VARIETAL EVALUATION OF WINGED BEAN (PSOPHOCARPUS TETRAGONOLOBUS L. DC) UNDER COCONUT FOR THE INTERMEDIATE DRY ZONE OF THE COCONUT TRIANGLE IN SRI LANKA.

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SUMMARY

Suitability of 16 varieties of winged bean (Psophocarpus tetragonolobus (L. DC) on the basis of their yield and other agronomic characters, to the agro-climatic conditions of the intermediate dry zone of the coconut triangle in Sri Lanka was tested during Yala 1981 and Maha 1982/83. Thirteen Papua New Guinea selections (UPS) and each from local, Thailand and Nigerian selections have comprised the 16 varieties.

The biological variation among the varieties was high. Significant differences in number of leaves, shoots per plant and plant height were observed. Thailand-D and SLS-47 showed excess vegetative growth compared to others. The tested varieties took 46.3 to 76.7 days and 45.3 to 58.0 days for first flowering in Yala and Maha season respectively. UPS-62 gave the earliest yield during both seasons. The highest vegetable pod yields were given by varieties TPT-2 (668.7g/plant) and SLS-47 (366.6 g/plant) in the Yala and Maha seasons respectively. UPS-99, UPS-121 and Thailand-D produced substantial vegetable yield in both seasons. The Yala season was better than the Maha for green pod production. The seed production of the tested varieties was low perhaps due to the problems associated with climate. However, SLS-47 (40.4 g/plant) and TPT-2 (30.4 g/plant) gave the highest seed yield in the Yala and Maha seasons respectively. In all varieties, the crude protein content of leaves, immature pods and seeds were above 22.5%, 18.5% and 30.5% respectively.

INTRODUCTION

The winged bean is regarded as a great green hope among scientists who worry about new food sources for the over populated and under developed world. It is an unexploited tropical legume, and has potential for improving human diet and enriching the soil. The winged bean or "dambala" as it is locally known, has been grown as a backyard crop in various parts of the island for centuries. The Government of Sri Lanka has launched a national programme to expand production and utilization of winged bean to combat malnutrition, to generate employment and to improve the income of the people. Sri Lanka is going ahead with plans to establish a pilot winged bean development centre. Plans for the pilot programme include collection of local and selected improved varieties, experimentation in various parts of the island to determine local adaptability, appropriate cultivation methods to produce immature pods, ripe seeds and tubers, etc. (Anon, 1980). Winged bean could be grown under coconut both as a leguminous cover crop and as a cash crop, for green pods, mature seeds and tubers. Although there are alot of winged bean strains found in the tropics, lack of information regarding their suitability for growing under coconut appears to be the main constraint for the development of winged bean cultivation under coconut.

The objective of this study was to evaluate some of the local and introduced strains of winged bean for their suitability for cultivation in the intermediate dry zone of the coconut triangle in Sri Lanka.

MATERIALS & METHODS

The experimental site was at Ratmalagara Estate, Madampe (elevation, 27 m) in the Intermediate dry zone of the coconut triangle. The soil was well drained, predominantly shallow, sandy clay loam deposited on gravels at depth.

The age of the coconut plantation was 50 years. Light penetration was %. The following 16 winged bean varieties were tested during Yala 1981 and Maha 1982/83.

UPS - 31, 32, 45, 46, 47, 59, 62, 66, 99, 102, 121, 122 and 139 (University of Papua New Guinea selections)

TPT - 2 (a Nigerian variety)

Thailand - D (a Thai variety)

SLS - 47 (A Sri Lankan selection)

All varieties were arranged in randomized blocks, replicated three time. Spacing and density of winged bean were 1m x 1m and 6666 plants per coconut hectare (leaving allowance for manure circle, calculation of plant density was based on land area 2/3rd that of the open field). The size of each plot was $40m^2$ located between two coconut rows, 1,8m away from the bole of the palm on each side. Two seeds per hill were planted on 12th May 1981 (Yala trial) and on 8th October 1982 (Maha trial) and thinned to one per hill after the development of the first trifoliate leaf. Gliricidia stakes were planted 21 days after sowing of seeds for training the vines.

Nitrogen as urea (46% N) at 67.5 kg/ha, phosphorus as conc super phosphate (48% P_2O_5) at 50 kg/ha and potassium as muriate of potash (60% KCl) at 100 kg/ha were applied at planting. Plants were top dressed with urea at the rate of 50 kg/ha 4,8 and 12 weeks after planting. The coconut palms were fertilized separately with a "CU-1" NPK mixture at the rate of 3 kg per palm during the year. Routine pest control measures were adopted.

The number of leaves per plant and shoot number per plant were counted and height was recorded at 2, 4, 6, 8 and 10 weeks after planting (WAP) to study vigourness of growth and early establishment of the different varieties. Number of days to first and 50% flowering, number of days to first immature pod harvest, pod length, seed number per pod, 100 seed weight, pod number per plant, fresh pod yield and seed yield were recorded. The protein content of a composite sample of leaves was estimated at 30 days after planting. Immature pods were taken for protein analysis at 3 weeks after pod setting.

