

A STUDY ON THE MAIZE-WINGED BEAN INTERCROP SYSTEM

H.P.M. GUNASENA AND H.A.J. GUNATHILAKE

Faculty of Agriculture,
University of Peradeniya,
Peradeniya.

SUMMARY

An experiment was conducted at the University Agricultural Experimental Station, Dodangolla (367 m) during Maha 1980/81 to study the feasibility of intercropping wingedbean and assess the suitability of maize as a supporting plant for the former. Fourteen treatments, (two wingedbean varieties (SLS-47 & UPS-99), three winged bean densities (8230, 12346, 24691 plants/ha) and two maize densities (12346, 49383 plants/ha) were included in the experiment.

Total yield of the intercropped systems were greater than when monocropped. The local strain, SLS-47 is more suitable than UPS-99 for intercropping with maize. The highest yields and gross returns were recorded for SLS-47 (27.12 m.t/ha) and 1:1 ratio of maize (each crop 24691 plants/ha). Both densities of maize tested had significant difference on the yield of maize. The densities of wingedbean did not affect the maize yield, but showed an effect on wingedbean yield.

This experiment showed that maize could be used as a support for wingedbean and combination of both crops produced more yield per unit area than when monocropped.

INTRODUCTION

Wingedbean locally known as 'Dambala' has been a long traditional home garden crop in Sri Lanka. In less than 8 years, the winged bean, a protein rich crop has elevated from almost complete obscurity to an important crop all over the world. There is no doubt that the cereal-legume intercropping systems could provide a well balanced diet to the under-nourished population of the developing countries. This has the added advantage that both the protein and energy providing crops could be grown in the same piece of land, which is a limiting resource in the over-populated developing countries.

There are evidences to show that at present intercropping with legumes practiced in countries like Tropical Africa where over 90% of the cowpeas are grown in association with support crops like sorghum, millet or maize (Arnon, 1972). Interplanting of wingedbean with maize and a variety of other crops is a common practice in the highlands of Papua New Guinea. It has been shown by Rachie & Luse (1978) that maize could provide satisfactory support for twining plants like wingedbean. The already well-established association of the climber and the support could be considered a most economically viable and least risky system available. In this system the climber may not necessarily produce higher yields, but the combination should ensure higher returns per unit area, while reducing the risk than, when the component crops grown in monoculture (Rachie & Luse; 1978). However, much need to be learned about genotypic, environmental and their interactions together with the economic advantage of the different systems.

The objective of this experiment was to study the feasibility of intercropping wingedbean and assess the suitability of maize as supporting plant for the former.

MATERIALS & METHODS

The experiment was conducted at the University Agricultural Experimental Station, Dodangolla (367 amsl). The soil of the experimental site was a clay sandy loam belonging to the Reddish Brown Latosols. The rainfall received during the experimental period was 410 mm which was fairly well distributed, hence supplementary irrigation was not required.

The treatment consisted of two wingedbean (*Psophocarpus tetragonolobus* (L) DC) varieties (UPS-99 and SLS-47) UPS-99 is an introduction from Papua New Guinea, with low vegetative growth, early flowering and short aged while SLS-47 is a local selection with high vegetative growth, long aged and high yielding. Both varieties are non-photoperiod sensitive. These varieties were grown using within row spacing of 45 cm, 90 cm and 135 cm as an intercrop with maize (*Zea mays*, L. Var. Thai composite) which was grown at two spacings, 22.5 cm and 45 cm. The plant population and the ratio of maize to wingedbean in each treatment are given in Table 1.

Both crops were established using two seeds/hill. in November 1980. After the development of the first fully opened leaf, the stand was thinned to one plant/hill. Wingedbean vines were supported on maize and as maize cobs were harvested the stems were left intact until the former reached maturity. Wingedbean received a basal fertilizer application of urea at 67.5 kg/ha, 50 Kg/ha of conc Superphosphate and 100 kg/ha of Muriate of potash. A top dressing of 20 kg/ha of Urea was applied 4 weeks after planting. Maize received 20 kg N/ha, 50 kg P_2O_5 /ha and 70 kg K_2O /ha as a basal dressing, followed by a top dressing of 20 kg N/ha applied 3 months after planting.

