

CURRENT TRENDS AND FUTURE CHALLENGES IN TEA RESEARCH IN SRI LANKA

M T ZIYAD MOHAMED

(Director,

Tea Research Institute of Sri Lanka, Talawakelle, Sri Lanka)

TEA INDUSTRY IN SRI LANKA

Sri Lanka is one of the oldest tea producing countries in the world, and its commercial scale tea production commenced more than 125 years ago. The tea produced in Sri Lanka is popularly known as “Ceylon Tea” and ranks among the best available teas in international trade, and over the years, the word Ceylon has become synonymous with quality tea. The contribution by the tea industry towards the country’s economy could be summarized as follows:

(A) Production

The current annual production in Sri Lanka is about 310 million kg, and mostly consists of black tea. Sri Lanka’s tea production grew annually at an average rate of about 10% over the last decade and following key factors could be identified as the major contributors towards the growth:

- a. Favourable weather conditions;
- b. Adoption of better management practices in the corporate sector after privatization of the management of estates previously managed by the state;
- c. Proliferation of small holders, mainly planting vegetatively propagated (VP) varieties;
- d. Replacement of low yielding seedling tea with high yielding VP varieties.

Out of the total extent of about 181,000 ha cultivated, 58% is managed by the corporate sector, contributing to about 38% of the production and the balance 42% is managed by the small holder sector while producing about 62% of the total. This clearly shows that the average productivity in the small-holder sector is significantly higher (2,216 kg ha⁻¹) than the corporate sector (1,151 kg ha⁻¹), thus giving a national average of 1,618 kg ha⁻¹ (Tea Information; Tea Research Institute, 2002).

(B) Export Earnings

Sri Lanka is the leading tea exporter in the world, exporting about 295 million kg yr⁻¹. The foreign exchange earning from tea exports in 2003 was about Rs. 65 billion, which accounts for 14% of the total national foreign exchange earnings. The contribution generated from the agriculture sector to, total national foreign exchange earnings is about 19.7% and

tea alone contributes about 70% to this value. Colombo auction prices are the highest and so are the FOB prices. The FOB prices are high, because out of the total quantity of exports, about 40% is in value added form. These prices are considered to be quite high, when compared with other exporting countries. However, the industry cannot be complacent about this fact and the quantity exported in value added form need to be increased to a level of 60% for the industry to be sustainable as the cost of production is increasing.

(C) Employment

The tea industry employs about 2.2 million people altogether directly and indirectly in the areas of production, trade, export, promotion, research etc. (Central Bank Report, 2002).

The industry had undergone major changes during the last two decades due to privatization of management of large estates and proliferation of small-holdings. However, over the years, the contribution from corporate sector towards total production has been declining in comparison to the small holder sector.

(D) Issues facing the industry

The issues that the tea industry facing at present could be broadly categorized into;

- high cost of production compared to other tea growing countries,
- low field, worker and factory productivity,
- worker shortage which is considered as a serious threat to the sustainability of the industry
- competition from other emerging producer countries, that are capable of producing similar type of teas at a much lower cost.
- exodus of experienced managers and staff, which threatens the corporate sector tea estates with impending decline.
- possible decline in the quality of tea, in the recent times.

CURRENT TRENDS IN TEA RESEARCH

The stakeholders expect updated, appropriate technologies to address the above issues and also to suit their local environmental conditions. Hence, to cater the needs of the stakeholders in the industry, research projects were formulated and prioritized by the Institute, using CADMAR (Composite Approach to Decision Making in Agriculture Research) methodology, with specific target dates and budgets. The same information was incorporated to the Corporate Plan of the Institute for the period 1999 - 2003. Subsequently, the same plan was updated (rolled over) in September 2003 for a further period of 5 years.

