

MAHAWELI ENTERPRISE DEVELOPMENT

MED/EIED PROJECT

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PROCESSING TOMATO TRIALS IN MAHAWELI SYSTEM C

A short-term consultancy report
by
Peter Florance

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INTERNATIONAL SCIENCE AND TECHNOLOGY INSTITUTE, INC.

WITH :

ERNST & YOUNG CONSULTANTS (Sri Lanka)
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The Mahaweli Enterprise Development Project

The Government of Sri Lanka and the international donor community have given high priority to the development of the natural and human resources of the Mahaweli river basin. The first phase of this development, the construction of dams, irrigation and power systems, roads and other physical infrastructure, is largely complete. The second phase, settling the land and forming an agricultural production base, is well under way. The third phase, the major challenge for the 1990's, is the building of a diverse and dynamic economy, improving employment and income prospects for Mahaweli settlers and their families. In this phase the private sector has a leading role to play.

The Mahaweli Enterprise Development Project (MED) is a USAID-supported initiative of the Mahaweli Authority of Sri Lanka to promote investment and business development in agribusiness, manufacturing, tourism, minerals and services. MED directly assists small, medium and large-scale investors with technical assistance, marketing support, training, business advisory services and credit. MED also provides policy assistance to improve access to resources, such as land, water and capital, and the legal and institutional framework for enterprise development.

The official MED implementing agency is the Employment, Investment and Enterprise Development Division of the Mahaweli Authority. The main MED technical consultancy is provided by a consortium led by the International Science and Technology Institute, Inc., a private consulting firm with head offices in Washington DC. Other firms in the consortium are Agroskills, Development Alternatives, Ernst and Young, High Value Horticulture and Sparks Commodities. Marketing services are provided by SRD Research and Development Group, Inc.

PREFACE

Mr Peter Florance, a tomato production agronomist is a MED consultant who is assisting Mahaweli investors in the development of processing tomatoes. He was in the field in Mahaweli Systems H and C during January/February 1992.

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VANATHAWILLUWA VINEYARDS LIMITED (V.V.L.)

Objectives

To establish commercial trial plots of selected varieties of processing tomatoes. To procure seed varieties that can be grown in dry tropical areas. To instruct and assist in the development of tomato production including seed bed preparation, transplanting practices, and correct soil moisture management. Other objectives according to the terms of reference were to grow tomato seedlings in plastic module trays with and without starter solution and to practice soil and media sterilization techniques. Unfortunately, facilities were not available for either demonstration.

Because the duration of service has been curtailed, it is not possible to be present for the harvest or post-harvest periods.

Areas Visited and Contacts Made

V.V.L. Head Office, Colombo
V.V.L. Cucumber Brining Station, Girandurukotte
V.V.L. Nucleus Farm, Girandurukotte
Department of Agriculture Research Station, Girandurukotte
In Service Training Institute (I.S.T.I.), Bandarawela
Wholesale and Retail markets at Colombo and Bandarawela
Deputy Director of Agricultural Research, Kandy
Outgrowers Association representative for the high country at Kalukadegama. Kandy fresh vegetable market.

Seed Procurement

During my stay in Sri Lanka I procured both hybrid and open pollinated tomato seed from California and Australia for trial work. The four Californian lines are Hybrid F1 varieties all with heat tolerance, and of the Australian lines, two were found to have the best tolerance of *Pseudomonas solanacearum* (Bacterial Wilt) in trials in Thailand, and the other three are dual purpose varieties i.e. for both processing and fresh market.

Heinz Lines from Dr. B. George, California, U.S.A.