Climate:

The climatic data is given in fig 1. During the yala season, rainfall distribution was satisfactory for crop growth, but in the maha season there was a dry period from the end of December to the end of February. The rainfall during the two experimental periods were 611 mm in the yala trial and 304 mm in the maha trial. The crop was supplementally irrigated when needed. Generally, end of maha day temperatures were higher than the yala day temperatures.

RESULTS

Trial 1 - 1981 Yala Season.

Germination percentage

The percentage of germination was counted 7 days after crop establishment (Table 1). In all varieties, germination percentage prior to seeding ranged 80-90%. After sowing germination percentage reduced to 30.3 (Thailand - D) to 78.8 (UPS-45). UPS varieties except UPS-59, UPS-121 and UPS-122 maintained a higher germination percentage than other tested varieties.

Leaf number per plant

At 2 WAP, UPS-66 and UPS-139 had more leaves per plant than other varieties (Table 2). UPS-31 and Thailand-D had more leaves at 4 WAP than others, while at 6 WAP, UPS-102, Thailand-D, UPS-31 and SLS-47 produced higher number of leaves per plant but with no significant differences among them. UPS-121 had the lowest leaf number (14.8) at 6 WAP. UPS-31 had more leaves per plant than other varieties at 10 WAP and it produced the highest number (82.7). The difference between it and other varieties was significant except UPS-102, Thailand-D and SLS-47. At the end, UPS-47 had the lowest leaf number (28.3). Generally, the leaf numbers were low in UPS-47 and UPS-121 compared to others.

Shoot number per plant

Among the varieties, there was no significant difference in the shoot production at 4 WAP. UPS-31,

UPS-102, Thailand-D and SLS-47 had more shoots/plant at 6 and 8 WAP than the other varieties. At the end of 10 WAP, UPS-31 and UPS-47 produced the highest and least number of shoots/ plant respectively (9.0 & 3.4). There were no significant differences among the UPS varieties except UPS-47. The local variety SLS-47 had the second highest shoot number/plant (6.9).

Plant height (cm)

At 2 WAP, UPS varieties except UPS-121 and 122 were generally taller than others (Table 4). UPS-45 was significantly the tallest (58.0 cm). Although, UPS-121 and 122, Thailand-D, TPT-2 and SLS-47 have recorded quick height increase compared to others. No significant height differences among UPS varieties were recorded except UPS-121. The increase of height from 4 to 6 WAP and 6 to 8 WAP was nearly two fold for all varieties.

Yield characters

Number of days to first & 50% flowering

The results are presented in Table 5. The varieties took 46.3 to 76.7 days and 58.0 to 91.7 days for the first & 50% flowering respectively. UPS varieties have taken 46.3 - 70.7 days for the opening of the first flowers. The earliest was UPS-47. All varieties came to 50% flowering within 4.0 - 32.3 days from the appearance of flowers.

Number of days to first immature pod harvest

The first fresh pod yield was harvested within 15-29 days after the appearance of first flower, however there was wide variation among the varieties (Table 5). All UPS varieties gave the first pod yield within 15-29 days after first flowering. UPS-121 TPT-2 and SLS-47 took significantly more days (98.3,98.3 & 94.7 days respectively) for first pod yield. The difference among the above three varieties was not significant. UPS-32, UPS-62 were the early harvesting varieties while UPS-121, TPT-2 and SLS-47 were the late harvesting ones.

Pod length at 3 weeks

The pod length at 3 weeks after pod set or when pods are at the immature stage has direct relevance to their marketability as a vegetable (Table 6). In UPS vars., pod length varied from 9.2 cm (UPS-139) to 19.6 cm (UPS-122). The local var. SLS-47 had pods of medium length (14.4 cm).

Seed number per pod

Only the fully mature seeds/pod were counted (Table 6). Among the UPS varieties, the seed number varied from 6.7 to 15.3. UPS-121 and UPS-122 had the highest seed number (15.3). UPS-46 and UPS-139 having small pods had about 6.3 and 6.7 seeds/pod respectively. The seed number/pod was related to pod length.

100 seed weight (g)

The seed weight which depends on seed size is a varietal character (Table 6). The average weight of 100 seed varied from 19.1 g (UPS-102) to 35.9 g (UPS-122). Among the UPS varieties, UPS-32, UPS-121 and UPS-122 had heavy seeds.

Pod number per plant

The total pod number/plant was counted upto five months after planting (Table 7). The highest number of pods were produced by UPS-31, followed by UPS-139, the former bearing a large number of small pods. The other varieties had pod numbers ranging from 21.5 - 48.7. UPS-32 yielded the lowest pod number. UPS-99, TPT-2 and Thailand-D produced large number of medium sized pods.

Fresh pod yield (g/plant)

The immature pods suitable as a vegetable were harvested regularly over a period of five months (Table 7).

