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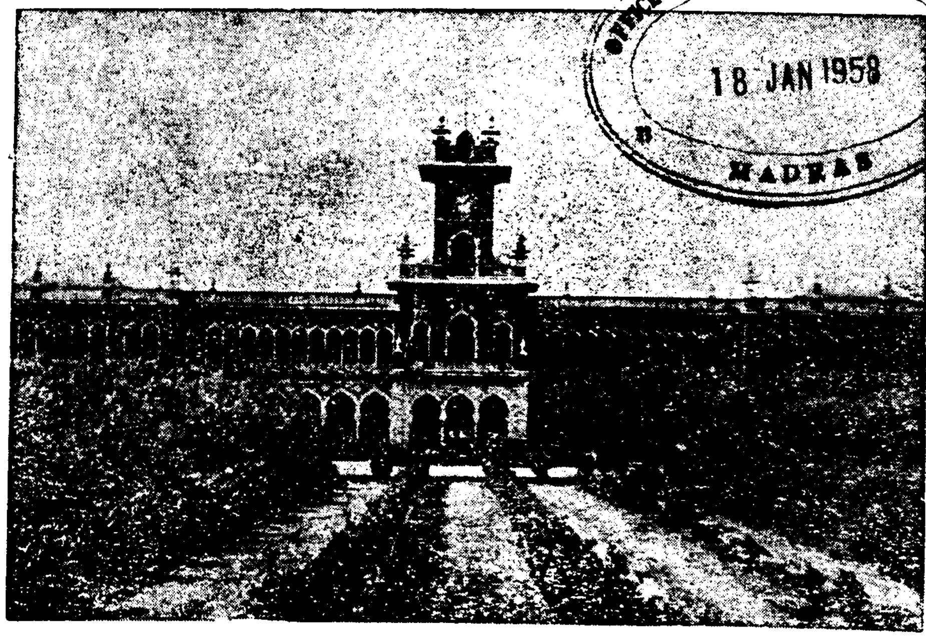

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Editorial

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THE subject of the Symposium held during the Thirtyninth College day and Conference in August, 1956 was 'Modern Trends in Indian Agriculture'. We are glad to publish the papers presented at this symposium, in the present issue. A reading of the papers would show that they have lost nothing of their modernity and topical interest, though published rather late.

The symposium was inaugurated by Dr. J. S. Patel, Additional Agricultural Commissioner, Planning Commission. In his thought-provoking address Dr. Patel dealt with the important role of the agricultural research and extension workers in a welfare state. Dr. Krishnamurthy, in his paper, makes a critical review of our expanding horizons in agricultural education, research and extension.

Sri R. M. Savur has some sharp comments to make on certain kinds of unrealistic agricultural research; we, however, welcome his frank but constructive criticism. The papers on rice and millet research take a bird's eye view of present trends in rice and millet breeding while that on oilseeds recounts the achievements in stepping up oilseeds production. The paper on cotton production and research vividly brings out what has been achieved in the evolution of long staple cottons and in increasing their production. The uses of the atom in elucidating problems connected with crop nutrition are discussed in the papers on agricultural chemistry. Recent advances in plant pathology especially certain aspects of plant wilts are summarised in the paper on plant pathology. The paper on water utilization by crops throws interesting light on this very important problem. On the whole the papers offer rich fare which we are sure our readers would enjoy reading.

OPENING SPEECH

By

Dr. J. S. PATEL, M. Sc. (Cornell), Ph. D. (Edin.),
Additional Agricultural Commissioner, Planning Commission,
while inaugurating the Symposium on Modern trends in Agriculture on 8th August, 1956.

After the attainment of independence, the people of India have given to themselves a constitution based on the concept of a Welfare State and it is, therefore, the duty of the State to see that this obligation is fulfilled. Our people have suffered for centuries and have put up with sqalor, poverty and social disabilities. They look forward towards a rapid progress within the shortest possible time and they are impatient for bettering their living conditions. When the rest of world is advancing fast, the gap between our standard of living and that of the advanced countries of the world is widening daily.

Every now and then the countries in the world are involved in war and the interval between the two wars is utilised for repairing damages and for further advances. The time, therefore, available for developing the country and the improvement of the standard of living of our people is limited. Our financial and our natural resources are also limited but the large human population is both our asset and liabitity.

Concept of Community Development: India's leaders have repeatedly pledged before the people that with the attainment of independence, India's new Government and its resources would be mobilised towards removing the conditions of poverty. With our own leadership and diligent efforts, our leaders thought of building new India by rebuilding its foundation — its 5·58 lakh villages, through determination, self-sacrifice and united group effort. The objective of the Community Development and the National Extension Programme is to assist each village in planning and carrying out an integrated multi-phased family and village plan directed towards increasing agricultural production, improving the existing village crafts and industries and organising new ones, providing minimum and essential health services and improved health practices, providing required educational facilities for children and an adult literacy programme, providing recreational facilities and programmes, improve housing and family living conditions and providing programmes for village women and children. Thus the programme is designed to benefit the entire community and all classes of people who constitute the community. The programme is not confined to economic fields like agriculture and industry but also covers certain basic amenities like roads, schools, suppy of pure drinking water and enviromental sanitation. The programme also covers the social fields by providing for education, cultural and recreational activities, youth and women organizations and development of leadership.

Since in a village all the above mentioned activities cannot be undertaken simultaneously, the particular item of work to be done first is chosen by the people of the village who determine the priorities on the basis of their felt needs. Those who are intimately connected with agricultural development may well feel that the limited resources should be diverted for the development of agriculture. In one village the ryots persisted that their need was for a hospital, though the project staff felt that the investment on a hospital would be unwise in view of the proximitry of another hospital about seven miles away. The project staff found that agricultural demonstrations in that village did not attract the villagers and since the villagers persisted in their demand for a hospital, they were persuaded to undertake the construction of a hospital for women and children. People contributed land and labour and in a short time a hospital building costing about Rs. 10,000/- was built up and a physician volunteered to visit the village once a week. After the hospital was complete the Government desired that the village should build residential quarters for the hospital staff before the Government could agree to post a physician. The villagers constructed the quarters. On the completion of this hospital, which took nearly two years, the villagers suddenly took keen interest in the development of agriculture and the field officers who went to see the hospital were decoyed by the people to the fields and the advance made in agriculture and in the adoption of the Japanese method of Paddy cultivation. This convinced the project workers that there was no short-cut for the development of agriculture and the progress that the village made in one field would help the progress in another. In another village, the villagers took keen interest in establishing an artifical insemination centre and constructed a building for this centre for housing the bulls. After they completed this project they suddenly took a very keen interest in the field of agriculture.

