THE EXPERIENCE AND MAJOR CONSTRAINTS ON THE COMMERCIAL PRODUCTION OF SOYABEANS IN TRINIDAD AND TOBAGO

Lawrence Cross
(General Manager, Central Marketing Agency, Trinidad)

Introduction

This paper attempts to bring together relevant information on the ability of tropical countries like Trinidad and Tobago to grow successfully and to produce economically their domestic requirements of soya and soya products for both human consumption and animal feeds.

Every major national and international agricultural service organisation today devotes a large part of its resources in finding the most efficient methods in eradicating the major protein-calorie deficiencies which exist among a significant proportion of the world population (especially in developing and underdeveloped countries with their teeming millions). Soyabean with its unique potential, with over 40 per cent protein and over 20 per cent oil can assist in satisfying this vital food need.

The Soyabean is generally considered as belonging to the best adaptable to temperate regions. For centuries soyabeans have formed an important part of the diet of the peoples of Asia particularly China and Japan. However, over 60 per cent of world production is grown in the United States. Plant breeders in the United States of America classify soyabeans according to the latitude of adaptation, the classes being designated from 00 to VII. More recently, a 1x class has been added for tropical regions. Attempts are being made with varying degrees of success to grow soya in the tropical regions of South East Asia, India, Africa, Central and South America and the Caribbean.

The importation of soyabean and soyabean products into Trinidad and Tobago is given in Table 1. The table shows that over the past few

Table 1. Trinidad and Tobago Imports of Soyabean and Soyabean Products, 1970-1973.

Year	Imports	
	Volume (lb.)	Value ($TT)
1970	32,837,894	4,341,939
1971	21,772,339	3,106,295
1972	49,110,329	6,300,010
1973	22,053,575	7,059,881

years imports of soya and soya products averaged around 30 million pounds. The possibility exists of greater consumption of soya and soya products than the figures reflect. This is due to possible increases in production of meat products and the present emphasis on exploiting the unique potentials of soyabeans as a source of protein for direct human consumption.

History of Soya in Trinidad & Tobago

Soyabeans were being grown in Trinidad and Tobago as far back as the 1930's. Graduates of Imperial College of Tropical Agriculture would remember seeing small plots growing in the crop museum or in student's plots, which were for observational purposes and limited study.

R.W. Radley conducted a facily comprehensive study of the prospects of soyabean production in Trinidad and Tobago during the period 1964 to 1968 [1]. He found that yields of between 1600 to 1700 pounds per acre were certain to be obtained on a commercial scale. He showed that soyabeans can be successfully rotated with maize to give an annual revenue per acre of between $400 and $430. He, however, illustrated that for a commercially feasible operation, mechanized operations were necessary and a minimum acreage of between 450 to 500 acres would justify capital outlay. He felt that a critical factor in this respect was the availability of skilled and experienced management supported by well trained farm technicians who are familiar with the operation and maintenance of farm machinery.

The Third Five Year Plan for Trinidad and Tobago also commented very favourably on soyabean production in Trinidad and Tobago. It stated in part that *"The Faculty of Agriculture of the University of the West Indies has made considerable headway in demonstrating that soyabean, given a high level of management, will give yields in Trinidad and Tobago which bear favourable comparison with those common in the older established soya growing countries. It has come forward with a positive recommendation for the development of a rotation based on corn and soyabean. There is now sufficient information available on both crops for serious consideration to be given to initiating large scale production"* [2].

Trinidad and Tobago has been striving for years to be more self-sufficient in meats and meat products. It is fairly self-sufficient in poultry and was also self-sufficient in pork until recently when swine fever affected production. Milk production is also increasing. All of this advancement however, depends on a high import content of corn and soyabean meal which account for about 90 per cent of livestock feeds. Recent increases in prices of the latter have made the need to find local replacements or substitutes even more urgent.

Justification of Soya as a Source of Protein

A more comprehensive review of the arguments for commercial production of corn and soya in Trinidad and Tobago and the Caricom area is given in a paper delivered by the author to the Third Annual Symposium for Coconut Growers of Trinidad and Tobago in September 1973 [3]. Researchers continue to wander whether the policy of concentrating on soya production in Caricom as opposed to greater research effort being

directed to other protein sources some of which are indigeneous is the best policy to adopt.