The mission of the TRI is to raise productivity and quality of teas by recommending appropriate technologies and practices to facilitate development of the tea industry, sustain resources and enhance the quality of life. There are 38 Research Thrusts formulated and embodied into the Corporate Plan highlighting the current trends in tea research. However, in this article, it would be more appropriate to highlight only the major areas of concern and they are as follows:

- i. crop improvement;
- ii. land productivity improvement;
- iii. crop management;
- iv. post harvest technology and
- v. resource planning.

CROP IMPROVEMENT

The current low level of productivity is a major concern in the industry. One of the reasons identified as responsible for low productivity in Sri Lankan tea lands is the lack of high yielding varieties. It was found that some of the varieties developed by the Tea Research Institute of Sri Lanka have been yielding more than 8,000 kg ha⁻¹ in South India under commercial conditions. This simply shows that the varieties developed by our Institute have the potential to give high yields. The actual reasons for poor performance of such varieties under local conditions are primarily poor soil conditions mainly due to negligence or non-adoption of proper control measures due to financial reasons. The low field productivity results in lower worker productivity and causing high cost of production.

The objectives of the Institute's crop improvement program has multiple objectives and they are to develop high yielding nutrient responsive cultivars with quality, resistance to pest and diseases, tolerance to drought and amenable to mechanical harvesting on commercial basis at Up, Mid and Low elevations. However, the serious limitation that exists in the crop improvement program is the narrow genetic base in the country's germplasm collection. It is a well-known fact that out of the VP cultivars introduced to the industry, nearly 85% is derived either directly or indirectly from a single parent. This might mean that the industry is sitting on a time bomb. For some reasons, if this genetic base is affected by some serious pest or disease almost 50% of the tea extent could be wiped out from the country. However, one could find solace in the fact that a woody perennial crop such as tea is not expected to be prone to such diseases/attacks. But, if proper cultural practices are not implemented, there will always be a danger of plants undergoing such stress, a phenomenon the scientists have already witnessed.

The Institute is also not in a position to use latest technologies, such as molecular biology/biotechnology/genetic engineering in the plant breeding programme, as the material produced using such technologies are not acceptable to the consumer. Under the circumstances, such advanced technology is used only to identify potential material for use in our breeding programme.

LAND PRODUCTIVITY IMPROVEMENT

Due to worker shortage, some estates in the corporate sector are facing problems at harvesting the entire quantity of available leaf. One of the obvious options available is diversification of the marginal tea lands into fuel-wood, which does not require much labour and the estates could employ the available workers more effectively, in fields, which have high potential to obtain yields. By adopting this approach, both land as well as worker productivity could be improved.

Replanting and Infilling

The Institute, very recently published a document titled "Agricultural Profile of the Corporate Tea Sector" which is a compilation of valuable data on the agricultural status of

304 tea plantations that are managed by 20 Regional Plantation Companies (RPC's), in the country.

The results of the survey of the corporate sector revealed that 53% of the lands are under old seedling tea and the balance 47% is under VP tea. About 90% of the seedling tea is older than 60 years and about 74% of extent yields less than 1300 kg ha⁻¹ of the VP tea. It also showed that about 30% is older than 30 years and only 35% of them yields more than 2200 kg ha⁻¹. These data emphasize the importance of undertaking replanting seedling tea, re-replanting old VP tea and infilling the rest. It was found that the replanting rate in the Corporate Tea Sector, over the past decade (1993-2002), has been only 0.70% of the total extent. There is sufficient documentary proof and commonly accepted, for the sustenance of the industry, replanting should proceed at a minimum of 2% per annum of the total tea extent.

Intercropping

Intercropping in tea lands is another viable option that could be practiced to maximize land productivity. TRI had already recommended guidelines on intercropping tea either with rubber, coconut or with some minor export crops.

Soil Fertility improvement

Tea soils in Sri Lanka, especially in areas of Mid-country and Uva are denuded/eroded. It has been estimated that most of the tea plantations in Sri Lanka have lost 300-450 mm of the top soil. This condition is mainly contributed by the poor stand of old seedling tea, which occupies a high percentage of the tea lands. Due to poor bush stand, the soil is exposed to rainfall leading to erosion and under dry weather, evaporation of moisture under extreme conditions. The most practical way to improve the soil is by adding more organic matter. Although such resources might not be economically feasible in the short run, however it must be done to sustain the industry. The more the delay, higher the cost of carrying out improvements.