So far Agricultural Departments had been mostly contacting individual farmers but with the development of community spirit in the village, group action develops and only a few leaders need to be contacted for advancing agriculture. Expectations for a higher level of living create motivation for the people to provide required leadership for the village development. To sustain the self-help programme it is necessary to make leaders and village organizations responsible and responsive by entrusting to them the work of planning and implementing the programmes. This essential difference in the approach should be adequately appreciated.

All Development Departments of the Government approach the village through the multi-purpose Gram Sevak or Village Level Worker and the village in its turn approaches the Government through the Gram Sevak. At the moment the country cannat afford to have separate extension workers at the village level in the fields of agriculture, education, public health, etc,, and even if the country could have afforded, the training of such personnel for the village work will prove a formidable job.

Agricultural Extension Worker and the N. E. S.: The Agricultural Extension workers who are to convey their expert recommendations to the farmers through the Village Level Workers should keep in view the following three conditions :-

(1) The needs of individual villages, vary from village to village and the development work is to be planned according to the needs of each village.

(2) Even in a village varying groups of people have varying needs and the agricultural programme should be so designed as to serve the different groups. There are some well-to-do, some poor, some advanced and some backward farmers in each village. The advanced farmers would need more advanced recommendations; the poor farmers would need such recommendations which do not involve large capital outlay. The agricultural programme in the village should cater to the needs of all different kinds of farmers. As the villages develop and as the community programme advances the programme will have to be much more specialised and advanced. With the increase in the income of the farmers and after the first lessons in improved farming have been learnt, the next step would be more advanced and may also involve a larger capital outlay on land development.

(3) Since money is limited, the development programe should largely be based on inexpensive items or items of work which require labour rather than cash investment. Grants and subsidies should

not be given when loans can serve the purpose and the timely repayment of loans is an essential pre-requisite for increasing the volume of credit.

(4) There should be appropriate extension recommendations for all groups and all fields. The gaps in research reccommendations should be filled up by referring the research problems back to the research laboratories.

(5) There should be an adequate organization for catering to the supplies required for the development of agriculture. Seeds, manures, fertilizers, implements, plant protection equipment and chemicals and agricultural credit should be readily available at locations near the village and should reach in time. Since the increasing volume of this supply work will be entrusted to villae co-operatives, in the development of co-operatives the agricultural extension workers will have a vital stake.

Agricultural Research : Each extension worker should locate the farmers' unsolved problems and communicate these problems to the research workers. The extension worker should also study the reasons for the modification by a farmer of the experts' recommendations and should communicate his analysis to the research worker. The research worker must quickly communicate his results of research to the extension worker. His research should be so designed as to serve not only a big land-holder but also a small land-holder who owns one to two acres of land. It would be useful for the research worker to study the reasons for the vast differences in the yields that are encountered even in the same village. The technological needs of a farmer whose yields are 1/3rd of those of the best farmer are different from the technological needs of the best farmer. Since agricultural production is competitive throughout the world, the research worker will have to ensure that the Indian farmer has the same degree of high technological advance available as that of the most advanced countries in the world. The research must ensure that border-line fields which fall between the two specialists are not ignored. Evolution of composite agronomical practices like the Japanese method of Paddy cultivation is likely to be missed unless the integration of the differant factors of production is attempted. While factorial designs enable the research workers to understand the interaction of various factors, a deliberate attempt has to be made to evolve composite practices. As agriculture advances, the recommendations will have to be more and more precise and therefore the contact of the research worker with the field will have to be very close. Very soon it would be necessary to appoint extension specialists in different fields at the district and even at the Block level. In some States extension specialists have been appointed for horticulture, sugarcane, soils, agronomy, and agricultural engineering at the district level. It may even be necessary to provide extension epecialists at the Block level.

In Madras good progress has been made in research, particularly, in the field of improved seeds but the research worker will now have to aim for serving every farmer and serving every field.

Agricultural Education : At the College level there are generalised courses in agricultural education and there is very little scope for specialization. As the country advances it would be possible to indicate the needs of specialists in different fields and the agricultural colleges will have to think of providing specialised under-graduate courses. In the past it has been observed that needs of the country have frequently been been under-estimated. Whenever a new college is opened or admissions have been increased in the existing agricultural colleges, there have been apprehensions regarding unemployment but experience has shown that even after a few years further expansion of agricultural education has been necessary. There is a distinct need for developing post-graduate courses in the Agricultural Colleges in different subjects.

When the Agricultural Schools were opened before the last war it was difficult to fill these schools to their capacity but now with the changed circumstances the need for a large number of agricultural schools has arisen. Some of the states have already established agricultural schools in every district with suitable incentives or stipends. Though it is difficult to visualize the further needs, it is safer to be over optimistic as under–estimates hold up the progress of the country. As farming becomes more remunerative and as agriculture is better organised, more farmers will come forward to receive training at the agricultural schools.

Suitable referesher courses should be organised at the Agricultural Colleges for extension workers so that over a period of two years the entire agricultural extension staff is trained up and brought upto date. The research specialist should devise ways and means for keeping the extension staff continuously up to date.

Duty of Public Servants : The officers in the Agricultural Department have been used to the idea of a production programe where expenditure on minor irrigation, distribution of fertilizers and seeds are expected to produce certain results. Apart from these contributory factors there is the effect of the general change that takes place in the country and in the farmers. There is the effect of the desire on the part of our people to improve and there is also the effect of harder and better quality of work. We should not underestimate the potentiality of a mass-movement producing remarkable results in a most unexpected manner.

The Government servants are like nuts and bolts. They may be fitted one day to a car and another to a plough or to tractor. They have no choice and no feelings. They as good public servants, are expected to carry out the policies that are framed. Our own views and our own ideas should not prove a handicap to public progress.

Since the country is changing fast, the public servants will have to anticipate events and think ahead. He should visualize the agricultural conditions, the land use pattern, the water requirements, the fertility levels that will be reached five and ten years from now on and should set about solving the difficulties that will arise in future.

The capacity of our people to understand, appreciate and to solve the problems is tremendous and let us not under estimate it. Let us consult them and let us participate with them in the discussions of the problems that exist now and that are likely to arise in future.

Modern Trends in Agricultural Education, Research and Extension in India

by Dr. S. KRISHNAMOORTHY,
Head of the Dept. of Agriculture,
Annamalai University.

The aim of this paper is to cover in a general way the trends in Agricultural education, research and extension, which have been noticed in recent years in India.