H 7038)	All determinate types. Medium to large vines
H 1810)	Heat tolerant, high yielding, good field
H 3025)	storage varieties. All have V, F1 and F11 nematode
H 2710)	and Bacterial Speck resistance

Australian Lines

- A 422 Large vigorous vine. Indeterminate type, with large
V & F1 round to flat-round fruit. Very firm, excellent flavour for fresh market or
 processing.
- Bounty Gem Small, compact vine. Small round fruit with pleasant
V & F1 flavour. High yielding. Not so firm as A 422. For
 fresh market or processing
- Arcadia A new improved variety, round fruited. High yielding. Excellent shelf life -
 very firm. Fresh market or processing.
- U.C 82B Widely grown in Australia. Excellent compact vine
V & F1 type. Determinate characteristics. Fruit shape - pear to long plum. Good
 shelf life. High yielding processing tomato.
- VC 134E Very early tomatoes - 105/110 days from seed to
V & F1 harvest. Flat-round fruit, good size. Good keeping processing tomato.

These seed lines have been given to Mr Navaratne, but have not been planted as yet.

Variety Trial Work - Bandarawela

I left Dambulla with Mr Navaratne on 2nd February 1992 and travelled to Bandarawela, via Nuwara Eliya. There we visited the In Service Training Institute where Mr. Navaratne had previously planted fifteen (15) Peto lines of tomato seed, and four (4) lines from Taiwan. At that stage there was no sign of Bacterial Wilt in the tomato plants, although a nearby capsicum plot was suffering from several incidences of the disease. This was confirmed by applying the "water" test. In the whole tomato trial only two plants had died, and another two were affected by Botrytis (Grey Mould). This is a fungal disease which can be spread by splashing water on plants. At this time the In-Service Training Institute was experiencing water constraints which might have contributed to the situation. I noticed that the hybrid plants, with the exception of Rio Grande, were much larger and had more vigour than the open pollinated lines.

On my second visit to Bandarawela five weeks later on 7th March, I was pleasantly surprised to find that the variety trial was growing well. There was still no Bacterial Wilt in the plot and the flower setting pattern was excellent, probably due to the more elevated situation with its cooler night temperatures. The water shortage at Bandarawela due to the drought had become very serious, with only sufficient water being given every second day to keep the plants alive. Such a constraint in a research institute tends to make a mockery of trial work, which needs proper husbandry to achieve accurate results.

Observations on the Bandarawela In-Service Training Institute Tomato Variety Trial

1. **Spectrum** Good, compact vine. Early sets. Plenty of flowers. Fruit-plum shaped.
2. **Hy 882** Extended, open vine with bad leaf roll. Fruit long plum. Heliothus.
3. **Nema 512** Similar to # 2. Not as good sets. Fruit round. Heliothus.
4. **Nema 1401** Better bush with larger foliage. Not as early as others. Fruit - plum.
5. **Nema 1435** Extended vine with good sets. Fruit - plum.
6. **Sausalito** Vigorous vine with early sets. Good flowering. Fruit - round plum.
7. **Hypeel 697** Dark green foliage. Best sets so far. Fruit-plum.
8. **Narcal** Good vine, early sets. Small foliage.
9. **Peto 9543** Pinched foliage. Good flowering.
10. **Peto 98** Good, fine foliage. Good flowering. Later setting.
11. **Peto 111** Much the same as # 10. Also late setting.
12. **Peto 343** Much the same as # 10. Also late setting.
13. **Rio Grande** Good, compact vine. Late setting.
14. **Royal Chico** Larger foliage than # 13. Late setting.
15. **Elios** Open vine with small sets. Fruit-long. Staking types.
16. **Precious** Extended open vine. Colour U.G.G. (green shoulders)
17. **Girls Sweet** Open vine. Extended. Setting well. Fruit-plum U.G.G. Best of Taiwanese lines.
18. **New King Kong** Extended open vine. Recessed blossom end U.G.G.
19. **Lovely Red** Very open vine. One good plant. Fruit-plum U.G.G.

