The Madras Agricultural Journal

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CONTENTS.

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Editorial

A meeting of research workers was convened on May 7th at Coimbatore by the Hon'ble Minister for Agriculture, Shri. A. B. Shetty, with the primary object of devising ways and means of effecting greater co-ordination among agricultural scientists and thereby secure a better output of useful results. It was recognised that research workers were now saddled with so much administrative and accounts work that senior workers could not devote sufficient time and attention to research work themselves.

Not even the most fervid of our patriots can claim that India is anywhere near the advanced countries of the West, like England, America or pre-war Germany, either in the output or quality of research. We are of course familiar with all the usual reasons that are adduced as responsible for this disparity, such as domination by foreign rule, the much earlier start the Westerners have had in such materialistic matters and the inevitable self-patting on the back that once upon a time we had a most wonderful civilization, but all these miss the mark, because the plain fact is that the research worker in India is seldom able to throw himself heart and soul into his work, on account of the administrative and accounts work that is put upon him. It often happens that by the time a research worker gets sufficient knowledge and experience to take up some work on his own initiative, he gets also burdened with so much of administrative duties that most of his time is taken up by them, to the detriment of real work.

In this context it may also be remarked that a striking contrast between research institutions in the West and those in our country is the small number of clerks and accountants there and their abundance here. Possibly this too, is a legacy from the bad old British days, but judging from the vehemence of the opposition that arises against any attempt towards relieving research officers of administrative burdens, it is open to doubt if we as a nation have not got into a feeling that administrative control over fellow workers is far more to be coveted than scientific eminence or technical skill.

It may perhaps be some consolation to that India is not unique in this respect. Lawrence Balls, writing about his own work on cotton in Egypt had occasion to remark: "Looking back over these twenty years one cannot but feel regret that more was not done with the many results obtained. Lack of concentrated and prolonged attention was due in part to the overweighting of the technical sections with accessory staff, which in turn involved distracting administrative responsibilities for the senior scientific officials. conducted within the limitations of rigid government regulations. Promotion for good work was hard to obtain and the scientific worker devoted to his subject was too fully occupied to have the time for acquiring the necessary influence. The acquisition of status and power over fellow-officials was too often valued far above scientific reputation or experimental ability and in this respect the Scientific Committee Reports give internal evidence concerning the value of a few non-Egyptian colleagues, who provided a stiffening frame of professional scientists as distinct from professional officials.

GEMS FROM STUDENT BRAINS

Animal Nutrition : A maintenance ration is one upon which the animal will be in a carbon and nitrogen ratio.

Plant Chemistry : Tannins are found in milk and plants.

Tannins are hormones found in plants.

Waxes are hydrocarbons and are known as mineral oils.

Soils : In soil, cat-ions are exchanged by more cats and anions by more ans.

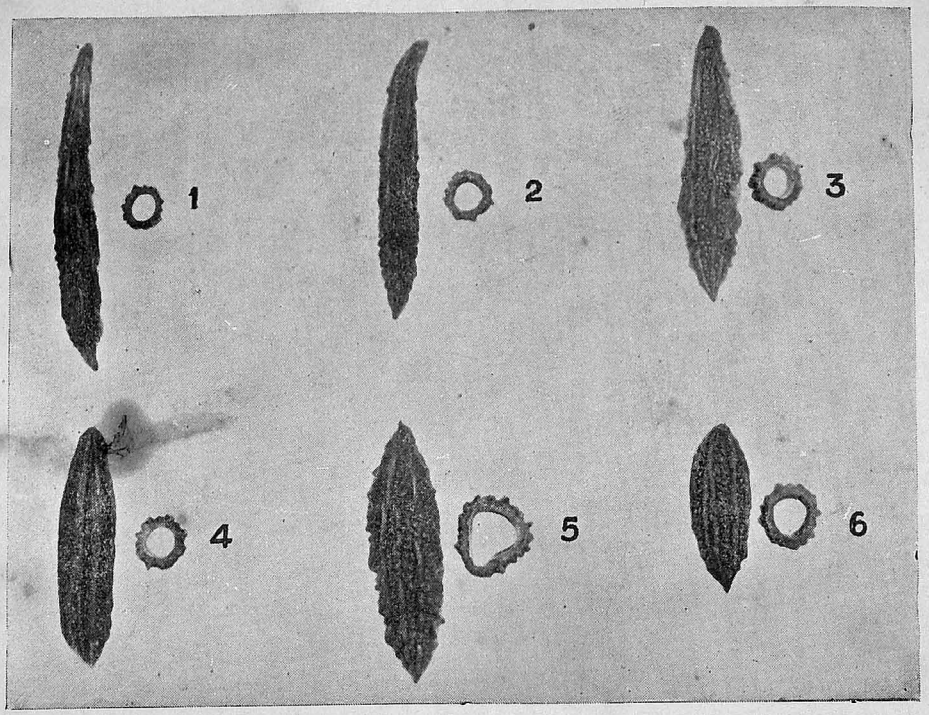
Soil Sampling for analysis : Spray the soil which is collected underneath the sieve while sieving and spray the soil on a long paper and spray it with a knife uniformly and make this uniformly sprayed soil cut into so many plots longitudinally, transversely and in cross manner.

Soil Erosion : Fine particles are etched away out of the surface and spread into different places by wind. Some of these are carried away by water. These losses is called soil erosion.

Laterite soils are derived from the parent rock, kankar.

Nutreonts : The fooding stuffs are classified according to their nutrition value. If they supply no nutreonts or very little nutreonts they are known as roughages. If they supply more nutreonts with less feeding though they may be supplying any special type of nutriant they are classed as concentrates.

Cyanogenetic Glucosides : The plants manufacture two kinds of sugars, one soluble and the other an insoluble sugar. The insoluble sugar is called cyanogenetic glucosides.



1. Salem.
2. Nandyal.
3. Pattambi (white).
4. Aduturai.
5. Kumbakonam.
6. Coimbatore (short).

Preliminary Studies on Bitter Gourd (Momordica charantia)

By

S. G. AIYADURAI, B. SC. (Ag.)
Oilseeds Section
Agricultural Research Institute, Coimbatore

Introduction: Of the cultivated gourds, melons and cucumbers, the bitter gourd (Tamil – *Pavakkai*, Telugu – *Kakara*, Hindi – *Karela*) is a common vegetable plant grown in almost every kitchen garden in South India. It is reported to be cultivated throughout India, as also in Malaya, China, Tropical Africa and America. People in Europe call it Balsam-Pear, but no information is available to show that the fruits are used by them for edible purposes.

Among the six species of *Momordica* found growing in the Madras State, only *Momordica charantia* is cultivated as a vegetable crop, in all the plains districts. This is a climbing annual herb with small, five to seven-lobed leaves, small yellow flowers and spindle-shaped fruits, green when young and bright orange on ripening, softly tubercled, splitting irregularly from the apex with the seeds surrounded by a crimson pulp. The plant is unisexual and monoecious.

The plant is grown for the tubercled, fleshy fruits. As the name signifies, the fruits are bitter in taste, but they are rich in iron and vitamin A. They are considered very good for culinary purposes. Almost every part of the plant seems to be used medicinally not only in India but also in countries like China and Africa. It is mentioned that the bitter gourd fruit is cooling, digestive, laxative and antipyretic and its administration cures biliousness, blood diseases, rheumatism and asthma. The leaf is used internally as a laxative and as an ointment for sores. In Ayurveda the juice of fresh leaves is prescribed for diabetes.

Work connected with the improvement of bitter gourd was carried out at the Agricultural Research Station, Tindivanam (South Arcot 1944 – '46. This paper records the observations made during the District) during course of this study.

2. **Materials and Culture:** Thirty-two samples of seeds were obtained from different localities in the State and from nurserymen. Circular pits (two to three feet in diameter and two feet in depth) were dug at intervals of seven feet and manured with well-rotted farm-yard manure. One row of four pits was allotted to each sample. Three seeds were sown in each pit to allow for possible defective germination. It took six to eight days for the seeds to sprout. A week after germination, the plants were thinned, leaving only one plant in each

pit and props were provided for the plant to climb up. A small pandal of five feet square at a height of five feet was erected for each plant. The plants were pot-watered when droughty weather prevailed.

3. **Observations:** (a) *Varietal studies:* Among the collection, there could be seen only two distinct habits of growth, one climbing and the other prostrate or runner. The latter is commonly called ***Mithipagal*** which name has probably been derived on account of the method of harvest of its fruits (i. e.. the fruits are picked by feeling with hand or foot). In the collection grown, four had prostrate habit. Late and early bearing types were also observed in the collection.

There was not much difference among the types with regard to their morphological characters except slight variations in the size and colour of leaves. But with regard to the fruits there were clear differences in size (length varying from 4·5 to 10 inches), thickness, colour (dark green, light green and dull white) and surface (tubercled and smooth ribbed). The differences in the shape and size of the fruits of the important types are shown in Plate I.