Agricultural Education : One of the latest trends in Agricultural Education in India is the spread of Agricultural Education itself all over the country in various forms from agriculture in the High Schools upwards to the Ph. D. in Agriculture. The Agricultural College and Research Institute, Coimbatore even a few years ago was the only institution of its kind in the whole of South India and it can be truly called the mother of all Agricultural Institutions in South India. To day there are Agricultural Colleges in Baptala, (Andhra State), Osmania (Hyderabad State) Hebbal (Mysore State) and Trivandrum (T. C. State). In addition to this, the Annamalai University has also established an Independent Department of Agricultural and rural Institutions of Agriculture running three year diploma course have sprung up in Perianaickenpalayam, Coimbatore and in Gandhigram, Dindigual (Madurai District). It is a matter of pride to the Agricultural College, Coimbatore, that most of its alumini have been associated with all these comparatively recent offspring of this Institutions. All of us who are at present working outside the institution have received initially our inspiration for new ideas which we are experimenting with from this great Institution which is one of the greatest of its kind in this country.

Not many years ago, agriculture could be called an untouchable in the Universities of India. This was merely in tune with the patterns of thought which existed in the country as a whole, that for an educated man Agriculture was not a thing which was respectable. So much so, while the Government in each State established it own Agricultural Colleges to train men required for managing their department of Agriculture and for the purpose of award of degrees, and the Colleges were affiliated to the Universities, the Universities by themselves did not take much interest directly in Agricultural Education as such. But in recent years generally after

India attained its independence and particularly after the food situation in the country became a great problem, the whole country's thinking has been revolutionised and tody it might be said in all confidence that agriculture occupies an important place in the minds of the people and in the plans of the Government. The Universities also have begun to take direct interest in Agriculture and Colleges of Agriculture and Institutes of Agriculture have become part of some of the residential Universities in India, such as the Banares University and Annamalai University.

One other thing which is a prominent feature in the thinking of all Educationists in the country is the unanimity with which they have expressed the importance of Agriculture as a subject in the curricula of schools in the country. In the Madras State, more and more schools have been coming up with agriculture as a subject of study in the High school. The Government of Madras have been planning that every school should have Agriculture as a subject with a moderate sized farm attached to it. It is therefore a matter of great satisfication that whatever controversies may be raging around the system of Secondary education, the necessity for agriculture in secondary education has been all the time in recent years, the most non-controvertial of matters.

It is a happy augary that this secondary education particularly with agriculture as an important subject has been tied up with a three year diploma course in Rural Universities, such as are coming into existance in Perianaickenpalayam, in Coimbatore and Gandhigram in Madurai. Situated as the institutions are in perfectly rural surroundings, the student materials coming up for such training are bound to be from rural agricultural communities and these diploma holders from rural agricultural institutions, would in my opinion fill up a gap in the country's agricultural personnel.

Another pattern of Agricultural Education which has come into prominence in the Annamalai University, which is again a University situated in rural sourroundings is the introduction of Agricultural as a Science optional subject like, Botany, Chemistry or Zoology. In the Intermediate and B. Sc degree courses, such courses have become extremely popular and while the graduates of the Annamalai University who take up Agriculture as a major optional Science cannot be exactly equated with the professional degree holders viz. B. Sc, Ag. from the Agricultural College, Coimbatore these courses are however suitable for giving an intensive and practical training in Agriculture and a highly useful agricultural bias to the Science Graduates. Those from the Annamalai University have proved highly useful in teaching of Agriculture in High Schools and for all departments, such as, the Revenue, the Co-operative, National Extension service and Community Projects etc. In addition, with Chemistry or Botany or Zoology, as a major subject these Graduates would also be useful in certain sections of Agricultural Research.

From all the above, it is clear that the patterns of thought regarding Agricultural Education have been undergoing a change and agriculture has come to occupy a pre-eminent place in all stages of education from the school to the University. It might truly be stated that the different patterns supplement rather than compete with each other. It is my personal opinion that the more agriculture gets into different curicula at different stages of boys and girls education, better and better would it be for the prosperity of Agriculture in the country as a whole. Let us therefore foster Agriculture as a subject of study in whatever form in every school, College and University keeping however the basic ideas of Agricultural Education sound and in tune with the needs of the country.

Besides the general patterns of agricultural Education for the last eight or ten years, a lot of thinking has been going on in the country regarding the remodelling of the professional Agricultural degree course. The Government Agricultural leaders and Agricultural educationists seem to think that the practical aspects of Agriculture should receive an even greater emphasis than it does at present. The Agricultural College at Coimbatore has introduced a 6 months-practical Farm training as one of the equirements for the completion of the degree. The formation of the Indian Council of Agricultural Education by the Central Government is indicative of the Government's concern in maintaining high standards of training in Agricultural Colleges in India. Under its auspices it is possible for the heads of Agricultural Institutions to come together and to evolve improved patterns of Agricultural training. A note of caution has however to be sounded at this juncture. While much hard work is expected of an Agricultural Graduate and more and more is being added to his curicula and while the professional agricultural degree course is one of the toughest courses among all professional degree course still the agricultural Graduate is among the lowest paid in the country. This is a matter which requires consideration of all the highest authorities of the Government and from the highest in the Agricultural field.

While what has been said above concerns Agricultural education at the under-Graduate level, some of the recent introductions of Post Graduate courses in Agriculture and its branches are praiseworthy. The Agricultural College and Research Institute has been running a Post Graduate diploma course in Horticulture for nearly 8 years. The Annamalai University has followed it up with a two year Post Graduate degree course leading to M. Sc. in Horticulture. Other Agricultural Colleges in India have already established such courses in other subjects or are on the point of introducing such courses. The Indian Agricultural Research Institute at New Delhi, has for a long time been a Mecca for post graduate courses in Agriculture and allied fields. To meet the needs of the greater agricultural development in the country and to increase poduction and export of all agricultural raw materials and industrial products depennding on Agriculture, more research is needed and hence a large number of Research personnel are needed, and therefore the modern trend of agricultural education at Post Graduate level should be accelerated at a satisfactory pace.

