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1. INTRODUCTION

Darjeeling district is the only place in India where large Cardamom (*Ammomum subulatum* Roxb.) is grown. It is also cultivated in the adjoining regions of Sikkim and Nepal to some extent. Being very restricted in its distribution, correct "figures of production of and trade in *Ammomum subulatum* are not available". Out of the three principal commercial crops of Darjeeling district, e. g., tea, orange and cardamom, large cardamom plays a very important part in the economy of the cultivators as this is primarily a small holder's crop. Large cardamom occupies about 1620 hectares with an average annual production of 4.44 thousand quintals of dry cardamom bringing a return of about Rs. 33.3 lakhs per annum. It is grown in 8 out of the 10 community development blocks of this district, Bijanbari block having the maximum area of about 554.7 hectares followed by Sukhiapokhri block having 368.4 hectares. Area under the individual plantations varies from 0.21 to 0.81 hectares with the exception of a few plantations of 1.2 to 2.9 hectares. The price per quintal of dry cardamom varies from Rs. 650 to Rs. 850. Local consumption being negligible, the large cardamom is exported out of the district mainly through whole-sellers who advance money to the growers and book their produce. Although correct figures are not available, it is estimated that an annual import of about 5200 quintals of dry cardamom is effected from

LARGE CARDAMOM CULTIVATION IN DARJEELING DISTRICT OF WEST BENGAL

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Sikkim. The price of Sikkimese cardamom is Rs. 35 to Rs. 50 per quintal more than that of Darjeeling cardamom.¹

2. DESCRIPTION OF THE PLANT

Large Cardamom (*Ammomum subulatum* Roxb.) belongs to the family *Zingiberaceae* to which the true cardamom (*Elettaria cardamom* Maton.), ginger and turmeric belong. It is commonly called as Greater Cardamom, *Bara elachi* or *Perivavelam* while the true cardamom is commonly known as *Chhota elachi* or *Velam*. Large cardamom is a perennial plant and propagates both from the seeds as well as from the rhizomes. Left uncared for, it thrives well for over 25 years and grows upto 5 to 8 metre in height. The long lanceolate leaves are borne on aerial shoots and the flowers are borne on long flexuous and prostrate panicles at the base. The aerial shoots die off after the fruits are mature but fresh leafy shoots and subsequently flower-bearing

shoots arise from the underground rhizomes at the base of the old ones. The flower-bearing shoots arise from the base near the ground level and flowers are borne on short peduncles alternately on the axis. The flowers have large white central strap-like lip and opens from the base of the axis towards the tip. The fruit is more or less triangular in shape broad towards the base, green in colour when unripe and purple to brown when ripe. Each capsule contains 40 to 50 hard, round, greenish-black to dark brown seeds embedded in soft slimy and jelly-like pulp which is sweet to taste. The spicy aromatic seeds contain a volatile oil known as cineole.

3. CLIMATIC & SOIL REQUIREMENTS

Large Cardamom is a native of Eastern Himalayan region where it is found in wild state by the side of springs and rivulets in the forests. It has been localised in a restricted area in Darjeeling district

¹ Handbook of Commercial Information. Pub. by Deptt. of Commer. Intelligence & Statistics, Govt. of India. P. 84, 1965.

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and in East Sikkim Nepal. It grows well between 830 to 1830 metres above sea-level in shady and damp places under evergreen forest canopy where enough of organic matters are naturally deposited due to the falling of leaves of the trees and light is available in a restricted way through the canopy. The crop thrives well in places having an annual rainfall of 200 cm. to 250 cm., maximum temperature of 14°C to 33°C and minimum temperature of 6°C to 22°C. Frost is injurious to the crop as is the hail storm which cause irreparable damage to the growing leaves. Although the plant loves damp places but water-logged area are not suitable for its growth. Light well-drained soil having a gradual slope by the side of perennial springs where there is enough moisture but water flows down constantly without any patch of water-logged area is ideal for the cultivation of large cardamom.