The yield/plant in UPS varieties ranged from 218.7 (UPS-46) to 574.3 (UPS-99). The highest yielding variety was TPT-2 (668.7 g/plant), followed by UPS-99 (574.3 g/plant) and UPS-122 (540.0 g/plant). The Nigerian var. TPT-2 was significantly superior to all UPS varieties, except UPS-99, 121 and UPS 122.

Seed yield (g/plant)

The seed yield varied from 7.4 (UPS-46) to 40.4 (SLS-47) g/plant (Table 8). Thailand-D, TPT and SLS-47 gave higher seed yield than the UPS varieties, with UPS-122 being the highest among them. SLS-47 and TPT-2 yields were significantly higher than others. There were no significant differences among the UPS varieties, except UPS-121 and 122.

Bio-chemical characters

Protein content of leaves, immature pods (on dry matter basis) and seeds (by weight).

The leaf protein content varied from 28.9% (UPS-99) to 22.54% (TPT-2). All UPS varieties, except UPS-32 had higher leaf protein content than the vars. TPT-2 and SLS-47 (Table 9). The protein percentage in immature pods of UPS-66 (23.13%) was significantly higher than other varieties. The lowest was UPS-32. The seed protein content ranged from 30.57% to 36.96% among the varieties. The highest seed protein percentage was recorded for UPS-99 (36.96%) followed by UPS-122 (35.67%), UPS-31 and SLS-47.

Susceptibility for virus disease

The plants which had more than half of the total leaves showing mosaic viral symptoms were considered as virus susceptible plants.

All UPS varieties showed a resistance to viral infection (Table 10). Vars. Thailand-D and SLS-47 were susceptible and susceptibility was decreased at 8 WAP.

Trial 11 - 1982/83 Maha season

Germination percentage

As in yala trial, germination percentage in all varieties prior to seeding ranged from 80 - 90% (Table 1). All varieties showed a higher germination % in the maha season than in the yala season. In this season, germination % varied from 63.3 to 86.6. In both seasons, Thailand-D showed a poor germination %.

Leaf number per plant

Leaf number/plant for all varieties except UPS-59 was less in the maha season than in the yala season (Table 2). It was generally half that recorded for the yala season. Var. UPS-59 was exceptional, and it recorded the approximately same leaf number/plant in both seasons. SLS-47 has shown the highest leaf number/plant at 6, 8 & 10 WAP.

Shoot number/plant

Similar to leaf number/plant, the shoot number/plant in the maha season was much less than in the yala season (Table 3), as indicated at 4 WAP. Except UPS-59, other UPS varieties did not produce shoots until 6 WAP. At 8 & 10 WAP, SLS-47 produced the significantly highest shoot number/plant. It was the only variety which had produced higher shoot number in the maha season than in the yala season.

Plant height (cm)

All varieties, except UPS-47 & Thailand-D had shorter plants in the maha season than in the yala season (Table 4). Vars. UPS-47 and Thailnad-D were exceptional with taller vines in the maha season. Heights of UPS-45, UPS-121 and TPT-2 were below one fourth the height of the tallest var. UPS-66. Generally, the increment in the plant height occured at 4 to 6 WAP. It was between 4 to 9 times for all varieties compared to the value between 2 to 4 WAP.

Number of days to first and 50% flowering

Unlike in the Yala trial, the time taken from planting to first & 50% flowering in maha was shorter, and first flowers bloomed between 45.3 to 58.0 days (Table 5). Time taken for first flowering in UPS-47 was a little longer in Maha than in Yala. Being earliest to flower, UPS-46, UPS-62 and UPS-99 took 45.3 days for first flowering. TPT-2 took the longest time of 58 days for first flowering.

Number of days to first immature pod harvest

Similar to that of flowering, number of days to first immature pod harvest for all varieties was shorter in the maha season than in the yala season (Table 5). All varieties took 70-99.7 days in the yala and 61 - 77 days in the maha for first pod yield. The two earliest were UPS-62 and UPS-99 (61 days). The longest was TPT-2 (77 days).

Pod number per plant

Unlike in yala, the pod number/plant was low in the maha trial (Table 7). UPS-31 produced the highest pod number/ plant in both seasons. The lowest was UPS-47. The decrease in maha, of the pod number/plant of all varieties, except SLS-47 was generally half compared to the Yala. SLS-47 yielded more or less the same pod number/plant in both seasons (24.4).

Fresh pod yield (g/plant)

Fresh pod yield of all varieties except SLS-47 was also lower in the maha season than in the yala season (Table 7). The pod yield decrease was 1/3 to 2/3 times as compared to the yala trial. The local var. SLS-47 was exceptional in that it recorded the highest yield (366.6 g/plant) and that yield was higher than in the yala yield. UPS-99, UPS-121, Thailand-D and TPT-2 produced substantially high yield.

Seed yield (g/plant)

All varieties except UPS-59 and TPT-2 produced higher seed yield in the Maha season than in the Yala season (Table 8). The TPT-2 was the highest yielder (30.4 g/plant) followed by Thailand-D (30.3 g/plant) and UPS-122 (28.4 g/plant) respectively. Var. UPS-59 was the lowest yielder (12.3 g/plant).

