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A NEW LOOK AT PIGEON PEAS
S.J.A. WILLIAMS AND J.A. SPENCE^{1/}

INTRODUCTION

Green pigeon peas, Cajanus cajan (L) Millsp. has always been a favourite pea among the people of the Caribbean, traditionally planted in May-June at a spacing of 3 ft. x 5 ft., and harvested between December and February of each year. High harvest cost, however, has tended to cripple large scale production because of the need to harvest green pods, as they mature, over a prolonged period of time. Within recent years a considerable amount of research at the University of the West Indies has been conducted to alter the habit of the pigeon pea plant from one that grows to a height of 12 - 15 ft. with indeterminate podding habit, to a dwarf or semi-dwarf type (3 - 5 ft. in height) that produces determinate inflorescences with all the pods maturing more or less at the same time. These aims have been achieved by breeding (3,5). In addition, pigeon peas are photo periodic and more specifically, short day plants, hence the later they are planted in the year, the shorter is the period from planting to flowering and the smaller the plant.

MATERIALS AND METHODS

In an attempt to facilitate the mechanical production of pigeon peas, a dwarf type (variety GI 27/4A) was planted in December 1970 - January 1971 at the Field Station U.W.I., Trinidad, after a preliminary trial in 1969 (Spence & Williams - In press) had shown the possibility of developing such a system. The aims were to determine:

- a) the feasibility of mechanical planting and harvesting;
- b) the yield obtainable when pigeon peas are planted as a row crop and the entire crop is harvested all at once;

^{1/} Faculty of Agriculture, U.W.I., Trinidad.

- c) the fruiting period with planting in late December-January (i.e. the period of the year when the day length is lengthening rather than shortening).

In addition, through the kind cooperation of the management of International Foods Ltd. (the company that financed the major portion of this work) portions of the crop, both in the form of plant tops plus pods, as well as pods alone were put through the viner which removes the pea from the pods.

Pigeon pea seed was sown on the 28th and 31st December 1970 and 12th and 20th January 1971 on River Estate loam soil at distances of approximately 5 to 23 inches in the row and 18 inches between rows by means of a Massey-Ferguson row crop planter, the resulting plant population densities varying from 55,400 to 15,100 plants/acre. This row crop spacing was used because it was standard for other row crops and in addition available inter-row cultivation equipment could be conveniently used at this setting. The different spacings within rows were used to determine the effect of varying density on yield (per plant and per acre).

Planting was on 12 ft. wide cambered beds to facilitate proper drainage, since the pigeon pea is very susceptible to water logging.

In the preliminary trial in 1969 four rows were successfully cultivated when the plants were approximately 9 inches tall with duck foot harrows mounted on a row-crop tractor. There was no damage to the crop. A pre-emergence weedicide, Atrazine (Gesaprim 80) was applied at the rate of $2\frac{1}{2}$ lb. per acre to most of the area planted in 1970/71 with good results. The latest planting in December 1970 had no pre-emergence applied, it would appear that growth, at that time and at the high densities used, was sufficiently rapid to control all weed growth.

Pod borer (Ancylostomia stercorica) was controlled with 3 applications of Tetrachlorovphos (Gardona) at the rate of $\frac{1}{2}$ lb. active ingredient per acre during early pod development. This insecticide was applied with a low volume mistblower sprayer.

Sampling for stage of maturity was determined by assessing 60 plant samples 100 days after planting and at 4 - 7 day intervals thereafter. Pods were sorted into immature, mature and dry. Fresh and dry weights were determined from these samples. Yields were determined by cutting and collecting all the pods from 1/60 of an acre plots.

Harvesting was done by the following three methods:

- 1) Cutting the plants 6 - 10 inches above ground level with a reciprocating mower.
- 2) Stripping all the pods by hand directly from the standing plants in the field.
- 3) Cutting the tops of the plants with a sickle knife.

RESULTS

Table 1 shows the percentage immature, mature and dry pods for three planting dates (28 December 1970, and 12, 20 January 1971). Highest yields of mature pods occur some where between 107 and 111 days of age. At the highest yield points a mean of 63.1% of pods are mature, 2.2% of the pods are dry.

In December 1970 - January 1971 four planting dates (28 and 31 December 1970 and 12, 20 January 1971) were used and flower buds were noted in each case 60 days after planting, i. e. peak maturity occurred at 107 - 111 days after each respective planting. This now establishes that:

- 1) Flower buds are initiated in Trinidad on both decreasing (Hammertan - personal communication)
- 2) Harvesting can be spread by planting at convenient intervals during December and January, and the processing plant can predict and regulate the flow of peas to its plant during March, April and May.

A comparison of yields, one computed from a 60 plant sample the other by harvesting 1/60 of an acre is shown in Table II. The purpose of the two yield figures was to determine the reliability of yield data from the 60 plant sample taken.

Table III gives an approximate indication of the time taken, and the cost involved in harvesting, at one picking, all the pods from an acre at a plant population of 55,400 plants per acre.

The viner at International Foods Ltd, normally handles the removal of peas from pods. The viner successfully removed peas from pods on the plant. This system however, is not practical because the long stem (15 - 24 inches in length) necessitated the slowing down of the elevator feeding the viner, and in addition the stems caused some damage to the canvas conveying this material through the viner. It would seem therefore, that picking will have to be restricted to stripping pods or cutting the end of branches with a sickle knife (as is done in rice) until design and construction of a mechanical harvester/elevator is completed.