Agricultural Research: One of the most modern and recent trends which are noteworthy in Agricultural Research is the fact that the research worker thinks more and more of the needs of the farmers and the lines of work are more and more in tune with the conditions in the country. While we have no doubt the highest words of praise for the British personnel who were pioneers in the early days of modern Agricultral Research in the country, they could not however be blamed if they had not the adequate background of Agricultural conditions in tropical countries like India. As a result of this, some of the research projects and the lines of Agricultural development were not exactly an improvement for the country's needs. As important examples can be mentioned the agricultural implements advocated by the British for a long time in the country and the projects for breeding of cows with foreign bulls which were unsuitable for the country. Today our Agricultural Scientists understand that their lines of research have to be entirely tuned with the conditions of the country and the economic conditions of the farmer. At the same time they have not lost sight of the fact that we should catch up in the modern lines of Agricultural Research, which have broadly proved useful in advanced countries. The modern use of chemicals of all kinds in the shape of fertilisors, plant, hormones, insecticides, fungicides etc. is receiving every attention from our Scientists. Our young men in the Agricultural Research laboratories are just waiting when they could do something even with atomic energy. The establishment of the first atomic reactor for the whole of Asia, recently in Trombay, provides a happy augury for keeping up the most modern trends in Agricultural Research.

Agricultural Extension: On Agricultural Extension nothing better could be said about some of the things I have had on my mind than what Dr. M. S. Randhawa has said in a recent article on Extension Training Programmes published as a selected article by the latest issue of the Madras Agricultural Journal. It is a good thing that the word 'Propaganda' which used to explain in the past the activities of the District Agricultural Staff, has in recent years been replaced by the word 'Extension'. Somehow or other this word 'Propaganda' began to connote, particularly during the last World War, something different from what the word really meant.

Today one of the modern trends of thought in the country with regard to spreading better knowledge of Agriculture is not merely to tackle the farmer but the family as a whole. It is being more and more realised that in Indian Farming it is not the farmer alone that comes into the picture, but it is a farmer's family as a whole which forms a farming unit. Therefore in recent years in Extension work, the addition of home economics in Extension has been coming in more and more into the plans of the Extension work sponsored by the Government. It is also being realised that one of the best means of spreading better agriculture is to train Village leaders who became centres of the spread of improved practices in Agriculture.

Again one of the most laudable lines of work in Agricultural Extension in recent years has been not to treat agriculture as a sole subject for improvement in rural areas, but with Agriculture as a nucleus to develop all round rural welfare by providing better communications, better sanitation more subsidary industries, more schools, better nutrition, better medical help through all the community Projects and National Extension Service so that the farmer and his family grow as better economic units, on the basis of which alone agriculture can be improved and production raised.

From all these, it is evident, that while there may be some defects in all our plans, and in the modern trends in agricultural education research and extension, we are proceeding on sound lines as far as agricultue is conserned in our independent India.

Farming and the Scientist

by Sri R. M. Savur

So long as man must eat the production of food will be the most basic of all occupations. So long as populations continue to increase more and more food will have to be produced. Since the area of land suitable for food production is limited the continuing aim will have to be ever increasing yields on the limited land available. The Agronomic scientist will be judged not by the fundamental problems he succeeds in unravelling or the pure scientific truths he discovers but by the success of his efforts in increasing yields on the land. Work that is essentially academic can quickly lose its agricultural significance if new principles are not (or cannot) be related in *simple effective economic* terms to the farmer. In agronomic enquiry the farmer should be associated with the scientist for such work can lose much of its value if not immediately and persistently associated with farming practice itself. Since our scientists know little or nothing of farming practice or farming problems nor care to associate farmers with their enquiry, research in this country tends to remain purely academic. This is where research in the U. S. A. or Australia scores over research in this country.

What is the remedy for this state of affairs? The remedy is to speak less about "science for the farmer" and think about the need of a knowledge of farming for the scientist. Only when our scientist learns something about farming can he teach some useful science to the farmer. And out of this association will develop a new philosophy of land use, a philosophy of maximum profitable crop production per acre of land with a minimum of soil deterioration. Before the scientist can teach the farmer how to use the land fully but wisely the scientist should learn how to use the land at all and what prevents the farmer from using all his land fully and wisely. First of all the scientist should cease to believe that the farmer is stupid or ignorant, and conservative. If our kisans had been anything like this they would have ceased to survive; but there is the fact that he has survived two world wars and the strains and stresses produced by them which have spelt innumerable bankruptcies among businessmen supposedly less ignorant and more intelligent.

They may be managing things better at the I. A. R. I., I have no means of knowing. But what is taking place around me makes me doubt whether our experts know their own science thoroughly. Let me cite only one instance to show that my criticism is not due to blind prejudice against agronomic scientists.

Though little or nothing has been done in this country twards the study of the defects and managements of red laterite soils these have been studied thoroughly by soil men and agronomists of the U.S.A. and West Indies. What they tell us should be the starting point of research on these soils in India. The ignorant farmers of the West Coast of South Kanara and Malabar are so well aware of the great need for potash in this soil and the response given by ash that a man would burn his hut if there was no other means of obtaining ash. Yet our experts have been and still are saying that potash is not necessary. Lakhs of rupees worth of nitrogenous and phosphatic fertilisers were stocked by Community Project authorities but not a pound of potassic fertiliser though ash is scarce and of poor and doubtful quality because it is obtained by burning vegetation grown on a soil extremely low in potassium. As if this was not enough a liming experiment on paddy was initiated where doses of 2000 and 3000 lbs. of lime — lime mind you not chalk — were prescribed per acre. Apparently the chemist forgot all about theories and effects of such excessive liming on intake of potassium and other essential metallic ions on soils already highly deficient in potassium, about constant ion effects, antagonism and competition between the metallic ions and such like things which make a world of difference between the results of experiments *in vitro* and *in vivo* in the soil. The conclusion drawn from these experiments was that addition of heavy doses of lime (3000 lbs.) gave a slight increase in the yield of paddy. If after learning this a farmer does not take to liming at this rate he would be dubbed ignorant and stupid forgetting the vital fact that the farmer has to make a living out of the soil.

For myself I have learnt that it is better to depend on myself than on such experts. My study of advances in agricultural science has convinced me that already in various parts of the world enough fundamental and applied research has been done to enable the progressive farmer to increase production many fold. A dozen years ago I started farming on pure sand so barren that it was not growing even weeds to prevent it from blowing away. By putting a low lying plot under a grass and legume mixture *(Brachiaria mutica* and *Sesbania speciosa)* for two years I have been able to raise my yield of paddy from nothing to 3000 lbs. per acre. Ten years ago even with heavy doses of F. Y. M. my sweet potato crop using a local variety of vine gave me tubers no larger than my little finger, By using a complete N. P. K. mixture and an American variety (T. S. T. white) my yield in the last two years were ¾ lb. per foot of row. This year by making my own mixture with a little copper sulphate and magnesium sulphate my yield of tubers averaged 1·66 lbs. per foot of row.

