(1) 37-40)
3. Optimum plot size for field trials with banana (Agri. Res. J. Kerala)
4. Control of Rhizome weevil (cosmopoliten sordidus) and banana aphid (Pentalonia nigronervosa) by the use of granular systemic insecticides (Agri. Res. J. Kerala, 1977, 15(1) 97)
5. Effect of weight of suckers of Nendran banana on plant growth and yield (Agri. Res. J. Kerala)

b. Pineapple:

6. Pollination studies in pineapple varieties (Agri. Res. J. Kerala 1976, 14(2)113-117)
7. Herbicidal control of weeds in pineapple variety 'Kew' (Agri. Res. J. Kerala 1976, 14(2)132-137)
8. Simple and partial correlation of some quantitative trials with the yield of pineapple (Agri. Res. J. Kerala)
9. Influence of planting suckers in level ground and in trenches of different depths on fruit yield of pineapple (Agri. Res. J. Kerala)
10. A note on germinating seeds of pineapple (Agri. Res. J. Kerala, 1976 14(2) 194-195)
11. A comparative study of certain fruit qualities of twenty pineapple varieties (Agri. Res. J. Kerala)
12. Efficacy of certain growth regulators in inducing flowering in pineapple (Agri. Res. J. Kerala)

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13. Estimation of leaf area in pineapple
(Research Note) Agri. Res. J. Kerala.
14. Seasonal behaviour of plant growth regulators in inducing
flowering in pineapple
(Agri. Res. J. Kerala)
15. Growth and yield of pineapple variety Kew as influenced by
planting densities.
(South Ind. Hort. J)
16. Effect of shade on flowering in pineapple (Paper presented
during the annual symposium of plantation crops in April 1972).
17. Preliminary studies on the stimulatory effect of certain doses
of Gamma rays in Kew pineapple.
(J. of Nuclear Agriculture and Biology (ISNA))

B. Popular articles.

1. Selection of banana suckers for planting - Kalpadhemu
July-August 1976
2. Pineapple cultivation
Kalpadhemu July-August 1976
3. Pineapple cultivation -
Mathrubhumi Karshikaranga Supplement dated 27.10.1976
4. Weed control in pineapple plantation -
Kalpadhemu March-April 1977
5. Monsmari - Kalpadhemu May-August 1977
6. Banana cultivation
Paper presented during Agricultural Production Seminar held
in connection with the inauguration of the Main Campus
of KAU in 1977.
7. Pineapple cultivation - Paper presented during Agricultural
Production Seminar held in connection with inauguration of KAU
Main Campus in 1977.
8. Neudran banana cultivation
Paper presented in the Banana Development Seminar held at
Kalady under the auspices of Department of Agriculture, Kerala
State in November 1977.

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9. Important disease of banana and their control - Kalpadhenu

9. ADDITIONAL INFORMATION:

1. Under the Village Adoption Programme, a Scheme for laying out six demonstration plots in pineapple to popularise the results of research so far obtained was sanctioned by the Kerala Agricultural University. As per the scheme, six demonstration plots sanctioning subsidies have been laid out during May-June 1977 and the same are in progress.

Signature of Head of
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TABLE 1
BIOLOGICAL STUDIES ON THIRTEEN MORPHOLOGICAL CHARACTERS OF BANANA

