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G E N E R A L

The Vellayani Centre of the All India Co-ordinated Project for research on forage crops was started during April, 1971. The agro-climatic conditions of the State is unique by itself. The cropping pattern is entirely different from other parts of the country. The pressure on land is very high. The size of the operational holdings are so small that 59.7% of the holdings are less than half hectare and 91.9% are less than two hectares.

Every inch of land is either cropped with food crops like rice, tapioca, pulses or plantation crops like coconut, arecanut, rubber, tea, cardamom, pepper etc. Fodder crops are at present cultivated only in a very negligible area in Government dairy and livestock farms. The present cattle population of the State is 34 lakh and the requirement of green roughage is estimated to be 56.1 lakh tonnes. The main source of roughages at present are cultivated fodder, paddy straw, collected weeds from cultivated fields, tapioca leaves, sugar wastes and other crop residues. The production of roughages from these different sources account for only 43.4 lakh tonnes. Thus there is a deficit of 12.7 lakh tonnes of roughage per year. In order to fill this gap all efforts should be oriented to include fodder crops also in the existing cropping system by profitably utilizing the already cropped areas like coconut, arecanut and rubber plantations. Nutritious and drought resistant perennial fodder varieties are to be raised in these plantations.

II. BRIEF DESCRIPTION OF THE AREA

Location:-

The project is situated in the College of Agriculture, Vellayani, Kerala Agricultural University. Vellayani is located in an picturesque suburban area surrounded on 3 sides by the Vellayani Lake. The institution is about 11 km. away from the capital city of Trivandrum and less than 10 km. from the international tourist centre, the Kovalam Beach Resort. The road leading to the College is a deviation from the Trivandrum-Kovalam Road at Patchalloor. The main College building and farm area belonged to the Royal family of the erstwhile Travancore State:

Climate:

Vellayani is located 8° N latitude and enjoys a tropical climate. The altitude of the place is 29 m. above MSL. The average rainfall is 2113 mm. distributed over a period of 92 rainy days. The monthly precipitation ranges between 18 mm in February to 375 mm in June. The N.E. Monsoon is uneven and usually the period from November to April are hot and dry. The maximum temperature ranges between 30° to 35°C and the minimum temperature ranges between 21° to 23°C. The average relative humidity is between 80 to 85%. The region is blessed with abundant solar energy throughout the year with an average of 10 hours of Sun shine per day.

Soil:

The soil type is red loam. It is typically acidic in reaction with a pH of 5.6. The soil is very low in available nitrogen, medium in available phosphorus and moderate in available potash. The iron and aluminium content of the soil is rated high.

Crops:

Coconut, tapioca, banana, rubber, cashew, pulses, vegetables and other horticultural crops are being cultivated in the uplands and rice is confined to low lands.

III. (a) PRESENT STAFF POSITION

1. Officer in charge : Shri G. Raghavan Pillai,
Assistant Professor of Agronomy.
2. Other staff :
1. Shri H.K. Ramakrishna Bhat,
Junior Instructor.
 2. Shri L. Davy,
Grade I Agricultural Demonstrator.
 3. Smt. K. Radhama Thankachy,
Grade I Agricultural Demonstrator.
 4. Shri P.V. Joseph,
Laboratory Attender.
 5. Shri P. Sreedharan,
Peon.

(b) FINANCIAL AND PHYSICAL ACHIEVEMENTS

Year	Budget	
	Allotment	Expenditure
1971-72	29,598.00	30,559.45
1972-73	35,348.00	41,951.05
1973-74	36,164.00	37,099.49
1974-75	30,178.00	42,165.62
1975-76	77,500.00	60,551.54
1976-77	40,600.00	52,494.57
1977-78	73,000.00	63,036.03
1978-79	51,400.00	26,206.57

(as on 31-8-1978)

IV. LIST OF EXPERIMENTS CONDUCTED

From the very inception of the project, experiments on agronomical and botanical aspects of annual and perennial forage crops were carried out. The following is the list of experiments conducted.

I. AGRONOMIC TRIALS

A. Perennial Fodder Crops

- (i) Fertilizer-cum-interval of cutting trial on Guinea grass.
- (ii) Spacing-cum-organic manure experiment on Guinea grass in coconut gardens.
- (iii) Intercropping of pulses with Guinea grass in coconut gardens under rainfed conditions.
- (iv) Comparative performance of Guinea grass and Hybrid Napier in coconut gardens and in the open under varying levels of nitrogen and cutting intervals.
- (v) Fodder production potential trial.
- (vi) Manurial trial on 3 promising Guinea grass types.
- (vii) Initial Evaluation trial of Hybrid Napier types for disease resistance and yield.
- (viii) Collection and evaluation of indigenous and exotic varieties of forage crops.

B. Annual Fodder Crops

- (ix) Comparative performance of different varieties of cowpea under different levels of phosphate and potash manuring.
- (x) Comparative performance of different varieties of Maize under varying levels of N and P.
- (xi) Response of Dinanath grass to varying levels of N and P.

II. BREEDING (VARIETAL) TRIALS

- (xii) Fodder production potential of *Panicum miliaceum* under different regional conditions.
- (xiii) Evaluation trial of Dinanath grass varieties.
- (xiv) Evaluation trial of cowpea varieties
- (xv) Evaluation trial on 4 varieties of Phaseolus calcaratus.
- (xvi) Evaluation trial on 5 varieties of Velvet bean.
- (xvii) Co-ordinated trial with 7 cultivars of Sorghum.
- (xviii) Co-ordinated trial with 5 cultivars of Maize, Teosinte and their hybrids.
- (xix) Varietal trial on Sorghum varieties during Summer.
- (xx) Evaluation trial on 6 varieties of Bajra.

