

## KEY NOTE ADDRESS

# PLANTATION CROPS RESEARCH STATUS AND STRATEGIES FOR INCREASING PRODUCTION AND PRODUCTIVITY

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Plantation crops play a vital role in the rural economy of the country, particularly in the states of Karnataka, Tamil Nadu, Assam and West Bengal. Out of total cultivated area of 180 million hectares in the country, the plantation crops namely, tea, coffee, rubber, coconut, arecanut, cashew, cardamom and black pepper occupy about 3.76 million hectares representing 2.6% of the total cultivated area. However, this group of crops fetched 12.17% of export earnings from all the crops put together (Rs. 18384 million) during 1991-92.

India is the leading producer of cashew, tea and arecanut, second in cardamom, 3rd in coconut and 9th in coffee. The country's position in pepper production varies from 1st to 3rd in various years.

A look at the area, production and productivity of these crops at an interval of two decades (1970-71 and 1990-91) shows that there has been considerable increase in area and production as well as productivity (Table I). The percentage of increase in area varied from 9.3 in cardamom to 122.2 in rubber. Rubber also showed the maximum increase in production (257.6%),

the minimum being in coconut (59.6%). Increased productivity ranging from 8.3% in coffee to 61.0% in rubber shows that the increased production was not only due to increased area but also due to improved input technologies available for all these crops during the last two decades.

The national average yield in various plantation crops (Table II) shows that India has one of the lowest national average yield in coconut, black pepper and cardamom and comparatively lower average yield in all other plantation crops. A critical analysis of data presented in Table II indicates that the productivity of these crops has not reflected on the research achievements made during the last two decades. The actual yield achieved under the scientific management either at the Research Station or by the progressive farmer (given in column 4 of Table II) reveals that the percentage of increase over national average yield under these situation varies from 98 in Tea to 455 in arecanut. The impact of research inputs available on the increased productivity of the crops shows that greater impact on productivity was achieved in black pepper, arecanut, cardamom, coconut and cashew in that order. Comparatively lesser impact on the

Table I **Increase** in area, production and productivity of plantation crops in the last two decades.

Crop	Area (million ha)			Production (million tonnes)			Productivity (kg/ha)		
	70-71	90-91	% increase	70-71	90-91	% increase	70-71	90-91	% increase
Coconut	1.046	1.514	44.7	6077*	9700'	59.6	5810"	6407**	10.3
Arecanut	0.167	0.208	24.6	0.141	0.249	76.6	844	1197	41.8
Black pepper	0.120	0.173	44.2	0.026	0.049	88.5	217	283	30.7
Cardamom	0.075	0.082	9.3	0.003	0.005	66.7	40	61	52.4
Cashew	0.303	0.532	75.6	0.177	0.305	72.3	584	573	-1.9
Tea	0.356	0.427	19.9	0.436	0.7%	72.5	1225	1761	43.8
Coffee	0.136	0.242	77.9	0.109	0.210	92.7	801	868	8.3
Rubber	0.203	0.451	122.2	0.092	0.329	257.6	453	729	61.0

in million nuts \*\* nuts/ha

Table II. Average and potential yield in plantation crops

crop	Unit	National average	Research station yield	Super/potential yield	% increase over national average (%)	
					Research station	Potential yield
Coconut	Nuts/palm	36.0	175	471	386	1208
Areca nut	Chaii kg/ree	0.9	5	9	455	900
Black pepper	kg/ha	283.0	1100	13465	288	4658
Cardamom	kg/ha	65.0	350	900	438	1284
Cashew	kg/tree	3.6	16	125	344	3372
Tea	kg/ha	1762.00	3500	7500	98	325
Coffee	kg/ha	867.0	2800	6000	223	592
Rubber	kg/ha	730.3	2500	6000	242	721

productivity of estate crops (tea, coffee, and rubber) is not a reflection on research results achieved in these crops. On the other hand, these estate crops which were introduced mostly in the beginning of 20th century were under organised sector of the cultivation and have the advantages of receiving individual attention to the developmental programme resulting in higher productivity in the initial years of cultivation.