Cross & Thomas (1) have shown that the total pre-harvest cost of a commercial crop of pigeon peas is \$86,00 TT per acre. The pre-harvest cost of pigeon peas as a row crop is estimated to be \$109,00/acre using the same rates as Cross & Thomas,

Using the values in Table III a comparison of the harvest cost can be made between the traditional system (at a 3 ft. x 5 ft. plant spacing) and pigeon peas grown as a row crop. While the most economical system of harvest is moving and passing the plant through the viner, cutting with a sickle knife is the most practical in view of the damage done to the vining equipment. Table IV shows that harvest cost can be greatly reduced by growing pigeon peas as a row crop (from \$147.00 to \$32.00).

The gross profit, at a plant population of /55,400 plants/acre, is \$270.00 with yields of 4110 lb. pod/acre as compared to \$167.00 when grown in the traditional

system. A yield of 4110 lb. pod per acre yields some 2000 lb. of green peas per acre. It is possible that the profitability may be increased further as a result of a second flowering.

DISCUSSION

The above work demonstrates a new concept in pigeon pea production, and for the first time opens new avenues for large scale, out of season production, with the following advantages:

- 1) It establishes, at least as far as Trinidad and Tobago is concerned, that a dwarf cultivar developed by research workers at St. Augustine, can be planted both in December and January and produce yields (4000 lb. pod/acre) equal to the traditional system, if yields at a single harvest are considered.
- 2) While pre-harvest cost are higher by 21% in row crop planting system the harvest costs have been reduced by some 70%.
- 3) Late planting allows for better land use, since planting may be carried out during the dry season; other crops might require irrigation.
- 4) Pigeon pea cropping can be extended into April and May, and the processing plant can predict and regulate the flow of peas to the plant at this time of the year by the adoption of different planting dates.
- 5) Regrowth of plants will allow for collection of seed for the following December planting.
- 6) Due to the shorter time to cropping the yield per acre per day of the cropping period for pigeon peas as a row crop is 36 lbs. as compared to 19 lbs. per acre per day for the traditional system.

- 7) The regrowth could be used as fodder if pod yields appear uneconomical to harvest.

There is of course, much research still to be done in order to maximise yield in the row crop system. One study of interest is the development of cultivars that will produce 100% mature pods at the same time instead of only 60% as shown in this study. Table 1 shows that there is 36% immature and 4% dry pods when plants are 107 days old. It is interesting to note that if all the pods were allowed to mature, or matured all at once, the yield would be in the neighborhood of 6850 lb. pods per acre, a yield that is 2850 lb. greater than that reported by Cross & Thomas (1).

Salette & Coubois (6) have shown that the yield from the second flowering, of a Trinidad dwarf (GI 54/3), was approximately half that obtained from the first flowering, and while we await the second flowering from our trials, it is quite likely that these yields will be about 1000 lb. pod per acre. Nevertheless, the yields herein are better than those for commercial production as reported by Henderson (2) in Trinidad, Salette and Courbois (6) in Marie Gelante or Riollano et al (4) in Puerto Rico and compare favourably with other experimental results for a single harvest.

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TABLE I
 SAMPLE HARVEST FOR STATE OF MATURITY AS A PERCENTAGE
 December 1970 - January 1971 Planting

Planting Date	Grade of POD	Plant Age in Days		
		100	107	111
December 28, 1970	Immature	83.7%	33.3%	27.8%
	Mature	16.3%	61.1%	69.7%
	Dry	NIL	5.6%	2.5%
January 12, 1971	Immature	52.2%	35.8%	4.8%
	Mature	47.8%	61.0%	57.0%
	Dry	NIL	3.2%	38.2%
January 20, 1971	Immature	76.9%	40.7%	7.8%
	Mature	23.1%	58.5%	50.0%
	Dry	NIL	0.8%	42.2%
				114
				9.5%
				62.7%
				27.8%
				12.9%
				56.1%
				31.0%

TABLE II

Pigeon pea yields as a row crop

Planting date	Plant Population	Computed yields from 60 plant sample at a mean wt. of 4.1 oz./plant (lb./acre)	1/60 acre sample (lb./acre)
December 28, 1970	55,400	4840	4110

TABLE III

The approximate time and cost of harvesting
Pigeon Peas grown as a row crop with yields
of 4100 lb. pod/acre.

Harvesting Operation	Harvesting time (per acre)	Cost/acre \$TT
1a. Cutting the crop with a reciprocating mower	3 hours	5.40
1b. Collecting and loading plants after mowing	4 man days	16.00
2. Cutting plant tops with sickle knife	8 man days	32.00
3. Stripping all pods from plants standing in the field	12 man days	48.00

Note on Costings

For the purpose of this paper costings are as per Cross and Thomas (1).

Labour costs: At the commercial rate of 50 cents TT per hour for unskilled labour and 55 cents TT per hour for tractor operators. These figures are considerably lower than those paid at the University Field Station where Government rates apply.

Tractor costs: The rates used for the tractor are \$1.80 TT per hour, and for the rotoator \$1.00 TT per hour.

Materials: All materials are charged at cost.

TABLE IV

Operation	Comparison of cost of production per acre of pigeon peas	Row crop system at 18 in. x 5 in. spacing yield/acre 4110 lb. pod
Pre-harvest cost	Traditional system at a 3 ft. x 5 ft. spacing ^{1/} yield/acre 4000 lbs. pod- \$ 86.00	\$ 109.00 ^{2/}
Harvest cost	147.00	32.00 ^{3/}
Total	233.00	141.00
Value of crop at \$0.10/lb.	400.00	411.00
Gross Profit	167.00	270.00
		1/ Reference: Cross and Thomas (1) 2/ Costings as per Gross and Thomas (1) 3/ Harvest by sickle knife.