III. GRASSLAND MANAGEMENT AND SILVI-PASTURE EXPERIMENTS

- (xxi) Effect of plant population on the yield and quality of Koob abool.
- (xxii) Evaluation of production potential of grasses/legumes under varying combinations with forage trees.

V. RESEARCH PROGRAMMES UNDERTAKEN AND THEIR RESULTS

A. (1) Fertilizer-cum-interval of cutting trial on Guinea grass

Objective:

To study the effect of graded doses of nitrogen on the yield and quality of guinea grass at different intervals of cutting.

Treatments

1. Levels of nitrogen (3) 100, 150, 200 kg N/ha.
2. Schedule of nitrogen application (3)
 - i. Full basal
 - ii. 2 split doses
 - iii. 4 ,,
3. Intervals of cutting (3) 30, 45, 60 days
4. Levels of lime (3)
 - i. Lime to correct soil pH to 6.5
 - ii. 1/2 of the above dose
 - iii. No lime.

Design. 3^3 Factorial experiment

Gross plot size: 4.5 x 4.2 ms.

(A uniform doses of P & K @ 50:50 was also applied as basal every year)

This experiment was started during 1972-73 and was continued upto 1976-77. The mean yield of green fodder in tonnes/ha obtained from the experiment in each year are furnished below in Table- 1.

From the above table it is evident that the effect of nitrogen was significant throughout the experimental period. The response was linear upto the maximum level of 200 kg N/ha, which recorded an average yield of 34.04 tonnes of green fodder/ha. The lowest dose of 100 kg N/ha gave an yield of 25.26 tonnes while 150 kg N/ha gave 30.10 tonnes.

Regarding the schedule of application of nitrogen, it was found that basal application of the full dose of fertilizer recorded the highest mean yield of 31.80 tonnes

of green fodder/ha annually followed by application of the fertilizer in 2 equal splits, which gave a mean yield of 30.05 tonnes/ha. Application of fertilizer nitrogen in 4 equal splits was statistically inferior to 2 equal splits.

Table 1

Green matter yield due to levels of N, schedule of N application, levels, of lime and intervals of cutting.

Treatments	Green matter yield in tonnes/ha					Mean
	1972-73	1973-74	1974-75	1975-76	1976-77	
<u>Levels of nitrogen</u>						
100 kg/ha	37.00	25.97	22.64	20.62	20.09	25.26
150 ,,	39.02	32.08	27.25	26.95	25.20	30.10
200 ,,	48.26	35.50	29.63	30.55	26.24	34.04
<u>Schedule of Nitrogen application</u>						
Full basal	45.21	30.14	31.17	25.97	26.50	31.80
2 split doses	34.78	33.43	27.68	29.18	25.17	30.05
4 split doses	44.29	29.98	20.68	22.96	19.71	27.52
<u>Levels of lime</u>						
Lime applied to correct soil pH to 6.5	44.42	34.09	27.49	28.56	25.04	31.92
1/2 of do	41.23	31.31	20.83	24.79	24.03	28.44
No lime	40.64	28.16	25.21	24.70	22.41	28.22
<u>Intervals of cutting</u>						
30 days	43.64	28.31	25.93	25.76	22.41	29.21
45 days	42.48	31.92	24.56	23.30	26.18	29.69
60 days	38.17	33.31	29.05	28.99	22.87	30.48

What was the species? with 40x20 spacing of 50/16 in on yield is 28 odd tons!

Thus it was concluded that the application of entire dose of fertilizer nitrogen as basal to rainfed Guinea grass is the best method for the increased yield of fodder.

There was gradual increase in yield due to increase in doses of lime. Unlimed plots recorded the lowest yield.

was the best for increased green fodder production in guinea grass grown in coconut garden.

Table 2
Yield of green matter as influenced by spacing and organic nitrogen.

Treatments	Green matter yield in tonnes/ha					Mean
	1972-73	1973-74	1974-75	1975-76	1976-77	
Spacing						
80 x 40 cm	24.41	29.18	26.88	20.16	20.51	24.23
60 x 30 cm	27.32	29.25	28.74	22.52	21.95	25.96
40 x 20 cm	31.23	31.38	29.999	23.72	21.43	27.55
Levels of organic Nitrogen						
0 N/ha	25.93	28.43	24.66	21.19	19.59	23.96
25 kg N/ha (5000 kg FYM)	27.50	29.90	37.52	20.67	20.42	27.20
50 kg N/ha (10000 kg FYM)	29.53	31.48	31.02	24.54	24.77	28.27

It was also noted that application of organic nitrogen significantly increased the yield of guinea grass grown. The yield was increased due to increasing doses of organic nitrogen. The highest dose of 50 kg N/ha (organic) (10000 kg FYM) gave the maximum yield of 28.27 tonnes of green fodder which was significantly superior to 25 kg organic N/ha (5000 kg FYM) which in turn was superior to control.

By statistical interpolation of the data, the optimum dose of organic nitrogen could be fixed at 53 kg/ha.

Experiment No. iii.

Intercropping of pulses with Guinea grass in coconut gardens under rainfed conditions.

Objective:

To find out the fodder production potential of the mixed crops of guinea grass and pulses grown as intercroops in coconut garden.

Treatments

<u>Throughout the year</u>	<u>June-July</u>	<u>September-October</u>
T1. Guinea grass alone	-	-
T2. Guinea grass	Cowpea C.152	Horsegram
T3. Guinea grass	,, Kanakamani	do
T4. do	,, C.152	Fallow
T5. do	,, Kanakamani	do
T6. do	Fallow	Horsegram

Design: Randomised Block Design.

Replications: 5 (Five)

Plot size: 6.3 x 4.5 m.

(All the plots received a uniform dose of NPK @ 100:50:50 every year. N was given in 2 split doses and P & K were given as basal dose).

This experiment was started during 1972- 73 and continued upto '76-77 in the existing coconut gardens. The mean yield of green fodder obtained during the period are presented in Table-3.