4. VARIETIES:

There is no distinct classification of the varieties. The local varieties, named as Ramsai, Baghe Ramsai, White Ramsai, O-Khray, Kopringay etc. are all mixed varieties and are identified according to the colour and size of the fruits. It is rather difficult to classify the varieties from the morphological characters of the plants alone. As such, attempts are being made to classify them from morphological, anatomical and Physiological points of view. The work so far done indicates that there may not be more than 3 to 4 distinct types available.

2. PROPAGATION:

Large cardamom is generally propagated from the rhizomes like banana. More commonly, a planta-

tion is kept for 20 to 25 years without any replacement. When the aerial shoot dies in December-January after fruits are mature, the soil is lightly cultivated by means of forks and spades and the rhizomes are covered with soil. Fresh shoots appear during the rainy season in May-June. As all the plants do not mature at the same time, the plantation remains productive throughout its existence of 20 to 25 years but the vigour of the crop is gradually decreased and yield is reduced considerably. This also calls for pests and diseases and serious virus diseases like "Foorkey" and "Chirkey".

(a) *Planting from rhizomes:* Planting of rhizomes, which method is gradually losing popularity due to apprehension of diseases, is done with a view to avoid the labour and expenditure to raise seedlings and to get production about 2 years earlier than that from the seedlings. Rhizome pieces, collected from healthy and good yielding plants, are planted in holes 12 to 15 cm. deep and 15 cm. in diameter at a distance of 2 metre both ways. Holes are dug and are filled with fine soil, woodash, compost or well-rotten leaves and sand or powdered gravels along with a pinch of B. H. C. 50% powder, Captan and lime. The rhizome pieces are put in the holes, one piece in each, in such a way that the top portion is just at the ground level. The holes are covered with a fine layer of soil over which a layer of leaves and straws are put to serve as a mulch. The holes are arranged in a horizontal manner to form a contour and serve as bench-terracing for soil conservation purpose. Proper planting time is May-June at the onset of the monsoon rains. The growers at large, however, do not allow so much spacing as a result

of which the plantation becomes so crowded that no inter-cultural operations become possible.

(b) *Planting from seeds:* When seedlings are planted, care has to be taken to select the seeds from healthy and disease-free plants. For this purpose, a large number of healthy and disease-free plants are selected in the month of September from large good plantations. The plantations are revisited at the time of harvesting in November-December and yield of those selected individual plants are taken.

Seeds from those selected plants which give high yield are finally chosen to serve as seeds. The green fruits are brought to the nursery, dried for 7 to 10 days in open sun, the seeds are removed from the capsules and washed clean free of any mucilaginous substance and planted in the nursery beds. It has been observed that over-drying of the capsules or presence of any mucilaginous coating on the seeds hamper germination considerably. Pitting of seed coat, scarification by means of Sulphuric or Nitric acid or by rubbing on rough surface, have been found to have no effect on improvement of seed germination. Attempts are being made to treat the seeds with different chemicals to improve their germination. It appears that presence of the volatile oil cineole and some alkaloid in the slimy substance may have some blastocholine activity to cause retardation in germination. Attempts are being made to isolate and identify the alkaloids, if any.

On an average, it has been observed that out of the total seeds sown in a seed bed, germination does not exceed 45% as shown below:

Within	2	months	...	7.5%
"	3	"	...	1.5%
"	4	"	...	1.0%
"	5	"	...	1.5%
"	6	"	...	1.5%
"	7	"	...	1.0%
"	8	"	...	1.5%
"	9	"	...	2.5%
"	10	"	...	5.0%
"	11	"	...	12.0%
"	12	"	...	10.0%
			Total	<u>45.0%</u>

Although, in the laboratory, germination continued till 18 months after putting the seeds to germination test it is not so in seed beds due to fungal attack. It is also uneconomic to keep the seed bed for such a long time with an expectation of a few more plants to come up.