The biological productivity achievable in these group of crops are higher than those already achieved at the Research Station. According to Swaminathan (1983), the biological productivity of coconut was estimated as 580 nuts/palm/year. Some of the super palms identified by Iyer *et al.* (1979) was estimated to yield about 400 to 407 nuts/palm/year. A single vine of black pepper at CPCRI Regional Station, Vittal gave an average yield of 11.5 kg of black pepper in 1975 which

works out to 13465 kg of black pepper per hectare. Though at a first glance these figures may look fantastic, in Sarawak even higher productivity has been achieved indicating the potential yield of black pepper under ideal conditions. In Andaranda the Cardamom Research Station, Appangala (at present NRC for Spices) in yield of 900 kg/ha has been achieved in an estate under a high production technology demonstration programme.

Isolated cashew trees at Horticultural Research Station, Vengurla under the All India Co-ordinated Cashew Improvement Project has given an yield of 125 kg/tree/year. An average yield of 500 kg of tea/ha has been obtained from latest high yielding variety of tea though the biological productivity is higher than this. Similarly, the latest high yielding varieties of coffee and rubber are capable of yielding 600 kg/ha each. The percentage increase of these super varieties

Table III. Realised yield and realisable yield (in million tonnes)

Crops	Area (million ha)	Production (1990-'91)	Anticipated demand by 2000 AD	Expected production	
				Scientific Cultivation	Theoretical
Coconut	1.514	9700*	12000*	46366*	124791*
Areca nut	0.208	0.249	0.190	1.42	2.56
Black pepper	0.173	0.049	0.075	0.46	2.32
Cardamom	0.082	0.005	0.009	0.029	0.07
Cashew	0.532	0.305	0.360	1.33	10.37
Tea	0.427	0.752	1.400	1.49	3.20
Coffee	0.242	0.210	0.200	0.68	1.45
Rubber	0.451	0.329	0.750	1.13	2.71

\* Coconut in million nuts

over the National average yield is given in the last column of Table II. Though these figures are highly speculative at present, it is not impossible to achieve under ideal conditions.

The latest production figures available for plantation crops given in column 2 of Table III shows that the country's production has exceeded the anticipated demand by 2000 AD (National Commission on Agriculture) in arecanut and coffee and nearing the targetted production in coconut and cashew. However the national production at present is below the anticipated demand in the case of black pepper cardamom, tea and rubber.

It is estimated that by utilising the available production technology eight fold increase in production can be achieved in arecanut, four times each in coconut and cashew, thrice in cardamom and coffee, twice in rubber and  $2\frac{1}{2}$  times in black pepper (Table III).

It will be relevant to review briefly the available input technologies in plantation crops, to achieve the projected production.

The scientists working in these crops have evolved and released a number of varieties and hybrids mostly during recent years (Table IV). In coconut 10 hybrids and two varieties were released so far by the CPCRI and three Southern Agricultural Universities working under All India Co-ordinated Research Project on Palms. While

the West Coast Tall's average yield is around 80 nuts/palm/year, the yield potential of released hybrids and varieties range from 98 to 151 nuts/palm/year.

High yielding varieties of arecanut namely, Mangala, Sumangala, Sreemangala and Mohitnagar selected and released by CPCRI has the yield potential ranging from 8.8 kg to 15.08 kg/palm/year in comparison with about 4 kg in the local cultivar. In black pepper eight high yielding selections and hybrids released by the erstwhile Regional Station of CPCRI (at present NRC for Spices) and Pepper Research Station, Panniyur (Kerala Agricultural University) give 100 per cent more yield than the local cultivars. 64 selections in tea, 12 selections of Arabica and 3 selections of Robusta in coffee and 8 high yielding varieties in rubber all have comparatively very high yield potential than the local cultivars (Table IV). The data presented in Table IV indicates that there is no dearth of high yielding varieties in any of the plantation crops.