The Institute has been advocating burying of prunings or addition of decomposed waste tea to improve the organic carbon content in the soil. However, burying of prunings is not practiced, in estates where the workers are not provided with adequate firewood for their domestic use. Addition of decomposed (refuse) tea also does not take place due to difficulties in the decomposition and the long time taken for the same operation, according to the traditional methods. Recently, the Institute has developed a rapid method to decompose refuse tea into a compost with high content humic substances. The laboratory/glass house studies have amply demonstrated the benefits of using such material on the growth of plants and the Institute obtained a patent for this method. Experiments are already underway, to prove the effect of such compost under field conditions and preliminary results are very encouraging.

There have been queries from the stakeholders about the possibilities of using city solid waste as compost material in tea plantations, to enhance the organic matter content. One of the limiting factors, in using such material is the high content of heavy metals it contain. Here again, the Institute has developed a method to detoxify heavy metals using humic substances. This method too has been patented. However, the impact of application

of such material on tea cultivation not only with regard to yield and quality, but also on the environment and possible contamination of tea (if any) will be carefully studied, using field trials before making any firm recommendation.

FERTILIZER APPLICATION

The Institute had been advocating 'blanket' recommendation on fertilizer requirements for tea based on yield potential. Ideally it should be on site-specific basis, field by field, if one were to optimize returns and reduce the cost. The research focus had been in this direction since of late, and the fertilizer recommendations have been revised with a view of reducing the cost without adversely affecting the yield, quality etc. Recently the Institute has developed a user friendly simple computer model to work out the fertilizer requirements on a field basis and to assist identification of nutrient deficiency symptoms and employ remedial measures to rectify them.

CROP MANAGEMENT

Harvesting

Harvesting is the most costly operation in tea cultivation, which requires large amount of labour. Furthermore, due to changing socio-economic situation, and also due to social stigma attached to plucking, there is very poor outturn of workers, in the plantations. The way forward is mechanization, although it might have an impact on the yield as well as on the quality of processed tea. The Institute has developed a plucking shear, a mechanical pruner and a collapsible plucking basket and the use of such innovations would alleviate the problem of worker shortage and improve the quality of the harvested material. These three innovations have been patented. Realizing the importance of this, the Institute has taken a decision to establish a Mechanization Division, to strengthen this area of research.

Pruning

Pruning of tea is another worker intensive operation. Recently, TRI innovated a pruning machine with very high maneuverability compared to the imported machines. Its performance is comparable to imported machines.

Pest and Disease control

Due to adoption of integrated pest management (IPM) approach in controlling pests, diseases and weeds as recommended by the Institute, Sri Lankan tea earned an accolade as the "Cleanest Tea in the world, with regard to pesticide residues". The ISO Technical Committee on Tea, pronounced this in 1997, 1999, 2001 and 2003. The tight limits imposed by countries in the European Union on pesticide residues in tea is of our concern. In March 2003, a new pesticide regulation came into force from the European Union (EU). Before this regulation was introduced, individual EU member states had their own maximum residue levels (MRL) for different crop/pesticide combinations. In the new regulation, all MRL's will be established in a harmonized way at EU levels. The basis for agreeing on the harmonized EU levels of MRL's will rest on recommendation from the newly established European Food Safety Authority (EFSA). Taking cognizance of this fact, the research focus is more towards biological control of pests, diseases and weeds. Since of late, the Institute found several biological control methods for pests, diseases and

weeds. In this regard, the Institute had come up with biological control methods of Shot Hole Borer, Horse hair blight etc. The Institute has recommended soil solarization as a substitute for Methyl Bromide, introduced soil substitutes, soil-less media etc to raise nursery plants.