Table 3
Yield of green fodder as influenced by intercropping

Treatments	<u>Green matter yield in tonnes/ha</u>					Mean
	1972-73	1973-74	1974- 75	1975-76	1976-77	
1. Guinea grass alone	17.77	26.59	25.43	19.17	16.25	21.04
2. Guinea grass + Cowpea C.152 + Horsegram	19.88	29.13	29.22	22.10	18.38	23.74
3. Guinea grass + Cowpea Kanakamani + Horsegram	18.64	29.45	27.74	21.63	16.10	22.71
4. Guinea grass + Cowpea C.152 + Fallow	19.57	29.48	26.82	19.46	17.88	22.64
5. Guinea grass + Cowpea Kanakamani + Fallow	17.47	29.27	26.19	21.78	16.46	22.23
6. Guinea grass + Fallow + Horsegram	18.56	27.37	26.08	19.39	15.69	21.42

From the data it was observed that growing Guinea grass alone in coconut garden was significantly inferior to other treatments with regards to green matter production. There was

no significant difference in the green fodder production among the different crop mixtures. However, maximum yield of 23.74 tonnes of green fodder was produced by the crop mixture of guinea grass + cowpea C.152 + Horsegram. Therefore it could be concluded that growing of Guinea grass mixed with cowpea in the first season and horsegram in second season would be a profitable system of intercropping in coconut garden.

Experiment No. iv.

Comparative performance of Guinea grass and Hybrid Napier in coconut gardens in the open under varying levels of nitrogen and cutting intervals.

Objective:

To find out the production potential of Guinea grass and hybrid Napier grown as an intercrop in coconut gardens as well as in the open under identical conditions of management practices.

Two sets of experiments with the following treatments ^(a) are laid out one each in the existing coconut gardens and in the open field.

- A. Crop varieties (2)
 - i. Guinea grass
 - ii. Hybrid Napier
- B. Levels of Nitrogen (3)
 - i. 150 kg N/ha
 - ii. 200 ,,
 - iii. 250 ,,
- C. Intervals of cuttings (2)
 - i. 30 days
 - ii. 45 days

Design Randomised Block Design
Replication 3 (Three)
Plot size 4.8 x 4.8 m.
Spacing Guinea grass - 40 x 20 cm
Hybrid Napier 60 x 30 cm

The experiment was started in the second half of 1975-76. Regular harvests of grasses were started only from 1976-77 onwards. The yield data collected during the period are presented in Table 4.

Quality of the fodder produced has not been selected, with the legume mixture 23.74 must be a much better yield than 21 tonnes of just grass!

Table 4

Yield of green fodder (t/ha) for the grasses grown in open and coconut garden conditions.

Treatments	Open			Coconut garden		
	Green fodder yield (t/ha)			Green fodder yield		
	I year	II year	Mean	I year	II year	Mean
<u>Varieties</u>						
Guinea grass	73.00	47.58	60.29	57.64	31.30	44.47
Hybrid Napier	56.00	32.48	44.24	48.11	20.42	34.26
<u>Levels of Nitrogen</u>						
150 kg N/ha	60.86	32.66	46.76	51.23	24.46	37.84
200 kg N/ha	65.56	42.40	53.98	53.99	26.03	39.99
250 kg N/ha	67.24	44.91	56.07	53.41	27.21	40.31
<u>Intervals of Harvest</u>						
30 days	63.27	36.76	50.01	50.66	22.01	36.33
45 days	65.83	43.21	54.52	55.08	29.81	42.44

In both the conditions, Guinea grass was superior to Hybrid Napier with respect to green matter production.

Regarding the effect of nitrogen also a progressive increase in yield of green fodder due to increased levels of nitrogen was noticed.

With respect to cutting intervals, longer interval of 45 days was superior to 30 days.

It could be noted that the yield was lower in the partial shade of the coconut garden when compared to open field conditions.

Experiment No. v

Fodder production potential trial

Objective:

To find out a suitable cropping pattern for fodder crops to obtain higher production per unit area per unit of time.

Treatments

1. Guinea grass alone
2. Hybrid Napier alone
3. Hybrid maize in June followed by cowpea in October
4. Hybrid maize + cowpea mixture in June followed by the same mixture in October.
5. Hybrid maize in June followed by hybrid maize in October.

The experiment was laid out in a randomised block design.

The experiment was started in the year 1976-77. The data recorded on the yield of fodder and leaf stem ratio are given in the following Table.

Table 5

Green fodder yield and Leaf/Stem ratio due to different cropping pattern.

Treatments	Green fodder yield (T/ha)		Leaf/Stem ratio
	Ist year	IIInd year	
Guinea grass alone	48.08	47.41	3.68
Hybrid Napier alone	32.91	36.28	3.12
Hybrid maize + cowpea	14.19	10.73	1.02
Hybrid maize-cowpea mixture followed by same mixture	8.66	11.06	1.19
Hybrid maize followed by Hybrid maize	16.68	11.49	2.56

It was observed that maximum green fodder was obtained when Guinea grass alone was grown followed by the Hybrid Napier. The mixtures have given comparatively lower production of green fodder during both the years and the lowest yield was recorded by the Hybrid maize cowpea mixture in the first season followed by the same mixture in the 2nd season. Regarding the leaf stem ratio also guinea grass gave the maximum values of 3.68 and the lowest value was recorded by Hybrid maize-cowpea mixture (1.02).

Experiment No. vi

Manurial trial on 3 promising Guinea grass types.

Objective

From a preliminary study on 30 types of Guinea grass 3 types viz. F.R.600, F.R. 599 and Mackuenii have been found to be very promising. This study is to assess the fodder production potential of these 3 Guinea grass types and to find out their nitrogen requirements.