Long term trials conducted in these crops have helped to standardise spacing requirement as indicated in Table V. The fertilizer requirement, irrigation and other cultural practices have also been standardized based on field experimentation (Table VI). In spite of the advances made in the research front in evolving high yielding varieties, optimising spacing, fertilizer and inputs requirements and standardizing the cultural practices, expected level of production has not

Table IV. High yielding varieties available to realise the potential yield

	Unit	Realisable yield	Yield of local cultivar	No. of varieties released
Coconut	nuts/palm	98-151	80	10 hybrids and 2 varieties
Arecanut	kg/palm	8.8 - 15.08	4.1	4
Black pepper	kg/ha	2442	1428	8
Cardamom	kg/ha	260 - 656	397	6
Cashew	kg/tree	8 - 10	5	25
Tea	kg/ha	3000-7500	1762	56 clones + 7 bicultural + 1 polyclonal
Coffee	kg/ha	2800-6000	800	12 Arabica selections and 3 Robusta selections
Rubber	kg/ha	2500-6000		8 popular varieties and several series

Table V. **Crop** production technologies

Crop	Spacing	Other cultural practices
Coconut	7.5 x 7.5 m	✓
Arecanut	2.7 x 2.7 m	✓
Black pepper	3 x 3 m	✓
Cardamom	2 x 1 m	✓
Cashew	8 x 8 m	✓
Tea	1.2 x 0.75 m	✓
Coffee	2 - 2.5 m	✓
Rubber	445 - 520 trees/ha	✓

been attained in all these crops. One of the major causes for not achieving the estimated production has been due to the crops Loss caused by disease and pests. Though accurate data on crop loss due to many of the pests and disease of plantation crops are not available, information is available for few major pests and diseases.

A survey for the loss caused by the root (wilt) disease in the eight southern districts of Kerala conducted in 1984 by CPCRI in association with Department of Agriculture and Kerala Agricultural University showed that about 968 million nuts are lost annually due to this debilitating disease. In terms of production loss, this represents about one tenth of the total production of coconut in the country. The rhinoceros beetle, red palm weevil and black headed caterpillar are the major pests of coconut causing considerable crop loss annually. In addition, diseases like Ganoderma wilt, Thanjavur wilt and Tatipaka disease also cause substantial loss to the coconut production in this country.

A sample survey conducted to estimate the crop loss due to the Mahali disease of arecanut indicated that anywhere from 4986 tonnes to 94790

tonnes of arecanut are lost annually based on the varying intensity of the disease in different years. The loss due to the devastating Yellow Leaf Disease on arecanut in northern part of Kerala and five districts of Karnataka is recently estimated at 1876 tonnes. The scientists working at CPCRI conducted a survey in Calicut and Wynad districts of Kerala to estimate crop loss due to wilt disease and pollu beetle of black pepper. Based on the figures available for the two districts, the annual black pepper production loss in the country has been estimated at 5384 tonnes and 19500 tonnes respectively due to wilt disease and pollu beetle. The intensity of 'Katte' disease of cardamom in different plantations was estimated by Naidu and others. Katte disease causes reduction in yield from the first year of infection and the yield decline is upto 98 per cent in four to five years after the appearance of the disease. This survey also indicated that the annual loss of cardamom may vary from 0.5% to 100% in various estates based on the severity of the infection.

The annual loss of cashew due to tea mosquito and stem borer together may vary from 97600 to 1,86,000 tonnes cashew nuts. Though the latest crop loss survey figures are not available for tea, coffee and rubber, the survey conducted in 1978 has indicated that about 1/5 of the crop is lost annually in tea and coffee and 1/10 in rubber due to various diseases and pests (Table VII).

It has to be emphasised that though effective control measures available for rhinoceros beetle and leaf eating caterpillar of coconut, Mahali disease of arecanut, quick wilt and pollu beetle of black pepper, tea mosquito of cashew, leaf blight of tea, rust of coffee and leaf fall of rubber

Table VI. **Recommended fertilizer** dosage for plantation crops

crop	Dosage	N	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O
Coconut	g/tree	500	320	1200
Arecanut	g/tree	100	40	140
Black pepper	g/vine	100	40	140
Cardamom	kg/ha	75	75	150
Cashew		500	125	125
Tea	kg/ha	180-450	70-90	100-450
Coffee	kg/ha	160	120	160
Rubber	kg/ha	30	30	30