Variety Trials - Girandurukotte

After the early visit to Bandarawela in February Mr Navaratne and I proceeded to the V.V.L. Brining station at Girandurukotte where we met the Manager. He accompanied us to the nucleus farm of twenty (20) hectares, (45 acres) which was the proposed site for trialing. Here the same nineteen (19) lines had been seeded as open rooted seedlings on 20th January, and were at the 3rd and 4th leaf stage. Whoever had cared for the emerging seedlings had done an excellent job, and had a uniform, well spaced stand. We removed the palm leaf shade from the plants which were quite hardy but elongating and cultivated between the rows with a stick in lieu of other implements.

Beds had been prepared for a direct seeding trial and were laid out on the greatest fall of the land as is customary with paddy. This is not suitable for tomato culture because it encourages a too rapid flow of irrigation water causing flooding and erosion of beds.

Under our direction, labour reversed the layout of the beds to make the fall more gradual. We then broadcast 25 kgs. of M.O.N. and K. (46%) which was the only fertilizer available and started hilling. The dimensions of the cultivated plot are 73 feet long by 2³ feet wide. Using a 3 ft. bed top with 9 inch deep furrows we incorporated the fertilizer using chopping hoes, then placed a mixture of poultry manure and rice hulls in the shallow seed drill furrow on top of the bed. Using Peto tomato varieties "Caribe" in Row 1 and "Roma" in Row 2 we dropped 2/3 seeds in clumps at 9" intervals along the row. We then applied a further layer of the P.M. and R.H. mixture, which together with soil was compacted over the seed and then the bed was watered carefully with a hand held watering can to avoid washouts or movement of seed.

The remainder of the plot was fertilized and formed into beds and two more rows were planted without P.M. and R.H. as a control of the two varieties. Two further permanent high ridged beds three (3) feet in width at the base and with two (2) feet furrows were prepared and planted as before. Half of each of these two beds was covered with rice straw and half was left bare, and they were then watered in a similar fashion.

In this trial there was insufficient P.M. and R.H. mixture available to give a complete test of this method of combating the dreaded Bacterial Wilt. However, the soil at Girandurukotte is an excellent clay loam for tomato culture and good results were expected. On my next visit to the nucleus farm on 7/9th March, the results of the direct seeding trial were indeed encouraging. Unfortunately, the plants had been thinned to a single plant instead of being left in clumps as instructed and the transplants had been used to fill in gaps. This had disturbed the root systems of the originals and snapped tap roots off the relocated plants, retarding their growth. The unmoved plants were still twice the size of the transplants.

In rows #3 and #4, which had been planted without the P.M. and R.H. mixture, the strike was not as good as in rows # 1 and # 2 and the plant population was smaller. The two rows planted on the high bed had a very poor strike probably through lack of moisture due to poor irrigation.

I recommend that in future trials I.C.J's Devrinol pre-emergent weedicide which has been especially formulated for direct seeded crops of tomatoes, should be band sprayed on the soil. This would eliminate the need to cultivate close to the plants avoiding root damage with possibility of subsequent infection.

The construction of planting blocks using soil and the P.M. and R.H. mix was demonstrated to the staff at the farm. These blocks are to be used for seeding further varieties at a later date.

Variety Trial of Transplants

The nineteen (19) varieties of open rooted seedlings raised at the farm were transplanted on 13 February in an area adjoining the direct seeding trial. Very few have survived the ravages of Bacterial Wilt. See the following table. It seems unnecessary to keep watering the few remaining plants, but to grow these on is the only way to determine which varieties, if any, have some degree of tolerance. The seed should then be used in any future breeding programme.