All treatments were arranged in randomized blocks, replicated three times. Weed and pest control were as per local recommendations.

Number of wingedbean pods/plant, fresh pod yield, number of maize cobs/plant, average weight/cob, maize yield, yield of component crops and estimated gross monetary value at prevailing market prices were determined.

RESULTS

The number of pods were recorded at 5 day intervals upto 6 months and total pods/plant (Table 2). The local selection, SLS-47 produced more pods than UPS-99 due to its perennial growth habit. Therefore the difference in pod number in the two varieties could be considered to be a genetical character. Both varieties produced less pods at the higher density of maize due to the competitive effect of the two species. This difference was significant only when SLS-47 was grown at the highest density of maize, where a 25% reduction in pod number was recorded.

The pod number increased with increasing density of UPS-99 recording 27.8 pods/plant at the highest density. UPS, being a short aged, low canopy strain would have been able to adapt itself at high densities. On the other hand, SLS-47 had the highest pod number at the medium density (63 pods/plant) which could be attributed to its excessive vegetative growth. The interactions were not significant which indicates that no drastic reduction in pods have occurred and competitive effects are negligible.

Fresh pod yield of winged bean.

The maize densities had no significant effect on the fresh pod yield of both wingedbean varieties although in SLS-47 yield was higher at the lower density of maize. The pod yield in both varieties increased with plant density. SLS-47 produced the highest pod yield (27 mt/ha) at the highest density of 24691 plants/ha, while UPS-99 at the same density gave only 12.7 mt/ha, a yield reduction of 53%.

This is a reflection of its habit of growth, particularly with reference to the length of the growing season.

Maize - Cob number/plant and weight/cob

The cob number varied between 1.09 - 1.78/plant. Maize population significantly affected the cob number/plant and at higher density decreased it by 29-60%. The winged-bean had no effect on cob number/plant (Table 4). The cob weight was similarly affected by maize density, while winged bean had no effect on cob weight (Table 5).

Cumulative yield

The cumulative yield from the cropping systems are given in Table 7. The monocrop maize produced the lowest yield when compared to any mixture. Maize with wingedbean variety, SLS-47 gave a higher yield when compared to maize with UPS-99 due to high yielding performance of SLS-47. Increasing the number of plants/ha of SLS-47 from the lowest density to the highest density, doubled the yield. However, the cumulative yield did not vary with increase in the maize population.

Estimated monetary value

The monetary values based on the prevailing market price of wingedbean and certified price of maize were Rs. 4500/- m.t. and Rs. 4000/- m.t. respectively (Table 8).

Pure stands of maize gave a low income when compared to different combinations of wingedbean and maize. The maize with SLS-47 gave the highest income, because the latter produced the highest yield, compared to UPS-99 at both densities of maize.

Furthermore, the strain SLS-47 gave the highest monetary value at 3:1 ratio of maize and wingedbean when compared to others.

DISCUSSION

It could be seen in Table 2 that the number of pods/plant and fresh pod yield were higher in SLS-47 than UPS-99 although the pod size is equal in both varieties. This is because the strain SLS-47 being more vigorous, produced a higher yield over a longer period and having some tolerance to shade. But, UPS-99 plants showed weak growth when the maize grew up. It could be said that UPS-99 was susceptible to competition from maize at later stages. When wingedbean density was reduced, the wingedbean yield and the number of pods/plant also reduced. However, the above yield parameters were not affected, when the maize density was increased. This may probably be due to the different growth patterns exhibited by the two crops at different growth periods. However, SLS-47 showed an yield decline at the highest density of both crops. This indicates that there is competition between maize and interplanted wingedbean for nutrients and other resources. The results also suggest that when, SLS-47 is intercropped with maize a density of 24691 plants/ha (1:1 ratio) should be adopted.