Table VII. Extent of losses due to diseases and pests (in tonnes)\*

Crop	Production	Losses due to		Total
		Diseases	Pests	
Coconut	9700	960 (RWD) 5		
Arecanut	249300	4986-74790 (Mahali)		
Black pepper	48959	5385 (wilt)	19500 (Pollu beetle)	24885
Cardamom	5265	0.53-5212 (Katte)		
Cashew	305000		9700-183000 (Teamosquito + stem borer)	
Tea	752374	89600	44800	134400
Coffee	210000	18000	12000	40000
Rubber	329600	22500	7500	30000

\* Coconut in million nuts

£ For tea, coffee and Rubber losses estimated during 1978

\$ Estimated during 1984

timely prophylactic control measures are seldom practiced by the farmer. Due to the small holding size of coconut, arecanut, black pepper and to certain extent in cardamom, the farmers do not have the resources or incentives to undertake timely plant protection measures. It must be admitted that effective control measures are not available for some of the major diseases and pests such as root (wilt) disease of coconut, yellow leaf disease of arecanut, quick wilt disease of black pepper, 'Katte' disease of cardamom, stem borer of cashew, etc. While timely control measures can prevent most of the crop losses, it is to be emphasized that pathologists, plant breeders, entomologists and extension specialists will have to work in collaboration not only to develop effective integrated control measures but also educate the farmers in the advantages of taking timely plant protection measures.

#### STRATEGIES TO BE ADOPTED TO ACHIEVE THE ANTICIPATED LEVEL OF PRODUCTION

##### Coconut

The annual planting material requirement in the country has been estimated at 15 million coconut seedlings. Against this, the actual annual production is less than one million seedlings from all the hybrids and varieties released so far. Paradoxically the country which developed the first coconut hybrid in the world in the late thirties even now depends for 14 million seedlings

annually from local cultivars with low yield potential. Though the various State Department of Horticulture/Agriculture/Agricultural Universities/Coconut Development Board together have established more than one thousand hectares of seed garden, most of these seed gardens could not reach the targeted production even after several years of establishment. These seed farms are lacking infrastructural facilities and also trained personnel for production of required hybrids. Financial assistance to these farms probably through the Coconut Development Board, and training technical officials in hybridization technique at Central Plantation Crops Research Institute may help to redeem the situation. There is also need to establish more number of seed farms so that in a phased programme of 10 to 15 years, the entire planting material requirement of the country can be made available from elite planting material.

As a short term measure, efforts should be made to identify pre-potent palms with high rate of transmission of parental traits to the progenies. The seednuts are to be procured for these palms probably by Coconut Development Board as a nodal agency to raise the seedlings for distribution

Central Plantation Crops Research Institute in collaboration with Coconut Development Board has already initiated a programme wherein the disease tolerant high yielding palms in the eight disease endemic areas of Kerala have been

identified and the Coconut Development Board is collecting seednuts from these palms and raising seedlings. These two short term measures will go to some extent to meet the seedling requirement till the country is in a position to produce elite hybrids and varieties adequately.

As a long term strategy the breeders and pathologists will have to evolve varieties tolerant to the major pests and diseases specially to the root (wilt) disease of coconut. The two decades of research on coconut tissue culture has not achieved the desirable results though embryo culture technique has been perfected now. The biochemists and tissue culture scientists will have to work in cohesion to develop a protocol to propagate coconut clonally.

### Arecanut

Though the National Commission on Agriculture estimated the requirement of the country's arecanut production at 1,90,000 tonnes by 2000 AD, the country has exceeded in production by 60,000 tonnes during 1991-92. The price of arecanut is still very attractive and fresh arecanut plantations are being established by farmers enthusiastically. The demand for arecanut seedlings in the four released varieties received by this Institute during the current year is about 2 million. While there is a need to discourage indiscriminate area expansion, the possibility of establishing entire plantation with high yielding varieties and simultaneously reducing the area by removing the un-economic plantations are to be contemplated on a systematic basis. Crop substitution with arecanut is being done by the farmers at an alarming rate. Even some of the crops such as oil palm which is being planted with the government subsidy will have to face competition from arecanut for the ideal soil condition in view of the existing price of arecanut. The yellow leaf disease of arecanut is also spreading at an alarming rate and the disease has been mainly responsible for relegating Kerala to third position in production of arecanut next to Karnataka and Assam. The Mahali disease is also causing considerable loss depending on the weather condition. Breeding for tolerance to yellow leaf disease of arecanut and Mahali seems to be the only alternative to check the crop loss. Harvesting of arecanut is also becoming very expensive due to