Girandurukotte Variety Trials - Survival Rate

Variety	No. of seeds	Plants left	B.W. affected	Percentage lost
Spectrum 579	150	57	32	62%
Hybrid 882	150	12	7	92%
Nema 512	52	23	9	55%
Nema 1401	60	17	7	72%
Nema 1435	100	28	22	72%
Sausalito	60	8	3	86%
Hypeel 096	110	21	10	81%
Narcal	105	10	9	86
Peto 9543	70	49	10	30
Peto 98	100	36	22	64
Peto 111	100	9	7	91
Peto 343	20	3	3	85
Rio Grande	65	27	13	58
Royal Chico	60	6	6	90
Elios	25	19	7	24
Precious	70	27	10	61
Girl's Sweet	35	NIL	-	100
New King Kong	25	16	3 T.M.V.2	36
Lovely Red	60	12	4	80

Bacterial Wilt (*Pseudomonas solanacearum*)

Work carried out in Thailand two years ago showed that the addition of poultry manure to the planting medium helped to control Bacterial Wilt; because the pathogen tended to attack the manure rather than the plant root. We know that tomato variety Roma VF is susceptible to the Wilt and yet the direct seeding trial planted with P.M. and R hulls is still holding its own at this stage.

On the other hand, the transplanted variety trial without P.M. and R.H. was very adversely affected. It is possible that rising temperatures and humidity in March might have some bearing on the rapid spread of the disease. It is known that the bacteria does not attack until the soil temperature reaches 22°C. The tomato breeder at the Agriculture Research Station at Girandurukotte told me that there was no Bacterial Wilt in her tomato variety trials which were planted much earlier and had been completely harvested by January. This leads to the conclusion that Mr. Navaratne might find it useful to conduct further "observation" trials with small areas of each variety of seed in as many different locations as possible and at different times of the year. Unfortunately, the tomato plant breeder at the Research Station has been transferred to a rice project, so there will be no further tomato work done at Girandurukotte.

I have been told that some local tomato varieties are tolerant of Bacterial Wilt, but that the fruit is undersized and of poor quality. If this is so, a long-term breeding programme should be undertaken crossing these types with imported varieties to improve performance while retaining tolerance. When final assessment of the imported varieties is made, those (if any) that show tolerance to Wilt should be used in the crossing programme. Selections would be made in Sri Lanka and then sent to the Southern Hemisphere for crossing thus saving a season. The seed selected from this crossing would be returned to Sri Lanka for further trialing and so on. This process has been going on in Thailand for six (6) years, and should show results in 1992. However, there are many strains of *Pseudomonas* and seed that is tolerant or resistant there may not necessarily be so in other parts of the world. There are also many vectors for the spread of the disease. Teak, mulberries, anthuriums and bananas have all been named as host plants in tropical areas.

It would be interesting to find out if there is any incidence of Wilt in outgrower's tomato crops in the high country. It seems that elevation with cooler night temperatures might have a bearing on the problem.

Temperature Readings at the Agricultural Research Station Girandurukotte, System C

Wet/Dry bulb readings. Longitude and latitude 79° 30' - 81° 55'. Height above sea level 312'

Mean	Maximum	Minimum	Rainfall figures not available
January	29.7	20.4	
February	30.9	21.0	
March	35.5	23.4	
April	35.6	23.9	
May	35.4	24.6	
June	35.9	23.7	
July	35.9	24.6	
August	36.3	24.5	
September	36.5	24.3	
October	30.7	22.9	
November	28.9	23.0	
December	28.1	22.7	

Other Diseases

Tobacco Mosaic Virus

It was the only other disease noticed in the crops, at both Bandarawela and Girandurukotte. T.M.V. is spread by poor sanitation i.e. dirty hoes and implements, and by workers walking on beds and brushing the plants with clothing. **NB** There should be **NO SMOKING** when handling tomato plants, and hands should be washed and implements sterilized daily with a solution of hyperchloride where the disease is present. T.M.V. can also be seed or soil borne. Avoiding planting in soil which has grown a previous crop of tomatoes, eggplant, peppers or tobacco, clearing away and burning infected debris from a previous crop, and keeping crops free of weeds, can all help to control the virus. Direct seeding often helps to eliminate the problem, as does the use of resistant seed.