The maize yield was not affected by the treatments. Thus there was little effect on the maize yield, when wingedbean was used as the component crop. It appears that the competitive effect by the wingedbean was negligible during the stages of cob formation. The different growth patterns of the two species make this intercrop system compatible. As de Wit (1960) has suggested when species, differ in their growth patterns competitive effects particularly at critical stages seem to be negligible.

Table 6 shows no change in yield when the maize population was doubled. As expected, yield per plant decreased when the plant population was increased. In maize this effect was mainly brought about by decreases in the yield components of maize, particularly the number of cobs/plant and weight/cob.

In other words, for both species, intraspecific competition is more important than inter-specific competition. This could be readily visualized within the maize densities, for it simply means that any given population the maize suffered more competition from other maize than from wingedbean.

The yield of the mixture are best examined by considering the effect of replacing a certain proportion of one species by another. The pure maize treatments showed the typical parabolic type of yield/plant population relationship suggested by Holiday (1960). When the cumulative yield is compared with the pure maize systems, UPS-99 was the least efficient, because of its shorter life span. Thus cumulative yield was increased by more competitive species, SLS-47 mixed with maize. There was a large reduction in the cumulative yield, when the SLS-47 plant density was reduced. According to the above results, maize and SLS-47 at a 1:1 ratio at 24691 plants/ha of each spp. produced the highest yield. In this experiment there was a definite advantage in mixing the wingedbean and maize, because the highest yields were obtained from mixtures.

The highest monetary value for the intercropping were realized when SLS-47 was mixed cropped with maize in 1:1 ratio. That may be due to the highest yield of both crops recorded. When the wingedbean density was reduced income declined. However, a further increase in maize density, did not increase the monetary value, because the maize yield remained unaffected.

This study shows that the existing and predominant practice of monocropping of wingedbean or maize could be modified by intercropping. The advantages of this system would be an increased production and calorific and monetary value which could be an advantage to the small farmers of Sri Lanka.

CONCLUSION

Mixtures of wingedbean and maize gave considerably higher yield and income than that could be achieved by growing the two crops separately. The local strain, SLS-47 performed better than UPS-99 as a component crop with maize in intercropping. Wingedbean did not affect the yield of maize. However, both the densities of maize tested showed no yield difference. Therefore this suggests, that the inter-specific competition is less between the maize and wingedbean. The highest cumulative yield and income were given by maize and SLS-47 at 1:1 ratio, a population of 24691 plants/ha each crop.

ACKNOWLEDGEMENT

The authors gratefully acknowledge the financial assistance received from the University of Peradeniya which made this study possible. Sincere thanks are due to Mr. D.T. Mathes, O.I.C., Biometry Division in C.R.I. for analysis of the data, and to Mr. G.S. Premachandra, Farm Manager, Agriculture Experimental Station, Dodangolla, Kundasale for providing the field facilities.

REFERENCES

- Arnon, I., (1972). Crop production in dry regions. Vol-2 (Leonard Hill, London).
- de Wit, C.T., (1960). On competition. Versal landbouwk onderz. 66, 8.
- Donald, C.M., (1963). Competition among crop and pasture plants. Adv. Agron. 15, 1-18 p.

Gunaseena, H.P.M. and Gunathilake, H.A.J., (1981). Varietal Evaluation of Wingedbean for the Mid-country Intermediate Zone of Sri Lanka. Paper presented at Second International Seminar on wingedbean. Jan. 19-23, Sri Lanka.

Rachie, K.O. and Luse, R.A., (1978). Support systems for climbing food crops. Paper presented at First International Seminar on Wingedbean. Jan. 9-14, Philippines.

Thiruketheeswaran, A. and Senanayake, Y.D.A., (1981). Mixed cropping of wingedbean with snap beans. Paper presented at Second International Seminar on Wingedbean. Jan. 9-14, Philippines.