In addition to soya, the sources for protein in livestock feeds are such crops as sesame, peanuts, cotton seed, rapeseed and sunflower. In some tropical countries, a number of peas and beans including pigeon peas are also mentioned as possible sources of protein for this purpose.

Sesame, even now, is not being grown in any quantity on a world-wide basis chiefly because of agronomic problems, namely, the availability of varieties that are high-yielding, disease resistant and non-shattering at harvest. It is doubtful whether this crop with its present low potential, will become an important source of protein feeds.

Peanuts and cotton have been tried but are not ideal for Trinidad's climatic conditions. Soil structure and incidence of disease have been the main limitations to the production of these crops. It appears, though, that some production is possible in the other Caricom countries.

Rapeseed has become a major crop of Canada over the last ten years. It has not been tried under tropical conditions. If imported into Caricom countries, its cost will be similar to the present cost of soyabean meal.

Preliminary work at Chaguaramas shows that sunflower can be grown in tropical countries, and, if disease problems can be overcome, could become a source of oil and to a lesser extent a source of meal. In terms of oil content, sunflower will yield 42 per cent compared to 18 per cent in soya. If, however, the emphasis is on production of protein meal, sunflower will only yield 36 per cent in comparison to 81 per cent from soya. The oil is easily extracted from sunflower. Soyabean, however, appears to be the best and cheapest source of protein both for human consumption as well as livestock.

Research

Work on the production of soya under tropical conditions is not confined to Trinidad and Tobago. Since about 1965 a number of research centres throughout the tropical world have been attempting to grow soya. Most of this work is now being co-ordinated by the International Soyabean Programme (INTSOY) under the auspices of the University of Illinois. The INTSOY variety evaluation trials were established in early 1973 to determine the adaptability of soyabeans throughout the tropical and sub-tropical areas of the world.

Trinidad, Guyana and Puerto Rico are participants in these trials. The trial consists of a number of varieties grown in all interested and participating countries, the results of which are sent to the University of Illinois for computer evaluation. *"When sufficient data is collected from each location to indicate the varietal characteristic most desirable zonal evaluation tests will replace the standard test. Co-operating sites will be categorized into zones according to environment. Only those varieties or line which have potential in the zone will be tested on the sites of that zone. New material will be tested in more than one zone until adaptability is identified"* [4].

Radley [1] in his study identified the important factors for

production of soyabeans. Early work at the Charuaramas Agricultural Development Project was directed towards establishing the major parameters for commercial production. While these parameters will change with increasing production and continuing research, the project had to identify the critical parameters of variety, time of planting and population at the outset.

Variety

In addition to the INTSOY trials previously mentioned, a large number of varieties were screened. Pelican and Jupiter, two of Radley's previously selected varieties were found to be the most suitable for production at Chaguaramas. Selection within these varieties have been done to improve pod height and plant characteristics suitable for mechanical harvesting.

Time of Planting

The soya is phototropic and under Trinidad conditions will grow well and develop sturdy plants and numerous pods in the May planting. Build up of diseases and high rainfall and humidity during maturity and harvesting rule out commercial production at this ideal period. Quality of beans are extremely poor, and unpredictability of the *Petite Carem* could mean that the crop may not be harvested on time if at all. Soya is thus planted after October and may even be planted in the dry season if irrigation is available.

Population

Since planting is done at a less favourable season, plants develop to a smaller size when planted in October. Restrictions may be due to photo periodic response and water stress. To counteract this, plant population is increased to the extent that ground cover and weed control is improved. The yield depends on population per acre. Row width is a function of mechanical harvesting and is determined by size and width of equipment wheels.

Commercial Farming

Table 2 gives the yields for some of the soyabean crops grown at Chaguaramas. A yield of at least 1500 pounds per acre is expected.

Table 2. Chaguaramas Agricultural Development Project, Acreages and Yields of Soyabeans for Selected Plots, 1972 and 1973.

Year	Crop	Plot	Area		Yield		
			Acres	Hectares	Total (lb.)	lb./ac.	kg/ha
1972	1st crop	iv/2	6.25	2.53	9,660	1,546	1,733
1972	2nd crop	v/1	18.33	7.42	37,406	2,041	2,288
1973	2nd crop	iv/2	1.35	0.55	3,500	2,593	2,907
1973	2nd crop	v/1	10.16	4.12	11,549	1,432	1,605

However, under ideal conditions, 2000 to 2500 pounds per acre is not uncommon. The rotation of corn and soya is ideal since the corn crop will assist in reducing the weed population during the crop of soya.

