

Varietal Evaluation of Winged Bean (Psophocarpus tetragonolobus L.DC) for the Mid Country Intermediate Zone of Sri Lanka

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SUMMARY

An experiment was conducted at the University Agricultural Experimental Station, Dodangolla during May - September, 1980, to evaluate the growth and yield performance of ten Papua New Guinea (UPS), two Indonesia (LBNC), two Nigerian (TPT) introductions and three local (SLS) strains of winged beans. SLS 3, SLS 29, TPT 1, LBNC 1 and LBNC 3 produced flowers after 100 days or more due to photoperiod sensitivity, while others flowered in 45 to 60 days after planting. All photosensitive strains produced excessive vegetable growth. The fresh pod yields of TPT 2 and SLS 47 were 60 t/ha and 56 t/ha respectively. The photo-period sensitive strains, UPS 47 and UPS 102 gave lower fresh pod yields. The highest grain yields recorded for the following were, UPS 122 (3.1 t/ha), UPS 121 (2.88 t/ha), TPT 2 (2.7 t/ha), SLS 47 (2.55 t/ha). Thailand - D (2.32 t/ha) and UPS 99 (2.2 t/ha). SLS 47, UPS 122 and TPT 2 performed best both in fresh pod and seed production and are suitable as dual purpose strains, for cultivation in the intermediate zone of Sri Lanka.

INTRODUCTION

In addition to the major cultivated legumes such as soybean, peanuts and beans there is an under exploited multi-purpose legume, the "winged bean" which could be a potential protein rich crop for the tropics. Presently it is grown as a back garden crop in Sri Lanka and in many other South East Asian countries. The versatility of its use and the high

protein content makes it a potential crop for the future to alleviate protein malnutrition, most wide spread in the tropics. The objective of this study was to evaluate some of the local and introduced strains of winged bean for their suitability of cultivation in the mid country intermediate zone of Sri Lanka.

## MATERIALS & METHODS

The experiment was conducted at the University Experimental Station, Dodangolla during May - December 1980. The elevation of the experimental site was 367 amsl, and soil was a Reddish Brown latosol. The following 18 winged bean varieties were evaluated:-

1. UPS, 31, 32, 45, 47, 62, 66, 69, 102, 121 & 122 (University of Papua New Guinea selections)
2. TPT 1 and 2 (Nigeria)
3. LBNC 1 and 2 (Lembaga Biologi National, Indonesia)
4. SLS 3, 29, & 47 (Sri Lanka selections)
5. Thailand D (Thailand)

All strains were planted in randomized blocks, replicated four times. Nitrogen as Ammonium Sulphate (20 % N) at 125 kg/ha, phosphorus as concentrate super phosphate (48 % P<sub>2</sub>O<sub>5</sub>) at 50 kg/ha, and potassium as potassium sulphate (46 % K<sub>2</sub>O) at 100 kg/ha were applied at planting. Two seeds per hill were planted on 13th May, 1980, and thinned to one per hill after the development of the first trifoliolate leaf. Gliricidia stakes were planted 21 days after planting for training the vines. The crop was irrigated when needed and routine pest control measures were adopted. The following measurements were made; germination at 7 days after planting, leaf number/plant at 2 week intervals, number of days to first flower and 50% flowering days to first immature pod harvest, pod number/plant, pod length, pod colour, seed number/pod, seed colour, 100-seed weight, fresh pod yield, grain yield and protein content in leaf and mature seed.

## RESULTS & DISCUSSION

### Germination

The germination percentage in all strains prior to seeding ranged from 80 - 90% and under field conditions germination was reduced (Table 1). UPS and the Nigerian strain TPT - 2 maintained a higher germination percentage, the highest being that of UPS 122 (87%). The high germinability and good establishment of UPS strains have also been reported in Ghana, Karikari (1978). It is an advantage to have early cover which will ease subsequent crop management practices.

### Leaf number per plant

The leaf numbers were counted at 3, 5, 7, 9 and 11 weeks after planting (WAP) to study vigor of growth and early establishment of the different strains (Table 2). At 3 weeks after planting UPS 99 had 9 leaves/plant, being significantly superior to other strains. This was followed by SLS 47 (8.0). There was no definite relationship between the early germination and leaf development and even at 5 WAP, UPS 99 had more leaves than others. UPS - 31 had more leaves at 7 WAP than other UPS strains. At this count the highest leaf number was recorded for LBNC 3 (82.3) followed by SLS 47 (73.3) TPT (71.3). At 9 and 11 WAP, leaf development was rapid in LBNC 3 (134 & 294) and Thailand - D (135 & 233) and UPS 31 maintained the same trend as earlier, both at 9 and 11 WAP (109 & 146). The leaf numbers were significantly different among strains except in SLS strains. Generally the leaf numbers were less in UPS strains compared to the others, except in TPT 2 which had 149 leaves per plant. The leafiness was associated with extensive vegetative growth of the different strains.