The experiment was started during 1976-77 and the data on green matter yield are given below:

Table 6

Green matter yield due to varieties and nitrogen levels

Treatments	Green matter yield (T/ha)		Mean
	1st year	2nd year	
<u>Grass varieties</u>			
FR-600	35.54	19.02	27.28
FR-599	41.65	23.02	32.335
Mackuenii	44.38	27.64	36.01
<u>Levels of Nitrogen</u>			
150 kg N/ha	41.72	23.78	32.75
200 kg N/ha	40.98	22.27	31.625
250 kg N/ha	38.78	23.64	31.21

It is seen from the above table that there was no significant difference in green matter yield among the 3 varieties tried. However Mackuenii gave the maximum yield of 36.01 t/ha followed by FR-599 and FR. 600.

With regard to the effect of nitrogen also no significant difference could be noticed due to graded doses.

Experiment No. vii

Initial evaluation trial of Hybrid Napier types for disease resistance and yield.

Objective:

It is observed that hybrid Napier is susceptible to fungus disease in this area and it has become necessary to isolate varieties which are resistant to disease. In order to study the disease resistance and the comparative yielding ability of different types the present trial was undertaken.

The experiment was started during the year 1976-77 using 17 types. During the 1st year of the experiment there was no incidence of disease. Hence, their comparative resistance towards fungal diseases could not be judged. Regarding yield performance, there was appreciable difference among the types. The type HGA-BN-5, Kamadhenu and Mercara gave the top yields, while Mysore, PGN and PGN-Kulathumpuzha were poor yielders.

Experiment No. viii

Collection and evaluation of indigenous and exotic varieties of forage crops

Objective:

To collect and evaluate the indigenous and exotic varieties of forage crops for their production capacity under Kerala conditions and to maintain a germ plasm bank.

Under this programme, 175 different plants belonging to fodder grasses, cereal fodders, legume fodders and fodder trees were collected and maintained.

Annual Fodder Crops

Experiment No. ix. Comparative performance of different varieties of cowpea under different levels of phosphate and potash manuring

Objective:

To find out the production potential of different varieties of cowpea under varying levels of $\frac{1}{4}$ P and K.

Treatments

Varieties	Russian Giant, CO1, EC.4216, FOS-1, Calicut-78, C-152, New Era and Kanakamani.
P-Levels (4)	0, 30, 60, 90 kg P ₂ O ₅ /ha.
K levels (2)	0, 30 kg K ₂ O/ha
Design	Split plot in R.B.D.
Plot size	3 x 3 m.
Replications	4 (Four)

All the plots received a uniform dose of 25 kg N/ha as ammonium sulphate.

This experiment was laid out during 1971-72. and continued for 5 years. There were differences in the varieties selected in the different years. The crop was harvested for fodder at 50% flowering. The green fodder yield obtained during each year and their mean values are given in the following table.

Table 7
Yield of green fodder due to cowpea varieties, and
P and K. applications.

Treatments	Green fodder yield (t/ha)					Mean
	1971-72	1973-74	1974-75	1975-76	1976-77	
<u>Varieties</u>						
Russian Giant	4.82	2.24	2.06	9.01	-	
Co-1	5.99	3.29	-	-	-	
EC.4216	5.91	-	-	-	-	
FOS-1	-	1.85	2.88	9.34	-	
Calicut-78	-	-	2.43	10.07	-	
C-152	-	-	-	-	4.23	
New Era	-	-	-	-	4.00	
Kanakamani	-	-	-	-	3.53	
C.D.	0.94	NS	NS	1.57	NS	

	1971-72	1973-74	1974-75	1975-76	1976-77	Mean
P₂O₅ levels						
0	4.31	2.47	2.05	8.92	3.44	4.24
30	5.14	2.66	2.15	9.10	4.27	4.66
60	5.97	2.43	2.78	9.08	3.86	4.82
90	6.45	2.29	2.87	10.78	4.17	5.31
C.D.	0.21	NS	0.57	0.89	NS	0.56
K₂O levels						
0	4.95	2.03	2.13	7.52	3.09	3.94
30	6.20	2.90	2.80	11.42	4.78	5.62
C.D.	0.13	NS	0.57	1.28	1.06	0.76

The varietal means are not given since different varieties were used in different years.

During the years 1971-72 and 1973-74, Co-1 variety of cowpea gave the highest yield. In 1974-75, Russian Giant, FOS-1 and Calicut-78 were the varieties tried and FOS-1 gave the maximum yield, but was on par with other varieties. In 1975-76 Russian Giant, FOS-1 and Calicut-78 were the varieties tried and Calicut-78 was found significantly superior to Russian Giant. In 1976-77, C-152, New era and Kanakamani were the varieties tried. Among them there was no significant difference in yield of green fodder.

Regarding the levels of P, mean data showed that there was a response upto 90 kg P₂O₅/ha. However, there was no significant difference between 30 kg and 60 kg and 60 kg and 90 kg/ha. But the difference between 30 and 90 kg were statistically significant. Hence it is proved that cowpea varieties responded to higher levels of P₂O₅ under the acid soil conditions of Vellayani.

The effect of potash was also significant. The 30 kg K₂O/ha gave a mean yield of 5.62 tonnes of green fodder per crop per year, which amounts to an increase of 45% over control.

Experiment No. x

Comparative performance of different varieties of Maize under different levels of Nitrogen and Phosphorus

Objective

To assess the fodder production potential of maize varieties under varying levels of N and P.

The experiment was laid out during the year 1971-72 and continued for 5 years. The treatments were the following:

1. Three varieties of maize:

1971-72	Hybrid Maize-Ganga-5 Local maize Teosinte
1972-73	Hybrid Maize-Ganga-5 Local maize Teosinte
1973-74	Hybrid maize-Ganga-5 Composite Maize-Vijay Teosinte
1975-76	Hybrid Maize Ganga-5 Composite Maize-Vijay Ganga Safed-2

2. Levels of N 0, 40, 80, 120 kg/ha

3. Levels of P_2O_5 0, 30 and 60 kg/ha

This experiment was started in 1971-72 with the above treatments and concluded in the year 1976-77. The yield data of green fodder obtained during this period are given in the following Table.