What little increase in production has been attained in the last three years has been entirely due to the efforts of progressive farmers, amateurs like those of Kora Kendra, favourable monsoons, and increased facilities for supplemental irrigation. If this rate of increase in production is to be sustained in the future - and sustained it must be to provide for population increase – our scientists must change their attitude and come out of the splendid isolation of their laboratories and associate with at least progressive farmers to learn from them what are their problems, what prevents them from increasing yields, what are their cultural practices, etc.

Such association of the farmer with the scientist will make the latter realise that breeding of improved strains and varieties alone can effect no increase in production unless they are used along with improved cultural and manurial practices. More importaut it will make the scientist realise the great need for reorientation of ideas of farming in general and enable them to convince the politician that his present muddled ideas of land reforms will not lead to the desired goal of ever increasing production.

I am fully alive to the need for increase in fundamental knowledge. But for food production which will keep in step with the requirements of ever expanding populations what is urgently needed is increase in that type of fundamental knowledge that helps to determine the best practices for a given set of conditions. Cultural improvement of any crop is entirely dependent on advances in cultural practices. The utilization of these advances depends on improvement in implements and equipment. So long as we small farmers have to depend entirely on the wooden plough and the mamooti so long will we be unable to employ knowledge of cultural improvements.

What changes, then, will be necessary in the organisational set up of agricultural research and education if there is to be developed an increase in that type of fundamental knowledge that

helps to determine the best practice for a given set of conditions? Upon this will depend the future of agriculture in this Country. Let me state, for what they are worth, my ideas about the necessary changes.

Firstly, what may be called an "Experimental Husbandry Farm" should be set up on every special soil (the laterite for instance) to act as a sub-station to the existing research stations to provide facilities for experiments by the advisory service. This experimental husbandry farm should be under a Committee of which the farm and the Station Superintendents as also the head of the District Advisory Service will be members in addition to representatives of local Farmers' Forums and other farmers' organisations especially chosen because they are progressive farmers.

Secondly, in future, attention should be given to farm-management studies both in teaching and advisory work, so that the future agricultural advisory service staff may consist of men trained to advise on problems of sound farm management and soil management which will be necessary if farming is to be raised from being a means of subsistence to an industry.

Changing Scenes in Rice Research and Extension

by M. BHAVANISANKAR RAO,
Paddy Specialist &
P. C. SAHADEVAN,
Assistant Paddy Specialist

1. **The Background:** India occupies a unique position on the rice map of the world. In acreage it has the first place with almost 30 percent of the world area under this crop. In production it stands second to China because of the low acre yield; it is one of the lowest on record. Difference in either climatic condition or size of holding cannot account for such poor out-turns as the average for other countries in the tropics (between 21° and 30° latitude) is about 1,650 lb., and the small size of his holding has not been a handicap to the Japanese farmer who takes over 3,000 lb. from an acre of his field. Economic problems however, do exert a strong influence since the largest yields are recorded in countries where enough credit facilities exist and where the lands are mainly owner-cultivated as in Japan, Italy or the U. S. A.

Lack of such facilities or interest on the land which in turn led to indifferent attention to both 'nurture' of seed and 'nature' of the crop contributed not a little to the sad tale of India's declining yields and deficits through the decades. Madras shared the same fate and for over two centuries the State had to fall on imports of rice from Orissa and Bengal in earlier years and later from Burma, Siam and Indo-China.

The first change in the scene was in evidence when the Department of Agriculture was organised in Madras, as in other States of India. Scientific achievements in the fields of breeding improved varieties and use of fertilzers made much headway ever since, in line with other states and countries. Absence of a co-ordination between the different States was however, noticed and this has since been overcome by the establishment of a Central Rice Research Institute at Cuttack. Extension work too was not given the attention it deserved with the result that the State faced a food crisis, familiar in long history, during the Second World War. By this time the country attained independence but the battle had to be continued on the food-front. The Grow More Food campaign initiated

in 1942 was intensified in 1949 with a determined effort to attain self-sufficiency in food, further impetus to this being given by the decision of the Government of India to stop all imports by the year 1951. A new stage was thus set for an all-out effort to increase production intergrating all the efforts under the First Five Year Plan.

It is against this background that the modern trends in rice research and extension in the country and the State have to be viewed.

2. **The Five Year Plan:** The First Five Year Plan fixed a target of production of three million tons and this target was reached in the fourth year of the plan itself. The factors that contributed for the increased production were improvement in land and irrigation facilities on the one hand and the use of fertilizers and improved seeds on the other, A target of five lakh tons is tentatively fixed for the Second Five Year Plan and this is sought to be achieved under the followlng heads.

I	Irrigation and land improvement	1·5 lakh tons
II	Improved seeds	1·5 ,,
III	Manures	2·0 ,,
	Total	5·0 ,,

Of direct concern to the Agriculture Department under item I are the River Pumping Scheme and Filter Point Scheme which together are expected to cover 33,000 acres. An additional area of 80,000 acres of virgin land and one lakh area of current fallows is expected to be brought under tractor cultivation as part of the Land Improvement Scheme.

3. **Research Paves the Way:** Improved seeds in all the major varieties are now available and annually 200—250 tons of nucleus seed are distributed. Useful ancillary characters are also synthesised in certain cases. Nevertheless the range of cultivation of a majority of the improved strains is admittedly low. Soil-climatic differences continue to restrict their range but recent experiments have shown as in the case of GEB. 24, TKM. 6 and Co. 25 that cosmopolitanism exhibited by these could be exploited further and genic factors that are seen separated in the many different forms now under cultivation, could be brought together at least in the case of the more important agronomic characters.

Evolution of medium and short duration strains resistant to 'blast' is one of the latest items of work in this direction. All the available stocks (over 2,300 in number) are proposed to be tested out for their resistance as preliminary to further breeding. It is also on the programme of the Food and Agricultural Organization that resistant varieties existing in the collection of different countries are to be tried in all other countries where 'blast' is prevalent. Verietal differences in resistance to the disease like Foot-rot are also noted and comparative study of the disease including those caused by physiological factors, is one that has come up for consideration in recent years.

Studies on insect resistance too have assumed importance. Varietal difference to the incidence of pests is already noted in the case of the paddy gall-fly. It must be possible to detect similar resistance to other pests as well. Biological control of pests like stem-borer is still another item of work that is receiving attention. A big step in the direction is the decision taken by the Food and Agricultural organization to establish a research centre in India.