#### Number of days to first and 50% flowering

UPS strains took 41 to 61 days for the opening of the flowers (Table 3). The earliest was UPS 99 and the latest was UPS 121. The UPS 122 took 54 days to flower and confirms the findings of Anandarajah (1978). TPT 2 and SLS 47 and Thailand took approximately 65 days to flower. The other strains namely TPT 1, LBNC 1 and 3, and SLS 3 and 29 took from 100 - 113 days to flower. The last being for SLS-29 (113 days). These strains are photosensitive, taking a longer period of about 3½ months for flowering when grown from April to June (Yala season). They produced more leaf growth compared to the early flowering varieties. All strains produced 50% flowers within 3 to 10 days of the appearance of the first flowers. Thus, UPS strains took 3 to 5 days, except UPS 121, TPT strains 6 to 7 days and LBNC strains 8 to 10 days. Thailand - D 12 days and SLS 8 to 9 days for 50% flowering.

#### Number of days to first immature pod harvest

The first fresh pod yield was harvested within 19 to 40 days after the appearance of first flowers, however there was wide variation among the strains (Table 3). All UPS strains except UPS 66 gave the first pod yield within 19 to 30 days after first flowering, while the latter took 40 days. Thus the first harvest of most UPS strains will be within 2½ months after planting and in UPS 66, 121 and 122 it may be extended for 3 months. Nigerian strains TPT 2, Thailand D and SLS 47 took 3 months and TPT 1 took 4 months, LBNC 1 and 3 took 4 months, while SLS 3 and 29 took 4½ - 5 months to give the first harvest. The delay in flowering (as reported earlier) and harvesting was due to photoperiod sensitivity of these strains. These strains when grown under short day conditions (Maha season) are known to flower and produce pods like non-photosensitive strains. (Senanayake, pers comm.)

#### Pod length at 3 weeks

The pod length at 3 weeks after pod set or pods at the immature stage has direct relevance to their marketability

as a vegetable. In strains of UPS pod length varied from 12.0 to 28 cm (Table 4), the longest being that of UPS 122 (28.1 cm) and shortest were UPS 31 and 102 (12 cm). There were no significant differences in pod length within or between other strains (19.8 - 24.9 cm). The difference in pod length are due to genetical differences among strains.

#### Pod number per plant

The total pod number per plant was counted up to 8 months after planting (Table 4). UPS strains had variable pod numbers according to strains, hence pod bearing ability appears to be a genetical character. The highest number of pods were produced by UPS 31, followed by UPS 62, the former bearing a large number of small pods. The other strains had pod numbers ranging from 123 to 193, UPS 47 yielding the lowest pod numbers among photosensitive strains. TPT 2 produced large number of medium sized pods while UPS 122 had large considerable number of pods. All photosensitive strains which flowered later produced less pod/plant up to this stage.

#### Immature pod yield

The immature succulent pods suitable as a vegetable were harvested regularly over a period of eight months (Table 4). Highly variable yields were noted due to differences in the yielding ability of strains. In the UPS strains, the yield varied from 14 to 51.5 t/ha. The highest yielding strain was UPS 122. Of the Indonesian strains, photoinsensitive variety TPT 2 and SLS 47 recorded highest yield of 59.5 mt/ha, & 55.8 mt/ha/, being insignificantly superior to all others tested.

#### Seed number per pod

Only the fully mature seeds per pod were counted (Table 4). The seed number among UPS strains varied from 9 to 18. UPS 122 had the highest seed number among all strains tested. In most strains including those locally collected, the seed number was around 12 to 14 per pod. The seed number per pod is related to pod length. UPS 31 and 102 having short pods had about 9 seeds, while UPS 122 with long pod contained 18 seeds.

### 100 Seed weight

The heaviest seeds were in the local selections, weighing from 42 to 47 g per 100 seeds (Table 4).