It was observed that the varieties tried differed significantly in the green fodder yield. HM Ganga-5, Ganga Safed-2 and Composite maize-Vijay were superior to local maize, Teosinte and Deccan.

There was significant difference in the yield of green fodder due to graded doses of Nitrogen. 40 kg N/ha was superior to control, which in turn was significantly inferior to 80 kg N/ha. Maximum yield was recorded by 120 kg N/ha which was significantly superior to 40 kg. The effect of phosphorus was also significant and maximum yield was obtained under 60 kg P_2O_5 /ha level.

Table 8

Yield of green fodder due to Maize varieties, nitrogen and Phosphorus.

Treatments	Green fodder yield (t/ha)					Mean
	1971-72	1972-73	1973-74	1975-76	1976-77	
<u>Varieties</u>						
HM Ganga-5	13.08	13.27	6.75	9.14	-	-
Local maize	7.12	10.12				
Teosinte	10.61	9.35	5.60	-	5.88	
<u>Composite</u>						
Maize Vijay	-	-	8.63	2.41	-	
Ganga safed-2	-	-	-	9.94	10.38	
Doccan	-	-	-	-	9.34	
C.D.	0.83	0.32	1.50	4.61	1.71	
<u>Levels of N</u>						
0 kg/ha	2.2	2.66	1.30	4.39	4.07	3.35
40 ,,	9.33	9.84	4.98	4.49	10.74	8.95
80 ,,	13.44	14.14	10.73	12.89	12.08	12.44
120 ,,	16.19	17.03	10.97	15.23	11.25	13.05
C.D.	1.15	0.37	1.12	4.82	1.69	1.78
<u>Levels of P</u>						
0 kg/ha	9.64	10.22	5.44	10.10	7.43	8.14
30 kg/ha	10.47	10.88	-	-	-	10.68
60 ,,	10.76	11.66	8.54	10.90	11.64	11.05
C.D.	0.83	0.32	1.22	NS	1.71	1.25

Experiment No. xi

Response of Dinanath grass to varying levels of N & P

Objective:

To find out the response of Dinanath grass to different levels of N and P.

The experiment was started during the year 1977-78 with 4 levels of Nitrogen viz. 0, 50, 100 and 150 kg/ha and 3 levels of phosphorus viz., 0, 30 and 60 kg P₂O₅/ha.

The experiment was vitiated during 1977-78 and is being continued in 1978-79.

Experiment No. xii

Fodder production potential of *Panicum miliaceum* under different regional conditions.

Objective:

To study the performance of *Panicum miliaceum* under graded dose of Nitrogen.

The experiment was conducted for one year (1972-73) only. The levels of N tried were 0, 20, 40 and 60 kg/ha. All the plots received a common basal dose of 20 kg P_2O_5 /ha.

From the results it was concluded that this crop was unsuitable for this locality.

Experiment No. xiii

Evaluation trial on Dinanath grass

Objective:

To evaluate the performance of different varieties of Dinanath grass under the Agroclimatic conditions of Vellayani.

The different varieties were tried from the year 1973-74 onwards. A uniform manurial dose of 100 kg ^{nitrogen}, 50 kg P_2O_5 and 20 kg K_2O /ha was given to all the varieties. The results obtained so far are given in the following Tables - 7

During the year 1973-74 the differences between the varieties were not significant. However, PP-10, PP-15 and PP-3 were the top yielders giving an average yield of 30.40, 30.10 and 29.0 t/ha respectively.

During the year 1974-75 the varieties were significantly different in green matter yield. The varieties PP-15, Pusa-6 and Pusa-1 gave the highest yields of 29.94, 29.31 and 29.01 t/ha respectively.

In 1975-76 the varieties did not differ significantly in their yielding ability. However, the maximum green matter yield of 65.43 t/ha was recorded by the variety Pusa-1, followed by 64.81 t/ha by PP-33 and 64.19 t/ha by JP-12.

Table 9
Green fodder yield (t/ha) due to different varieties
of Dinanath grass.

Variety	1973-74	1974-75	1975-76	1976-77	1977-78	Mean
1 PP-3	29.00	26.54	57.40	22.75	18.33	
2 PP-10	30.40	12.34	47.22	25.00		
3 PP-15	30.10	29.94	60.18	18.52		
4 PP-4	28.70	23.15	-	-		
5 T-12	28.39	-	-	-		
6 T-15	27.00	-	-	-	11.67	
7 Pusa-1	27.00	29.01	65.43	21.6		
8 Pusa-3	28.85	24.69	58.33	19.12		
9 Pusa-6	25.93	29.31	54.93	18.52		
10 Pusa-19	25.00	19.13	57.40	22.75		
11. Pusa-38	21.30	21.30	52.62	23.15		
12 Pusa- 42	25.00	16.35	54.62	24.07		
13 S-32-1	22.22	-	-	-		
14 S-886-1	20.37	-	-			
15 PP-33	-	19.75	64.81	24.07		
16 PP-5	-	19.13	60.49	22.83	16.11	
17 JP-12	-	20.06	64.19	20.98	8.33	
18 PP-H	-	-	55.55	19.75	-	
19 T-13	-	-	58.95	23.45	-	
20 Pusa-3-IARI	-	-	-	21.60	-	
21 Pusa-38-IARI	-	-	-	20.67	-	
22 PP-5-Hissar	-	-	-	20.05	-	
23 PP-47-Hissar	-	-	-	19.66	-	
24 PP-3-Hissar	-	-	-	19.44	-	
IGFRI-32-1	-	-	-	-	10.5	
IGFRI-43-1	-	-	-	-	10.0	
IGFRI-852	-	-	-	-	8.88	
IGFRI-860	-	-	-	-	10.55	
IGFRI-866	-	-	-	-	10.55	
IGFRI-869	-	-	-	-	11.67	

IGFRI-870	-	-	-	-	7.78
IGFRI-3808	-	-	-	-	8.88
PS-38-white	-	-	-	-	15.00
PS-3-red	-	-	-	-	12.22
CD	NS	5.79	NS	NS	4.42

During the year 1976-77 the different varieties tried did not show any significant difference, in the green matter yield of fodder. The highest yield of 25 t/ha was given by PP-10, the next high yielders being Pusa-42 and PP-33 giving an yield of 24.07 t/ha.