Though bitter gourd can be cultivated throughout the year, it is grown chiefly during the rainfed season (July to December.) Where facilities are available for irrigation it is also raised during the summer season (February to July). Of all the types studied, the following were found to be good yielders, besides possessing such desirable characters as earliness, long and thick fruits and good flesh :-

1.	M. C. 2 (Salem) ...	Climbing type with dark green, long (above 8 inches) and slender fruits, moderately bitter.
2.	M. C. 4 (Pattambi White) ...	Climbing type with dull white, long and thick fruits, less bitter.
3.	M. C. 6 (Pattambi Green) ...	Climbing type with light green and thick fruits of medium length (5 to 8 inches), more bitter than the white.
4.	M. C. 12 (Aduturai) ...	Climbing type with light green, thick, smooth ribbed fruits of medium length, more bitter.
5.	M. C. 16 (Nandyal) ...	Climbing type with green, long and thick fruits, moderately bitter, late bearer.
6.	M. C. 20 (Kasargod) ...	Climbing type, early and profuse yielder with dull white and medium sized fruits, moderately bitter.
7.	M. C. 24 (Kumbakonam) ...	Climbing type with whitish green and thick fruits of medium length, more bitter.
8.	M. C. 26 (Coimbatore short)...	Climbing type with green, short, (below 5 inches), thick and smooth ribbed fruits, early bearer, less bitter.
9.	M. C. 30 (Bangalore) ...	Climbing type with dull white, long and thick fruits, with smooth ribs, moderately bitter.

These types were found to breed true for the economic characters when grown in isolated blocks.

Of the above types, M. C. 4, M. C. 12, M. C. 16 and M. C. 20 were found suitable for growing during summer under irrigated conditions. To obtain good yields the plants have to be watered liberally at regular intervals.

(b) ***Flowering and fruiting:*** The plants commenced flowering in 30 to 35 days from the date of sowing. The peak of flowering was noted from the 50th day onwards and lasted for about a fortnight. In the early stages, the ratio of female flowers to male flowers produced was one to ten and in the later stages one to fifteen or even twenty. As the number of male flowers is large , the fertilisation and setting of fruits was found to be nearly cent per cent. Fruits for cooking purposes can be gathered after the 15th to 20th day after flowering. The fruits get fully mature by the 20th day from flowering and then begin to ripen. Ripe fruits for seed collection can be picked on the 25th day.

(c) ***Pests and diseases:*** Epilachna beetles were found to cause serious damage to bitter-gourd plants. The pest is found to be active during the months of September and October. The grubs scrape the green matter from the leaves and young fruits and the affected vines present a ragged appearance. Both the grubs and adults cause much damage to the immature fruits, as a result of which a number of young fruits fail to grow normally and in some cases they become rotten.

To control the pest, dusting calcium arsenate in the proportion of one part of calcium arsenate to six parts of slaked lime or spraying calcium arsenate at a concentration of half to one ounce mixed with an equal quantity of slaked lime in one gallon of water is recommended. Healthy fruits collected from treated plants will have to be washed well in fresh water before they are used for consumption.

No disease was observed to attack the bitter gourd crop when raised both during the rainfed and summer seasons at Tindivanam.

4. **Hybridisation:** About 20 crosses were attempted with selected parents. Some of the hybrids were found to yield large-sized fruits with thick flesh, showing hybrid vigour. Detailed observations regarding the yielding capacity and bitterness of fruits are in progress. There is indication to show that the hybrid vigour can be utilised to produce more and better quality fruits.

The following technique of crossing was adopted :-

The female flower bud which was expected to open the following morning was covered with a thin paper bag (of about $2'' \times 3''$) and tied with a thread in the evening. Next morning at about 7 O'clock the male flower was brought for pollination. The paper bag was removed and the pollen dusted four or five times to ensure proper pollination. The paper bag was then replaced and removed the next day so that the fruit may develop normally.

From the study of the crosses, types M. C. 6 (Pattambi Green), M. C. 16 (Nandyal), M. C. 20 (Kasargod) and M. C. 26 (Coimbatore short) appeared suitable for producing useful hybrids. Crosses in which the first two were used as female parents and the other two as male parents were found to be more promising than the others. The hybrids were compared with the selfed progenies of the parents and they were observed to have longer and thicker fruits than the parents.

5. **Conclusions:** The preliminary observations have shown the possibility of evolving new and better yield types of bitter gourd by careful selection and hybridisation. These aspects will have to be studied in more detail to find out the extent to which improvement in this vegetable crop can be effected.

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Seed Viability Test with 2, 3, 5 Tri-Phenyl Tetrazolium Chloride

By

L. VENKATARATNAM, M. SC., B. SC., (Ag),
Agricultural College, Bapatla.*

In 1941 Kuhn and Jerchel (6) drew attention to the properties of colourless tetrazolium salts which get reduced by some phytochemical process to stable red formosans on contact with the tissues of embryos of viable seeds and suggested their use as reduction indicators of living tissues. Since then, the test has been in use in German Breeding Stations for testing viability in oats.

Lakon (7) gave up his erstwhile 'topographical method' of determining seed viability with selenium salts in preference to 2, 3, 5 triphenyl tetrazolium chloride. Cottrell (2) Porter and his colleagues (8) have confirmed the reliability of these tests with several cereals; but do not recommend their use with minute seeds, as the staining is not clearly

* Now Government Horticulturist, Hyderabad—(Dn.)

perceptible. Goodsell (4) found the method unreliable with immature seeds. Bennett and Loomis (1) have, however, indicated that this test provides a rapid means of testing frost injury in corn in 24 hours instead of one or two weeks. Hyde (5) noted that the germinating capacity of Fescue seed could be rapidly estimated with less than 5 per cent error. Flemion and Poole (3) and Shuel (9) found significant correlations with the rapid viability test and ordinary tests.

Trials were conducted in the Agricultural College, Bapatla with 2, 3, 5 triphenyl tetrazolium chloride on several seeds to assess the efficacy of this method of testing viability of seeds of crop plants.

5 c.c. of one percent solution of tetrazolium chloride was added 24 hours after moistening and the viable crop seeds were kept at freezing point in an Electrolux refrigerator. None of the embryos reacted to the salt even after a week's storage. The seeds lost viability and consequently failed to show any reaction. Similarly seeds boiled in water developed no stain. Beyond 5°C deep pink staining of the embryos was visible in viable seeds, within 24 hours of addition of the salt. The stain remained stable even after washing, alternate drying or soaking treatments. To assess the optimum range, different concentrations of tetrazolium chloride were used with G.E.B. 24 strain of paddy and the results are presented below :—

Concentration in p. p. m,	Concentration as percentage	Percentage stained	Percentage of germination	Remarks.
100 p. p. m.	0·01	38	100	Very light pink.
250 ,,	0·025	59	100	,,
500 ,,	0·05	95	100	Light pink.
750 ,,	0·075	98	100	Pink.
1000 ,,	0·10	100	100	Deep pink.
2000 ,,	0·20	100	100	Very deep pink.
5000 ,,	0·50	100	100	Very deep pink.
10,000 ,,	1·00	100	100	Intense pink.

With increase in concentration, the intensity of stain and the percentage of embryos stained is found to increase upto 1000 p.p.m. or with 0·1 per cent of tetrazolium chloride. The degree of staining does not differ beyond this level and the optimum is found to range between 0·05 to 0·1 per cent.

Further tests were carried out with 2 c.c. of 0·1 per cent of tetrazolium chloride with several freshly harvested strains of paddy, dehusked

and previously soaked with water adequate to moisten the seeds and the count of stained seeds with their actual germination is furnished below :—

Strain	Percentage of embryos stained. Deep.	Medium.	Light.	Percentage germination.
G. E. B. 24–Kichili samba	98	1	...	100
A. K. P. 4 Mypali	100	...	...	100
S. L. O. 16 Kasipichodi	87	2	...	85
M. T. U. 7 Guttikusuma	87	...	...	85
S. R. 26–B.	59	5	1	62
C. O. 4 Gobi Anaikomban	98	...	1	69
A. D. T. 22 Vadan Samba	98	1	...	99
B. C. P. 1. Molugolukulu	97	1	1	98

Similar tests carried out with over 30 strains of paddy gave significant correlations with less than 5 per cent error between actual germination and the number of embryos stained with tetrazolium chloride. In case of doubt the grain had to be peeled for examination of the stain developed by the embryo.

The results obtained with similar tests conducted with other monocotyledonous grains and dicotyledonous seeds are given below:—

Name of crop.	Percentage stained. Deep.	Medium.	Light.	Persentage of germination.
Sorghum *(Sorghum durra)*	99	...	1	100
Ragi *(Eleusine coracana)*	100	...	...	100
Samai *(Panicum miliare)*	96	3	...	95
Tenai *(Setaria italica)*	99	...	...	100
Kudiaivali *(Echinochloa frumentacea)*	96	2	2	98
Varagu *(Paspalum scrobiculatum)*	95	3	2	99
Panivaragu *(Panicum miliaceum)*	98	1	1	100
Dicotyledonous seeds.				
Cowpea *(Vigna catjang)*	98	2	...	90
,, ,, No. 419.	11	7	2	10
Bengal gram *(Cicer arietinum)*	79	9	12	89
Pillipesara *(Phaseolus trilobus)*	99	1	...	94
Green gram *(Phaseolus radiatus)*	89	8	3	87
Red gram *(Cajanus cajan)*	96	4	6	100
Groundnut *(Arachis hypogea)*	89	7	4	98
Indigo *(Tephrosia purpurea)*	87	8	...	64
Dhaincha *(Sesbania aculeata)*	91	6	3	86

With millets and paddy the results obtained showed significant correlations between actual germination and the number of embryos stained, indicating that the test is fairly reliable with monocotyledonous seeds. In dicotyledonous seeds, the cotyledons developed light pink to deep pink colour irrespective of the viability of the seed. The counts of stained seeds did not correspond with actual seed germination and in several cases the differences were very large and significant. The method is found unsuitable for dicotyledonous seeds for critical assessment of seed viability.