(i) PRIMARY NURSERY

Two nurseries are required for raising seedlings of large cardamom, i. e. the primary nursery for sowing the seeds and raising one-year old seedlings and the secondary nursery for care of the seedlings from one-year to two-year stage. The primary nursery is prepared in a clean place where a few trees are there to provide a little shade. It is better to avoid the slope facing south to protect the seedlings from strong wind and direct sunshine. Each nursery should not be longer than 3.5 metre, and broader than 1.5 metre. It should have a shade of straw at a height of 2 metre from the beds. The shade should be slightly slopy so that the rain-water may be drained off and cannot drop on the seed-bed. The nursery should be protected from stray animals by putting a fencing all around with bamboo poles. A few twigs may also be placed against

the fencing so that strong wind or direct sun-rays are prevented while allowing adequate ventilation. The nursery-bed should be prepared by ploughing the soil at least 10 to 15 cm. deep, incorporating enough of compost, well-rotten cowdung and leaf manure and a little wood-ash and raising the beds 10 cm. above ground level. Lime at 5 Kg. per bed (3.5 x 1.5 metre) may also be incorporated at least 3 months prior to sowing of seeds. Before sowing of seeds, B. H. C. 50% powder and Captan may be dusted on the beds. Aldrex may also be dusted where white ant is present. There should be a small path between the beds for supervision and irrigation.

(ii) SOWING:

Seeds are sown at the rate of 600 seeds per bed. Well-formed mature seeds are sown in lines 9 cm. apart just below the soil (seed bed) level and covered with a fine layer of dry soil over which a 3 cm. thick layer of dry straw or leaves cut into small pieces, should be scattered to form a mulch. Light irrigation by means of rose-cans is given daily, if necessary in the morning and in the evening, to keep the seed bed moist but not damp. Too much water should always be avoided. During the dry season, the straw of the nursery shade should also be sprinkled with water to keep the nursery humid. The seeds begin to germinate from the 2nd month after sowing and continues to do so till about 10 to 12 months. Thus, great care should be taken in the nursery stage to keep the seed beds moist and clean and weeding should be done without disturbing the seedlings. Sometimes, algal growth develops, particularly at the later period. Light scratching by means of a stick removes the scum.

(iii) SECONDARY NURSERY AND CARE OF SEEDLINGS

As the seeds, sown at the same time, germinate at different periods, the age of different seedlings that appear in the primary seed bed is not the same. It has been observed that only 5 to 10 percent of the seeds sown germinate within 2 months and 20 to 25 percent after 10 months. Thus, a seed that germinates within 2 months, i.e., July, attains an age of 1 year in next July but that which germinates after 10 months, i.e., in March next year, becomes only 4 months old at that time. Hence, during replantation of the 1 year seedlings in the Secondary nursery bed, care has to be taken to take out only those seedlings that are 1 year old, keeping the younger seedlings undisturbed. The 1 year old seedlings are carefully taken out of seed bed by digging up the soil and are replanted in the Secondary nursery bed which is made in a separate place just like the primary nursery bed excepting that there is no shade on top and the distance between individual seedlings both ways is kept at 0.5 metre. Where rainfall is heavy, a temporary shed is provided for this secondary nursery also. Holes 15 cm. deep and 15 cm. in diameter are dug at 0.5 metre distance both ways and filled up with a mixture of dry soil, sand or powdered gravel, compost, cowdung or dried well-rotten leaves, wood-ash and a pinch of B. H. C. 50% powder and Captan. The seedlings are planted in these holes so that the roots and the root-stalk are just completely covered with soil but do not go deep into it. The base of each seedling is covered with a thick mulch of dry leaves. As this transplanting is done during the rainy season, there is no need of any irrigation but

during dry periods, frequent irrigation has to be provided to keep the soil moist. It is necessary to spray Blitox at 15 days interval during the rainy season and at 30 days interval during the winter season in the secondary nursery to protect the tender seedlings from disease. Dusting of B. H. C. 50% powder has also to be done occasionally as a protection against insect attack. Drenching of the soil by Captan at least once at the onset of dry period is also recommended.

