SOYA BEANS IN THE PNG LOWLANDS

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The value of soya bean as a protein source both for humans and animal food is well known. The oil obtained from the seeds of soya bean also has many uses.

Soya bean has, however, not been grown much in Papua New Guinea because it is not a "traditional crop". Also, it is not very good to eat unless it is properly cooked.

Over the last few years people have become more aware that the traditional diet in many parts of PNG is not good enough for good nutrition. This has led to more interest in soya bean as a food for people, because of its high protein value.

The cost of imported stockfeed for the rapidly expanding pig and poultry industry is now very high, and this has also created an interest in growing soya beans for pig and poultry food.

A paper on how to grow soya beans on a small scale has been written for the Department of Primary Industry's Farming Notes series.

The following article describes research carried out at the Agriculture Research Centre, Bubia, between 1972 and 1975, to find the most suitable varieties and ways of growing soya beans for large-scale plantings in lowland areas of PNG.

Trials are continuing at Bubia and also at Aiyura in the highlands.

Staff at the Agriculture Research Centre, Bubia, carried out trials looking at varieties, plant populations and nutrients through 1972 to 1976 and are now in a position to make recommendations.

Most of the trial work was carried out in the Markham Valley ranging from Bubia near Lae to Umi some 160 km west. Some trial

work was also carried out near Madang.

Results of these trials are summarized in this article and recommendations are given.

TRIAL RESULTS

Varieties

Some 112 experimental lines underwent preliminary assessment, together with 14 commercial varieties. The experimental lines were bred by the Department of Agriculture, University of Queensland, with the aim of producing types suited to low latitude (tropical) conditions. These lines are also being tested in Australia, Sri Lanka, Indonesia and Thailand.

Each of the 126 was tested at three places. Further trials were carried out with the most promising in 1975 and 1976.

The results of a trial in 1975 of the best ten commercial varieties are shown in *Table 1*. The results clearly show that Gilbert, Daintree and Ross, the varieties specifically selected for low latitude (north Queensland) conditions, gave satisfactory yields and acceptable heights for mechanical harvesting.

Nodulation in all cases was satisfactory.

Establishment was quite variable to variations in seed quality. Vegetative growth was good at Cleanwater and Leron Plains while at Umi growth was stunted. The latter is almost certainly due to a phosphorus deficiency as rock phosphate releases phosphorus only slowly and it appears to be of little immediate value with annual cropping.

Plant Population

Four varieties were used to compare various plant populations in 1975. Trials were planted at three sites.

Rows were sown 70cm apart, and within-row spacings of 4,8 and 16cm were used, to give maximum possible plant populations of 357 000, 178 000 and 89 000 plants/ha.

Results are summarized in *Table 2*.

Percentage establishment was quite variable, both with regard to variety and site. At Umi it was evident that in some instances more seed was sown than was intended.

Generally, Gilbert and Daintree showed better establishment than Semstar or Wills. Establishment increases as spacing within the row increased, no doubt due to decreased competition between plants. Within a variety higher populations gave higher yields generally, and increased plant height considerably.

Increased plant height correlates with increased height of pods from the ground, an important feature with mechanical harvesting. Results indicate clearly that increased populations increase yield as well as height.

Further trials — 1976

Two trials looking at 34 promising varieties and experimental lines were sown at Cleanwater late in January 1976. Two different spacings were used to see if it would be possible to get more height by decreasing between-row spacings. Between-row spacings of 75 and 50cm and within-row spacings of 4cm were used to give plant populations of 333 000 and 500 000 plants/ha. Results are summarized in *Table 3*.

Yields were lower than in 1975 averaging 2 200 kg/ha which is a little disappointing. This can largely be attributed to moisture stress at certain times. Gilbert and Daintree (two recommended varieties) yielded quite well and this was encouraging.

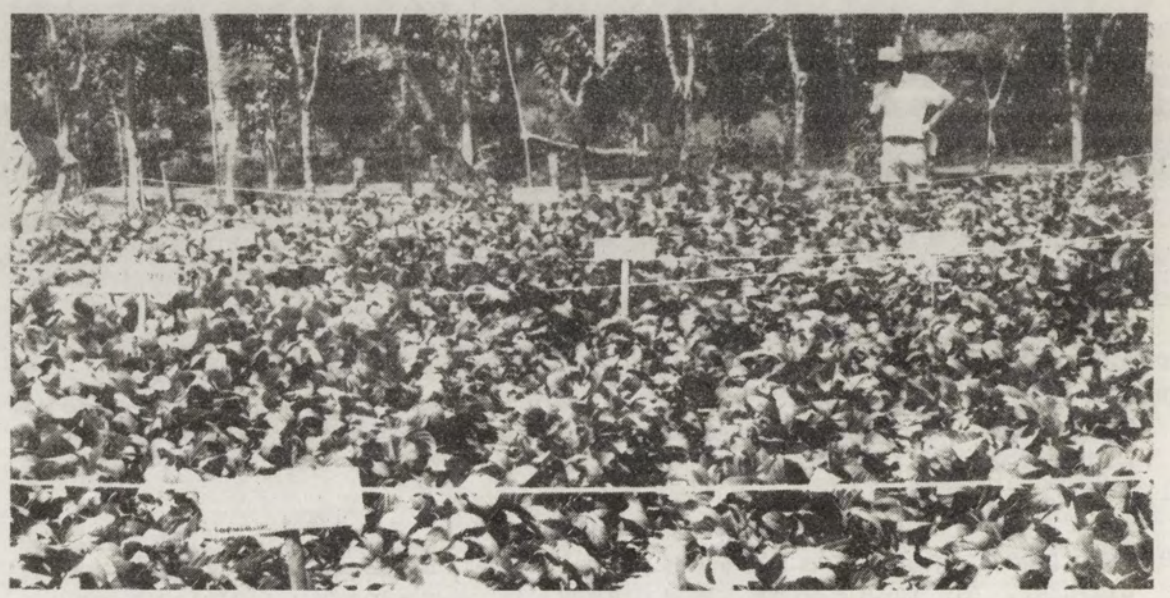
While yield did not differ significantly with the two plant populations plant height was increased considerably.