This method of assessing seed viability is capable of exploitation in cereals which include the major food crops. Marketing, grading and storage depend on seed germinability. In this sphere tetrazolium chloride test is an aid to forecast fairly accurately, the seed viability even in the dormant stage of the grain, and thereby assist seed procurement and distribution.

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A Cheap Device for a Cool Chamber.

By

P. PRAKASAM, B. SC.

Agricultural Research Station, Anakapalle

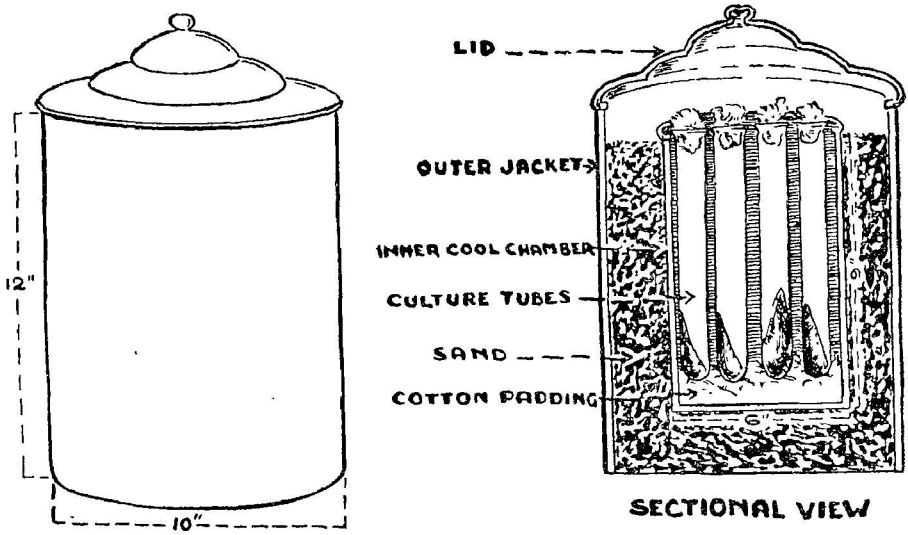
The need for preserving fungal cultures in cool chambers needs no emphasis. In some of the moffussil research stations where neither electricity nor refrigerators are available the maintenance of cultures particularly in the summer months is difficult. Some cheap and efficient devices without the use of ice or refrigerator were tested. The following device described in brief was found to be of very helpful.

A mud cylindrical jar 12″×10″, forms the outer jacket. A smaller cylindrical jar, 9″×6″, which forms the cool chamber is placed inside. A lid fits in with the outer jacket.

Clean and washed fine sand is spread to a depth of 2 inches at the bottom of the outer jacket. The smaller cylinder is then placed in the centre, and the space between it and the jacket is filled with the sand. This sand packing is wetted with clean water and the lid placed in position (Fig). The whole apparatus is kept on a stool in a corner of the laboratory. The lid is covered with a wet cloth. With such a device the temperature inside the cool chamber was brought down by 10 – 15°F.

The mud jars are likely to become mouldy as also the sand used for packing. To prevent this 0·1% of mercuric chloride solution is used occasionally in cleaning the walls of the mud jars and also in wetting the sand.

COOL CHAMBER



This type of cool chamber made with the help of the local potters was found to work satisfactorily in this laboratory in preserving fungal cultures in the hot season. It is recommended for use in all places where refrigerators or ice are not easily available.

My thanks are due to the Indian Central Sugarcane Committee which is partly financing the research scheme at this station.

The Wild Flora of the Nilgiris and its Bearing on Humanity

By

S. N. CHANDRASEKHARAN, D. DANIEL SUNDARARAJ

and

H. SUNANDA KAMATH

Agricultural Research Institute, Coimbatore.

The Flora in general: The Nilgiris abound in beautiful jungles, the *sholas* as one familiarly calls them, rich in natural vegetation. The vegetation on the hills are partly responsible for the heavy rains on these hills during the monsoon season, the conservation of soil and above all for the beautiful climate of the place. The climate is often compared to an "English summer at its best and is probably the most equable in the world". The flora of the Nilgiris vary according to the different elevations. Lower down we have the tropical and sub-tropical, rich and diversified vegetation made up of a host of evergreen species of Acanthaceæ, Euphorbiaceæ, Guttiferæ, Myrtaceæ, Rubiaceæ, Orchidaceæ and Scitaminæ among other members of various phanerogams. Dense growth of *Ochlandra travancorica*, Gam., are found in many places. Along the banks of streams a wealth of tree forms, tropical ferns, mosses and liverworts abound. *Cycas* representing the Gymnosperms are also quite common. As one goes higher up he is struck with the change in vegetation, the whole panorama now being one of temperate regions, with ferns, liverworts and mosses, the cryptogamic types as well as the phanerogamic types being all of temperate regions excepting a few odd species which are of cosmopolitan nature. The tract above 6,000 feet consists of open grasslands with small alpine plants and bushes besides the naturalised trees as the Blue gums (*Eucalyptus*) and Wattles (*Acacias*). *Rhododendron nilagiricum*, Zenk., with their lovely bouquets of crimson add colour to the existing panorama. The various species of *Rubus*, *Strobilanthus sp.* with their characteristic seasonal flowerings, *Gaultheria fragrantissima*, Wall., the leaves of which yield an oil similiar to that of Canadian wintergreen and the ubiquitous *Lantana* are found along the roadsides and the fringes of evergreen forests. Tree ferns are to be found in the swampy regions near about streams. So also some types of grasses, *Arisaemas* and *Eriocaulons*. In this connection we have to mention that the conifers, several of them introduced, species of *Pinus*, *Cupressus*, *Auracaria* etc. have now become so well established that they grow self-sown in many places. The earlier settlers of the Nilgiris had introduced many valuable plants, not only of the coniferous types but also of the phanerogamic – economic types of which mention

must be made of the wattles, eucalyptus, the potato, coffee, tea, vegetables and various ornamental plants, and the last but not the least, fruits of temperate regions such as the peaches, plums, and apples.

We would suggest the following books for a wider knowledge of the Flora. (1) The South Indian Hill Stations – By Fyson (1932) Vols I and II (2) Col. Beddome's account of the Flora of the Nilgiris in the District Gazetteer of the Nilgiris. (3) Neilgherry Plants – by Wight. None can at any time say that he has completely exhausted the flora, for the flora of a country are of a changing character just as many other things in nature change with time. It is therefore for the botanists to be working on the flora and see why some have made their exit and others made their appearance.

Present Day Changes in the Vegetation: We find today a good many tropical species that were once very unusual at higher elevations. It looks as if the climate on the hills is becoming warmer due to the vandalism done to the natural flora of the hills so that the species of the tropics are invading higher ranges of the hills as they find them suitable climatologically.

The denudation of the forests that is now taking place for purposes of fuel, for clearing up areas for the cultivation of tea, potato etc., have a destructive effect in the long run. The policy at present adopted is almost like killing the goose that lays the golden eggs. A plea for the preservation of natural parks has been recently raised in our country and rightly too. The wild flora of a country are repositories where one can often find plants closely allied to the domesticated ones. Such wild allies are often of immense use in the improvement of the cultivated ones like cereals, fruit plants, fibres etc.,

One important aspect of economic botany which concerns the hills has to be emphasised here. In all countries Plant Introduction Bureaux are doing valuable service, with a well-established organisation. As already mentioned, some of the earlier settlers of the hills have introduced numerous economic plants, some of them very valuable. It is upto us to take steps to organise a similiar department, so that all valuable plants may be given a fair trial and such of them that get acclimatized grown on a larger scale to improve the prosperity of the country. The Nilgiris is the place for such trial of plants from subtropical and temperate regions.

Food Yeast from Cane Molasses

By

D. MARUDARAJAN, B. A.
Government Mycologist
(Agricultural College and Research Institute, Coimbatore)

Yeasts are unicellular fungi which thrive in a sugary medium and are responsible for various types of fermentation. They are widely employed in industrial concerns for the production of alcohol and alcoholic drinks. The yeasts themselves are rich in proteins and also vitamins of the B complex (especially thiamin, riboflavin and nicotinic acid). These are important accessory factors in human nutrition. Consequently the yeast sludge obtained from fermentation industries is dried and marketed.

But food yeast is another type, which is more palatable and grows readily on molasses. It does not produce much of alcohol. The use of yeast is highly desirable in a country where the people use as staple food starchy grains like polished rice, so that the deficiencies in protein and vitamins can be made up.

Cane molasses from one of the chief raw materials in yeast manufacture and this is available in plenty as a waste product of sugar industry. From the point of view of agricultural economy the utilisation of such waste products is of great importance. The following extract from the booklet published by the Colonial Food Yeast Ltd., is interesting. It says "Taking as a basis the acreage required for the production of necessary sugary material, the most bulky of the raw materials the yield of protein per acre in food yeast is several times that of the best protein producing plants directly available as human food, i. e. leguminous seeds, and many times that derived indirectly from plant material in the form of animal food products (meat, milk, eggs etc.). From this point of view the production of food yeast promises to be a most economic means, in terms of the use of agricultural resources, of improving the dietaries of people who have a low standard of living".