Dormancy in short term rice, which is an unusual feature is achieved in the strain TKM. 6. Isolation of varieties capable of response to high fertility is another important aspect of synthesis, the work on which is progressing on an international scale. One of the factors contributing to such response is resistance to lodging and separate programmes to induce the character in as many strains as possible have begun in most of the States in India. Stiff straw combined with a quick and tall growing nature would incidentally lead to the production of strains that withstand submersion. Problems of drought and alkalinity have loomed large in the programme of breeding improved strains and in breeding for resistance to drought, wild species are used as parents in hybridization.

On the side of nature we already know the optium conditions of growth with reference to seed rate, age of seedlings, spacing and varietal requirements. The practical value of major nutrients N, P and K, their quantity and proportion in the organic and inorganic forms as also the time and method of their application, are well established. Minor elements and deficiency diseases as well as the balance of macro and micro nutrients are subjects that are now receiving wider attention. Foliar diagnosis and tracer techniques for detecting the role of major and minor nutrients have already yielded interesting results. Investigation on soil micro biology has proceeded apace and studies on the influence of alage in fertilizing rice have begun in Madras also. On the physiological side, thermo and photo induction studies are initiated in some States especially at university laboratories and a comprehensive programe of work is contemplated at the Central Rice Research Institute, at Cuttack. The need for more genetical and cytogenetical investigation is being increasingly felt with reference to sterility and the linkage group in rice.

These fundamental aspects apart, yield has been the major point in view in all breeding and agronomic programmes. Wide interest is now shown in the quality of the produce, hulling percentage volume expansion on cooking, nutritive aspect, as also the hitherto undefined qualities of taste and flavour. Nutritional studies initiated by Dr. Srinivasan at the Indian Institute of Science are being continued elsewhere under the auspices of the Medical Research Council.

Designing of implements for the different operations pertaining to rice cultivation has come to the scene with the introduction of the Japanese system of cultivation. Cultivators themselves are evincing increasing interest in this direction.

4. **Extension Gains Tempo:** *New method introduced:* The advance made in paying greater atention to rice production during the First Five-year plan has increased by 40 per cent. The acre yields too have registered steady increase. The following figures bear it out.

Year	*Rough rice (pounds per acre)*
1940—41	1,529
1945—46	1,501
1950—51	1,328
1953—54	1.593
1954—55	1,695

There was already the drive for increased production. The cultivators became manure-minded and were in search of fertilizers for quick effect. To add to this, three years ago the Japanese system of cultivation was introduced. Reports of phenomenal increase in yield as much as the novelty of the name continue to facinate the farmers of India as much as those in this State. This has been partly responsible for the extensive use of improved seeds and fertilizers.

The Departmental strains have now covered 50 percent of the area under rice and are expected to cover another 25—30 per cent by the end of Second Five-year Plan. The prospect is indeed bright since the newly introduced Village Seed Farm Scheme, has increased the spread as never before. According to this Scheme primary seeds are distributed at one pound per acre under rice in a village, to selected cultivators who multiply and distribute the seeds in the next season to other cultivators on exchange basis. The supply of nucleus seed may present a problem but this may not be insurmountable with the establishment of as many as 400 State Seed Farms under the Five Year Plan. Regional Seed Testing Stations for rice are also to be established.

The different aspects of rice and rice cultivation comprising genetical and agronomic investigations are now lending themselves to a new integrated approach and this in itself augurs well for the future. Better co-ordination and co-operative efforts are now discernible. The Institute at Cuttack has forged ahead to serve as a connecting link between the States in which many co-operative trials are beginning to be taken up. The proposed appointment of Liaison Officers in each State by the Centre is a welcome step in this direction.

In this State, a 25-year Plan for rice research and extension has been recently drawn up, implementaion of which is expected to give Madras the lead in all round development.

5. **Synthetic Rice in the Air:** Whatever be the merits or demerits of synthetic rice from a socio-economic point of view, its production is the greatest tribute that technologists pay to rice. It is nothing but a blend of flours of tapioca, groundnut and wheat in the proportion of 60, 15 and 25 percent respectively. Still another improvement made is to give a coating of calcium caseinate to the synthetic rice to make it richer in calcium and protein. It would be useful to know its chemical composition.

Chemical composition

Particulars	Natural rice Raw milled %	Synthetic rice %	Synthetic rice coated with calcium caseinate
1. Moisture	12·5	10·5	9.8
2. Protein	6·6	11·2	14·4
3. Fat	0·5	1·9	1·9
4. Carbohydrate	79·6	73·8	71·0
5. Calcium	0·01	0·05	0·22
6. Phosphorus	0·12	0·14	0·15
7. Iron (mg.)	1·8	2·9	2·8
8. Vitamins (mg.) (Thiamin, Nicotinic acid and Riboflavin)	1·33	3·99	3·84

A processing plant capable of producing 10—12 tons of synthetic rice per day costs Rs. 4 lakhs and the cost of working Rs. 50 per ton. The many advantages claimed for the synthetic rice, like rapid cooking, keeping quality, nutritive value, etc., may probably weigh in its favour for commercial expolitation in the near future.

6. **Mechanization:** Mention of synthetic rice leads to a consideration of mechanization in rice cultivation. The purchase of war-surplus tractors by Government and hiring them out to farmers have put many into the fields. The Japanese rotovator and inter-cultivators have also come into the picture recently. Labour-saving and time-saving implements are a boon to cultivators in areas where labour is scarce and obviously much remains to be done in this sphere. Machines for transplanting and harvesting have to be designed to suit Indian conditions. How far mechanization would gain momentum in our country depends on the scope and content of our policy of industrialisation And this would mean that in the field itself the cheap labour should give place to simple and efficient machinery at all cost. That way alone, an all round efficiency can be maintained and bountiful production ensured for a vast section of population to whom rice means life.

Modern Trends in Indian Agriculture: Millets and Pulses Improvement

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MILLETS

Introduction: In the United States of America, Union of South Africa and in Australia where agriculture is highly advanced, millets are grown as feeds for poultry and pigs. The converted meat is consumed as human food. Unlike these countries, in India, millet grains are used for human consumption and the straw as cattle feed. Under these circumstances, it is not surprising tht the best quality of millet grains and high quality of millet straw in the world. are found in this country.