### Dry weight of pods

TPT 1, LBNC 1 & 3 & SLS 29 gave considerably low pod dry weight due to photosensitivity when grown in the Maha season (Table 5). TPT 2 and LBNC 3 showed rapid pod development over a short period, however the yields were lower than most of the photoinsensitive strains. Among UPS and all other strains the outstanding strains were UPS 121, 122 and 99 recording yields ranging from 5286 - 7113 kg/ha. Among other strains those showing promise were TPT 2 (4713 kg/ha), Thailand (4530 kg/ha) and SLS 47 (5440 kg/ha), the latter a non-photosensitive local strain was significantly superior to the other local strains SLS 3 and 29.

### Grain yield

All photosensitive strains (TPT 1, LBNC 1 & 3, SLS 3 and 29) gave significantly lower grain yields compared to photoinsensitive strains (Table 5). They took a long period for flowering and are perennial in growth habit. Therefore they may not be suitable for grain production, although useful for fresh pod and leaf yields which could be harvested over several months. The best yielders were UPS 122 & 121, TPT 2, Thailand - D, UPS 99 in the decreasing order, all yielding over 2200 kg/ha UPS 47 had the lowest yield among non-photosensitive strains.

### Protein percentage of leaves and seeds

The protein content of a composite sample of leaves was estimated at 30 days after planting (Table 6). There were significant differences among the strains. The protein percentage in leaves of UPS 102 was significantly higher than the other strains. Nigerian and Indonesian strains had 14 to 16 % protein in leaves. Among local strains SLS 47 had more (18 %) protein in leaf than others (16%). The leaf protein reported agrees with the results of others (Anon, 1975).

Senanayake (1976) reported higher protein percentages for the first fully expanded mature trifoliate leaves ranging from 24.48 to 31.46%. As leaf is used widely in salad, strains with a higher protein content could have potential use in varietal improvements. The seed protein content ranged from 26.3 to 33.7% among strains and confirms previous findings (Anon, 1975). The highest seed protein percentage among UPS strains was recorded for UPS 122 (33.7%).

Table 1: Germination percentage at 7 days after planting

Strain	Germination (%)	Strain	Germination (%)
UPS - 31	66.66	TPT - 1	31.66
UPS - 32	73.33	TPT - 2	73.33
UPS - 45	73.33	LBNC - 1	48.33
UPS - 47	76.66	LBNC - 3	55.00
UPS - 62	73.33	Thailand - D	43.33
UPS - 66	68.33	SLS - 3	50.00
UPS - 99	83.33	SLS - 29	50.00
UPS - 102	68.33	SLS - 47	63.33
UPS - 122	86.66		

LSD (P = 0.05) 24.50

CV (%) 22.97

Table 2. Leaf number per plant.

Strain	WAP <sup>a</sup>	5 WAP	7 WAP	9 WAP	11 WAP
UPS-31	7.66	31.33	70.33	108.66	146.00
UPS-32	6.66	22.00	45.33	68.66	103.66
UPS-45	7.00	20.66	43.00	78.30	91.33
UPS-47	6.66	19.00	52.66	76.33	83.33
UPS-62	7.00	24.00	44.00	64.33	76.00
UPS-66	7.66	19.00	42.00	83.66	91.00
UPS-99	9.00	32.66	61.33	83.66	112.66
UPS-102	7.33	25.66	67.66	95.66	126.66
UPS-121	7.83	28.00	56.00	80.00	118.66
UPS-122	6.00	18.66	44.66	115.33	210.00
TPT-1	7.00	28.66	71.33	113.33	210.00
TPT-2	7.66	22.00	36.66	66.66	149.33
LBNC-1	7.66	31.30	58.30	105.00	202.33
LBNC-3	7.33	31.00	82.30	134.00	294.00
Thailand-D	7.33	29.66	67.00	134.66	233.22
SLS-3	7.00	21.00	64.00	113.00	200.66
SLS-29	6.00	20.00	53.66	110.00	182.66
SLS-47	8.00	28.66	73.33	120.00	233.66
LSD (P=0.05)	0.952	4.742	12.962	27.428	50.898
CV %	7.93	11.36	13.62	17.50	19.99

<sup>a</sup>WAP = Weeks After Planting.



Table 3. Number of days from planting to first and 50% flowering and immature pod harvest.