In 1977-78 trial, the top yielders were found to be PP-3, PP-5 and PS-38, yielding 18.33 t/ha, 16.11 t/ha and 15.00 t/ha respectively.

In studying the performance of different varieties of Dinanath grass, it was observed that the varieties Pusa-1, PP-33, JP-12, PP-3 and PP-15 gave very good performance, giving satisfactory green fodder yield under the agroclimatic conditions of Vellayani. The other varieties which came up well were Pusa-6, PS-38 and Pusa-42.

Experiment No. xiv

Evaluation trial of cowpea varieties

Objective:

To evaluate the performance of cowpea varieties for fodder production under the agroclimatic conditions of Vellayani.

The varieties were grown under identical cultural and manurial practices. The data on yield of green matter obtained from different varieties during different years are given below.

During the year 1973-74 the maximum green matter yield of 6.38 t/ha was given by the variety C-26-28. followed by Co-1 (5.56 t/ha).

In 1974-75 Co-1 recorded the maximum green matter yield of 6.58 t/ha followed by the variety 998 (6.17 t/ha).

The highest yielders in 1975-76 was C-28 contributing to 18.52 tonnes of green fodder/ha followed by UIC-5236 (17.49 t/ha).

Table 10

Green fodder yield t/ha

Treatments	1973-74	1974-75	1975-76	1978- 79
<u>Varieties</u>				
CP-1	4.32	-	-	-
NP-3	3.91	3.09	-	
CP-3	3.300	-		
No.10	1.48	3.28	12.14	
FOS-1	4.94	1.24	-	25.42
42-1	1.44	-	-	
No.53	5.35	-	-	
Co-1	5.56	6.58	-	
C-1	1.44	5.75	9.88	
C-14-20	4.94	-	-	
C-26-28	6.38	-	-	27.08
979	-	4.11	-	
C-14	-	3.70	-	
C-26	-	3.70	-	
978	-	4.11	-	
C-24	-	4.11	-	
CL-1	-	3.28	-	
1013	-	5.35	-	
843	-	5.75	-	
C-25	-	4.94	-	
998	-	6.17	-	
515	-	3.70	-	
R G	-	1.64	-	
985	-	5.35	-	
UPC-42	-	-	9.05	
UPC-287	-	-	16.67	
UPC-5286	-	-	17.49	25.42
UPC-9020	-	-	9.05	
POS-1	-	-	9.67	

HFC-42-1	-	-	2.14	23.33
MPKV-1	-	-	5.77	16.25
Russian giant	-	-	12.96	
J.C-1	-	-	11.75	
J.C-21	-	-	10.28	
C-28	-	-	18.52	
RS-9	-	-	-	35.42
UPC-4893	-	-	-	30.83
UPC-1956	-	-	-	29.17
UPC-1008	-	-	-	28.15
UPC-9079	-	-	-	25.83
Cowpea-74	-	-	-	20.42

In 1978-79 maximum yield was obtained from the variety RS-9 (35.42 t/ha) followed by UPC 4893 (30.83 t/ha).

From the 4 years of trial in selecting the promising cowpea varieties for Vellayani centre, it was seen that higher quantities of green fodder were recorded by the varieties RS-9, UPC-4893, C-28 and UPC-5286. The varieties Co-1, 998, C-26, 28, Kanakamani, and Russian Giant also came up very well in this area giving profitable fodder yield.

Experiment No. xv

Evaluation Trial on (Phaseolus calcaratus) Rice bean

Objective:

To select the most suitable variety of Rice bean for fodder purpose.

During the year 1973-74, four varieties of Rice bean (Phaseolus calcaratus) were grown under identical conditions of fertility and management.

The green fodder obtained from these varieties are recorded below.

The varieties were significantly different in green matter yield. Maximum green matter yield of 17.67 t/ha was recorded by V₄ followed by V₁. Considering the short duration nature and high production of fodder (17 t/ha) it was found

Table 11
Yield of green fodder due to different varieties

Variety	Green matter yield (t/ha)
V ₁	16.81
V ₂	11.73
V ₃	16.36
V ₄	17.67
C. D	0.23

worthwhile to introduce this crop in this region for fodder purpose.

Experiment No. xvi

Evaluation trial on Velvet beans

Objective:

To select the best variety of Velvet bean for fodder purpose.

The experiment was conducted during 1974-75 and 1975-76 with 5 varieties. The data on green matter are recorded below.

Table 12
Yield of green fodder due to different varieties of Velvet bean

Varieties	Green matter yield (t/ha)	
	1974-75	1975-76
V ₁	17.12	7.25
V ₂	16.23	15.74
V ₃	16.32	12.96
V ₄	14.84	10.80
V ₅	15.93	12.81
C.D	N S	3.06

During the year 1974-75 no appreciable difference could be noticed between the varieties. However, V₁ gave the maximum yield of 17.12 Tonnes/ha. During the year 1975-76 there was

significant difference in green matter yield among the varieties. The maximum green fodder yield was recorded by the variety V₂ (15.74 t/ha) followed by variety V₃ (12.96). Thus it was found that this crop is also suited for the tract.