(iv) PLANTING OF SEEDLINGS IN FIELD

The 2 year old seedlings, i. e., seedlings that have spent a year in the secondary nursery bed, are fit for transplantation in the field. The soil where final transplantation will be done has to be worked out at least 3 months prior to transplantation. Holes, 22 cm. deep and 30 cm. in diameter are dug at a distance of 2 metre both ways horizontally to form a contour to make a sort of bench terracing. The seedlings are carefully dug out of the secondary nursery bed and transplanted in the field in a similar manner as in the case of their transplantation in the secondary nursery bed. As the transplantation is always done during the rainy season, no irrigation is required. It is to be seen that the shade trees do not provide much shade to make the plantation dark. In such a case, the shade-trees are lopped off so that sun-rays may be permitted to come through the canopy of the trees which serves as a filter screen.

6. CULTURAL OPERATIONS

The plants get established in the field within a month and vigorous growth starts. From the third year, flowers are produced but

it requires 5 years to attain the stage of full production potential. During this period, control of shade by lopping the shade-trees as and when required, inter-cultural operations to prevent crust-formation on the soil due to constant deposition of leaves and their decomposition, making of ridges to support the plants and cover the rhizomes are all what are needed to be done. Occasional spraying of Blitox and dusting of B. H. C. 50%, application of compost or cowdung every year before the onset of the monsoons are necessary to keep the plants healthy. It has been observed that application of 30 Kg. nitrogen along with 30 tons of cowdung or compost per hectare every year increases the yield of large cardamom by 0.5 quintals. Wood-ash has also been found to be effective. One hectare contains about 3030 plants. Thus, the dose of nitrogen per plant comes to about 10 gm. nitrogen and 10 Kg. of cowdung or compost. 25 gm. of Superphosphate per plant is also needful. In most plantations, however, fertilisers are not applied at all as the soil is very rich in organic manures.

7. REPLANTATION

The large cardamom crop starts bearing from the 3rd year after final transplantation in the field and continues to do so till 25 to 30 years, but the optimum production period is from the 5th year till the 10th year after which the yield decreases. Thus, replantation has to be done after the 9th year by gradual steps as it is difficult and uneconomic to destroy the entire plantation at a time, replant the same and wait for 3 to 5 years to have the new produce. However, destruction of the entire plantation and re-plantation has to be done in case of any indication of "Foorkey" infection. While keeping the plant-

ation undisturbed, planting of new rhizomes in place of diseased plants only was in vogue some 6 to 8 years back but this method is not followed now due to the awareness of the growers of the "Foorkey" disease. Replanting in place of otherwise damaged plants due to landslide, destruction by animals or white ants, is however, done. The growers in general, however, do not follow regular spacing nor take much care of their plantation in respect of manuring and inter-cultural operations as a result of which they do not get the maximum benefit out of their plantations.

8. HARVESTING, YIELD AND MARKETING

Harvesting starts from September and continues till December-January. Ripe, purple to brown coloured capsules are picked out once in a month. The fruits are dried in open threshing floor or on bamboo platforms in the sun for 7 to 10 days and sold in the markets or to the whole-sellers. For keeping seeds for raising seedlings, the seeds are taken out of the capsules, washed thoroughly and dried in shade or directly planted in the nursery beds. The capsules, dried for 7 to 10 days in sun, turn deep purple and contains enough of moisture. These green cardamoms, as they are commercially called, fetch much lower price as they contain about 50 percent water and are to be dried again for export or for storage otherwise fungal growth makes these unfit for consumption within a month or so. Many growers dry the green cardamom artificially. 3 to 6 platforms made of bamboo-strip are placed one above the other keeping a space of 15 cm. between the platforms, the bottom platform being at a height of 1 metre from the ground level

and a tin shed is provided above the top one. Green cardamoms are spread on these platforms very loosely 2 to 3 layers thick. 2 to 3 small ovens are made on the ground where slightly damp wood along with saw-dust and green leaves and twigs are lighted so that instead of direct fire, heated smoke is liberated and passes up through the bamboo platforms. The positions of the bamboo platforms with the cardamom capsules are inter-changed i. e., the top one is brought to the bottom and vice versa, every day so that all the cardamoms on different platforms are uniformly dried. This heat treatment is continued for 5 to 6 days when the colour of the capsules turn black or deep brown. This dried cardamom contains 15 to 20 percent water and is sold at a much higher price. The yield of green cardamom varies from 2 to 6 quintals and that of dry cardamom from 1 to 4 quintals per hectare. Any yield as high as 10 quintals of green cardamom per hectare may easily be obtained by using scientific methods of cultivation.