A. DESSERT TYPES.

S.No.	Name of varieties	Height in cm	Girth in cm	No. of leaves produced	Weight of hands	Weight of fruits	Weight of bunch	No. of fruits	Length of fruits	Diameter of fruits	No. of hands	No. of fruits per hand	Length of diesel	No. of roots per plant
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1.	Nendrakunnam	305.0	70.67	32.33	1300.53	79.67	9.67	99.0	12.80	9.63	7.33	13.43	87.0	318.0
2.	Peykunnam	331.67	81.0	26.67	1038.27	70.47	17.67	154.67	10.9	8.77	13.33	13.8	132.33	226.33
3.	Valiyakunnam	263.67	67.33	32.67	1058.20	75.83	10.33	114.67	12.67	11.03	7.67	15.30	76.33	..
4.	Kodupilla kunnam	258.67	68.67	27.0	766.4	76.2	9.47	118.0	15.33	10.77	11.0	10.77	84.0	..
5.	Thenkunnam	268.67	72.33	31.33	655.67	42.47	8.50	156.67	11.07	8.70	10.67	14.83	84.67	235.67
6.	Poochakunnam	297.67	80.00	28.00	529.69	33.33	6.33	214.0	9.40	8.47	12.67	16.90	86.33	239.00
7.	Adukkakunnam	277.0	74.67	29.33	480.67	26.13	5.67	175.33	6.33	6.67	10.33	10.87	62.33	279.00
8.	Selection 2	267.33	65.00	31.00	893.67	59.07	8.17	138.33	12.11	10.73	8.33	16.99	73.67	134.00
9.	Selection 1	288.9	75.33	30.33	1135.67	79.13	16.47	176.33	11.77	8.93	10.0	17.73	103.33	269.00
10.	Rasthali	284.67	83.33	28.00	519.97	46.93	6.83	126.0	10.13	8.43	8.33	15.13	57.0	..
11.	Neypoovan	666.87	44.87	9.17	184.33	11.0	8.60	10.67	17.57	78.0	231.67
12.	Tomgate	246.0	63.67	30.0	731.33	47.93	10.17	153.33	11.20	9.07	10.0	15.33	88.33	..
13.	Njalippovan	321.67	72.0	32.67	728.37	47.53	12.33	177.33	10.10	9.33	10.67	16.67	78.33	..
14.	Ayiramka poovan	300.0	65.67	31.0	637.03	53.77	18.00	261.0	10.47	6.87	21.33	12.27	108.0	..
15.	Poovan	294.67	72.67	30.67	858.63	77.90	10.53	109.67	11.73	9.80	7.67	14.33	89.0	..
16.	Chenkadali	1003.00	88.00	26.20	3284.0	303.67	19.5	85.00	17.87	16.50	5.33	15.90	77.67	277.00
17.	Redbanana	323.67	77.00	29.00	2758.33	170.40	19.00	94.33	16.70	15.17	6.00	15.73	84.00	279.33

Table 1 continued

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
18. Ambalakadali	366.67	66.67	31.67	780.67	45.73	9.67	164.33	10.33	9.67	9.67	16.87	88.00	354.33	
19. Vadakkan kadali	348.33	70.33	32.67	610.00	32.33	9.83	230.33	9.23	8.30	12.67	18.17	78.67		
20. Chakkarakadali	234.00	61.33	29.33	810.27	48.07	8.00	87.00	12.43	9.10	7.00	12.43	56.00	218.33	
21. Karinkadali	252.33	58.00	30.67	921.87	74.00	8.17	89.00	16.50	8.37	6.67	13.33	80.00		
22. Monsnari	182.67	58.00	29.33	813.70	63.53	10.33	97.73	15.47	9.77	7.67	12.77	53.33	263.67	
23. Amritsagar	130.33	63.67	27.00	1043.00	94.20	6.50	58.67	17.43	10.43	5.00	11.78	61.67	204.33	
24. Robusta	220.00	72.00	28.33	1213.17	104.67	13.57	115.00	16.7	12.57	8.33	13.20	105.67	189.67	
25. Peddapacha arathy	232.67	65.67	27.00	1380.00	96.50	12.17	118.67	13.63	10.37	8.00	13.20	115.67	246.67	
26. G.G.	161.00	57.33	30.00	1459.67	115.47	12.73	104.33	17.17	9.80	7.00	14.70	93.67	224.33	
27. Wather	255.67	68.33	26.67	1920.00	185.50	12.93	78.00	19.00	16.30	5.67	13.63	84.67	187.67	
28. Harichal	260.00	60.33	29.00	1071.53	70.57	11.00	112.67	17.43	10.00	8.00	14.07	115.33	169.33	
29. High Gate	244.00	68.00	28.00	1450.50	85.10	12.83	150.00	16.13	11.17	10.00	15.00	63.00	153.00	
30. Grosnichel	305.00	66.00	30.67	1268.23	89.53	11.33	105.33	17.23	10.30	8.00	13.13	59.33	182.67	
31. Sapumialaner- malu	236.33	57.67	28.00	858.73	63.63	7.67	98.33	16.20	9.60	7.67	12.87	73.33	211.67	
32. Mouritius	173.33	62.33	29.00	1284.73	91.53	129.33	107.0	15.93	8.90	7.67	13.71	74.33	182.67	
33. D.C	118.67	61.00	29.67	1408.33	105.27	13.13	118.00	16.27	10.87	8.00	14.77	81.67	152.67	
34. Binkehel	170.00	68.33	29.00	1145.63	96.13	12.83	117.67	16.10	11.70	8.00	17.57	85.00	158.67	
35. Lacatan	270.00	69.33	28.33	1043.00	35.83	9.50	116.33	17.67	10.30	6.33	18.60	74.83	134.67	
36. Vamanakeli	156.00	61.67	30.33	1135.00	81.67	10.50	105.67	18.60	10.63	7.67	13.27	72.33		
37. Nakasullulu				816.27	75.67	7.50	72.33	13.00	11.80	4.67	11.77	47.67	144.33	