DISCUSSION

Existence of high genetic variations in the growing habit, yield and biochemical characters was observed in the different varieties tested under the field conditions of the coconut triangle in Sri Lanka. The results indicated that some varieties were more suitable for this area than others. Introduction of exotic varieties of winged bean into coconut growing areas is therefore essential to select high yielding varieties to boost crop production.

Field conditions were not optimal for seed germination as indicated by the reduced germinability. Maha season has offered better conditions for germination than Yala. High germinability and good establishment are advantages to have early cover which will ease subsequent crop management practices.

The number of leaves/plant, shoot number/plant and plant height could be considered as an outward expression of the vegetative growth habit. The variations in them may also depend on various factors. For example, UPS-31 has more number of small leaves while UPS-122 has few large leaves. However, all UPS varieties showed low or medium vegetative growth. Generally, when all the growth parameters were considered, SLS-47 and Thailand-D showed a higher vegetative growth and confirms the findings of Gunasena and Gunathilake (1981). Vegetative growth of all varieties except the local variety SLS-47 was higher in the yala season than in the maha season. The reasons may be due to better rainfall distribution in the yala season compared to the maha season (Fig 1).

Number of days taken to first flower opening & 50% flowering differed according to the variety and the season. Number of days to flower was shorter in the yala season when compared with the same varieties grown in the maha season. Winged bean is a short day plant, and hence early flowering was observed during maha season, which had short days compared to yala season.

Gunasena & Gunathilake (1981) reported even shorter periods for flowering than the present results, by the same winged bean varieties.

The date of maturity is important for green pod production as they form the most popular of all winged bean products in most countries. UPS-32 and UPS-62 were the early harvesting varieties, and the highest vegetable pod yielding variety, TPT-2 took nearly one month more for first harvesting than the above varieties in the yala season. However, this time gap between UPS-62 and TPT-2 in the maha season was only a half month. The same difference was recorded between SLS-47 and UPS-62 in the maha season.

Pod characters have direct relevance to their marketability as a vegetable. The pod length, seed number per pod and 100 seed weight are subject to varietal and ecological variations (Gunasena and Gunathilake, 1981).

Normally, varieties with large pods and more seeds carry heavier seeds. eg. UPS-121 and UPS-122 had large pods and more seeds and their 100 seed weight was high.

Generally, the protein contents of leaves, immature pods and seeds of all varieties were high. The varieties, UPS-99, UPS-47, UPS-102 with fewer number of small sized leaves had high protein content in the leaves. SLS-47 produced more leaves with 22.91% protein. In all cases the protein content of immature pod was above 10.5% on the dry matter basis. The seed protein content was over 30% of the seed weight for all varieties. The results are comparable to those of Senanayake and Thiruketheeswaran (1981), but are a little higher than the mean seed protein content of 29.96% obtained by Gunasena & Gunathilake (1981).

Significant varietal differences were observed on pod number per plant, immature pod yield and seed yield. The present results on green pod production in winged bean clearly demonstrate the horticultural potential of this crop. In the yala trial, TPT-2 and in the maha trial, SLS-47 gave the highest vegetable pod yield. In both seasons UPS-99, UPS-121 and UPS-122 produced substantial vegetable pod yields. All varieties except SLS-47 showed a yield decrease in the maha trial than in the yala trial due to poor distribution of rainfall and occurance of high temperature in latter part of the maha season. Hence, the yala season is better than the maha season for winged bean cultivation in this area.

Two approaches to selection are possible. In market gardening, where there is a premium on early yield, varieties could be selected for earliness and low number of pickings (Kesaram & Erskine, 1978). On this basis the varieties TPT-2, UPS-99, UPS-121 and UPS-122 could be useful, Alternatively, varieties could be pursued for extended periods of harvest to suit subsistence agriculture and home gardening. The local variety, SLS-47 could be adopted for the above type of agriculture.

Conditions of the mid-country intermediate zone of Sri Lanka for green pod yield (Gunasena and Gunathilake, 1981) are much better than these intercropped conditions. This could be attributed to difference of soil, climatic conditions and competition from the coconut palms as a main crop.

The present seed yield was much lower compared to other reports (Gunasena and Gunathilake, 1981; Khan & Edward, 1981; Wong Kai Choo, 1975) when the harvesting time was taken into consideration, perhaps high rainfall in the yala season resulted in rotting of most of the dry pods and seeds. Therefore, the seed yield of most varieties in the maha season showed higher values than in the yala season. On the other hand, in the latter part of the maha season when rainfall was less, flower and pod production was low and abscission was high. Hence, seed production of tested varieties was low and would not suit extensive commercial cultivation for seeds. As concluded by Khan and Erskine (1976) the environmental effects are more important for grain yield. The Nigerian variety, TPT-2 was the best for seed purpose&for both seasons and the local variety, SLS-47 is suitable only for the yala season.