non-availability of trained climbers. Dwarf genotype has been identified at CPCRI Regional Station, Vittal and effective breeding programme has also been initiated to transfer the dwarf gene to the high yielding released varieties of Mangala, Sumangala, Sreemangala and Mohitnagar.

We have to anticipate that the present remunerative and attractive price of arecanut will be reversed in the near future due to over production. The future of arecanut will depend on designing the arecanut plantation to accommodate most compatible and profitable cropping system. Arecanut-cocoa-pepper or arecanut-clove-pepper are the two profitable crop combinations for the coastal Karnataka and Kerala. Similarly, more remunerative crop combination has also been identified for maidan part of Karnataka. Such crop combinations will be the effective crop insurance against the fluctuation of prices of arecanut and component crops.

### Black pepper

It is estimated that out of about 0.173 million hectares of black pepper, 1/3 of the area need to be replanted as the vines have become senile and unproductive. The replanting programme will have to be taken in a phased manner for a duration of about next 10 years. If this policy is accepted, the total planting material requirement for the entire replanting period will be about 125 million rooted cuttings or the annual requirement of the planting material will be about 12 to 13 million rooted cuttings.

The Pepper Research Station, Panniyur under the Kerala Agricultural University and the National Research Centre for Spices have released so far eight high yielding varieties. As a policy matter it must be our endeavour to supply the required planting material only in these high yielding varieties. The rapid multiplication technique originally developed in Sri Lanka and subsequently modified at the then CPCRI Regional Station, Calicut has been found to be the most economical method of multiplication in the absence of micro propagation technique. The two Research Centres mentioned above give attention only to generate the nucleus planting material in these released varieties. The State Department of Agriculture/Horticulture will have to establish

rapid multiplication nursery by utilizing nucleus material supplied by the research centres. The target for **each of the rapid** multiplication nursery will have to be fixed. If these programmes are implemented, it is to be expected that the pepper growing states will become self-sufficient in the requirement of planting material in released varieties early.

As indicated earlier, the wilt diseases of **pepper** causes considerable crop loss every year and the intensity and spread of the disease depends on the weather factors. The scientists working at the National Research Centre for Spices have accumulated a wealth of basic information on the epidemiology, etiology and mode of spread of the disease. Prophylactic control measures have **been evolved including use of systemic fungicide.** In view of the health hazards, use of **Bordeaux mixture** seems to be the only acceptable control measure available at present. This points out to the need for identifying newer non-systemic **fungicides** which can be used by pepper farmers with **least risk.** A permanent solution to this debilitating disease, no doubt, is only developing disease tolerant varieties. The screening work carried out at Calicut for the last one decade has helped to identify only one nematode tolerant pepper variety. While many genotypes have been identified showing varying degrees of tolerance and in various stages of evaluation, further hybridisation and selection are required before identifying a disease tolerant high yielding variety. The work in this direction needs to be intensified.

Kerala State accounts for more than 90 per cent of the area and production of pepper and majority of the pepper holdings are less than **2 hectares.** Pepper being a component crop of the **homestead** garden in Kerala, the available input **technologies** developed for the monocrop **is not fully suitable** for the homestead conditions. **The scientists** working on black pepper will have to give their attention in developing input **technologies** suitable for the homestead gardens so that the pepper vine is treated as a component of the whole backyard cropping system.