Table 1 continued....

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
38. Pisang embon	300.00	68.67	30.33	1158.90	71.00	9.33	113.00	14.67	10.17	8.00	14.20	67.00		
39. Marthaman	234.00	74.00	32.33	606.33	409.13	7.33	130.67	10.67	80.67	9.00	14.50	82.00		
40. Pachachingau	310.00	71.00	30.33	1198.37	81.83	10.33	101.33	15.90	11.23	7.00	14.47	61.00		
41. Sikusani	172.33	55.67	25.33	686.93	37.70	5.67	93.67	16.10	7.60	6.67	14.10	61.32	296.53	
42. Chingan	205.33	70.67	29.00	553.73	53.03	4.50	77.67	14.37	8.90	6.67	11.70	51.33	307.33	
43. Matti				644.44	36.03	5.17	114.00	12.27	8.03	7.67	14.87			
44. P.Lilin	129.00	39.00	24.00	425.00	32.50	3.33	60.67	11.33	8.43	5.00	12.13	59.67	187.67	
45. Pachanañan	201.00	72.33	30.00	756.70	76.73	8.17	87.67	12.83	11.57	6.67	13.17	62.33	299.67	
46. Sirumalai	316.67	70.33	27.33	585.57	57.23	5.83	85.67	11.83	10.50	6.67	12.80	80.00	242.00	
47. Charapunchi	319.33	87.67	33.33	1071.30	64.70	14.33	211.00	11.77	10.73	12.33	17.20	85.00		
48. Charapadathy	297.33	57.33	26.33	988.57	73.87	6.83	82.33	12.20	11.00	6.67	12.40	81.67		
49. Thiruvanan- thapuran	246.33	70.33	27.00	935.00	70.20	8.00	80.67	13.47	10.70	7.33	12.23	82.33	189.33	
50. Ladiesfinger	292.67	68.67	30.00	1121.60	76.87	8.67	88.00	11.53	11.33	6.33	13.90	89.67	241.67	
51. Nendrapadathy	208.33	73.33	29.67	1433.63	101.93	8.83	98.00	15.00	11.83	7.33	13.37	86.00	218.00	
52. P.Raja	238.67	74.33	32.67	1158.30	87.53	10.90	97.33	15.77	10.50	7.33	13.30	111.67		
53. Radja	302.00	79.67	31.67	1115.50	63.10	11.17	155.33	13.00	8.93	8.33	16.20	62.67		
54. Chimali	202.33	73.00	32.67	1567.20	123.17	11.83	114.53	15.17	9.90	7.67	14.80	112.00	228.67	
55. Krishnavashai	284.00	77.00	31.00	875.47	65.63	8.00	100.00	10.87	0.63	6.33	18.17	79.00	213.67	
56. Sira	201.67	57.00	25.33	1699.67	126.97	5.83	56.00	19.57	12.33	4.33	12.80	57.67	247.67	
57. Virupakshy	291.33	70.00	31.00	1045.43	72.30	8.57	90.00	12.65	11.13	6.33	13.03	66.00	210.67	
58. Radjasirah	294.00	69.67	31.33	1692.57	140.10	10.50	83.67	16.60	12.60	6.00	13.90	87.33	811.00	
59. Adukkan	248.67	69.00	30.00	707.83	53.17	6.50	110.33	11.00	9.03	8.00	14.57	49.00	214.00	
F.Values	42.52*	9.65*	41.97*	299.99*	36.95*	16.06*	41.02*	27.79*	135.0*	49.21*	55.47*	43.2*	106.15*	