Much progress has been made in foreign countries in perfecting a process of manufacturing food yeast, by using a particular strain of the organism called *Torulopsis utilis* and large-scale developments are taking place in the establishment of food yeast industry. The Colonial Food Yeast Ltd., London, a Government undertaking sponsored by the British Colonial Office have started as early as in 1944 a project in Jamaica for the establishment of a huge food yeast factory at a cost of £.150,000/-; the funds being provided by an interest-free loan by the Government under the Colonial Development and Welfare Act. The Government of South

Africa have also recently sponsored the establishment of an experimental factory for the manufacture of food yeast with the idea of supplying the protein requirements of the native population.

Work at Coimbatore: In order to find out the commercial possibilities of food yeast production under South Indian conditions and to help private enterprise in a new venture calculated to contribute to the rectification of nutritional deficiencies in the dietary of our people, investigations were undertaken in the first instance in a small laboratory plant. This consisted of a cylindrical aluminium fermentation vessel of 50 gallons capacity provided with a lid. The lid had two openings, one in the centre to admit a $\frac{3}{4}''$ air main of a star-shaped aerator resting on the bottom of the vessel and another provided with a hinged shutter to admit a large-size funnel for addition of periodical charges of concentrated wort (molasses solution). The vat was provided with a sampling tap on the side and an exhaust tap at the bottom for emptying the contents. The air main was connected to an air blower worked by a $\frac{1}{4}$ H. P. motor.

The Process: The following process was first adopted. Twenty five pounds of cane molasses of an average total sugar content of 50 percent were diluted with an equal volume of tap water, 4 ounces of arsenic-free double superphosphate and 21 cc. of 1 : 1 sulphuric acid added to the solution and kept at boiling point for ten minutes. The mixture was left undisturbed for 3 to 4 hours and the precipitates allowed to settle. The supernatant clear liquid was then siphoned off. A solution of ammonium phosphate was prepared by mixing an aqueous solution of ammonium sulphate (280 grams of ammonium sulphate in two litres of water) with an aqueous extract of arsenic-free double superphosphate (500 grams in 3 litres of water) and siphoning off the clear liquid. With the above stock solutions 8 litres of the concentrated wort was diluted with 35 gallons of tap water to form the initial charge. The sugar level had to be maintained at 0.6 percent. Ammonium phosphate solution was added at the rate of 100 cc. for every pound of molasses used. Seed yeast originally multiplied from single cell cultures of *Torulopis utilis* var. *major* (A Teddington strain obtained through the courtesy of the Head of the Division of Mycology. Indian Agricultural Research Institute, New Delhi) and kept over from the previous day's production was added at the rate of 6 litres of cream (equivalent to about 12 oz. of dry yeast). Filtered air was blown through the medium at the rate of about 2 c.ft. per minute. Additional charges of concentrated wort were made at the following rates.

1.	After 1½ hours	— 8 litres of concentrated wort	and 130 cc. phosphate solution.
2.	" 3 "	8 litres	do
3.	" 5 "	6 litres	do

The temperature of the wort at the start was round about 28°C. and the rise in temperature during the generating period of 8 hours was about 2 to 3°C. The initial pH of the medium was kept at 5 by addition of 1 : 1 sulphuric acid. With the progress of aeration and multiplication of yeast a rapid fall in the pH of the wort was noted. The pH was however, checked up at intervals of 30 minutes and maintained at about 4-8 by addition of a ten percent solution of commercial ammonium carbonate. At the end of 8 hours the aeration was stopped. The yeast settled to the bottom of the tank in about an hour. The spent wort was drained off through the side tap and the sludge was further washed by changes of fresh water and settling again. The cream yeast was then passed to a basket type centrifuge from which it was collected as a wet cake. This was drawn into strings and spread over a cloth tray and dried in the hot air oven at about 50°C. The dried vermicelli was ground into fine powder. In the initial stages wide variations were observed in the yield of yeast; on an average a net yield of 18 ounces of dry yeast was obtained for every 25 pounds of molasses used. It was necessary to exercise the utmost care in regard to the supply of nutriments and to the maintenance of purity of the culture, to ensure satisfactory returns.

In order to determine the optimum amount of sugar required to produce the maximum outturn of yeast within a period of 8 hours, variations were tried in the total quantity of molasses used. 18 lb., 25 lb. and 30 lb. of molasses were used and the other factors were kept constant. The total sugars in the wort were estimated at intervals and the periodical addition of concentrated wort was controlled so as to avoid excess of sugar at any stage. The results showed that with 25 lb. of molasses 11 percent by weight of dry yeast was obtained as against 10% and 8% with the use of 18 and 30 lb. of molasses respectively.

The optimum pH of the wort for satisfactory production was reported to be 4·8. With the progress of the growth period the pH showed a sharp fall within an hour from the start. Alkaline agents like liquor ammonia and caustic soda have been recommended to bring up the pH. Caustic soda was found to be unsatisfactory, apart from having an inhibitory effect on yeast growth it also affected adversely the settling quality of yeast. A ten-percent solution of ammonium carbonate was tried and found to be a very good substitute for liquor ammonia. Its availability as a commercial product of fairly high purity and the absence of any harmful effects on the yeast are favourable points for recommending it in the place of liquor ammonia.

A small pilot plant with a productive capacity of about seven pounds of food yeast per day was installed early in 1948 and has been working for about two years now. The important items of equipment fitted up are: (1) a clarification tank (400 gallons), (2) a clear wort tank (200 gallons), (3) two sterilization and storage tanks (200 gallons),

(4) two yeast generators (350 gallons) (5) a centrifuge for separating yeast, (6) a vermicelli press, (7) a drying oven and (8) a pulveriser. An air compressor and ceramic aerators were also fitted up for aeration of the medium. A separate set of seed multiplication equipment was also got up.

The method followed in the pilot plant was generally on the lines adopted in the laboratory plant with suitable modifications wherever necessary. Studies on some important aspects were taken up.

Clarification of molasses: This is an important operation which helps in removing substances that are harmful to yeast growth. There are several methods of clarification among which the lime process gave satisfactory results. 1,000 lb. of molasses were dissolved in about 120 gallons of water. Two litres of sulphuric acid were added bringing down the pH from 6 to 4·8. The solution was heated to about 70°C. by letting in live steam. Then 10 lb. of calcium superphosphate were added and the heating continued to bring the solution to boil for ten minutes. After an hour's time milk of lime prepared by slaking 5 lb. of quick lime was added and the solution was agitated. It was then allowed to stand overnight and the clear brown wort was decanted and pumped to the storage tank for sterilization. This method of clarification resulted in considerable improvement in the colour and flavour of yeast and a marked increase in yield was also noted.

Utilisation of sugar by the organism: During a fixed period of seven hours quantities of molasses solution containing 50 lb., 56 lb., 60 lb. and 64 lb. of total sugars were used, the quantity being distributed four charges. The sugar content of the wort was estimated and the addition of molasses solution was so regulated as to avoid accumulation of sugar. It was found that the maximum utilisation of sugar by the organism took place when 50 lb. of sugar were used and a yield amounting to 14% recovery of yeast was obtained. In other cases the sugar levels in the substrate became uneven and the yields were also low.

Optimum level of inoculum: An experiment was carried out in which the quantities of inoculum used were varied, keeping other factors constant. Quantities equivalent to ½%, 1% and 1½% of the weight of the medium (calculated on wet yeast basis) were used as seed. The average yield of yeast obtained worked out to 11, 12 and 14 percent on sugars, thus showing that the optimum quantity of inoculum to be used was 1% of the weight of the medium.

The use of roller drier: It was found that much time and labour could be saved if the roller drier was used for drying yeast instead of the vermicelli press, the drying oven and the pulverisor. Roller drying of yeast was a quick and simple process and the product obtained had also a better flavour compared to oven-dried yeast.

Economics of yeast production: By the experiments carried out in the pilot plant at Coimbatore, it has been possible to increase the recovery of yeast from 8% at the start to 14%. This is of course still considered as a low yield and much higher percentages of recovery have been claimed in other countries. Further work in the pilot plant is being pursued to improve production. The cost of production of yeast in the pilot plant has been high (about Rs. 3/- per pound) and two factors have contributed towards it, the high steam charges and the cost of purchasing and transporting molasses, the chief raw material. But this cost of production should not be taken as a standard. The experience so far gained has shown that yeast manufacture can be a profitable concern if it is started as an adjunct to a sugar factory where molasses form a waste product and there is no charge for transport. Further the overhead charges can also be considerably reduced as many of the facilities available in the sugar factory, can be easily utilised for yeast production.

Yeast industry is bound to be of national importance in a country of undernourished population like ours. The raw material is available in plenty as a waste product. It is hoped that the work carried on at Coimbatore will provide the necessary incentive and encouragement to private enterprise.

Cardamom — (Elettaria Cardamomum, Maton)

By

V. GOMATHINAYAGAM PILLAI

Cardamom Specialist

Cardamom occurs wild in the evergreen jungles of the Western Ghats in Travancore, Madras, Coorg and Mysore. It is also cultivated in those areas between 2,500 to 4,500 ft. above sea level. It can be grown only under the shade of forest trees and it does well in areas where the annual rainfall is about 100 inches and well distributed. Cardamom is almost entirely a South Indian product though its cultivation extends to Ceylon, Eastern Archipelago and Java to a comparatively small extent.