Pepper is a highly heterogeneous and **polyploid species** and as such is an ideal breeding material for exploitation of the inherent genetic variability. While the breeders can continue to

exploit the rich variability available in the **germplasm** collection, it is also necessary to develop protocol for tissue culture technique to **exploit the somaclonal** variation. **in vitro** screening for tolerance and also micropropagation. I am happy to note that work in this direction has already been initiated at the National Research Centre for Spices, Calicut. It is to be hoped that fruitful results will emerge from these programmes in the near future.

## Cardamom

In the 70's India was in the first position (70%) in international market for cardamom. However in recent years, this position has rapidly changed with Guatemala pushing India to second position in terms of export. The export of cardamom from the country has drastically declined during the last few years and spices in general have registered declining export from 1,20,170 metric tonnes in 89-90 to 97,200 metric tonnes in 1991. It is estimated that cardamom production is likely to be 20 to 25 per cent lower in 1991 compared to the previous year and the reasons attributed are adverse climatic conditions in the high ranges, indiscriminate deforestation in cardamom plantations, increasing production cost and crop loss due to pests and diseases.

The effective economic life of cardamom plantation is 10 to 15 years. Most of the existing plantations are of more than 15 years and **re-planting is being seldom practised by the planters.** Declining trend in production resulting from drought and other adverse ecological conditions enumerated earlier has contributed to low production as well as productivity. Scientists will have to bestow their attention on priority basis to develop drought tolerant cardamom varieties which will give economic yield even under adverse climatic conditions. 'Katte' disease continues to be a major bottleneck in increasing the production of cardamom. 'Katte' management methods developed by the research institute are though effective, not economical. Katte tolerant varieties need to be evolved early to overcome this problem.

The tissue culture technique standardised at the Central Plantation Crops Research Institute has been commercialised and few private entrepreneurs have started supplying the tissue cultured

seedlings indiscriminately. Authentic research results on the comparative performance of seedling progenies, clonal progenies and tissue cultured seedlings are still wanting. The scientists involved in this programme and planters in their over-enthusiasm have started large scale multiplication and distribution of tissue cultured seedlings with the expectation that these seedlings are likely to perform better. In the absence of any reliable results on the performance of tissue cultured seedlings, this approach may become disastrous if not exercised with caution.

## Cashew

Efforts on the establishment of cashew plantations with clonal material were initiated in the early eighties at various research institutes. Even now many plantations are being established with seedling progenies. However, we are happy to note that the trend has changed rapidly due to the soft wood grafting technique standardised at the National Research Centre for Cashew, Puttur, and the Horticultural Research Station, Vengurla. Based on the progress in vegetative propagation, the last workshop on All India Co-ordinated Cashew Improvement Project has come out with its recommendation to establish new cashew plantations only with soft-wood grafts. While the annual planting material requirement of cashew is estimated as two million grafts, even now 50% of the target has been achieved and a major portion of this are produced by the Konkani Krishi Vidyapeeth, Vengurla and a private nursery man in Goa. National Research Centre for Cashew not only produces about 50,000 soft-wood grafts annually but also supplies clonal material for establishment of scion orchards. In addition, the research centre is also giving training to farmers, fieldworkers and extension officials on soft-wood grafting technique.

The tea mosquito of cashew continues to be a major pest causing about 30 to 40 per cent of the crop loss in the case of severe infestation and control measures will have to be taken for managing tea mosquito. The stem borer, another problem for cashew farmers also is affecting about 2 to 10 per cent of trees annually. An effective chemical/biological control measure needs to be developed to control this pest. Simultaneously efforts are also to be taken to evolve varieties

tolerant to tea mosquito and stem borer

The experiments conducted at National Research Centre has clearly shown that a minimum pruning involving removal of dry branches and water shoots at the right time can increase the yield by 20 per cent. The farmers need to be trained in selective pruning and demonstration plots are to be established to show the advantages of selective pruning,

Cashew was originally introduced to India in the sixteenth century to conserve soil in the coastal areas. Even now cashew is being relegated to poor and marginal soils unsuitable for any other crop. There needs to be a drastic change in our outlook and cashew is to be considered as a horticultural crop to be cultivated in fertile soils with all available input technologies in case we are to meet the production target. Water requirement of the crop also needs to be experimented and in case the productivity of cashew could be increased substantially under irrigation, the estimated production target could be achieved and area under cashew could be brought down simultaneously.