From the tested varieties, only SLS-47 and Thailand-D were the virus succeptible ones. The visual symptoms of the virus disease initiated 3 weeks after planting, and the attacked plants recovered after 10 weeks. Fortuner et al. (1979) also reported that the virus symptoms disappeared as the plants grew older. This may due to a build up of a natural resistance for virus disease. The same phenomenon was observed by Gunathilake and Gunasena (unpublished).

Cultivation of winged bean as an intercrop in the intermediate dry zone of the coconnut triangle is better suited for green pod production than for seed production. A survey conducted in the dry zone of Sri Lanka, suggested that the ideal way of promoting cultivation of winged bean at the initial stage of its development would be as a vegetable crop (Anandarajah, 1981). Hence, of the varieties tested in the yala season, var. TPT-2, UPS-99, UPS-121 and UPS-122 were superior.

In the maha season var. SLS-47 was the best, followed by varieties Thailand-D, UPS-121, UPS-99 and TPT-2.

The performance of 16 winged bean varieties in the intermediate dry zone of the coconut triangle in the yala and maha seasons were tested. Thailand-D and SLS-47 showed a high vegetative growth compared to the UPS varieties and Nigerian variety TPT-2. The varieties TPT-2 and SLS-47 were the best for green pod production in the yala and maha seasons respectively. Yala was better than Maha for green pod production due to the poor rainfall distribution in the latter part of the maha season. Seed production was not satisfactory for all tested varieties in both seasons.

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Table 1: Percentage of germination at 7 days after planting

Variety	Yala - 1981	Maha 1982/83
UPS - 31	64.4	66.6
UPS - 32	61.3	73.3
UPS - 45	78.6	80.0
UPS - 46	69.2	63.3
UPS - 47	62.9	70.0
UPS - 59	45.4	83.3
UPS - 66	70.4	73.3
UPS - 99	51.7	86.6
UPS - 102	51.3	63.3
UPS - 121	40.8	63.3
UPS - 122	40.4	63.3
UPS - 139	65.3	70.0
Thailand - D	30.3	46.6
TPT - 2	43.8	76.6
SLS - 47	37.1	66.6
LSD (P = 0.05)	24.7	22.0
CV %	22.9	26.32

Table 2: Leaf number/plant

Variety	Yala - 1981					Maha - 1982/83				
	2 WAP	4 WAP	6 WAP	8 WAP	10 WAP	2 WAP	4WAP	6 WAP	8WAP	10WAP
UPS-31	4.8	12.9	31.8	72.4	82.7	3.0	8.3	21.5	27.4	34.2
UPS-32	4.3	11.0	24.0.	35.0	41.8	3.0	8.4	18.2	19.1	26.3
UPS-45	4.4	11.1	21.2	30.8	43.6	2.6	8.5	14.6	16.1	22.7
UPS-46	4,6	10.4	21.1	35.6	56.2	2.4	8.5	17.6	24.7	29.9
UPS-47	3.4	7.1	18.7	22.4	28.3	2.8	7.7	14.0	15.6	19.1
UPS-59	4.0	8.0	16.7	26.9	38.2	3.1	10.9	21.9	30.1	31.1
UPS-62	4.9	11.6	27.7	43.7	48.5	2.2	7.1	11.8	14.8	17.9
UPS-66	5.0	11.7	27.9	46.3	51.6	3.2	8.8	16.8	21.3	30.6
UPS-99	4.0	10.8	22.8	42.7	47.6	2.2	7.9	14.0	20.0	25.6
UPS-102	4.4	11.2	33.9	54.0	60.9	3.1	9.6	25.0	31.9	38.4
UPS-121	3.1	9.3	14.8	25.7	32.5	2.0	5.8	9.8	13.3	19.5
UPS-122	3.9	9.7	20.3	36.4	49.7	2.0	6.2	10.9	14.9	19.1
UPS-139	5.1	11.0	25.5	43.7	49.2	2.8	10.1	17.5	22.9	31.8
Thailand-D	4.5	12.5	38.9	55.5	71.5	2.9		28.7	38.2	44.5
TPT-2	3.9	10.1	25.9	40.8	51.7	2.2	7.5	12.7	19.1	21.2
SLS-47	4.1	12.1	31.6	50.7	71.8	2.3	9.0	26.3	46.5	55.8
LSD(P=0.05)	1.1	3.6	11.0	25.3	26.5	0.7	2.0	6.4	10.4	11.0
CV %	16.0	20.5	26.8	36.7	30.9	15.3	14.5	22.3	26.5	22.6