Experiment No. xvii

Co-ordinated trial with 7 cultivars of Sorghum

Objective:

To test the performance of 7 cultivars of fodder sorghum.

During the year 1975-76, 7 varieties of sorghum were tried.

The green fodder yield obtained from these are given below.

Table 13

Yield of green fodder due to varieties of sorghum

Varieties	Green fodder yield (t/ha)
MP-chari-1	13.58
MP-chari-2	8.33
MPKV-1	32.50
J.S-20	17.70
S-1049	20.00
JS-3	34.79
A1-14-8	17.29
C.D	4.34



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Significant difference in green matter yield was observed among the varieties. The highest yield of 34.79 Tonnes of green matter was recorded by the variety JS- 3 followed by 32.50 Tonnes by the variety MPKV-1.

Experiment No. xviii

Co-ordinated trial with 5 cultivars of Maize, Teosinte and their hybrids

Objective:

To test the performance of 5 cultivars of Maize, Teosinte and their hybrids.

During the year 1975-76, 5 cultivars of the above crops were tried under identical conditions. The yield data are presented in table shown below.

Table 14

Green matter yield due to different varieties

Varieties	Green fodder yield (t/ha)
J-Ann (2)	28.54
Deccan	28.75
Ganga-5	29.58
Maize x Teosinte- Adv-generation	33.33
Teosinte	23.75

The varieties were not significantly different in green fodder yield, thereby showing that all the varieties can be grown under Kerala condition. However, the maximum green matter yield of 33.33 Tonnes/ha was recorded by the Hybrid (Maize x Teosinte) Adv-generation.

Experiment No. xix

Varietal trial of Sorghum during summer

Objective:

To identify high yielding varieties of Sorghum for summer fodder production.

During the summer 1978, 7 varieties of Sorghum were tried. A uniform fertility dose 60:25:20 was given to all the varieties. The yield obtained from these varieties are given below.

It is evident from the above data that none of these varieties is suitable for growing during summer season under Kerala conditions.

Table 15

Green fodder yield due to sorghum varieties

Variety	Green fodder yield (t/ha)
IS-6953	2.62
Sel-472	1.55
C-10-2	1.31
MKJ	1.21
IS-4776	1.00
S-1049	0.95
SS G-593	0.83

Experiment No. xx

Evaluation trial of Bajra varieties

Objective:

To evaluate the performance of Bajra varieties for fodder purpose. The experiment was conducted during the year 1978-79 with 6 varieties and data collected are presented below:

Table 16

Yield of green fodder, dry matter and leaf/stem ratio of different fodder varieties of bajra.

Treatment	Green matter t/ha	Dry matter t/ha	Leaf/Stem ratio
V1 Nagarjuna	12.08	4.05	0.67
V2 Visaka	12.92	3.56	0.95
V3 Anand Selection	8.33	2.02	1.36
V4 Giant Bajra	11.77	3.41	1.21
V5 Balaji	14.17	3.90	0.76
V6 Rajarat Selection	13.33	3.14	1.23
C.D.	N.S.	N.S.	N.S.

The difference between the varieties was not significant in green matter yield, dry matter yield or L/S ratio. However, maximum green matter yield was recorded by variety Balaji (14.17 T/ha) followed by ~~Gujarat selection~~ (13.33 T/ha). Balaji and Gujarat selection are found to be best suited for the locality.

Experiment No.xxi

Effect of plant population on the yield and quality of Koobabool

Objective:

To study the performance of Kooba bool under varying plant densities.

The experiment was started in 1977-78.

Treatments - 9

(a) Row spacing	1.0, 1.5, 2.0 m
(b) Plant spacing	10, 20, 30 cm
Design	RBD
Replication	3
Plot size	Net - 5 x 3 m
Date of planting	30-11-1977
Fertilizer	N - 20:P ₂ O ₅ /50

Since Summer was severe during the early stages of the crop, only one cut could be taken from this crop and the mean data are furnished in Table below.

Table 17

Yield of green fodder of Kooba bool under varying spacings

Treatments	Green matter, dry matter yield (kg/ha)	Mean height of plants at first cut cm
1.0 m x 10 cm	3333.33	144
1.0 m x 20 cm	1555.56	94
1.0 m x 30 cm	2111.11	98
1.5 m x 10 cm	1111.11	110
1.5 m x 20 cm	1888.89	105

1.5 m x 30 cm	2444.44	111
2.0 m x 10 cm	2000.00	111
2.0 m x 20 cm	2333.33	142
2.0 m x 30 cm	1000.00	96
C.D	N.S	N.S

It was observed that the difference between the treatments were not significant. However maximum green matter yield of 3333.33 kg/ha was obtained by the spacing of 1.0 m x 10 cm. Regarding plants height also the same treatment recorded a maximum of 144 cm. The experiment is in progress.

Experiment No.xxii

Evaluation of production potential of grasses and legumes under varying combinations with forage trees.

Treatments (18)

- A. Forage trees (3)
 - i. Loucaena (Koobabul)
 - ii. Sesbania grandiflora
 - iii. Sesbania aegyptica
- B. Grasses (2)
 - i. Guinea grass
 - ii. Setaria grass
- C. Legumes (3)
 - i. Velvet bean
 - ii. Cowpea
 - iii. Rice bean

Design : Split plot with trees & grasses as main plots and legumes as subplots.

Plot size: 4 x 3 = 12 Sq. m.