Cardamoms are used in India for flavouring sweets and curry powders. They from part of some Indian medicines. They are used for flavouring cakes in Europe especially in Russia, Sweden, Norway and parts of Germany. In European medicine, they are chiefly used in tincture of cardamom, as a stomachic, and in combination with other

drugs as an aromatic. The cardamom owes its special properties to a volatile oil its contains. The oil is light yellow, viscid, has the strong aromatic odour of cardamoms and a pleasant cooling taste.

Botanical description : The cardamom plant, ***Elettaria cardamomum,*** Maton comes under the natural order Scitamineae and family *Zingiberaceae.* The plants consist of perennial rhizomes throwing up leafy aerial shoots bearing at their bases one or more flowering panicles. The leafy shoots and flowering panicles have a short life of three years. New shoots arise from the bases of old ones, thus extending the rhizome system and resulting in the gradual formation of a large clump of leafy stems.

The leafy shoot consists of a central stem, bulbous at the base and bearing the sheathing leaf bases of the alternate leaf blades. The leaf blades are elongate, elliptic. The flowers are borne on lax panicles usually called racemes which arise from the base of the leafy shoot. These panicles may be erect, flexuous or prostrate according to the variety. Each panicle consists of a main rachis extending up to four feet, bearing short alternate racemes. These racemes bear the flowers. The flowers open in succession from the base towards the apex.

The floral parts are arranged on the trimerous ground-plan of the monocotyledons, but the members of the successive whorls originate in a close spiral series. The outermost whorl, the calyx, is tubular having three toothlike lobes at its apex. The corolla is tubular below and is divided into three distinct lobes, each of which is oblong-linear with slightly inflected margins and the ends turn up at the edges slipperwise. The members of this whorl alternate with those of the calyx whorl. Only one of the six anthers is functional. Three anthers are modified into a false petal called 'Labellum' the attractive and prominent portion of the flower, while the other two anthers are non-functional. The pistil is composed of a trilocular, inferior ovary with a filiform style ending in a capitate stigma.

Varieties : The genus *Elettaria* consists of only one species ***Elettaria cardamomum,*** Maton. Among the various varieties of the species met with, four are important; the descriptions of which are given below :

1. "***Malabar***" : This is the most common variety widely cultivated in the Cardamon Hills of Travancore and on the Southern side of it, up to the river Tambraparani. The plant is of medium size, neither as robust as the "Mysore" nor as small as "Munzerabad". The panicles are prostrate and the pods are round and slightly elongate. The lower surface of the leaf is pubescent.

2. "***Mysore***" : Robust plant with erect panicles. Pods are elongate and leaves glabrous.

3. "*Ceylon*": Slightly more robust than "Mysore". The panicles are erect. The pods are loosely packed in the panicle and elongate. Leaves are glabrous.

4. "*Munzerabad*": This is a short variety; yields well. Pods are round and arranged closely in the panicles which are prostrate. Leaves are pubescent on their under surface.

Besides the cardamoms proper, there are a few plants closely allied to the cardamoms whose seeds resemble the true cardamoms in taste and smell. They are (1) the round or cluster cardamom (*Amomum kepalage*) of Java, the seeds of which have a camphor-like taste, (2) Korarima cardamom whose fruits are larger, reddish-brown in colour, striated and the seeds tasting like true cardamoms, (3) Bengal cardamoms (*Aframomum aromaticum*) the fruits of which are larger, winged and the seeds tasting somewhat like camphor and (4) Wild cardamoms (*Aframomum xanthoids*) or "Siam cardamoms" the fruits of which are spiny and the seeds resemble closely the genuine cardamoms but with a different flavour.

Distribution and Area: The cultivation of this crop is very restricted as it can grow only under favourable conditions such as the following:

(i) Elevation ranging from 2,500 to 4,500 above sea level. (ii) A well-distributed rainfall of at least 80 inches per year — 100 to 150 inches being the ideal (iii) The presence of evergreen forest affording shade to the crop throughout the year. (iv) A well-developed mulch regularly replenished by shade trees and a well-marked humus accumulation below. (v) Good protection from wind.

From the available records, the total area under cardamoms is estimated to be 1,08,400 acres, distributed as follows:

	Approximate area in acres
a. Travancore — Cardamom hills	6,0000
b. Mysore — Hassan and Kadur	21,800
c. Madras — Coimbatore, Madura, Ramnad and Tirunelveli	15,000
d. Coorg	10,000
e. Bombay, North Canara	900
f. Cochin	700
	1,08,400

Soils and manuring: The soils most favourable for this crop are those of the evergreen forest. Such soils owe their suitability to the climate and cover of dry leaves dropping from the shade trees. The crop

appears to have an adaptability to get on in a variety of soils, the ideal one being the deep chocolate coloured forest soil. It is also found to thrive well on stony soils and in localities on a shallow zone of humus over white gravel. The presence of a well-developed mulch, a well-marked layer of humus and adequate moisture are the common features of all cardamom-growing areas.

Cardamom is not generally manured, though in Coorg, the practice of applying well-mixed cattle manure and ash is in vogue in small holdings.

Season and climate: Cardamom is a perennial crop. Once it is planted, it continues in the field for 15 to 20 years. It is considered necessary to replant the field after about 15 or 20 years. The soil should be deep and moisture well conserved. It is also necessary that the rainfall should be well distributed.

Preparation of the field: The shrubs and short plants are first cut and then heaped in rows to decay. The debris so collected is utilised to arrest erosion in steep lands. The shade trees are pruned so as to allow adequate sunlight to the plants. Pits are then dug at desired distances usually of the size of $2' \times 2' \times 1'$.

Propagation: Cardamom is propagated by two methods, (1) Vegetatively and (2) through seeds. In the vegetative method of propagation, old clumps are lifted and the rhizomes split into small parts each bearing at least one big and one small aerial shoot. Then each of these parts is planted in a pit. This becomes a full clump in two years. By adopting this system, the crop begins to yield in two years after planting.

The planting of rhizomes has to be done with care. Three-fourths of the soil dug out is pushed and spread inside the pits. The rhizome with its aerial shoots leaning against the slope of the land is placed in the pit and the soil left outside is then spread over the rhizome. The soil is then compacted gently and dry leaves are spread around the plant to serve as mulch.

The selected clump can be propagated vegetatively without any chance of "splitting" in its characters. But the scope of multiplication is limited since more than 20 splits cannot be got from one clump. Further, mosaic disease and insects such as thrips can pass on from the old to the new plantation. The transport of rhizomes is laborious and planting has to be done as quickly as possible as rhizomes pulled out cannot be kept long. The propagation through seeds has the advantage of getting a large number of seeds from one clump. The seed material can be easily transported and the seeds can be treated against pests and diseases. But raising a nursery is difficult and requires experience. The bearing is delayed by a year or two and the cost involved is high.

Nurseries require shade and this is provided either by jungle trees or by artificial sheds. The former is cheap while the latter is more successful. Slopy areas are terraced and reinforced with logs of jungle trees. On level grounds the beds are formed $\frac{3}{4}$ to 1 foot above the groundlevel. The beds are levelled. Over this, fine black jungle soil is spread to a depth about one inch. Ash and well-rotted cattle manure are spread and stirred. Ripe pods are collected and the seeds removed. Ripe seeds alone are taken and washed three or four times to remove the mucilaginous coating over them to prevent ants from carrying away the seeds. The seeds are then dried in shade and mixed with ash before sowing. They are then sprinkled gently and covered with a thin layer of fine sand. A thin layer of grass is spread over them to serve as mulch and the beds are watered frequently. Germination starts after 4 to 5 weeks. Two months after sowing it is advisiable to spray 0·5% Bordeaux mixture against nursery diseases. Much virtue is claimed for the leaves and branches of "*Phyllanthus emblica*" for shading the nursery and in Mysore, the branches are stuck in the ground close enough to afford them shade both in the nurseries and for the newly transplanted seedlings. The leaves of Phyllanthus soon drop off completely and leave the branches quite bare. The beneficial effect may be due to the astringents, gums or other active principles in the leaves and branches and the leaves are credited with the power of keepingoff vermin and insect enemies. In Areca gardens, it is the invariable practice to apply these leaves to cardamom plants as manure and perhaps for the sake of the above advantages as well. When the seedlings are about 6″ to 12″ high, they are to be lifted and planted 2 feet apart either way in a second nursery. After a year in the second nursery, the plants are fit to be planted in the field. The most common spacing adopted in the final planting is 8 feet either way. The spacing is increased or decreased by a foot or two according to varieties, rainfall and climate.

Intercultivation: The soil in the cardamom field is not generally disturbed. In a few instances the surface soil is scrapped and spread around the base of the clumps. Two or three weedings for the first two years and one weeding per year later on are given in the hot weather before the picking commences. During weeding, the clumps are trimmed off; the dry aerial shoots and dry leaves on the green shoots are pulled out. The parts so removed and the dry leaves are spread around the clumps to serve as mulch.

Harvest and yield: The first crop is usually a small one, the second one a partial crop and the third, that is five years after planting, a full crop. Harvesting is done once in 30–40 days. Pods that are just attaining ripeness are carefully picked at each harvest. The harvested fruits are dried either in a drying house or on

the ground in the sun. Drying houses are fitted with racks of wire mesh or jute hessian and heated by a system of pipes connected with an outside furnace.