Newly cleared land is extremely weedy and three continuous crops of corn are recommended before a crop of soya is planted. Selection on the project with the two varieties Jupiter and improved pelican have improved the height of the first pods from the ground. The percentage loss (estimated in the beginning at 20 per cent) from mechanical harvesting has gradually been reduced. The average cost of production of soyabean was worked out (using 1972 input costs) at about TT$271.62 per acre at the project. This of course is the figure obtained using the highest form of mechanization practised so far. The percentage of labour in the total cost is higher than in maize for instance. In maize 9 per cent of total cost was attributable to labour as compared with 14 per cent from soya. Soya is a crop where maximum mechanization should be attempted. The experiences at Chaguaramas have shown that by increasing the percentage of cost attributable to labour reduces the profitability of the crop considerably.

Appendix II summarizes the procedures used in the production of the crop at Chaguaramas. Some of the more serious considerations in the growing of soya are:

1. It must be grown in rotation, the other crop in the rotation occupying the wetter part of the year. Corn and sorghum are ideal since the crop grown must be harvested by early October. The longer the delay in harvesting the first crop and planting of soya, the shorter the season for soya before the onset of the dry season. If irrigation is not available precise timing is critical.

2. Complete mechanization means heavy reliance on maintenance of machinery. Availability of spare parts and minimum loss of time for repairs during crop operations are critical. This is an important consideration where expertise in sophisticated machinery is not yet available and the operations in the field call for precise timing.

3. The minimum acreage recommended for use of a harvester is 200 acres. Small pieces of machinery are needed if greater participation by small farmers is expected particularly with present emphasis on production for direct human consumption.

Processing of soya requires large investment in plant equipment (solvent extraction) and is only feasible where thousands of acres under the crop are assured. This appears to be more achievable under a Caricom scheme where, like in Guyana, large expanse of underutilized lands are available. In Trinidad, alternate cropping will have to be debated. Trinidad should therefore relate soyabean production to direct human consumption rather than to animal consumption.

Cost of Production

The cost of production of soyabeans at Chaguaramas is given in Table 3, and information and data used in formulating this table is shown in Appendices 2 and 3. Table 3 indicates that costs per acre averaged TT$271.40 per acre.

Table 3. Cost of Production of Soyabean at the Chaguaramas Agricultural Development Project, 1972 on 65.4 Acres*

($TT)

	Material Cost	Labour Cost	Machinery Cost	Total Cost	Cost/ Hectare	Cost/ Acre	% of Total Cost
Land Preparation:							
Brush cutting	6	102	257	365	13.79	5.58	)
Ploughing	18	208	428	654	24.72	10.00	)
Disc Hoeing	15	173	365	553	20.89	8.45	)16.7
Collecting stones	1	102	45	148	5.59	2.26	)
Seed Bed Comb.	23	122	591	736	27.82	11.26	7.1
Liming	-	-	-	-	-	-	-
Fertilizing	4,675	120	117	4,912	185.64	75.13	47.9
Planting	1,179	137	370	1,685	63.72	25.79	16.4
Fertilizer Top Dressing	-	-	-	-	-	-	-
Spraying Herbicide	142	22	25	189	51.78	20.96	1.8
Spraying Insecticide	45	23	40	108	29.59	11.97	1.0
Harvesting	2	52	245	299	81.92	33.15	2.9
Transport Loading	1	17	23	41	11.23	4.54	0.4
Drying	31	-	42	73	20.00	8.09	0.7
Harvesting by tractor	6	359	124	489	133.97	54.22	4.8
Total Costs	6,144	1,437	2,672	10,252	670.66	271.40	100
% of Total Costs	59.9	14.0	26.17	100	-	-	-
% Included in costs between 1972-1975	7.5[1]	6.6	82.0[2]	-	-	-	-

Notes: * Does not include management and land rental.
1 Based mainly on increase in cost of NPK.
2 Based mainly on increase in cost of brush cutting and ploughing.