9. COST OF CULTIVATION AND PROFIT

It has been observed that large cardamom responds to inter-cultural operations and manuring. The yield, which accounts for the ultimate profit, is directly proportional to the investment made (vide Fig. 1)

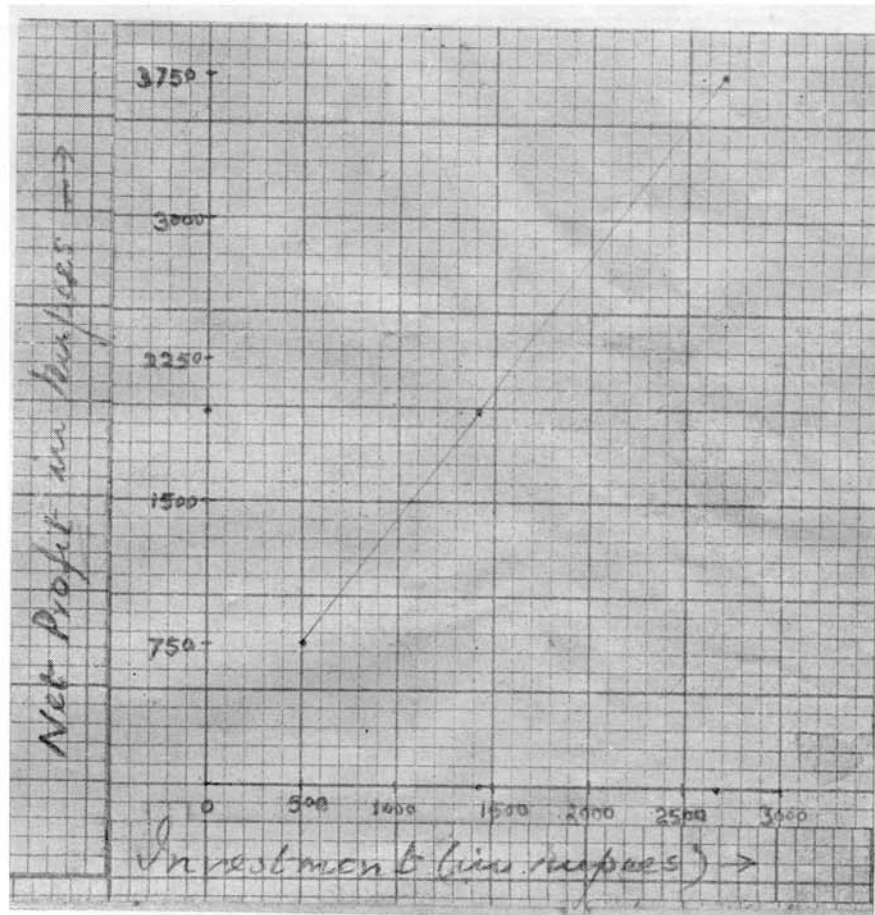


Fig. 1. Showing annual net profit from 1 hectare of large Cardamom Cultivation in respect of investment per year per hectare

in terms of clean cultivation, application of manure and fertilisers and adoption of plant protection measures. The cost of cultivation varies widely from Rs. 500/- to Rs. 2685/- per hectare per annum according to the financial resources of the grower and their scientific approach. It has been calculated that a grower who spends Rs. 500/- per hectare per annum gets a profit

of Rs. 750/- whereas one who spends Rs. 2685/- gets a profit of Rs. 3750/- per hectare per annum. Thus, the ratio of net profit to investment remains almost constant at about 1.4.