POST HARVEST TECHNOLOGY

Research on process technology is more towards energy conservation and automation of the process towards establishing food factory concepts. Tea produced in Sri Lanka is mainly of orthodox type. As orthodox manufacture is a batch process, where worker productivity plays an important role. On account of the worker shortage in the recent times, the current research is focused on automation of tea processing to minimize the over-dependence on workers.

The introduction of a computer model to select rolling program in tea manufacturing and rapid microwave oven method for determination of moisture in green leaf and withered leaf are some valuable tools to improve the quality of processed tea while reducing the cost of tea processing.

Product development and diversification

The industry has to focus on product development and diversification to increase its share on value addition. To assist the industry, the Institute research is presently focused on producing value added products such as Instant tea, Ready to drink tea (RTD tea), tea wine, tea yoghurt etc., with increased tea character.

Health benefits of tea

Diet plays the most important role in preventing degenerative diseases. Recent research carried out at the Institute and other laboratories around the world had shown that regular drinking of tea could reduce the risk of degenerative diseases. Therefore, tea could easily fit into modern day balanced diet. The Institute had strengthened its research focus on health benefits of tea and recently, obtained a patent on the discovery of anti-fungal activity of catechins and theaflavins in tea.

Computer Aided Manufacture (CAM)

Tea processing is still considered as an art by the people concerned and it is distinct from science, and several critical judgments are left to subjective decisions of factory staff. For this reason, the Institute's current research focus entails computer-aided tea processing, such as examining the possibility of using electronic sensors at critical control points in the process. However, the difficulties in using such technology are mainly due to the non-uniformity of the starting material, presence of dust (light weight particles), which interferes with electronic sensors, and the high initial cost involved.

Energy conservation measures

Another area of concern is the cost of energy used in tea processing. Tea processing is highly energy intensive. The tea industry is the largest consumer of firewood and electricity and also the second largest consumer of imported oil. Accordingly, the Institute's research is focused on developing energy-efficient technologies, with a view to reduce the outlay on electrical and thermal energy.

The Institute has recommended measures to reduce the cost of electrical energy for withering by controlling the hygrometric difference of the air supplied, and by using speed controllers to reduce the speed of the withering fan. A minimum saving of about 40 per cent on electrical energy consumption in withering is possible, by using speed-controllers.

The Institute's research is presently focused on environmental-friendly, energy-efficient, renewable alternatives, such as solar energy for drying. Results from experiments carried out with solar-energy, indicated a saving of about 25 per cent on fuel used for drying. However, the capital investment cost of the system is about Rs. 2 million, which makes it less attractive.

RESOURCE PLANNING

Resource planning in estates is an important aspect in resource management because it helps the utilization of resources more effectively. At present, research programmes are formulated under the following categories:

- i. human resource planning through socio economic surveys;
- ii. natural resource planning. Land use planning systems are recommended using Geographic Information System (GIS) as a tool taking into account the productivity of tea lands and worker requirement/availability;
- iii. capital resource planning, mainly by analyzing the return on capital investment.

FUTURE CHALLENGES

Finally, the challenges that the Sri Lankan tea industry as well as the institute face today, could be summarized as:

- i. to develop high yielding cultivars, with other possible attributes to achieve an average yield of 2000 kg/ha by year 2015 for the country;
- ii. mechanization of field practices to overcome worker shortage;
- iii. product development/diversification and increase the value addition in our tea exports. However, to prioritize research and development of such products market intelligence is required;
- iv. produce tea with minimum level of pesticide residues to meet the demand of the Western countries. Virtually it is expected that the product be pesticide free. In this regard, research on biological control methods takes prominence;
- v. A shift in fertilizer recommendation from 'blanket' application to site-specific recommendation, with a view to having higher returns on investments;
- vi. Introduction of computer aided manufacture (CAM) with automation to establish food factory concept and to achieve energy efficient, environmentally sound technologies, in processing to reduce cost of processing and preserve the environment.