TABLE 2

B. CULINARY TYPES:

S.No.	Name of varieties	Height in cm.	Girth in cm	No. of leaves produced	Weight of hands	Weight of fruits	Weight of bunch	No. of fruits	Length of fruits	Diameter of fruits	No. of hands	No. of fruits/hand	Length of pedicel	No. of roots/plant
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1.	Nallabatheesa	270.67	70.00	33.00	613.03	47.59	12.33	221.67	11.05	8.79	16.33	13.74	97.00	204.67
2.	Nanguneri Peyan	287.67	79.00	34.67	700.60	49.68	11.50	114.67	10.05	9.98	9.00	13.66	70.33	232.00
3.	Jawa	284.67	80.00	30.67	607.39	31.89	9.33	155.67	10.35	8.07	9.33	16.96	65.33	277.67
4.	Hybrid Sawai	290.00	76.67	31.67	1557.17	99.01	13.00	133.00	10.92	11.42	8.67	15.83	78.67	196.00
5.	Gounia	303.33	73.67	32.00	1149.27	73.61	13.50	129.00	13.57	10.93	9.67	13.76	82.87	315.00
6.	Erachivazhai	212.00	62.67	30.67	1058.67	69.63	7.40	90.33	19.00	10.00	6.67	19.13	79.17	122.00
7.	Dakshin sagar				2000.33	162.94	14.17	78.00	20.72	14.72	6.00	13.00	97.83	189.00
8.	Boodi	289.33	78.00	33.00	1080.73	91.23	14.50	151.67	11.38	10.41	9.33	16.47	82.50	185.33
9.	Ennabanian	204.33	69.67	30.00	880.37	64.01	5.33	80.00	14.25	10.55	7.67	11.35	74.33	205.33
10.	Sawai	288.00	80.00	32.00	1218.18	95.71	11.17	96.00	11.45	13.85	7.00	13.71	54.00	187.67
11.	Pisang awak	299.67	78.67	32.33	884.12	55.79	13.67	221.77	10.04	8.80	12.67	17.52	95.00	347.67
12.	Peykunnan	331.67	81.00	31.67	1003.88	68.73	20.17	275.33	10.27	8.37	15.00	18.36	134.67	203.67
13.	Neymannan	272.67	78.00	33.33	1348.33	98.57	15.17	133.67	13.42	11.26	8.00	16.71	64.50	191.33
14.	Alukahel	262.00	77.33	33.67	1309.00	105.50	10.33	84.00	14.50	12.63	6.33	12.71	72.67	236.33
15.	Bainsa	340.00	75.33	30.33	1628.07	145.00	13.83	77.33	16.50	14.42	6.00	12.89	102.00	218.00
16.	Bluggoe	295.67	68.67	31.33	1802.57	152.00	11.17	58.33	16.33	14.35	5.00	11.67	78.83	268.00

Table 2. contd.....