An observation plot looking at varieties and spacings at Leron Plains indicated that while closer between-row spacings will raise the height of short varieties, efficient mechanical harvesting would still not be possible.

Closer spacing with Daintree, a medium stature variety, increased height. Improved Pelican was tall and very impressive at all spacings.

It was disappointing that none of the newly developed lines outyielded Gilbert or Daintree and that most of the taller lines yielded significantly less and were in many cases susceptible to lodging.

There were considerable differences in time to maturity and this characteristic would be an asset in certain environments and situations in PNG. For instance, short season varieties would be desirable in the lower Markham while the reverse would probably hold for the upper Ramu.



An observation plot of soya bean varieties at Bubia

Pests and diseases

The green vegetable bug *(Nezara viridula)* was evident in considerable numbers in 1975 and appeared to be at least partially resistant to regular sprayings of DDT. In 1976 it was well controlled by spraying with Orthene (1 kg/ha) at regular intervals after flowering. Indications are that incidence will vary considerably from season to season. An entomologist is looking at the possibility of introducing parasites and predators of this insect from Hawaii. Insecticide trials are also in progress.

Some damage by a ladybird *(Hemosepilachna signatipennis)* occurred in 1975 but control was not considered warranted, although DDT deals with it quite effectively.

An unidentified disease occurred at Bubia in 1975. There was considerable variability between lines in susceptibility to this disease.

Bacterial pustule affected a number of lines in 1976 but Gilbert and Daintree are largely resistant to it.

RECOMMENDATIONS

Varieties

Gilbert, Daintree and Ross are recommended for the Markham and Ramu Valleys and other suitable lowland situations, on the basis of 1976 and previous results. Steps should be taken in advance to obtain seed as supplies may be limited.

Plant populations

Populations of 300 000 to 350 000 would be desirable. Spacings will depend largely on equipment available and the methods of weed control to be used.

If mechanical weed control is to be used, row spacings of 70cm with seedlings every 4 to 5cm within rows would be adequate.

If weeds are unlikely to be a problem or pre-emergence weedicides are to be used, closer row spacings should be used as these are likely to give better plant height. Rows 40cm apart or closer with the within-row spacings varied accordingly should be used.

The amount of seed needed will vary according to seed size and the population desired (*Table 4*).

Seed treatment

Soya bean seeds quickly lose viability in warm humid weather and seed should therefore not be stored under lowland conditions for more than three weeks. Seed should be stored under temperate conditions, for example in the highlands, or under air-conditioning. Preferably fresh seed should be obtained.

Soya bean requires a specific rhizobium and seed should be inoculated, especially if it is being sown on land that has never previously had soya beans growing in it. Agar inoculum can be obtained by writing to the Chief Plant Pathologist, Department of Primary Industry, P.O. Box 2417, Konedobu. Inoculum should be used within four weeks of receipt.

Experimental line of Gilbert variety

This picture shows the taller plant produced by closer within-row spacing (left). A taller plant is an advantage for mechanical harvesting

Seed should not be treated with fungicides as this may be detrimental to nodulation.

Land preparation and sowing

Soya beans do not require a particularly fine seed bed as they are quite large, but land should be as flat and uniform as possible to facilitate harvesting. Sowing depth should not exceed 5cm in heavier soils and 8cm in light sandy soils. Soils should not be compacted.

Sowing dates

As adequate moisture is essential during flowing and pod-filling, sowing times as below are suggested —

Erap area — early January
Sasiang, Leron, Mutsing — late January to early February
Kaiapit, Gusap, Dumpu — mid February to early March.

Fertilizer

Currently only the better to medium quality soils are recommended. Starter applications of nitrogen (20 to 30 kg/ha) may be beneficial on virgin soil or soil previously used for growing cereals. Phosphorus may also be needed in some situations. More research into nutrition in poorer soils is required.