In order to obtain the so-called white or bleached cardamoms which is a distinct trade quality that is greatly in demand, cardamoms are subjected to a special bleaching process. The Indian demand is met by a peculiar bleaching process which is confined to Haveri in Southern Bombay – a great trade centre for cardamoms. The process consists in washing the dried cardamoms in water containing a mash of soapnut (both *Sapindus saponaria* and *Acacia concinna*) and also ordinary soap, draining soon, washing again, draining and then spreading out to dry indoors, with occasinal sprinkling with well water, and then drying in the sun on the following day. Of late, the use of bleaching powder and sulphur is said to be in vogue. Kiln-dried cardamoms of the larger varieties are green in colour but the smaller cardamom capsules dry a more yellowish-green. The outturn from fresh fruit to dried capsules varies between 20 to 28%.

Yields of cardamom vary widely. The average yield from big cardamoms (Mysore) may be 50 to 100 lbs. of dry capsules and that from small (Malabar) cardamoms, 40 to 80 lbs. per acre.

Method of storage: The dry pods after cleaning are graded and packed in double gunnies. The gunnies are preserved in dry rooms. The produce is disposed off as soon as possible. If however preservation is essential, frequent drying is done to keep off weevils.

Pests and diseases: The insect pests that attack cardamoms are :–

(a) Thrips – *Taeniothrips cardamomi* (Ramakrishna). (b) Shoot and Capsule borer – *Dichocrocis punctiferalis.* (c) Leaf-eating caterpillar – *Eupterote canaraica.* (d) Scale insects – *Diaspis Sp.* (e) Rhizome borer – *Prodioctes haematicus.* (f) The root borer – *Hilarographa caminodes.*

(c to f): Are of very minor importance and have not occurred so far in pest form.

(a) *Thrips – (Taeniothrips cardamomi* Ramakrishna): This is the most harmful. Its appearance result in a marked decrease in the yield. This pest is found in all cardamom-growing areas. Both the nymphs and the adults cause immense harm to the flowers and the developing pods. They take shelter under the leaf sheaths and in the covering panicles and cause minute injuries resembling pin pricks on the tender developing fruits which turn brown, become scabbed and corky. Nicotine sulphate (0·05%) spray, at the rate of 20 gallons of spray solution per acre and Gammexane (0·025) as a dust at the rate of 3 to 4 lb. have proved very effective.

(b) *Shoot and capsule borer: (Dichocrosis punctiferalis):* The insect bores through the stem and panicles and causes withering. The capsules are also bored, sometimes causing slight damage. The affected

shoots and panicles are to be removed as early as possible to prevent the further spread of the pest.

Disease: *Mosaic:* This is the chief virus disease and appears in the shape of pale mottling and curling of young leaves. The size of the shoots dwindles rapidly and finally the clump dies. The infection is carried very rapidly. Complete destruction of the affected crop is recommended. The field may be left fallow for a year or two and then planted with healthy seedlings. No real remedy has so far been found out.

Clumprot: Known as '*falling off*' disease, caused by *Pythium* Sp. occurs in patches attacking stray clumps. The aerial shoots when attacked fall prostrate radially around the clumps. The affected shoot breaks off easily due to the rot at its base where it is discoloured. The panicles are also affected thus reducing the yield. Ammonium phosphate, superphosphate or lime when applied at 3 oz per clump check the spread of the disease and also induce fresh growth of aerial shoots.

Economics: Cardamom cultivation is considered to be a profitable business, especially now when cardamom is selling at Rs. 10/- per lb. But its scope is limited due to several conditions that must exist for raising the crop successfully – such as elevation, evergreen forest leaf mulch, rainfall, its distribution and protection from winds. When once the crop is planted, it continues to bear for a number of years. Though the initial cost of preparing the land and planting the area is high, the recurring expenditure is comparatively low.

The economics of this crop is worked out below. The figures may have to be modified for various districts depending upon the labour conditions, the cultural practices in vogue and spacing between the plants.

EXPENDITURE.

Particulars	Labour	Rate	Amount	Cost per acre per year
A. Non-recurring:				
1. Cleaning 'undergrowth' in the forest	25	1—8—0	52—8—0	
2. "Lining" – marking spots for planting	5	,,	7—8—0	
3. Digging pits – 680 – 20 per labourer	34	,,	51—0—0	
4. Pulling out old clumps and preparing rhizomes for planting.	5	,,	7—8—0	
5. Cost of rhizomes for 680 pits		Lump sum	20—0—0	
6. Planting – 50 pits per labourer	14	1—0—0	21—0—0	
7. Extra weeding during the first two years	30	,,	45—0—0	
		Total	204—8—0	
Share of non-recurring expenditure apportioned for each year taking the life of the crop as 20 years				10—4—0
B. Recurring:				
1. Annual weeding and cleaning 15 labourers @ 1—8—0			22—8—0	
2. Picking charges @ 0—1—3 per lb. (120 lb. green pods)			9—6—0	
3. Drying, cleaning, and packing – lump sum			4—0—0	
4. Dusting Gammexane against thrips – 12 times a year			30—0—0	

Particulars	Labour Rate	Amount	Cost per acre per year
@ 2—8—0 per time			
5. Supervision charges		5—0—0	
6. Transport charges per acre (lump sum)		2—0—0	
		72—14...0	72—14—0
C. The interest on the capital invested on the purchase of the land or the annual lease thereof.			7—0—0
D. Interest on non-recurring expenditure @ 4% per annum			4—0—0
			94—2—0

Receipts: If dusting against thrips is done once a month, 30 lb. of dry capsules may be expected even on a very conservative estimate.

The crop does not give any yield for the first two years and gives only a poor yield (say half normal) during the last five years. Thus $15\frac{1}{2}$ years out of 20 only may be taken as normal yielding years. So the average annual yield should be taken as $30 \times 15\frac{1}{2} \div 20 = 23\frac{1}{4}$ lbs. or 23 lbs.

The value of 23 lbs. of dry cardamoms at the present rate of Rs. 10/- per lb. Rs. 230—0—0

Net profit per are Rs. 230—0—0 — 94—2—0 = Rs. 135—14—0

The profit appears to be high but it has been worked out carefully. It should be mentioned here that the present price of Rs. 10/- per lb. of cardamom is phenomenal. Well-informed business men believe that the price may not go down much. Even if it goes down to Rs. 6/- per lb. (40% reduction in prices) the net profit per acre will be not less than Rs. 44/- per acre, which is appreciable.

Conclusion: By cultivating cardamom, the ever green forest is not disturbed much. The big trees remain intact. It is believed, that the adverse effect on rainfall caused by de-forestation is avoided when cardamom is cultivated on a hill. So the forest department, of late, is leasing suitable sites for cultivating cardamoms. Year by year, new areas in the reserve forest are alloted, in small pieces. Enthusiastic agriculturists have an opportunity here to invest their capital on this profitable industry.

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EXTRACTS TAKEN FROM "DRAFT PROGRAMME OF WORK FOR 1951" FOOD AND AGRICULTURAL ORGANISATION PUBLISHED IN AUGUST 1950

The Food and Agricultural Organisation's headquarters will be moved to Rome during February/April 1951. The activities are classified into three groups namely :

(i) the collection and publication of statistics and technical and economic information ;

(ii) the provision of advice and assistance to member Governments ;

and

(iii) the furthering of international co-operation through conferences, regional meetings and export committees.

The Agricultural production comprises a vast range of problems each of which has both economic and technical aspects inevitably interlinked. Among the activities designed to have immediate practical results, may be mentioned the hybrid corn programme which has been in operation for three years in Europe.

A parallel activity is the rice-breeding programme in South-East Asia now under the auspices of the International Rice Commission. Other examples are locust control in Central America, animal nutrition, animal disease control. Training centres for statisticians, economists and extension workers will be organised as in previous years.

Next may be mentioned a range of activities of considerable importance from which benefits materialize only at a later date. Such are the building up of a catalogue of genetic stocks, advisory work in animal breeding, surveys of soil erosion and soil conservation practices, studies and advisory assistance on fertilizer problems, missions to individual countries to recommend which branches of agriculture should be expended and by what means. Another activity is aid to Governments in developing agricultural production goals and targets to which the programmes in particular fields can be oriented. These goals also provide raw material for the appraisal of regional and world-wide trends. A more general service is the periodic review of the out-look for demand and prices in regard to farm products, assessing the influence of prospective changes in business activity, employment, international monetary conditions and other factors on producers, consumers and markets.

The nutrition work of Food and Agricultural Organisation extends over a wide range of subject matter from mobilising the services of experts on the highly technical problems of physiological requirements and food composition down to advising national agencies on methods of measuring food consumption in the home.

Its year books and monthly bulletins give trade data, while economic analyses are found in the commodity bulletins, and reports, the out-look for demand and prices of farm products, various food appraisals and the annual state of Food and Agriculture. In 1951 commodity reports on cereals, rice, fats, and oils, tea, rayon, jute, textiles, dairy products, live-stock and meat, foods, sugar, coconut, coffee, tobacco, fruits, potatoes, fish, and fisheries products, lumber, pulp and fibres.

Among 1951 projects under agriculture, the chief items are :

Implementing the recommendations of the 1950 meeting of the International Rice Commission with respect to the production and processing of rice.

Completion of a publication on principles and methods of agricultural extension.