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
17. Malai Monthan	295.67	73.33	31.00	1806.78	153.32	13.33	79.00	20.00	13.13	6.00	13.90	68.33	270.67	
18. Samprani Monthan	315.00	72.67	31.67	1352.53	119.50	8.50	54.67	15.60	13.30	5.00	10.93	92.17	205.00	
19. Nalla Bontha	346.67	73.00	28.33	2068.27	189.18	14.00	75.00	16.74	15.82	6.00	12.50	103.33	277.00	
20. Monthan	343.33	73.67	30.67	1542.60	141.43	13.17	79.67	17.40	14.57	6.67	11.96	77.83	271.00	
21. Booditha Bontha batheesa				918.00	71.57	20.50	254.00	13.30	9.26	18.33	13.85	149.67	196.00	
22. Kanchikela	303.33	73.00	31.00	156.03	124.50	14.50	105.33	18.13	13.45	8.00	13.17	81.83	197.00	
23. Ashy batheesa	306.67	73.33	30.00	943.33	74.67	16.83	185.00	13.92	11.31	14.00	13.50	102.83	268.33	
24. Pachabontha batheesa	311.67	73.00	27.67	2369.00	217.17	12.17	61.00	19.83	25.38	5.00	12.13	74.67	241.67	
25. Karibontha	335.00	71.33	30.67	1733.47	155.05	13.17	73.33	16.67	14.89	6.33	11.77	54.33	237.33	
26. Ash monthan	340.00	73.33	31.67	1447.33	117.00	9.83	56.67	17.83	14.30	5.33	10.69	98.17	138.67	
27. Kapur	321.33	69.67	29.00	535.40	25.70	8.33	131.67	11.65	8.43	7.33	15.85	65.33	285.67	
28. Walha	317.33	75.67	32.33	353.93	275.99	16.33	201.00	13.38	10.00	13.30	15.46	138.66	167.00	
29. Chetty	322.00	75.00	31.67	2177.33	175.33	11.33	57.00	18.37	23.66	5.33	10.77	79.00	221.33	
30. Neyvannan	302.67	75.33	32.00	971.17	55.00	9.00	87.00	12.38	10.22	7.33	12.32	62.17	228.33	
31. Vannan	283.67	70.00	29.00	1014.17	71.33	6.50	68.00	12.30	12.33	6.00	12.76	83.83	234.00	
32. Mannan	292.33	74.00	30.00	1161.93	77.04	7.67	108.33	12.49	9.58	8.00	13.50	48.00	210.67	
F. Value	6.87*	2.91*	3.91*	192.31*	323.02*	18.37*	44.07*	156.60*	7.78*	26.23*	3.44*	196.46*	135.9	
*Significantly different														
Range in mean values					156.03	31.89	5.33	54.67	10.04	8.07	5.00	10.69	48.00	122.00
					to	tc	tc	to	to	to	to	to	to	
					2369.00	217.02	20.50	275.33	20.72	25.38	18.33	19.13	149.67	347.67

TABLE 3

COMPARISON OF DIFFERENT VARIETIES IN RELATION TO FRUIT QUALITIES

Name of varieties	T.S.S	Acidity	Reducing sugar	Non-reducing sugar	Total sugar	Sugar acid ratio
1. Binkehel	31.66	0.128	13.51	4.77	18.50	144.33
2. Wather	39.33	0.573	8.34	4.52	12.86	22.00
3. Mauritius	30.00	0.270	10.28	7.04	17.32	68.67
4. Sikumani	40.00	0.620	10.56	6.40	16.99	27.00
5. Nedunendran	40.00	0.635	16.71	1.69	18.40	28.33
6. Anaikomban	35.00	0.510	7.44	12.03	19.46	37.00
7. Vadakkankadali	35.00	0.695	10.75	8.11	18.89	27.00
8. Venneettukunna	40.00	0.767	11.47	7.60	19.08	24.67
9. Kodappillakunna	33.00	0.543	12.55	4.36	16.91	30.33
10. Pachachingan	30.00	0.632	13.45	2.23	15.77	24.67
11. Poomkalli	38.00	0.357	6.50	2.84	9.27	25.00
12. Ambalacadali	36.00	0.383	9.44	2.52	13.10	33.67
13. Thiruvananthapuram	30.00	0.371	5.47	1.91	7.39	19.67
14. Kunnann	35.00	0.447	6.38	6.34	12.72	28.00
15. Pisang awak	39.00	0.147	7.32	3.77	11.09	75.67
16. Pachanadan	35.00	0.523	8.19	5.60	13.79	26.33
17. Selection No.2	35.00	0.378	7.87	4.59	12.45	33.00
18. Red banana	30.00	0.384	3.41	2.93	6.34	16.33
19. Poochakunna	38.00	0.511	7.66	6.19	13.88	25.67
20. Attunendran	40.00	0.574	13.20	6.52	19.73	34.00
21. Ayiramkapoovan	40.00	0.699	8.39	7.49	16.21	22.67
22. Selection No.1	33.00	0.766	9.09	2.25	11.32	14.33
23. Monsmari	28.00	0.127	7.68	12.61	20.29	159.00
24. Giant Governor	27.00	0.163	7.64	11.76	19.40	119.00
25. Robusta	26.00	0.195	7.43	11.13	18.58	94.67
26. Peddapacha arati	26.00	0.240	6.55	11.09	17.64	73.00
27. Zanzibar	38.0	0.437	15.54	5.24	20.78	51.00
28. Changanacherry Nendran	42.00	0.465	11.56	6.42	18.31	39.00

.....contd.