Strain	1st flowering	50% flowering	Immature pod harvest
UPS - 31	45.3	51.0	76.0
UPS - 32	48.3	53.6	68.0
UPS - 45	49.3	53.0	68.0
UPS - 47	47.3	52.6	76.3
UPS - 62	45.3	48.6	72.0
UPS - 66	48.3	55.3	88.0
UPS - 99	41.0	44.3	66.0
UPS - 102	48.6	52.6	72.0
UPS - 121	61.0	74.6	87.0
UPS - 122	54.3	61.3	84.0
TPT - 1	99.6	106.3	127.0
TPT - 2	64.6	71.3	89.0
LBNC - 1	104.3	114.6	133.3
LBNC - 3	102.0	108.3	126.0
Thailand - D	65.6	78.3	89.0
SLS - 3	105.6	115.0	136.0
SLS - 29	113.6	120.6	149.3
SLS - 47	65.6	73.0	89.0
L.S.D. (P = 0.05)	2.90	4.43	5.62
C.V (%)	2.61	3.60	3.6

Table 4. Pods/plant, Seeds/pod, 100 seed weight, fresh pod yield and pod length - 3 weeks after pod set.

Strain	Pods/plant	Seeds/pod	100 seed weight	Yield mt/ha	Pod length cm.
UPS - 31	444.0	9.5	28.79	35.01	12.01
UPS - 32	123.0	14.6	31.19	24.39	19.00
UPS - 45	184.0	14.3	23.23	28.37	17.20
UPS - 47	125.0	13.7	29.50	14.18	15.63
UPS - 62	345.0	12.0	31.48	35.54	12.94
UPS - 66	158.6	12.1	23.31	15.95	13.10
UPS - 99	193.3	12.3	36.70	36.72	17.56
UPS - 102	178.3	09.4	27.58	14.01	12.07
UPS - 121	135.0	14.4	37.26	21.69	21.47
UPS - 122	188.3	18.4	35.36	51.50	21.47
TPT - 1	97.6	11.3	37.71	22.32	19.79
TPT - 2	330.0	13.3	36.69	59.93	21.03
LBNC - 1	74.3	13.3	32.75	14.91	21.25
LBNC - 3	131.0	14.4	37.58	32.16	23.13
Thailand - D	224.0	12.5	33.28	33.74	19.96
SLS - 3	94.3	12.1	46.66	29.38	24.91
SLS - 29	34.6	14.6	45.40	11.63	19.65
SLS - 47	281.0	13.3	42.43	20.72	20.72
L.S.D.					
(P = 0.05)	28.8	1.23	0.78	3.84	9.10
C.V (%)	9.3	5.68	1.37	7.79	29.13

Table 5. Dry pod yield, grain yield and dressing percentage.

Strain	Dry pod yield Kg/ha	Grain yield Kg/ha	Dressing
UPS - 31	2966	1136	38.9
UPS - 32	3196	1198	38.2
UPS - 45	4383	1765	40.4
UPS - 47	2230	832	40.1
UPS - 62	2976	1929	68.7
UPS - 66	2573	1054	43.5
UPS - 99	5280	2223	52.5
UPS - 102	2303	1214	52.8
UPS - 121	7113	2875	40.7
UPS - 122	6913	3101	45.3
TPT - 1	2306	1018	44.6
TPT - 2	4713	2703	42.9
LBNC - 1	1000	501	40.3
LBNC - 3	1963	1210	58.1
Thailand - D	4530	2323	51.9
SLS - 3	1283	526	42.3
SLS - 29	646	27	43.7
SLS - 47	5440	2546	46.4
LSD (P = 0.05)	1293	361	17.56
C.V (%)	2216	14.0	23.20

Table 6. Protein percentage of leaves and seeds (dry weight-basis).

Strain	Leaves	Seeds
UPS - 31	12.35	28.75
UPS - 32	13.68	31.96
UPS - 45	17.47	29.63
UPS - 47	17.51	27.31
UPS - 62	18.99	26.25
UPS - 66	17.11	31.33
UPS - 99	18.40	29.35
UPS - 102	21.70	26.29
UPS - 121	17.67	31.14
UPS - 122	16.43	33.66
TPT - 1	15.90	29.11
TPT - 2	14.49	26.89
LBNC - 1	16.35	28.96
LBNC - 3	16.21	31.08
Thailand - D	18.75	26.49
SLS - 3	16.31	30.39
SLS - 29	15.90	28.73
SLS - 47	18.04	29.72
LSD (P = 0.05)	0.48	4.9
CV (%)	1.75	10.0