WAP = Weeks After Planting

Table 3: Shoot number/plant

Variety	Yala - 1981				Maha - 1982/83			
	4 WAP	6 WAP	8 WAP	10 WAP	4 WAP	6 WAP	8 WAP	10 WAP
UPS-31	2.2	3.8	5.9	9.0	0.0	1.3	1.8	2.1
UPS-32	1.7	1.7	3.1	4.3	0.0	0.3	0.6	2.1
UPS-45	1.3	1.3	3.0	5.3	0.0	0.2	1.0	1.9
UPS-46	1.6	2.2	4.1	6.0	0.0	0.0	1.7	3.1
UPS-47	0.6	0.9	2.4	3.4	0.0	0.5	0.2	1.2
UPS-59	1.6	2.0	3.4	5.2	0.0	1.3	1.8	3.9
UPS-62	1.5	2.5	3.6	4.9	0.0	0.3	0.8	1.9
UPS-66	2.0	2.4	3.8	5.7	0.0	0.8	1.1	1.7
UPS-99	1.0	2.0	4.0	5.0	0.0	0.3	0.5	1.7
UPS-102	1.7	3.3	6.7	6.7	0.0	1.7	1.8	2.3
UPS-121	1.5	1.5	1.5	4.9	0.0	0.0	1.0	1.9
UPS-122	1.5	1.9	3.7	6.7	0.0	0.3	1.0	1.3
UPS-139	2.0	2.9	3.6	5.0	0.0	1.1	1.8	2.9
Thailand-D	1.3	4.3	4.9	5.4	0.3	1.4	3.0	3.4
TPT-2	1.3	2.0	4.1	6.3	0.0	1.1	1.6	2.9
SLS-47	1.3	2.8	5.0	6.9	0.1	1.3	5.0	7.1
LSD (P=0.05)	1.5	1.9	2.3	3.7	0.2	0.9	1.6	1.6
CV %	72.2	50.2	35.1	40.1	189.9	73.9	60.9	37.7

WAP = Weeks After Planting

Table 4: Plant height (cm)

Variety	Yala - 1981				Maha 1982/83			
	2 WAP	4 WAP	6 WAP	8 WAP	2 WAP	4 WAP	6 WAP	8 WAP
UPS - 31	38.0	81.7	114.8	245.4	24.0	30.0	140.7	184.0
UPS - 32	23.0	63.4	170.5	242.5	13.0	16.7	147.0	202.3
UPS - 45	58.0	88.1	154.7	237.5	9.0	14.0	100.7	157.0
UPS - 46	19.2	72.6	190.6	275.1	7.3	20.7	192.3	256.0
UPS - 47	14.8	50.2	142.5	203.8	28.0	36.7	=44.0	233.3
UPS - 59	48.3	82.5	119.5	238.2	49.3	64.3	193.0	247.7
UPS - 62	37.4	74.2	181.1	254.1	11.0	16.0	91.3	151.7
UPS - 66	34.3	67.3	167.9	273.2	12.7	20.0	165.0	618.0
UPS - 99	44.7	66.3	160.2	283.9	19.0	28.0	87.3	155.7
UPS - 102	29.1	78.1	124.6	205.2	13.0	18.3	146.0	191.0
UPS - 121	5.5	46.2	86.6	166.1	5.3	11.7	49.3	113.0
UPS - 122	9.0	74.5	148.2	231.3	6.0	12.7	68.7	130.7
UPS - 139	42.7	79.2	113.1	245.0	27.7	32.7	167.0	211.0
Thailand - D	8.1	52.5	108.9	192.3	10.7	22.7	130.3	220.7
TPT - 2	6.3	70.9	112.6	200.6	8.3	20.0	68.7	165.7
SLS - 47	9.5	50.9	95.0	211.9	5.7	14.3	134.7	245.3
LSD (P=0.05)	3.7	29.6	38.8	80.0	10.6	12.5	82.1	92.1
CV %	66.5	33.9	35.1	17.9	40.5	32.0	38.7	28.9

WAP = Week After Planting

Table 5: Number of days to first & 50 percent flowering and first immature pod harvest.

Variety	Yala - 1981			Maha - 1982/83		
	First Flowering	50% Flowering	First immature pod harvest	First Flowering	50% Flowering	First immature pod harvest
UPS - 31	54.0	68.7	78.0	50.6	60.3	62.7
UPS - 32	55.0	62.0	70.0	53.3	61.7	65.0
UPS - 45	57.3	65.3	78.0	52.3	57.0	69.0
UPS - 46	51.3	61.0	75.3	45.3	51.7	74.0
UPS - 47	46.3	58.7	72.7	48.6	57.3	65.0
UPS - 59	60.3	72.7	75.3	55.0	63.7	73.3
UPS - 62	50.0	58.0	70.0	45.3	54.7	61.0
UPS - 66	53.3	64.0	75.3	51.0	63.0	67.3
UPS - 99	48.0	60.0	72.7	45.3	47.7	61.0
UPS - 102	52.7	58.3	75.3	47.0	56.0	63.0
UPS - 121	70.7	81.3	99.7	54.3	61.0	74.3
UPS - 122	56.3	65.3	80.0	49.0	53.0	67.0
UPS - 139	56.0	71.7	78.0	52.0	65.0	69.7
Thailand - D	55.7	88.0	78.0	49.3	53.0	67.0
TPT - 2	69.0	82.0	98.3	58.0	60.0	77.0
SLS - 47	76.7	91.7	94.7	53.3	60.3	75.7
LSD (P=0.05)	6.6	7.1	9.5	4.4	8.1	9.4
CV %	6.9	6.1	7.2	5.3	8.4	8.2

Table 6: Average Pod length (cm) 3 Weeks After Pod set, Seeds, per Pod and 1000 Seed weight (g).

