SOME PROBLEMS WITH THE INTRODUCTION OF A NEW BEAN CROP TO NEW ZEALAND.

John Palmer
Crop Research Division, D.S.I.R.
OTARA

SUMMARY

The adzuki bean Phaseolus angularis (Willd.) Wight was grown near Auckland for several seasons and observations made on growth, disease infections, pest infestations, weed control and harvest technique.

INTRODUCTION

The adzuku bean Phaseolus angularis (Willd.) Wight, is of Asiatic origin. Purseglove (1968) suggests that it is probably native to Japan. It is grown extensively in the northern Japanese island of Hokkaido, in Korea and parts of mainland China, and to a lesser extent in Malaysia. The crop has been introduced to West Africa and South America in recent times.

The dried seed is used for human consumption, usually ground into a bean flour. The Japanese use adzuki bean meal in the preparation of cakes and confectionary. Japanese domestic production is of the order of 150,000 to 175,000 tons per annum with additional imports of around 40,000 tons.

Morphologically the plant resumbles the common 'dwarf' bean, P. vulgaris. It is an annual bushy legume normally 40 to 50 cm in height under New Zealand conditions. The leaves are more or less hisip, angular, and trifoliate. Flowers are small, yellow and insignificant. Pollination may be largely cleistogamous. Seed pods are cylindrical, normally some 10 to 12 cm in length, containing 5 to 8 laterally adpressed seeds. The seed normally has a bright maroon red colour but other colour forms exist.

This bean is a high temperature summer crop with a low temperature tolerance approximately similar to that of soya. Japanese figures for germination rates are expressive and show that frost is fatal.

TABLE 1 : NUMBER OF DAYS REQUIRED FOR GERMINATION AT VARIOUS TEMPERATURES (BASED ON DATA PROVIDED BY MITSUBISHI (1971))

Temperature C	Number of Days	Temperature C	Number of Days
6.1°	27	17.8°	3.3
10.0°	15.6	27.8 - 33.9°	2.1
13.9°	5.4	41.7°	2.5

The most favourable temperature for flowering is stated by Mitsubishi, 1971, to be 30°C with a minimum of 20°C. This indicates a plant better adapted to the extremes of a continental type climate rather than our own more mild insular one. However, the same information source quotes trials in the United States and Canada where the individual seed size was considerably reduced at high temperatures (Presumably due to dry conditions). Cumulative temperature figures calculated from median temperatures multiplied by days over the growing period, have been directly correlated with yield in Hokkaido.

TABLE 2 : BEAN YIELDS KG/HA AT VARIOUS TEMPERATURES (BASED ON DATA PROVIDED BY MITSUBISHI (1971))

Integral Temperatures (°C)	Bean Yield kg/ha
2,233	1746.9
2,156	1407.5
2,027	598.9
1,997	188.0

Calculated on this basis, the Otara integral temperature value for the period between 19 November and 15 March 1972 was 2124°C and the mean yield from our trials 778 kg/ha.

AGRONOMIC ASPECTS IN NEW ZEALAND

The seeding of trial areas in South Auckland have been delayed until mid-November to allow soil temperatures to rise. The Otara soil temperature at 5 cm depth on 19 November was 18.4°C which was the same as the monthly average. In theory it should be possible to continue sowing over a six week period from mid-November to the beginning of January. A Stanhay seed drill was used for all trials and spaced seed at 5 cm in 75 cm rows. There are indications that a spacing of 10 x 10 cm would be better in practice. We were restricted to the wider row spacing by the need for frequent inspections of the trial crop but plants tended to become somewhat etiolated and complete ground cover was not achieved until very late in the season. Seed rates were around 35 kg/ha.

Germination is hypogeal and the initial growth rate is slow compared with that of 'dwarf' and soya beans.

Initial weed control is very important. A pre-emergence spray of Dinoseb amine 16.85 litre/ha, plus monolinuron 1.12 kg/ha gave adequate control under local conditions where the weed flora mainly consisted of Portulaca oleracea, Amaranthus sp, Solanum nigrum and Digitaria sanguinale. Paspalum distichum was not controlled and caused considerable trouble later.

Trials with Treflan at Otara and Pukekohe and with Tribunyl at Pukekohe gave very unsatisfactory results. Tribunyl at rates in excess of 0.56 kg/ha killed the crop.

No satisfactory post emergence spray was found and this necessitated in the mid-December period a roundof mechanical weeding which had the side effect of ridging up the base of the crop. Mechanical weeding gave satisfactory weed control but the concomitant ridging caused trouble during the harvesting operation.

Adzuki bean plants at Otara all appeared to be well nodulated. Nevertheless a side dressing of nitrogen up to 50 kg/ha is recommended at the 4 to 6 leaf stage to boost early growth. Rhizobia from naturally occurring adzuki nodules have been cultured and are being held at the Plant Diseases Division head office at Mt Albert for future use should this prove necessary.