Willey, R.W. and Osiru, D.S.O., (1972). Studies on mixtures of maize and beans (*Phaseolus vulgaris*) with particular reference to plant population.

Table 1. Plant population and ratio of each treatment.

Maize (plants/ha)	Winged bean (plants/ha)		Plant ratio	
	UPS-99	SLS-47	Maize	: Wingedbean
24691	24691	-	1	: 1
24691	12346	-	2	: 1
24691	8230	-	3	: 1
24691	-	24691	1	: 1
24691	-	12346	2	: 1
24691	-	8230	3	: 1
49383	-	-	1	: 0
49383	24691	-	2	: 1
49383	12346	-	4	: 1
49383	8230	-	6	: 1
49383	-	24691	2	: 1
49383	-	12346	4	: 1
49383	-	8230	6	: 1

Table 2. Number of Wingedbean pods per plant.

Maize density (plants/ha)	UPS-99 (plants/ha)			SLS-47 (plants/ha)		
	8230	12346	24691	8230	12346	24691
24691	19.9	23.7	27.7	54.0	63.4	59.1
49383	12.1	20.3	22.4	46.5	63.8	47.7

LSD (P = 0.05) - 10.3, CV% - 16.9

Table 3. Mean fresh pod yield of wingedbean (mt/ha)

Maize density (plants/ha)	UPS-99 (plants/ha)			SLS-47 (plants/ha)		
	8230	12346	24691	8230	12346	24691
24691	3.05	5.44	12.70	8.26	14.57	27.12
49383	1.86	4.67	10.30	7.12	14.66	21.91

LSD (P = 0.05) - 5.54 CV% - 16.08

Table 4. Cob number/plant.

Maize density (plants/ha)	Without wingedbean	UPS-99 (plants/ha)			SLS-47 (plants/ha)		
		8230	12346	24691	8230	12346	24691
24691	1.64	1.61	1.61	1.78	1.75	1.47	1.52
49383	1.17	1.12	1.09	1.11	1.14	1.09	1.18

LSD (P = 0.05) - 0.16 CV% - 6.5

Table 5. Weight per cob (g)

Maize density (plants/ha)	Without wingedbean	UPS-99 (plants/ha)			SLS-47 (plants/ha)		
		8230	12346	24691	8230	12346	24691
24691	141.8	142.7	151.5	158.9	144.9	153.0	136.8
49383	113.9	119.4	115.7	137.5	122.6	113.6	132.4

LSD (P = 0.05) - 24.3 CV % - 10.78

Table 6. Maize yield (m.tons/ha).

Maize density (plants/ha)	Without wingedbean	UPS-99 (plants/ha)			SLS-47 (plants/ha)		
		8230	12346	24691	8230	12346	24691
24691	5.76	5.65	6.00	7.02	6.24	5.59	5.00
49383	6.63	6.66	6.20	7.51	6.86	5.98	5.64

LSD (P = 0.05) - 1.46 CV% - 13.11

Table 7. Cumulative yield (winged bean and maize) (m.t/ha).

Maize density (plants/ha)	Without wingedbean	UPS-99 (plants/ha)			SLS-47 (plants/ha)		
		8230	12346	24691	8230	12346	24691
24691	5.76	8.70	11.44	19.72	14.50	20.15	32.13
49383	6.63	8.51	10.87	17.81	13.98	20.64	27.55

LSD (P = 0.05) - 5.82 CV% - 11.38

Table 8. Estimated gross income (Rs./ha x 1000).

Maize density (plants/ha)	Maize only	UPS-99 (plants/ha)			SLS-47 (plants/ha)		
		8230	12346	24691	8230	12346	24691
24691	23.04 (16.2)	36.33 (25.6)	48.48 (34.1)	85.23 (60.0)	62.13 (43.7)	87.93 (61.9)	142.04 (100.0)
49383	28.52 (18.7)	35.01 (24.6)	45.82 (32.3)	76.39 (53.8)	59.48 (41.9)	89.89 (63.3)	121.16 (85.3)

(*Relative income in % to the highest income)