Weeds

Chemical weed control has not been studied for soya beans in PNG, but north Queensland findings are reasonably applicable. Under furrow irrigation trifluralin (Treflan) at 1.4 l/ha on light soils and 2.8 l/ha on heavy soils is incorporated into the soil, preferably by harrowing and cross-harrowing immediately after spraying. Treflan controls most grasses and some broad-leaved weeds. Clorthal-dimethyl (Dacthal W75) or linuron (Linuron 50, Afalon) may also be used as post-planting pre-emergence sprays. There are no effective post-emergence sprays commercially available. Manufacturers' directions should be carefully followed and hormone sprays such as 2,4-D should not be used.

Pests and diseases

It appears likely that many crops will need to be sprayed for green vegetable bug (*Nezara viridula*) and perhaps other sucking insects. The 1975 tests indicated that DDT was relatively ineffective against green vegetable bug. Other insecticides are currently being tried out. Orthene (½ to 1 kg/ha) or endosulphan (½ to 1 kg/ha) can be used with first applications commencing about 14 days after flowering with follow-up applications as necessary. Endosulphan is more toxic than Orthene. If damage is severe *Hemosepilachna signatipennis*, a ladybird, can be controlled with DDT or carbaryl, but the damage is unlikely to be severe enough to warrant chemical control.

Generally to date diseases have not proved a problem, but some will undoubtedly occur. Some of these can be dealt with through the use of resistant or semi-resistant varieties. Bacterial pustule occurred at Cleanwater in 1976 but resistant varieties will control it.

FUTURE WORK

The more promising of the experimental lines will again be thoroughly tested against Gilbert, Daintree and Ross at several sites.

Table 1 — Average yields (kg/ha) and plant height (cm) in brackets at three sites.

Variety	Cleanwater	Leron	Umi
Gilbert	2 361 (42)	2 804 (41)	826 (20)
Daintree	2 287 (53)	2 715 (49)	802 (21)
Ross	2 614 (57)	2 419 (49)	1 096 (28)
Semstar	1 430 (69)	855 (71)	417 (28)
Bragg	832 (30)	1 142 (36)	742 (26)
Wills	1 597 (30)	2 274 (31)	673 (20)
Davis	1 465 (32)	1 405 (33)	615 (21)
Hampton	1 670 (29)	1 328 (32)	724 (22)
S2		1 273 (64)	483 (30)
Hood		547 (21)	399 (19)

Table 2 — Yields, % establishment and plant heights for three spacings

Site	Spacing*	Semstar			Gilbert or Daintree †			Wills		
		Yield	% estab.	Height	Yield	% estab.	Height	Yield	% Estab.	Height
Cleanwater	1	1 328	25	49	3 658	65	44	1 888	48	29
	2	1 181	41	49	3 125	76	35	1 064	50	28
	3	830	33	36	2 351	90	32	997	55	24
Leron	1	1 060	54	48	1 945	91	54	1 428	42	27
	2	655	77	38	1 794	92	40	1 499	55	26
	3	599	99	47	1 469	97	33	1 219	91	25
Umi	1	349	67	31	876	78	27	441	70	27
	2	335	86	31	726	92	20	502	86	23
	3	294	92	30	520	101	18	398	102	18

* 1, 2 and 3 represent within-row spacings of 4, 8 and 16cm respectively.

† Gilbert used at Cleanwater and Umi. Daintree at Leron.

Table 3 — Average yields and approximate heights* under two plant populations at Cleanwater.

Variety or line	Yield (500 000 pl/ha)	Yield (333 000 pl/ha)	Height
K39	3 639	2 643	M
P6	3 471	3 320	S/M
Gilbert	3 416	3 177	M
Daintree	3 379	3 477	M
71-39	3 374	2 857	S/M
K53	3 202	3 017	S/M
K8	2 747	2 222	M/T
X2S27	2 745	3 107	M
K152	2 729	2 974	M
X2S31	2 637	2 130	T
Ross	2 616	2 905	M
K70	2 539	2 460	M
P28	2 537		S
K195	2 502	2 749	M/T
P15	2 464	1 939	M
K157	2 457	1 894	M/T
71-20	2 426		M/T
K85	2 409	2 958	M/T
K12	2 377	2 621	S
K171	2 366	2 184	M
K197	2 324	1 957	T
X2S29	2 082	2 593	T
P47	2 027	1 444	M
X2B49	2 021	1 881	M
X2S21	1 898	1 118	T
K134	1 821	1 703	M
K77	1 791	1 265	M
49-9	1 789		T
X2L44	1 775	1 537	T
P36	1 297		S
K123		2 285	M/T
49-8		1 937	T
P33		1 135	S
P23		889	S

* S less than 30cm
S/M 30 to 40cm
M 40 to 50cm
M/T 50 to 60cm
T > 60cm

Table 4 — Seed required (kg/ha) for different planting densities. (It is assumed that 60% of the seed will establish).

Seeds/kg	200 000/ha	300 000/ha	400 000/ha
5 500	59	90	121
6 600	49	74	101
7 700	41	64	87
8 800*	37	56	76

* Gilbert, Daintree and Ross are relatively small-seeded types (8 600, 8 000 and 9 000 seeds/kg in the 1975 variety trials) so seeding rate would be about 50 to 60 kg/ha or perhaps less if good seed viability can be guaranteed.