Compiling and publishing material on equipment available for use in developing small industries to service agriculture.

Collecting and making available information on tropical tree crops as sources of food and feeds and in relation to soil protection.

Assembling and making available information on new spraying techniques.

Collecting and making available information on virus diseases of fruits.

Preparing a review of techniques of improving crops and forage production and methods of testing new and improved crop and herbage varieties.

Collecting, collating and making available the policies and methods followed in different countries to produce and distribute improved seeds.

The preparation and publication of available information on principles of safe grain storage and modern methods of infestation control.

Preparing a resume of information concerning six major diseases and nine major insect pests of rice.

Assembling and publishing information on tools and implements adapted to use on small farms in various parts of the world including tools and implements for the culture, harvesting and processing of rice and facilitating international exchange of tools and implements known to be useful in other countries.

Collecting information on fertilizers, manures and soil amendments used in rice production and the treatment of rice seed with nutrient solutions.

Collecting and disseminating information on methods of producing fertilizer from natural organic materials.

EXTRACTED FROM "CALORIE REQUIREMENTS" REPORT OF THE COMMITTEE ON CALORIE REQUIREMENTS — FOOD AND AGRICULTURAL ORGANISATION — JUNE 1950

The calorie requirements of individuals are influenced by many factors and requirements may vary widely even in individuals of the same physical type living in the same environment and performing the same kind of work. Calorie standards are used to assess the adequacy of diets or national food supplies to plan satisfactory diets and to work out national production and consumption policies which aim at an adequate and equitable distribution or food supplies. For these three purposes, knowledge of the per capita calorie requirement of the population group concerned is necessary.

The report shows in detail how the average calorie requirements of the total population of a country, according to adult weight, temperature, age and sex composition can be determined by the committee's system of extrapolation from a reference scale.

2. The basic requirements are:

(a) Man requires 3200 calories daily.	Age 25, free from disease. weighs 65 kilograms (about 162½ lbs.), living in temperate zone at mean annual temperature 10° c – working for 8 hours a day in light industry, dairy farming or market gardening.
(b) Woman requires 2300 colories daily.	Age 25, healthy, weighs 55 kilograms (about 137½ lbs.), engaged in general household duties or in light industrial work.
(c) Pregnancy requires 450 additional calories daily.	Calorie requirements are not affected during the first six months. In the last stage i.e.: three months prior to delivery there is an increase in body weight and decrease in activity.

(d) Lactation requires 1000 additional calories daily. The average period six months.

3. Variations due to :

(i) **Body size** :— $E = 152\ (W)\ 0{\cdot}73$ men and
$E = 123{,}4\ (W)\ 0{\cdot}73$ women.

Where E = energy requirement.
W = crude weight.

This formula should be used to calculate calorie requirements of individuals when their activity is normal.

(ii) **Age** :—

In men at the age of 65, the metabolic expenditure is about 20% less than at the age of 25.

In women the decline is somewhat less rapid particularly at the age of 45.

For each decade beyond age of 25, calorie requirement will decline by 5 to 10 per cent. On this basis people aged 45 would require 15 per cent less calories than people aged 25, both groups being comparable in respect of all factors except age.

(iii) **Climate** :—

There is relation between climate and food consumption.

The basic requirement (all other factors being the same) should be decreased by 5 per cent for every 10° above the basic temperature (10°c) and increased by 5 per cent by every 10° below the basic temperature.

In practice this would mean that—

(a) for every 10° above the basic temperature – 160 and 115 should be deducted from the basic requirements of man and woman ;

(b) for every 10° below the basic temperature – same figures should be added.

(iv) **Activity** :—

Investigations have not been conducted on a wide scale. It is difficult to establish scales of requirements appropriate to different activities and even if this could be done such scales would not be of great value in calculating requirements, because similar occupations in different countries and regions call for different degrees of activity for example – mining may require varying amounts of physical effort according to the amount of equipment available.

4. **Children and adults, requirements** :—

The requirements of nursing infants upto the age of six months are included in those of the lactating mother (para 2 – item (d). For infants from six months up to one year the requirement will be 110 calories per kilogram of body weight (1 lb. is 4/10 kilogram).

The recommended allowances are :—

Children.		1 — 3 years.	1200 calories.
		4 — 6 ,,	1600 ,,
		7 — 9 ,,	2000 ,,
		10 — 12 ,,	2500 ,,
	Girls.	13 — 15 ,,	2600 ,,
	Boys.	13 — 15 ,,	3200 ,,
	Adults.	16 — 19 ,,	3800 ,, (males).
			2400 ,, (females).

Note:— No adjustments for body size need be applied to children upto the age of 16.

The note concludes stating that the recommendations must be regarded as highly tentative and open to testing and further research.

Weather Review — For April 1951

RAINFALL DATA

Division	Station	Total rainfall for the month	Departure from normal in inches	Total since January 1st in inches	Division	Station	Total rainfall for the month	Departure from normal in inches	Total since January 1st in inches
Orissa & Circars.	Gopalpur	1·4	+0·7	3·7	Central Contd.	Coimbatore	4·6	+3·0	5·1
	Calingapatnam	0·4	−0·4	1·0		Tiruchirapalli	4·7	+2·3	4·9
	Visakhapatnam	0·8	+0·1	0·8	South	Nagapattinam	5·1	+4·0	6·9
	Anakapalle*	1·5	+0·3	1·6		Adutuari*	1.1	−0·3	1·7
	Samalkot*	2·3	+0·9	2 3		Pattukottai*	2·4	+0·4	4·6
	Kakinada	0·8	+0·2	0·9		Madhurai	6·0	+3·8	6·8
	Maruteru*	0·2	−0·5	0·2		Pamban	8·5	+6·7	13·7
	Masulipatnam	0·7	−0·0	1·1		Koilpatti*	5·7	+2·6	7·9
	Guntur*	4·2	+3·2	4·4		Palayamcottai	2·8	+0·3	7·4
	Agrl. College, Bapatla*	1·5	...	2·0		Ambasamudram*	5·3	+2·0	10·6
	Agrl. Farm Bapatla*	1·9	...	2·6					
	Rentachintala	2·5	+1·3	3·0	West Coast	Trivandrum	3·6	−1·0	7·4
						Fort Cochin	5·9	+1·0	7·9
Ceded Dists.	Kurnool	2·0	+1·3	4·7		Pattambi*	5·2	+2·4	5·2
	Nandyal*	1·1	+0·3	1·5		Kozhikode	3·6	−1·3	4·0
	Hagari*	1·7	+0·7	3·8		Taliparamba*	6·3	+3·9	6·3
	Siruguppa*	0·7	+0·1(a)	0·9		Nileshwar*	4·4	+1·7	4·4
	Bellary	0·5	−0·3	1·8		Pilicode*	4·0	+1·5@	4·0
	Cuddapah	1·8	+1·2	2·6		Mangalore	0·5	−1·5	0·5
	Kodur*	1·2	+0·8	1·5		Kankanady*	2·8	+1·6	2·8
Carnatic	Nellore	0·5	0·0	1·9	Mysore & Coorg.	Chitaldrug	1·2	+0·2	1·8
	Buchireddipalem*	0·6	−0·3	1·1		Bangalore	0·4	−1·2	0·5
	Madras (Meenambakkam)	3·6	+3·0	3·8		Mysore	3·3	+1·0	3·7
	Tirurkuppam*	3·7	+2 3 @	4·4		Mercara	3·4	+0·8	5·7
	Palur*	2·9	+1·6	3·5	Hills	Kodaikanal	19·3	+14·5	26·9
	Tindivanam*	1·8	+1·1	2·0		Coonoor*	12 7	+7·6	22·5
	Cuddalore	2·6	+1·6	3·6		Ootacamund*	8·0	+3·9	8·9
						Nanjanad*	7·3	+2·2	9·2
Central	Vellore	4·4	+3·4	5·3					
	Gudiyatham*	1·8	+1·4	3·1					
	Salem	3·7	+1·8	5·8					
	Coimbatore A. M. O.*	2·4	−0·2	2·7					

Note:—

1. *Meteorological stations of the Madras Agricultural Department.
2. Average of ten years' data is taken as normal.
3. @ Average of eight years' data for Tirurkuppam and nine years' data for Pilicode is given as normal.
4. (a) Taluk office normal is 0. 88″ and rainfall is 0·26″
5. ... Data are not available since the farm is a newly started one.

Weather Review For April, 1951

Thundershowers occurred locally in Tamilnad and in a few places in coastal Andhradesa at the beginning of the month, due to the presence of a low pressure area over North Deccan. This low pressure area became unimportant the next day. The seasonal trough of low pressure over the central parts of India and the northern half of the Peninsula became more marked and a closed cyclonic circulation appeared over West Madya Pradesh on 4—4—1951, causing an in-draught of air from the Bay of Bengal, which also became unimportant the very next day.

Dry weather prevailed almost over the region upto 10—4—1951. Fairly widespread rains occurred in Tamilnad and West Coast due to the appearance of a low pressure area off the Konkan Coast on 11—4—1951, which became feeble on 14—4—1951. On the same day markedly unsettled conditions prevailed in the Arabian Sea in the Laccadives - Maldives region, due to which widespread rains occurred in the West Coast and Tamilnad for two days. These helped preparation for sowing in drylands. The unsettled conditions became less marked on 16—4—1951 but again concentrated into a deep depression on the 19th and weakened into a trough of low pressure off the Kuria Muria Coast on the 22nd and became unimportant after two days.