Variety	Average pod length (cm)	Seeds/pod	100 seed weight (g)
UPS - 31	9.4	8.3	26.2
UPS - 32	13.7	12.3	30.1
UPS - 45	14.0	14.3	23.8
UPS - 46	8.7	6.3	22.1
UPS - 47	18.5	12.0	21.4
UPS - 59	12.3	9.7	24.7
UPS - 62	10.5	10.7	27.3
UPS - 66	10.6	10.7	20.2
UPS - 99	12.9	12.0	25.98
UPS - 102	8.3	8.0	19.1
UPS - 121	18.4	15.3	30.45
UPS - 122	19.6	15.3	35.89
UPS - 139	8.2	6.7	19.3
Thailand - D	13.2	12.0	27.03
TPT - 2	18.1	12.0	29.83
SLS - 47	14.4	13.3	24.94
LSD (P=0.05)	2.0	2.4	4.1
CV %	9.4	13.0	12.1

Table 7: Number of Pods per plant and Fresh Pod Yield

Variety	Yala - 1981			Maha - 1982/83		
	No. of Pods/plant	Fresh Pod yield/plant	Fresh Pod yield kg/* coconut ha	No. of Pods/plant	Fresh pods yield/plant	Fresh Pod yield kg/* coconut ha
UPS - 31	65.3	431.3	2876	32.2	208.7	1391
UPS - 32	21.5	232.3	1549	12.6	138.4	923
UPS - 45	24.4	295.3	1969	16.6	240.7	1604
UPS - 46	39.3	218.7	1458	22.3	136.2	908
UPS - 47	24.7	224.7	1498	12.1	124.8	832
UPS - 59	26.9	272.6	1818	19.3	195.7	1305
UPS - 62	42.4	337.0	2246	18.5	178.9	1192
UPS - 66	35.3	295.0	1967	23.0	194.1	1294
UPS - 99	48.7	574.3	3829	22.4	316.0	2107
UPS - 102	46.7	228.0	1520	19.3	105.4	703
UPS - 121	28.5	453.3	3022	21.9	354.1	2361
UPS - 122	28.9	540.0	3600	13.0	240.4	1602
UPS - 139	59.8	348.0	2320	21.9	123.2	821
Thailand - D	37.6	416.7	2778	24.5	357.2	2381
TPT - 2	39.7	668.7	4458	18.2	252.9	1686
SLS - 47	24.5	340.7	2271	24.4	366.6	2444
LSD (P=0.05)	21.6	228.7	1520.0	7.0	95.8	638.8
CV%	34.8	37.2	37.2	20.8	26.0	26.0

*Leaving allowance for manure circle, yield calculation based on land area 2/3rd that of open field.

Table 8: Seed yield

Variety	Yala - 1981		Maha - 1982/83	
	g/plant	kg/* coconut ha	g/plant	kg/* coconut ha
UPS - 31	10.0	66.7	19.4	129.3
UPS - 32	9.3	62.0	18.9	126.0
UPS - 45	9.5	63.1	18.8	125.1
UPS - 46	7.4	49.3	27.4	182.7
UPS - 47	13.2	87.8	19.2	128.2
UPS - 59	16.2	108.2	12.3	82.2
UPS - 62	13.4	89.6	14.7	97.8
UPS - 66	11.9	79.1	13.3	88.5
UPS - 99	17.1	114.0	27.6	184.2
UPS - 102	10.4	69.1	14.1	94.0
UPS - 121	15.9	106.2	25.7	171.1
UPS - 122	21.3	142.2	28.4	189.6
UPS - 139	14.3	95.6	14.2	94.5
Thailand-D	32.0	213.7	30.3	202.2
TPT - 2	39.7	264.4	30.4	202.5
SLS - 47	40.4	269.6	27.9	185.8
LSD (P=0.05)	7.6	50.6	11.3	75.0
CV %	25.8	25.8	31.5	31.5

*Leaving allowance for manure circle, yield calculation based on land area 2/3rd that of the open field.