## Tea

India is the largest producer, consumer and exporter of tea and produced about 752 million kg of tea during 1991. The present productivity of 1762 kg/ha shows that during the last 25 years the tea productivity has increased substantially to the extent of 40 per cent in Southern India and 25 per cent in North-eastern region. Thus sustained increase in the productivity has been achieved in new clonal plantations and also old seedling plantations. Further increase in productivity is required to offset the increased cost of production so that India can continue to be the largest exporter of tea and compete well in the international market. The recent research results at the Tea Research Institute at Tocklai and Valparai have indicated that higher plant population per ha and newer technique of bringing young tea into bearing have been useful in enhancing the productivity. Rejuvenation pruning, consolidation of the existing plants by infilling, improvements in pruning, tipping and plucking practices, balanced manuring, application of growth promoters and formulation and application of chemical strate-

gies for control of pests and diseases are some of the factors which may help in enhancing the productivity of tea plantations.

## Coffee

The target production of 0.2 million tonnes indicated by the National Commission on Agriculture has already been achieved is coffee. **In spite** of this, considerable crop loss is occurring year after year due to outbreaks of major diseases and pests. Letting in coffee continues to be one of the major production constraints. Efforts to evolve letting tolerant varieties have not been **commercially** successful so far. In view of the tissue culture technique being developed at the Central Coffee Research Institute, the scientists will have now to **turn** for *in vitro* screening so **that in the near future** somatic culturing and clonal propagation can be effectively utilised.

Just like in tea, the cost of production in coffee also continues to rise and it is one of the highest in the world at present. The immediate **objective** must be to reduce the area in coffee but **simultaneously** increase the production. Increasing the population per ha than in the conventional planting, combined with evolving dwarf types are likely to be the answer to this problem. Breeding work **carried** out at the Central Coffee Research Institute has indicated that dwarf types can be developed by proper recombinants utilising San Ramon genotypes

**Cultivation of coffee in lower elevation (500-1000 mts) has not become popular due to the fact** that varieties suitable for lower elevation are not available at present. This has to receive the priority from the breeders working on coffee. Some of **the** indigenous coffee species *viz.*, *Coffea arabica* and *Coffea canephora* are reported to have low **caffeine** content. It would be worthwhile to utilise **these** indigenous species to evolve an improved **coffee variety** with low caffeine content and at the same time retaining the flavour and aroma of **coffee**.

## Rubber

Compared to about 300-400 kg rubber obtained in the early part of the century (immediately after **rubber cultivation** became **commercially accepted**), at **present** varieties are available with an average production of about 4000 kg per ha under good management. Moreover, some of the recent releases like RRIM-703 and RRIM-803 have a potential yield of **upto 7000 kg** per ha. On the other hand, the breeders in Malaysia have predicted about 10,000 kg per ha within the next one decade. Our objective must be to achieve this productivity since already we have obtained a very high productivity compared to many other rubber producing countries. Proper selection of the available parental materials and inter varietal hybridisation followed by selection are likely to yield success.

**Some of the other programmes** which need immediate attention are to evolve an early maturing variety by utilising related genera either through **conventional hybridisation programme** or through somatic hybridisation. From the traditional lower elevation of South India rubber cultivation is spreading fast to the higher elevation of North-eastern region. However, varieties suitable for this non-traditional area are not available at present and this will have to receive the attention by **the scientists** working at the Rubber Research Institute immediately.

RRIM 605 is reported to have a dwarfing gene. Can we utilise this as a starting material to evolve a dwarf improved variety in rubber? Few years back, a discussion centered round in evolving rubber with coloured latex. If this can **become** a reality, rubber based byproducts will become **comparatively** cheaper. Leaf fall in rubber continues to be the **major production** constraint in spite of the fact **that eight high** yielding varieties and many RRIM series of high productivity have been released. None of them are tolerant to the *Phytophthora* disease. Efforts are to be directed to evolve varieties tolerant to this fungus.