Spacing: Trees 3.0 m x 50 cm 2 rows @ 6 plants/row

Legumes - 50 cm x 10 cm

Grasses - 50 cm x 25 cm

The experiment was laid out in coconut gardens on 21-12-1977. During the early stages of the experiment due

Table 18
Mean yield of grasses, legumes and trees

Treatments				Yield of green fodder t/ha			
				Grasses	Legumes	Trees	Total
	<u>Tree</u>	<u>Grass</u>	<u>Legume</u>				
T ₁	Koobabool	+ Guinea	+ Velvet bean	14.38	1.11	5.00	20.49
T ₂	„	+ „	+ Cowpea	13.47	0.35	3.95	17.77
T ₃	„	+ „	+ Rice bean	12.99	1.59	1.70	16.28
T ₄	„	+ Setaria	+ Velvet bean	17.78	2.15	10.00	29.93
T ₅	„	+ „	+ Cowpea	13.33	0.38	3.50	17.21
T ₆	„	+ „	+ Rice bean	12.43	0.42	1.25	14.10
T ₇	Sesbania grandiflora	+ Guinea	+ Velvet bean	11.88	3.88	1.20	16.96
T ₈	„	+ „	+ Cowpea	16.60	0.35	1.12	18.07
T ₉	„	+ „	+ Rice bean	15.21	0.24	13.00	28.45
T ₁₀	„	+Setaria	+ Velvet bean	15.69	1.53	7.00	24.22
T ₁₁	„	+ „	+ Cowpea	11.88	0.77	1.25	13.90
T ₁₂	„	+ „	+ Rice bean	12.64	0.24	0.75	13.63
T ₁₃	Sesbania aegyptica	+ Guinea	+ Velvet bean	9.79	1.88	1.70	13.37
T ₁₄	„	+ „	+ Cowpea	10.49	0.49	12.00	22.98
T ₁₅	„	+ „	+ Rice bean	12.50	0.15	4.70	17.35
T ₁₆	„	+Setaria	+ Velvet bean	15.07	5.56	6.40	17.03
T ₁₇	„	+ „	+ Cowpea	7.78	0.32	6.00	14.16
T ₁₈	„	+ „	+ Rice bean	10.90	0.21	10.50	21.61
	C.D.			N.S.	1.60	N.S.	..

to severe and prolonged summer only one cut from the fodder trees could be taken. Altogether 3 harvests of grasses at 30-45 days interval and one harvest of legumes at flowering were taken. The yield data collected from the experiment till August 1978 are presented in Table below.

1. It was found that the best combination of Silviculture pasture was Koobabul + Setaria grass + Velvet bean which recorded 29.93 T/ha of green fodder. This is followed by the combination of Sesbania grandiflora + Guinea grass + Rice bean recording 28.45 T/ha. This trial is in progress.

VI. SALIENT FINDINGS

From the very beginning of the project, research works were focused to develop and select suitable fodder varieties of crops and to finalise the proper agronomic practices for them in order to augment the fodder production in the State. Some of the salient findings are given below.

1. Guinea grass responded to nitrogen application upto 200 kg/ha.
2. Application of the entire dose of fertilizer in nitrogen as basal was better than 2 split or 4 split application.
3. Progressive increase in yield was noticed when the cutting interval was increased upto 60 days.
4. Closer spacing of 40x20 cm was the best for increased fodder production in Guinea grass in coconut gardens.
5. Application of organic nitrogen progressively increased the yield of green matter and the optimum dose was found to be 53 kg/ha over and above the inorganic nitrogen application.
6. Growing annual legumes in between Guinea grass as intercrops was found to be promising proposition for increased yield of green fodder from a unit area. Guinea grass, intercropped with cowpea variety C.152 during June-July and Horsegram during September-October was the best crop combination for maximum yield in coconut gardens.
7. In a trial with Guinea grass and Hybrid Napier, both in open and in coconut gardens under different doses of nitrogen, it was revealed that in all cases Guinea grass was superior to Hybrid Napier.

8. The annual production of green fodder was the highest in the cropping pattern wherein Guinea grass alone was cultivated when compared to Hybrid Napier alone, Hybrid Maize + Cowpea, Hybrid Maize-cowpea mixture in two seasons or Hybrid Maize alone in two seasons per year.
9. Among the different varieties and types of Guinea grass, Mackuenii, FR.599 and FR.600 were found to be the top yielders and they were on par. However, Mackuenii was the best among these three types for green fodder production.
10. Among the Hybrid Napier types, HGA-BN-5, Kamadhenu and Mercara were the best, in green matter production.
11. One hundred and seventy five different varieties and types of fodder plants belonging to grasses, cereals, legumes and trees were collected and maintained.
12. Cowpea varieties responded to phosphorus application upto 90 kg P_2O_5 /ha and potash application upto 30 kg K_2O /ha.
13. The Maize varieties HM-Ganga-5, Ganga Safed-2 and composite to Maize Vijay were superior to local maize.
14. Maximum yield of green fodder was produced when maize crop was fertilized with 120 kg N and 60 kg P_2O_5 /ha.
15. The crop Panicum miliaceum was found unsuitable for fodder production in this tract.



16. Among the several Dinanath grass varieties, Pusa-1 PP-33, JP-12, PP-3, PP-15, Pusa-6, PS-38 and Pusa-42 were the high yielders as monsoon crops.
17. Among the cowpea varieties, RS-9, UPC-4893, C-28, UPC-5286, CO-1, 998, C-26-28, Calicut-78, Russian giant, Kanakamani and C-152 performed well in fodder production.
18. Rice bean (Phaseolus calcaratus) was found to be a good season bound fodder legume for this region.
19. Velvet bean was another legume fodder suitable for this tract.
20. Among the several fodder sorghum varieties tried, JS-3 and MPKV-1 gave comparatively higher yields.
21. The hybrid (Maize X Teosinte) performed well under the agro-climatic conditions of this region.
22. Bajra varieties, Balaji and Gujarat selection were better when compared to Anand Selection and Giant Bajra.
23. It was found that Koob-abool + Setaria grass + Velvet bean was a good silvi-pasture combination for this region.