Madras and Bombay are the two states in this country to specialise in millet breeding work from an early date. The contributions to Sorghum breeding at the Agricultural Research Station, Coimbatore in Madras under the lnadership of G. N. Rangaswamy Ayyangar, Millets Specialist are the most extensive and comprehensive is the tribute paid by the American Year Book of Agriculture 1936 with reference to the fundamental Research work dont at the Madras State (Martin 1936). The other states which have large areas of millets are following suit. For a long time the all-India policy for millets inprovement was lukewarm as greater stress was paid for the improvement of wheat, paddy, cotton, sugarcane and oilseeds. A recent review of the Scientific research done on an all-India basis pointed out the inadequate attention shown to these poor man's crops though they occupy a large area in the country.

The Indian Council of Agricultural Reserch convened an all-India Millet workers Conference at Kolhapur in 1955 when all the millet breeders of India along with the leading millet cultivators met and discussed the lacuna that is to be filled up by research on an all-India basis. As a result of thse recommendations, reorientation of millet breeding has been made on the following lines in the Madras State.

Modern Trends In Millet Research: Millet improvement in the Madras State is in progress for the past three decades. The three major millets viz; Cholam *(Sorghum* spp.*)*, Cumbu *(Pennisetum)*, Ragi *(Eleusine coracana)* and five minor millets, Tenai *(Setaria italica)*, Varagu *(Paspalum scrobiculatum)*, Samai *(Panicum miliare)*, Panivaragu *(Panicum miliaceum)* and Kudiraivali *(Echinochloa)* have been studied intensively. Millets being localised crops in the various zones of the State, it was found that strains evolved at Coimbatore (Central Research Station of the State) did not do well in the various tracts although they were best performers for the variety at the Coimbatore centre. This necessitated the opening up of a number of zonal research stations in the state (Krishna Rao & Subramaniam 1950). The intensive work done resulted in 23 strains in cholam, seven in Cumbu, five in Ragi and six in minor millets. Thus we have improved strains suitable for the entire state except the Ariyalur tract for which evolution of strains is in the final stages of trials. For a breeder three decades ago, this would have been the ultimate goal. But thanks to the advancement of science and scientffic breedig, it can be said that these 30 years of work would form only the basis for further improvement which is being visualized.

Though millets have specialised themseives for zones, recent trials have shown that some of the strains evolved by hybridisation have a tendency to suit a number of zones. This indicates that it is possible to evolve universal state strains in Cholam, Cumbu and Ragi by hybridisation of selected parents and testing a number of purified progenies in the entire state and fixing a strain with sufficient plasticity. The evolution of such strains would facilitate easy multiplication and rapid spread of improved strains.

Previously it was presumed that if the duration of the millet crop was shortened the yield also would tend to be lower. Trials during 1955 disclosed that one of the very short duration types (85 days) of irrigated Cholam, strain Co. 12 evolved at Coimbatore is capable of giving a very high yield of 6,000 lb. of grain under heavily manured conditions, The high yield has been found to be due to the capacity of the strain to utilise the manure efficiently. The study of such high fertility strains needs further exploitation as the country is steadily becoming manure conscious.

The nutritive value of millet grain has not been studied properly from genetic and agronomic angle. A variety of white Ragi cultivated in the Mysore tract was found to contain a high rhizobial nodules. Research work on the above lines has been taken up in the two important pulse crops of the state namely redgram and blackgram.

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Modern Trends in Cotton Production and Research in India

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India, at present, is the second largest cotton growing country in the world being only next to the U. S. A., in acreage. In production, however, it takes the third place, the first and second ranks being occupied by the U. S. A. and the U. S. S. R., respectively. As estimated from the figures of 1954–'55, the area under cotton in India is 18·3 million acres and the production is placed at 42·98 lakh bales. Towards the world's totals, the country contributes about 23·7% in acreage and 11·5% in production.

Owing to World War II and partition of the country in 1947—'48 a great shortage of cotton production was created in India, while the demand for raw cotton continued to increase since almost all the mills were located in the Indian Union itself and further development of more mills caused increase in spindlage. Therefore, urgent steps were taken to increase the area and production of cotton in the country to achieve self-sufficiency and save foreign exchange. The "Grow More Cotton Scheme" was launched by the Government of India in 1950—'51 and all the cotton growing states were requested to take part and targets were fixed for the country and every State. The scheme was incorporated in the First Five Year Plan in 1951—'52. The targets fixed were 18 million acres and 42·29 lakh bales. Since then steps were taken to increase the area and production as per the items fixed in the plan and a steady increase in area and production was achieved as seen below :

Year	Area in million acres.	Production in lakhs of bales (of 392 lb. lint)			
		Long staple (7/8" and above).	Medium staple (below 7/8" and above 11/16").	Short staple (11/16" and below).	Total
1950—'51	14·55	6·84	14·48	8·39	29·71
1951—'52	16·20	9·18	12·23	9·92	31·33
1952—'53	15·69	9·05	13·95	8·31	31·31
1953—'54	17·18	14·20	16·62	8·83	39·65
1954—'55	18·35	15·87	18·86	8·25	42·98

Year	Production in lakhs of bales (of 392 lb. lint)				
	Area in million acres.	Long staple (7/8" and above).	Medium staple (below 7/8" and above 11/6").	Short staple 11/16" and below).	Tatal
Average 1950—'55	—	11·03 (32)	15·23 (43)	8·74 (25)	35·00
1945—'50	—	3·83 (17)	11·48 (51)	7·21 (32)	22·52
1940—'45	—	6·19 (17)	14·61 (41)	15·26 (42)	36·06

N. B: The figures in brackets give the % on total production.

It is seen that the targets, both in area (18·35 lakh acres) and in production (42·98 lakh bales) have been achieved even one year ahead of the completion of the plan period in 1955—'56. It is also seen that in the matter of production, there is considerable increase in long and medium staple cottons and the percentage of short staple cotton to the total production is very much reduced. The contribution of Madras State for 1954—55 is 8·72 lakh acres and the 2·71 lakh bales, in the plan period.

The target fixed under the Second Five Year Plan ending with 1960—61 for the Indian Union is 20·4 million acres and 55·86 lakh bales, the share of the Madras State being 11·74 lakh acres and 5·57 lakh bales. It is thus seen that the trend of cotton improvement is towards self sufficiency in the First Plan period by expanding the area under cotton and increasing production.

At present India is importing about 6 to 7 lakh bales of long staple cotton from Egypt, Sudan, East-Africa, Peru and the U. S. A. During 1951—'52, a quantity of 12·40 lakh bales was imported and this figure has declined to 6·20 lakh bales in 1954—'55. The Government of India is now permitting to import only cotton of a staple length of 1-1/16 inch. As regards exports, since they are subject to quota allotment, only certain short medium staple cottons are allowed to be exported, like Bengal *Deshi*, Oomra *Deshi*, Mathio, Cocanadas etc., to countries like United Kingdom, U. S. A. Europe etc. The export in 1951—'52 was 1·99 lakh bales and 3·19 lakh bales in 1954—'55 and varied from year to year.