Pests

Heliothus - Tomato Fruitworm

At both Bandarawela In-Service Training Institute and on outgrowers plots Heliothus was noticeable. Since the crop at Girandurukotte is not yet at the fruiting stage, it is not present there as yet. It is impossible to control fruit worm with pesticides using knapsack pumps except on very small areas, because when the operator refills his tank or spends time mixing chemicals and then returns to the tomato bed, he frequently becomes confused and misses some areas. These lapses allow the grubs to survive and multiply, reinfesting the crop. Flag markers would help, but ideally, a motorised misting spray unit with a boom to cover a wider area in a shorter time should be considered for the future. Elimination of grubs is essential in a tomato processing operation.

Chemicals and Residues in Product

I have been shocked to find many brands of dangerous chemicals available in Sri Lanka which have been deregistered in other parts of the world e.g. dieldrin, aldrin, lindane, D.D.T. to name a few. These chemicals can leave residues in tomatoes which are not acceptable in the processing industry, so it is essential that V.V.L. has control over the spray material used by its suppliers. In Australia, State Departments of Agriculture perform frequent random checks on fruit and vegetables where insecticides are used.

Endosulfan is the safest insecticide available at present, but there are many new synthetic pyrethrum products coming on the market. In hot tropical climates regular preventative sprays should be applied to control bacterial problems i.e. Bacterial Speck, Spot and Canker. Copper hydroxide is recommended. Fungus diseases should be controlled with Dithane sprays, but this is not usually needed until fruit sets. Wettable sulphur should be applied to prevent russet mite attacking tomato vines.

Spraying chemicals by knapsack leaves the operator vulnerable through his bare feet, legs and arms. As many dangerous chemicals are absorbed through the skin, protective clothing should be provided in a Company project.

Implements and Tools

Big chopping hoes are used for all horticultural procedures at the moment. They are too large and cumbersome for successful vegetable culture, at times causing damage to tomato vines and roots. For close weeding a small hoe or three pronged cultivator would do a better job. These could be manufactured locally. The nucleus farm is very undulating and a tractor with grader blade would be useful for levelling. The soil there is good loam, and it would be a pity for depressions to become over-watered and wasted.

Weed Control

The nucleus farm at Girandurukotte is virgin country and has a normal sole of weeds. These are controlled by hand hoeing at present.

Irrigation

This was done by pumping water from a lagoon, lifting it on to the farm, and then using large hoses (about 3 inches outlet) or furrow irrigation. Mention should be made here about the quality of water used to irrigate tomatoes for processing. It should be reasonably clean and unpolluted, and without algae and slime.

Hand held hoses are not an effective method of watering vegetables as success depends on the operator's concentration and control, and water and mud splashing the plants can spread disease. Furrow irrigation was used to water the tomatoes, and this was efficient with excellent penetration of water and good drainage.

Pump maintenance should be attended to. The hose connected to the pump was tied on with hemp and needed a hose clip.

Outgrowers

From Bandarawela Mr Navaratne and I went to the village of Katukudagama. This is in the high country with pockets of tomatoes growing among the tea. There is a local staked variety grown there called BIANZ. We met an official of the Outgrowers Association who told us that there are 257 members of the association made up of 100 families, and an area of 173 acres under vegetables. In Maha they grow 25 acres of highland vegetables on terraces, mainly tomatoes and some rice and a small proportion of beans, cabbages and potatoes. The highest yields of tomatoes were in June and September when the price to the grower was Rs. 18-20 per kg. In January and February they received Rs. 6-7 per kg. The average yield of fresh market tomatoes was between 4/6 tons per acre off 1/4 acre blocks.

There was a significant constraint on transporting produce from these outlying areas - steps up and down the terraces, no made roads and no method of communication.