Assuming a yield of between 1700 and 2000 pounds per acre, then cost of production per pound of soyabeans is in the vicinity of 14 to 15 cents per pound (using 1972 prices).

Again, assuming that prices of inputs have risen by 75 per cent in 1975 due to increased cost of machinery, materials and labour and cultural practices remain the same, the present cost of production will be in the vacinity of 26 to 28 cents per pound. This figure compares favourably with the present wholesale market price which is 50 cents per pound at the Central Market in Port-of-Spain.

Profitability of soyabeans will also depend on the selling price of soya oil and soya meal. Presently these two commodities are imported from the United States. Recent quotations indicate that the landed c.i.f. prices of soya oil and soya meal in Port-of-Spain are TT$1.38 and 30.5 cents per pound, respectively. Assuming a 20 per cent oil expectation from soyabean, then for an acre of soyabeans yielding 2000 pounds, total revenue if sold at the c.i.f. prices would be as follows:

100 lb. soya oil at $1.38 per lb.	=	$5.52
1600 lb. soya meal at 30.5 cents per lb.	=	$4.88
		$10.40

Again, this revenue figure of $10.40 per acre[1] compares favourably with the production cost per acre of $271. Even if production of soyabeans were to be considered at 1700 pounds per acre total revenue from soya oil soya meal would be $665 per acre.

Conclusion

Work done to date clearly proves that soya can be grown in tropical countries and in particular Trinidad and Tobago. The study has also shown that soya will give reasonable yields under ideal conditions.

The study has not identified the minimum size of holding or the smallest types of harvesting equipment required. Soya is mostly grown in the United States of America where large size machinery is ideal. However, small scale machinery for use in developing countries are more difficult to obtain. Within Caricom, Trinidad and Tobago with its limited land acreage may not be able to produce its total requirements of soya and may better concentrate on growing limited amounts for direct human consumption. The seed unit at Chaguaramas, however, could continue to produce certified or basic seed for multiplication throughout the region.

There are now available a large number of recipies for the use of soya for human consumption. These are available on request and are being disseminated through the Extension Service of the Ministry of Agriculture. In addition, an introductory price of 30 cents per pound was set to encourage greater use of soya in the home.

Future plans for the crop include expansion of the area devoted to the corn and soya rotation project and greater emphasis to the crop

---

[1] Excludes extraction costs of soya oil.

through the extension service and nutrition units of the Government service.

References

1. Radley, R.W. "The Prospect for Soyabean Production in Trinidad and Tobago", *Proceedings of the Agricultural Society of Trinidad and Tobago*. Port-of-Spain, 1968.

2. Government of Trinidad & Tobago. *Third Five Year Plan, 1968-73*.

3. Cross, L. "The Introduction of Soyabean as a Source of Oil and Animal Feed", *Proceedings of the Third Annual Symposium for Coconut Growers*. Ministry of Agriculture, Lands and Fisheries, Port-of-Spain, 1973.

4. Whigham, D.K. "International Variety Trials", *Proceedings of the Workshop on Soyabeans for Tropical and Sub-tropical Conditions*. University of Puerto Rico, 1974.

Appendix I. Summary of Findings of R.W. Radley's Study on Soyabean Production in Trinidad and Tobago during the period 1964-1968.

"Although much work remains to be done, the experience gathered during the last 2½ years suggests that soyabean, given a high level of management, will give yields in Trinidad which bear favourable comparison with those common in the older established soyabean growing countries. In many of the small plot experiments, yields exceeding 2000 pounds per acre have been achieved. In one experiment planted in June, 1967, in which the variety F62/3977 (consistently the best performer) was used, yields of more than 2500 pounds per acre were obtained.

However, it is well known and must be recognised that commercial performance rarely equals that of small plot trials which are normally managed very carefully. Nevertheless, it should certainly be possible to obtain yields of between 1600 to 1700 pounds per acre on a commercial scale; this may be considered a realistic figure which could be improved upon by the better farmers. At this yield level, the home market alone for soyabean meal and cake could absorb the production from at least 8000 acres.

For commercial production to get underway in Trinidad, it must of course be demonstrated that the crop is likely to be profitable; this involves a projection of revenue and information on probable costs of production. In fact, a broader view must be taken and the whole rotation which is to include soyabean must be examined very carefully; its suitability in relation tc soil and climate must be established, its managerial problems must be anticipated and its overall contribution to the national economy assessed.