A detailed estimated cost of cultivation and expected profit from one hectare of large cardamom plantation is given below:—

	No. of labourers required.	Rate per Labour (Rs.)	Total (Rs.)
A. NON-RECURRING			
1) Clearing of land	40	2.00	80.00
2) Construction of 20 primary nurseries:			
a) Labourers	20	2.00	40.00

giving a net profit of Rs. 23708 (Rs. 37500 — Rs. 13792) i. e., Rs. 1975'66 or say Rs. 1975 per year.

10. USE

Large cardamom seeds is much in demand not only for masticatory use but also for medicinal purposes. The highly aromatic properties makes it an essential flavouring agent for sweet dishes, cakes and pastries. It is highly valued for chewing and as an agent for making betel leaves delicious for chewing. In Ayurvedic and Unani medicines it is used as a preventive and curative for throat troubles, congestion of lungs, inflammation of eye-lids, digestive disorders and even in treatment of pulmonary tuberculosis.

11. PESTS & DISEASES

Large cardamom has no major pest problem. Thrips and hairy caterpillars cause some damage to the young crop, but dusting of B. H. C. 50% powder at an interval of 15 days during the rainy season and once a month during the dry period is quite effective in controlling them. White ants sometimes cause damage particularly in the nursery stage which can be controlled by Aldrex.

Of the diseases, the virus disease "Foorkey" is the most important one. It caused havoc and cardamom plantations were on the point of total extinction some 10 to 15 years back. The disease appears as drying of the tips of the leaves which sometimes is mistaken for water-logging effect. Within a fortnight to a month, the entire plantation looks like a burnt field. There is no effective control measure that can be adopted against this disease excepting to uproot the plantation, burning out the plants, keeping the field

	No. of labourers required.	Rate per Labour (Rs.)	Total (Rs.)
b) Cost of materials	—	—	1,600 00
3) Making 3030 holes in the field and 1010 holes in the Secondary nursery	101	2 00	202 00
4) Cost of seeds (150 Kg. green cardamom capsules)	—	—	300 00
5) Sowing of seeds, transplantation in second nursery and maintenance of seed beds for first 2 years @ 4 labourers per day for 730 days	2920	2 00	5,840 00
6) Transplanting in field in the 3rd year	40	2 00	80 00
Total			8,142 00

B. RECURRING

1) Fertilisers, manures, plant protection materials and intercultural operations:			
a) Labourers	60	2 00	120 00
b) Cost of materials	—	—	200 00
2) Harvesting @ 50 labourers once a month for 5 months per year, i. e. $50 \times 5 = 250$	250	2 00	500 00
3) Drying, cleaning etc:			
a) Labourers	10	2 00	20 00
b) Cost of materials	—	—	20 00
4) Miscellaneous and unforeseen expenditure	—	—	50 00
Total			910 00

Taking an average of 10 years fruitful production life of a plantation, the total recurring expenditure comes to Rs, $910 \times 10 =$ Rs. 9100 00

Thus, for 12 years, the total expenditure per hectare comes to Rs. $8142 +$ Rs. 9100 = Rs. 17242 or say Rs. 17240., which is Rs. 1436. 66 or say Rs. 1437 per annum.

Taking an average yield of 5 quintals of dry cardamom per hectare for 10 years comes to 50 quintals. The average price of Rs. 750/- per quintal makes the total income at Rs. 37500/-.

Thus, a net profit of Rs. 20260 (Rs. 37500/- Rs. 17240) may be obtained from 1 hectare over a period of 12 years, i. e. Rs. 1688. 33 or say Rs. 1700 per year on an average. As large cardamom is a small-holder's crop, the expenditure side may easily be curtailed by 20 percent as most of the work is done by house-hold members. Hence, the expenditure comes down to Rs. 13792, thus

fallow for a year and then re-planting with healthy, disease-free seedlings. Another virus disease called "Chirkay" makes the affected plants stunted in growth and no fruit is obtained from such plants. This disease, however, is not so virulent as the former one. Up-rooting of the affected plants and burning them out is the only measure that can be adopted against this disease. A disease of minor importance, also caused by virus, is called leaf-streak disease. This, however, is not at all serious at present. Not much of fungus diseases are encountered within large cardamom. Leaf blight and clump rot, caused by *Alternaria* sp. and *Pythium* sp., are found to occur in small patches particularly in very damp places or after a period of continuous heavy rainfall for several days. Spraying Blitox at regular intervals and liming check the spread of these diseases.