In Girandurukotte we met the Secretary of the Outgrower's Association for that district. This man has 1 acre of high land and 2 1/2 acres of paddy, growing vegetables as an alternative crop. He sowed tomatoes last April, but was not successful. He intends to plant a nursery to have plants ready in early January, and will be given seed to distribute to the Association members. The second grower interviewed grows 1/2 acre of cucumbers per year, but does not have sufficient water to grow tomatoes.

The supply of tomatoes from these outgrowers and others like them would be fragmented and difficult to transport to a factory in a continuous flow, and continuity is a key word in a processing operation. Much more work must go into contacting outgrowers and establishing a more factual approach to quantities before any real progress can be made towards a viable processing industry.

Communications

The only telephone available in the Girandurukotte district is in a shop in the village. There is no phone at the Brining Station, which makes communication time-consuming and difficult. In the event of a factory being built, both a telephone and a two-way radio system to enable people in the field to pass and receive messages and to keep abreast of the current situation would be of vital importance. Also access for trucks to collection points where growers would take their fruit to be graded would need to be considered. At present, it takes eight (8) minutes by vehicle over a rough track and eight (8) minutes on foot to reach the nucleus farm from the main road.

Staff

Mr. Navaratne is a most able man who would make an excellent teacher. I recommend that his talents should be employed in training younger men to become field officers. At present, the manager of the Cucumber Brining Station at Girandurukotte is in charge of horticulture in the field. He is doing a good job within his limitations, but has no knowledge of tomato growing techniques. Mr Navaratne's knowledge and experience are invaluable and should be passed on. Also, if V.V.L. continues to do training and considers embarking on a crossing programme, which I recommend, he would be the appropriate person for this work.

Accommodation

On both visits to Girandurukotte Mr. Navaratne and I wasted a lot of time trying to obtain accommodation. Letter of introduction to MED's Circuit Bungalow brought a negative response and we were eventually forced to return a considerable distance to Mahiyangana where we stayed at a very indifferent Rest house. The MED is obviously not meeting it's obligations, and this situation should be remedied.

Conclusion

Before any thought is given to establishing a processing plant in System C, it must be demonstrated that tomatoes can be grown in sufficient quantities, and of a quality that will meet world export standards for tomato paste.

There are a number of constraints that will make this a most difficult undertaking that can only be implemented by a long-sighted development plan over say, at least five years, together with a programme to train staff, trial varieties and to give attention to the other details that have been outlined in this report.

Briefly, the constraints are these:

Water

Throughout the MED project, most consideration is given to the production of paddy. This is understandable since it is the staple diet. After the paddy harvest is finished water supplies are cut off and alternative crops must depend on wells or rainfall. Cucumbers can be grown because this is a short-term crop, but tomatoes, which take approx. 100 days from seed to harvest, suffer under this constraint. While subsistence crops, e.g. okra and butternut pumpkins can cope with an unreliable and sometimes too heavy rainfall, tomatoes need regular and measured amounts of water and respond badly to too much or too little.

Availability of Land

Hypothetical figures from previous reports regarding areas of land and numbers of outgrowers need to be substantiated to give an accurate estimate of quantities of tomatoes that might be produced to feed a processing plant.

Labour

The labour force for cultivating, bed-forming, weeding, picking etc. should be considered and checked out.

Roads and Transport

Reliable vehicles to transport produce from field to factory would have to be provided.

Roads and Tracks

Would need upgrading.

Communications

Are unsatisfactory and would have to be improved.

Variety Trials

In many situations and under various conditions, should be continued.

Mechanization

When all other factors are favourable mechanization would have to be considered. Manual production by outgrowers will not be sufficient to keep a plant in production and traditional cultural methods will need to be gradually updated and adapted to modern techniques. This can best be done by demonstration. Tractors and a chisel plough, tined implements and a spray unit with boom would be basic equipment for a company farm designed to be the nucleus of the operation.

I recommend that all these factors be considered and discussed at length by those people concerned, and firm decisions made for the future. Then, and then only should a processing plant be planned for the future.