A low pressure wave was passing over the Camorin area on the 18th and moved westwards through Laccadives and Maldives. This was followed by a discontinuity over Bay of Bengal off Ceylon and Cormandal Coast and this became weak the next day.

Another upper air discontinuity ran fram Lat. 7°N and Long. 77° E. to Lat. 15° N. and Long. 89° E. on the 28th and passed away through the Maldives - Laccadives region on the 30th.

Day temperatures were generally below normal over most of the region during the month except on the 27th when it was above normal in Rayalaseema, Coastal Andhradesa and Travancore-Cochin. Rentachintala recorded 108°F on 26—4—1951 and Cuddapah 107°F on 27—4—1951.

Particulars regarding the noteworthy falls and zonal rainfall during the month are furnished below :—

Serial No.	Date	Place	Rainfall in inches for the past 24 hours
1.	1—4—51	Nagapattinam	3·5
2.	12—4—51	Madras (Nungambakkam)	3·9
3.	do.	Madras (Meenambakkam)	2·6
4.	14—4—51	Kodaikanal	3·1
5.	do.	Palghat	3·0
6.	do.	Nagarkoil	2·7
7.	do.	Madhurai	2·5
8.	20—4—51	Vellore	3·3

ZONAL RAINFALL

Serial No.	Name of Zone	Total Precipitation
1.	Orissa and Circars	Just Normal
2.	Ceded Districts	Above Normal
3.	Carnatic	Far above normal
4.	Central	Far above normal
5.	South	Far above normal
6.	West Coast	Above Normal
7.	Mysore and Coorg	Just Normal
8.	Hills	Far above normal

Agricultural Meteorology Section,
Lawley Road Post, Coimbatore
Dated, 17—5—1951.

M. B. V. N., C. B. M., & M. V. J.

Agricultural College and Research Institute, Coimbatore

LIST OF ADDITIONS TO LIBRARY FOR APRIL 1951.

1. ARBER (A.): Natural philosophy of plant Form. 1st Edn. 1950, Cambridge University Press.
2. BALAKRISHNAN (M. A.): Elements of agriculture. Part I Tamil. 1st Edn. 1950, P. V. Chari & Co.
3. DARWIN (C. D.): On the origin of Species. 1st Edn. 1950, Reprint Walls & Co.
4. DAVIS (Cornellis): Mechanised agriculture. 1st Edn. 1950, Temple Press, Ltd.
5. DUTCHER (R. Adams): Introduction to Agricultural Bio-chemistry. 1st Edn. 1951, John Willy & Sons.
6. FOSTER (A. S,): Practical Plant Anatomy. II Edn. 1949, Van Nostrand Co.
7. HOWARD (A): Agricultural Testament. 1st Edn. 1950, Oxford University Press.
8. LANJOUN (J.): Botanical Nomenclature and Taxonomy. 1st Edn. Chron Botanica, 1950.
9. MALHERBE (I. De. V.): Soil fertility. 2nd Edn. 1950, Oxford University Press.
10. MANN (G. E.): Poultry Breeding. 1st Edn. 1951, U. K. Ministry of Agriculture.
11. Naik (K. C.) and GANGOLY (S. R.): Classification and Nomenclature of South Indian Mangoes. 1st Edn. 1950, Govt. of Madras.
12. RANGANATHAN (S. R.): Colon classification. III Edn. 1950, Madras Literary Association.
13. RUSSELL (E. J.): Soil Conditions and Plant Growth. 8th Edn. 1950, Longmans Green & Co.

Departmental Notifications

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,, Abdul Azeez,	A. D., Anantapur,	Asst. in Chillies, Narasaraopet.
,, Adinarayanamurthi, S.,	Spl. A. D., Ramachandrapuram,	A. D., Avanigadda.
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,, Pandurangan, S. V.,	Agrl. Instructor, Sir Sivaswami Iyer's High School, Tirukattupalli.	Seed Development Asst. in Paddy, Cuddalore.

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,, Udathu Rama Rao,	P. P. A. (Mycology), Tellicherry.

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2. V. Dakshinamurthy,	,,	Razole.
3. M. Satyanarayanamurthy,	,,	Kothapeta.
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5. Gulam Muhammad Sheriff,	,,	Amalapuram.
6. B. B. Vamsavardhanam,	,,	Srikakulam.
7. J. Appalanarasimhan,	,,	Palaconda.
8. R. Krishna Rao,	,,	Pathapatnam.
9. P. Jagannatha Rao Patnaick,	,,	Parvatipur.
10. Y. Shiva Rao,	Paddy Assistant	Ambasamudram.
11. G. Satyanarayana Raju,	A. A. D.,	Tindivanam.
12. V. Appa Rao,	A. D.,	Manjeri.
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2. A. Venkateswara Rao,	,,	Bimavaram.
3. K. Baskara Rao,	,,	Tanuku.
4. Y. Mallikarjuna Rao,	A. D.,	Udumalpet.
5. M. V. Surya Rao,	,,	Ootacamund.
6. Pitcheswara Rao,	,,	Peddapuram.
7. K. Shiva Rao,	Cotton Assistant,	Narasaraopet.
8. Y. Sivaramakrishniah,	,,	Anakapalle.
3. Krishna District :		
1. M. Venkateswara Rao,	A. A. D.,	Cannanore.
2. O. Srinivasa Rao,	,,	Vijayawada.
3. K. Baskara Rao,	,,	Vuyyuru.
4. K. V. Raghava Rao,	,,	Nandigama.
5. S. Adinarayanamurthi,	,,	Avanigadda.
6. T. Madhava Rao,	,,	Gudivada.

Names		To
7. V. Kameswara Sarma,	A. A. D.,	Manargudi.
8. S. Madhava Rao,	,,	Vayalpad.
9. T. Suryanarayanamurhi,	Chillies Assistant,	Guntur.
4. Guntur District:		
1. Satyanarayanan,	A. A. D.,	Guntur.
2. M. Hanumantha Rao,	,,	Tenali.
3. K. Koteswara Rao,	,,	Ongole.
4. S. Vasudeva Rao,	,,	Repalle.
5. K. Bh. V. Ramakrishna Rao,	,,	Guddalore.
6. K. Suryanarayanamurthi	,,	Lalgudi.
7. M. Krishna Rao,	,,	Gobichettipalayam.
8. K. Krishna Rao,	A. D.,	Tenali.
9. K. Gopala Rao,	Cotton Assistant,	Guntur.
5. Nellore District:		
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2. J. Raghevendra Rao,	,,	Atmakur.
3. T. K. Ramachandra Reddy,	,,	Kandukur.
4. M. Malakondeyya,	,,	Kovvuru.
5. P. V. Ranga Reddy,	,,	Sulurpet.
6. V. J. Patnaick,	,,	Musiri.
7. R. V. S. Suryanarayana Raju,	,,	Trichy.
8. B. V. Rama Rao,	,,	Manantoddy.
9. B. V. Gopala Rao,	A. D.,	Sulurpet.
10. A. V. Ramachandra Rao,	A. A. D.,	Villupuram.
11. S. Venugopalaswami	,,	Ponnani.
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2. N. S. Loganathan,	,,	Chingleput.
7. C. M. P. Area, Pattukottai:		
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3. N. Yuvaraj,	,,	Gudiyattam.
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5. V. Veeraraghavan,	,,	Conjeevaram.
6. J. F. George,	,,	Polur.
8. Tanjore:		
1. S. Raghavachari,	,,	Tanjore.
2. S. S. Parthasarathy,	,,	Kumbakonam.
3. A. S. Perumal,	,,	Mayavaram.
4. V. Balasubramaniam,	,,	Salem.
5. P. Bharathan,	,,	Namakkal.

Names		To
9. Tiruchirapalli :		
1. R. Subramania Chetty,	A. A. D.,	Erode.
2. A. R. Bhaskaran,	,,	Trivellore.
3. P. S. Krishnamurthi,	,,	Saidapet.
4. N. Bhanumurthi,	,,	Rasipuram.
5. Sadashiva Shetty,	,,	Coondapur.
6. C. Antony,	,,	Kasargod.
7. P. R. Augustine,	,,	Kulitalai.
10. Madhurai District :		
1. S. Kasiviswanathan,	,,	Madhurai.
2. K. Dinker Rao,	,,	Mangalore.
3. M. V. Panakala Rao,	,,	Nilakottai.
4. P. Krishnamurthi,	,,	Dindigul.
5. G. Sriramamurthy,	,,	Tirumangalam.
6. T. Narayanankutty Nair,	,,	Manjeri.
7. S. Ramasubramaniam,	,,	Sattur.
8. K. S. Muthukrishnan	,,	Attur.
11. Tirunelveli District :		
1. C. Shanmugam,	,,	Tenkasi.
2. K. Krishnamurthi,	A. D.,	Devakottai.
3. S. Rangaswami Reddiar,	A. A. D.,	Srivilliputtur.
4. Muhammad Majadduddin,	,,	Devakottai.
5. S. R. Santhanam,	,,	Coimbatore.
6. K. Srinivasa Rao,	,,	Ambasamudram.
7. K. Sivaramakrishnan,	,,	Wallajah (N. Arcot).
8. S. B. Venkattapathi Raju,	,,	Tiruenlveli.