12. STEPS TAKEN BY THE STATE GOVERNMENT FOR IMPROVEMENT OF THE CROP

Being a monopoly cash crop of West Bengal on which the economy of the cultivators of the hill regions of Darjeeling district depends to a great extent, large cardamom has received attention of the State Department of Agriculture more than a decade ago. At a time when it was apprehended that this crop might go out of cultivation due to virulence of the "Foorkey" disease, a scheme was initiated, by the Government to find out the cause and remedy for this dreadful disease. The scheme functioned at the District Seed Farm at Kalimpong from 1953 till 1962. After a detailed investigation, both in the laboratory as well as in the field, it

concluded that the disease was caused by a virus which was transmitted by a small aphid called *Pentalonia nigronervosa* Coq. commonly known as the dark banana aphid that is also responsible for the bunchy top disease in banana. This aphid was first identified by the French Entomologist Coquerel in 1859 and has been recorded subsequently by various workers in Australia, Bermuda, Brazil, Egypt, England, Fiji, Formosa, Hawaii, India, Jamaica, Philippines, Trinidad, the U. S. A. etc. As in most virus diseases, no remedial measure could be found out and it was recommended that the one and the only one effective measure to control this disease was to eradicate the plants, burn them out and replant with healthy, disease-free seedlings.

As an outcome of the results of this scheme, a new scheme was started in 1962 to multiply and distribute healthy, disease-free seedlings of large cardamom to the cultivators at a subsidised rate of 1 paisa per seedling. Seeds from healthy disease-free plants are selected, seedlings are raised under strict technical supervision of one Research Assistant with his Field Staff at the District Seed Farm at Kalimpong and healthy, disease-free seedlings are distributed to the cultivators. So far, more than 50,000 such seedlings have been distributed and demands from the cultivators are gradually increasing as they are convinced now of the utility of growing their crops through healthy disease-free seedlings. This project has again stabilised the situation and with the establishment of a separate Cardamom Farm, the supply position will be much improved. In addition to this, preliminary studies have been undertaken to classi-

fy the different varieties of large cardamom through an intergrated approach from morphological, anatomical and physiological points of view, effects of storage conditions and of different chemicals for improving the germination of seeds, clonal selection work for improvement of the crop and various agronomic studies on manuring, application of fertilisers, spacing, plant protection measures etc., are being undertaken to recommend a proper scientific package of practices to the cardamom growers of Darjeeling District.

13. FUTURE OF THE CROP

Large cardamom has been, so to say, a neglected crop and did not get such attention as it should have. The reason for this might have been its very restricted area. Its localised cultivation should, in all fairness, have attracted more attention to this crop, more so, when this crop can grow well in places where other crops cannot grow. The area may easily be increased if proper trials are undertaken in similar areas throughout the country. In Darjeeling district alone, the area may be increased at least five times as there is about 3.15 lakh acres under forest and 1.05 lakh acres under tea gardens. Large cardamom can grow under the forest and in the waste land in the tea gardens without affecting those. It checks soil erosion as it covers the soil so perfectly.

14. CONCLUSION

Large cardamom cannot replace small cardamom as it has different qualities and requirements for agro-climatic conditions. As such, large cardamom deserves proper attention not only to save this important cash crop from gradual extinction

but also to increase its area and production along with the improvement of the crop and finding out avenues for its more export and multi-purpose uses. The cardamom growers need encouragement to form cooperatives in order to get rid of the perpetual bondage

they suffer in the hands of the wholesalers who advance them money in lieu of their entire produce. It is of utmost necessity to assure the cardamom growers of economic returns from their produce so that they may be able to invest more money and take up scientific

cultivation. As research is the basic need for improvement of any crop, it is also necessary to set up a full-fledged research-cum-multiplication Farm for large cardamom in Darjeeling district so that local problems may be solved on the spot.