There are a number of reasons for suggesting that the rotation should be based on maize and soyabean. First, as is the case with soyabean, there is a large and expanding home market for maize (almost 80 million pounds per annum is imported at the present time). Second, the mechanical equipment required for maize cultivation can all be used for soyabean. Third, adequate information is now available on methods of cultivation of both crops (L. Cross, Agronomist, Central Experiment Station has completed a number of investigations on maize with encouraging results). And fourth, the practice of growing these crops in association with one another would be sound from a husbandry standpoint; one being a cereal and the other a fertility-building legume.

A crop of maize sown during the period mid-April to the end of May, to be followed by soyabean planted during September or October for harvesting at the beginning of the dry season (the order could be reversed) may be expected to produce a total revenue of between TT$400 - $430 per acre per annum (assuming a yield of maize of approximatley 1700 pounds per acre at 12 cents per pound). This is low in comparison with the net income of high value cash crops such as tomato, cabbage and lettuce and accordingly, both crops would have to be grown on large acreages (since the production costs are greatly influenced by scale of production) with all operations, including harvesting, mechanised to minimize labour inputs.

With regard to the minimum acreage required economically to justify equipment investment, the limiting factor is the combine-harvester unit and not tractor power. Assuming a combine-harvester with a 14-foot table and with a capacity of 8 acres per hour, then the minimum acreage suggested lies between 450 - 500 acres. Other machines required for this acreage would be

at least two 65 b.h.p. tractors, two disc ploughs, two sets of discs, possibly two rotavators depending on soil type, two 4-row planters and two tractor mounted crop sprayers for insecticide application. The total cost of machinery for this acreage would be approximately TT$65,000. For complete immunity from poor weather at harvest-time it would be necessary to invest in a dryer; this would be expensive but may be justifiable. Other fixed equipment required would include a machinery store and storage facilities for grain.

Large scale mechanised farming demands skilled, experienced management supported by well trained farm technicians who are familiar with the operation and maintenance of farm machinery. If, at the outset both of these are not assured, any maize/soyabean scheme would, without doubt, be doomed to expensive failure. Farm managers, then of the right type must be found. With regard to machinery operators, I am sure that the local agents for farm machinery would be willing to arrange short in-training courses."

Appendix 2. Chaguaramas Agricultural Development Project; Explanations on the Various Operations Performed in the Production of Soyabeans.

Land Preparation

Brush cutting with spraying where necessary
Ploughing
Disc-harrowing and manual removal of stones where necessary
Seedbed combination (rotary hoeing not recommended - line-harrow and crumbler)

Fertilizing

8-16-16 basic dressing before seed bed preparation (600 - 800 lb. per acre)

Planting

70 cm x 6 cm (27.5" x 2.3") Rhyzobium included with seed or 70 - 80 lb. per acre

Herbicide

Amonium salt of chloramben as pre-emergence

Insecticide

Azimphos (any broad operation insecticide for leaf eating and sucking insects)

Mechanical Cultivation

Until plant growth covers soil

Harvesting

By combine

Drying

Artificial drying hardly necessary under ideal weather conditions

Appendix 3. Chaguaramas Development Project, Breakdown of Time Spent on Various Operations in the Production of Soyabeans

Acreage	Land Preparation								Seedbed comb.		Fertilizer					Planting				
	Brush C		Plough		Disc. h		Removing stones													
	O	T	O	T	O	T	O	M/hr.	O	T	O	T	M/hr.	Rate	Type	O	T	M/hr.	Var.	date of planting
34.64	22	5	35	6	29	4	6	60	22	3	10	1.5	22	8000 kg	8/16/16	18	2	20	J	18/12/73

Herbicide				Insecticide				Hoeing				Harvesting/Drying			
O	T	M/hr.	Rate	O	T	M/hr.	Rate	O	T	M/hr.	Manual	Date	O		
18	2	24	21.0 10 spc	2	2	12	15 kg ag 8 demet	25	3	28	5	31/5/74	5	30 gal kero.	560 kwt.

Notes: O - Operation hours
T - Travelling hours or transport
M/hr. - Man-hours
J - Jupiter variety.