Table 9: Percentage of Crude Protein content of leaf, immature pod and seed

Variety	Leaf (DM basis)	Immature pod (DM basis)	Seed (by seed weight)
UPS - 31	25.97	20.33	35.58
UPS - 32	22.76	18.52	30.57
UPS - 45	26.42	19.23	33.79
UPS - 46	27.27	20.32	33.79
UPS - 47	28.06	21.95	32.24
UPS - 59	26.48	21.44	34.78
UPS - 62	26.78	22.22	30.92
UPS - 66	24.77	23.13	30.68
UPS - 99	28.92	19.24	36.96
UPS - 102	28.28	21.23	34.09
UPS - 121	27.74	19.44	32.80
UPS - 122	27.14	19.12	35.67
UPS - 139	27.36	21.53	33.09
Thailand-D	27.15	21.76	32.70
TPT - 2	22.54	20.44	32.21
SLS - 47	22.91	19.23	35.28
LSD (P=0.05)	0.64	0.52	0.86
CV %	1.14	1.19	1.21

Table 10: Percentage of virus disease susceptible Plants at 4 and 8 weeks after planting

Variety	4 WAP	8 WAP
UPS - 31	-	-
UPS - 32	-	-
UPS - 45	-	-
UPS - 46	-	-
UPS - 47	-	-
UPS - 59	-	-
UPS - 62	-	-
UPS - 66	-	-
UPS - 99	-	-
UPS - 102	-	-
UPS - 121	-	-
UPS - 122	-	-
UPS - 139	-	-
Thailand - D	40.0	15.0
TPT - 2	-	-
SLS - 47	35.0	10.0

WAP = Weeks After Planting

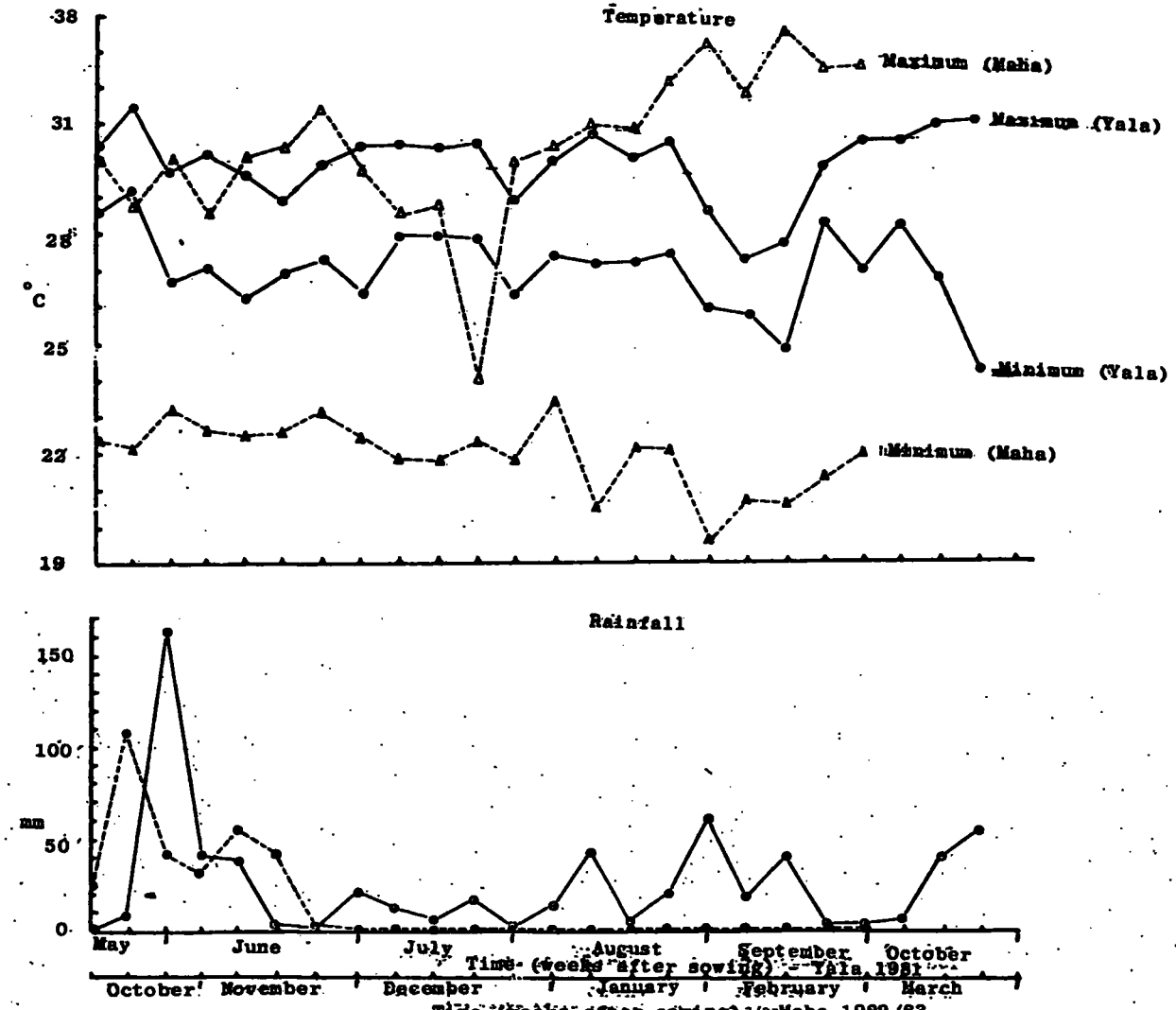

Fig. 1: Average weekly rainfall, minimum and maximum temperature in Yala - 1981 and Maha - 1982/83.