Neither major pests nor diseases have appeared in the crop to date.

A wilt probably caused by Fusarium oxysporum, was isolated from the roots, and is often widespread at about the first trifoliate leaf stage. At close spacings this disease tends to run along the rows causing patches to develop. Later plants appear to become resistant and no further symptoms are visible from late December onwards. However, this fungus may also be responsible for early senescence and patchy ripening of the crop. Crop losses in trials have not been high from this cause. Seed dressing with Captan had no effect on the incidence of the disease.

A leaf spot caused by Pseudomonas syringae was identified on volunteer seedlings growing in late autumn, but no such disease has been observed in spring sown crops.

A small looper caterpillar, Plusia chalcites, has been active in the late summer, cutting holes in leeves without having caused appreciable damage to any trial crop. Natural parasitism is probably a factor here.

Two nematodes commonly associated with white clover, Heterodera trifolii and Meloidogyne incognita have been found on adzuku bean roots but have not caused any obvious injurious symptoms.

It was possible to include a small irrigation trial in the seed production area. Two strips across the crop were given the equivalent of about 5 cm rain during the early flowering period in January and on assessment made by pod count a month later. Fifty plants from each replicate of each variety were pulled up and counted.

Results are given in Table 3.

Harvesting:

Harvesting has proved to be a major problem. Direct heading is impractical because pods are very close to the ground and the correct stage of seed maturity is very difficult to obtain. A crop dessicant - Diquat/Paraquat mixture - was used at varying rates without appreciable effect. It is proposed to use Ammonium Sulphamate in future trials.

It appears that the optimum time to cut the crop is when 70% to 80% of the pods are mature but still green. Later cutting can cause heavy losses through pods shattering. On the other hand immature seed is normally damaged in thrashing.

Japanese figures are available to corroborate the above hypothesis.

TABLE 4 : HOKKAIDO YIELD DATA SUPPLIED BY MITSUBISHI (1971)

Date of Harvest	Ripe Pods %	Seed Weight kg/ha
8 September	5	549.4
17 September	32	641.6
28 September	68	855.3
9 October	88	778.9
18 November	93	672.3

It is the practise in Japan to cut the crop below ground level and windrow for 2 or more days before thrashing. Our initial trials in which various hoe blades were used to cut the crop below ground level were unsatisfactory. This is in line with U.K. experience with navy beans. However, hoe blades have been widely used in the U.S.A. (Krause, 1971). Plough coulters mounted at an acute angle do a good job but tend to miss any plants which are a few centimetres out of line.

High speed flail type mowers throw up too much soil and some beans are apt to get buried.

Trial areas totalling about two hectares were cut with a modified sickle bar mower angled to cut just below ground. This method however, can be used only on one or two rows at a time and the beans have then to be moved clear of the tractor wheels before the next pass of the machine.

Three makes of combine harvester have been used successfully in thrashing out the crop. The Allis Chalmers 'Alcrop 60' presented few problems. The bars from the concave were removed completely and a sack hung behind the drum to prevent fracturing of the beans.

A Class "Senator" and a Massey Ferguson were hired from Pukekohe district contractors and did reasonable jobs on two lines without modification of their standard 'barley' rig apart from the cutter bar which was disconnected and the drum speed which was reduced to 500 to 600 rpm. A better job may have been possible had a grass seed pickup been fitted

TABLE 5 : ADZUKI BEANS YIELD 1971-72

Variety	Date Down	Date Harvested	Yield kg.ha	Calculated Average Yield, 2 Sample Plots kg/ha
Dainagon (Otara)	19.11.71	20.3.72	1220	2181
Dainagon (Pukukohe)	25.11.71	5.4.72	2695	2149
Chagara Wase (Otara)	19.11.71	22.2.72	1347	
Chagara Wase (Pukekohe)	25.11.71	24.3.72	2207	2604
Wase Tairiyu	19.11.71	15.3.72	1602	1660
Hakari Shiyozu	19.11.71	14.3.72	2033	2230
Takara Shiyozu	23.11.71	15.3.72	1929	2073
Tokati	22.11.71	7.3.72	2186	
BI 5028	22.11.71	7.3.72	2500	
BI 5029	22.11.71	7.3.72	2325	
BI 5030	22.11.71	1.3.72	1498	
BI 5031	22.11.71	7.3.72	1498	
BI 5032	22.11.71	1.3.72	1966	1905

Two sample plots of 2 rows 10 metres long were harvested and thrashed to check losses in heading.

but this was not available. As it was, too much soil was picked up and included in the seed sample.

CONCLUSION

Adzuku beans are probably better adapted to a more contental type climate with higher summer temperatures than is the case in New Zealand. Nevertheless, good yields are obtainable in the South Auckland district and the crop may prove to be worthwhile economically once initial problems mainly connected with weed control and harvesting technique have been overcome.

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