As regards the mill consumption of cotton the trend was as follows:

Year	Lakh bales	
	Indian cotton	Foreign cotton
1951—52	29·54	11·34
1952—53	35·90	8·89
1953—54	38·60	7·53
1954—55	41·24	6·46

The trends are for consumption of greater quantities of Indian cotton and there is a steady decline in consumption of foreign cotton. Of late, loose cotton is being consumed by mills and the trends show increase in consumption from 2·61 lakh bales in 1952–53 to 3·59 lakh bales in 1954–55. In Madras State there is large consumption of loose cotton and in 1954–55 it was 2·05 lakh bales as against 1·50 lakh bales in 1953–54.

The most important trend in the increase of production is the yield of cotton per acre. As it may not be possible to increase the area indefinitely, the only possibility lies in adopting the measures which gives greater yield per unit area. In India cotton is mostly grown as a rainfed crop and the yields of the crops grown on varying types of soils and rainfall are subjected to vagaries of the monsoon. As against a total area of 18·3 million acres the area under irrigated crop is only 1·7 million acres. Attempts are therefore being made to increase the area under irrigated cottons. The average yield of irrigated cotton in India is estimated to range from 200–250 lb. of lint per acre and in the unirrigated crop it ranges from 60 to 100 lbs. When compared to the yields of U. S. A. with 300 lb. lint per acre and Egypt with 700 lb. per acre the overall yield of 93 lb. per acre is too low. Attempts are therefore being made to improve the yield per acre by distribution of seeds of improved varieties, application of manure, irrigation, adoption of improved cultural practices and control of pests and diseases. By such method the yields of lint have increased from 93 lb. to 116 lbs. per acre, in 1954–55. It may be stated that out of 18 million acres of cotton in India about 9·4 million acres (52%) are covered by improved seed in 1954–55. This is expected to contribute an extra quantity of about 23,500 bales if we reckon that improved seed gives 10 lbs. of extra lint per acre.

The estimated extra income earned by the growers was Rs. 1412·4 lakh. In Madras State about 65% of the area was covered by improved seed and 225 lakhs of Rupees was realised as extra income.

Another important trend in the production of cotton was to switch over large areas from the unremunerative short stapled '*deshi*' to more remunerative and adaptable varieties of American cotton. This is particularly possible in recent years as there is increased scope of irrigation and suitable varieties of American cotton are available for cultivation as unirrigated crop. Such advances are seen in Punjab, Bombay. Madhya Pradesh and Madras. American varieties like Cambodia 2, Madras Uganda 1, P. 216F. Laxmi 134–Co. 2–M, 0394 are now grown in these respective states both as rainfed and irrigated crops. In Madras, out of three and half lakhs of acres under Cambodia about 1·5 lakh acres are grown as unirrigated crop in Salem, parts of Coimbatore, Madurai, South Arcot etc. Tracts receiving adequate rainfall and lighter soils are suited for such cultivation.

On the research side, great importance is attached to improvement in quality and yield per acre of cotton, in order to enable the cultivator to get the maximum cash return per acre. Notable achievements have been made in all the cotton tracts of the country and progressive improvements shown as a result of the tireless efforts of the breeder. As a result the quality and yield (particularly the ginning percent) of cotton are changed from the original short staple, low ginning cotton with low spinning value to one of long and medium staple cotton, with a higher ginning and better spinning cottons. The duration of the crop was much reduced and the loss from pests and diseases considerably minimised by the evolution of resistant varieties. Great encouragement is being given for the evolution of extra long staple American cottons and special purpose cottons like Sea Island to reduce the imports of foreign cotton.

In Madras, the charactor of both the American and *deshi* cottons was considerably changed as a result of progressive improvement. In the case of the American cotton, the original Cambodia with a ginning percent of 32, a staple length of 7/8" and spinning 30 counts was changed to one possessing a ginning percent of 35, a staple of 15/16" and 34 counts with the evolution of Cambodia 2. This hardy jassid resistant strain was responsible for its rapid spread even as an unirrigated crop and replaced the original inferior *deshi* cottons. Further efforts of the breeder finally led to the evolution of Madras Cambodia Uganda 1 (known in trade as Rajapalayam) in summer areas of the Southern districts of the state. This strain had a ginning percent of 36, staple length of one inch or more and capable of spinning 44 counts. On account of its shorter duration of six months it gained rapid popularity in the summer area for growing under wells in rice lands and on account of its superior quality and shorter duration it also became popular in the winter Cambodia area and gradually replaced Cambodia 2. Thus, it was possible to bring the entire Cambodia area of about 3·5 lakh acres under one cosmopolitan strain. In trade, this cotton gained great reputation and the consuming mills were able to get greater quantities of long staple cotton. As this variety is placed outside price control by Government of India on account of superior length of one inch and over, the cultivators were benefitted by higher valuation, particularly for the certified produce. Further achievement in the direction of quality and earliness resulted in the release of Madras Cambodia Uganda 2, for the summer area, which gained rapid popularity on account of its earliness by a fortnight, higher yield, a staple length of 1–1/16" and a spinning value of 50 counts. This replaced M. C. U. 1 very rapidly. Improvement in staple length and ginning percent is in progress and strains like 9030, which are capable of spinning 50 counts, with a ginning percent of 38 and resistant to pests like pempheres and jassids are being made available for the winter area to replace Madras Cambodia Uganda 1. In the summer area selections like Lo–315, Lo 313. 0484 etc are available and these possess staple length over 1–1/16" and are capable of spinning 50 counts or more, with good strength.

Quality improvements with better ginning value have been made in the *deshi* cottons of the state. The inferior Uppam with low ginning of 23 to 25% and poor spinning value of 12 to 16 counts was almost eliminated and the local Tinnevellys were replaced by Karunganni strains. The position of local Karunganni with a ginning percent of 30, staple length of less than 7/8" and 24s was improved with the release of Karunganni 2 and Karunganni 5, which are superior in ginning by 1 to 2 percent. The staple length was pushed up to 15/16" level and the spinning to 29 to 30 counts. Further improvement in wider range of adaptability, resistance to diseases, better yield, ginning percent, staple length and spinning resulted in the evolution of a new strain 6186–9 which proved to be superior to both Karunganni 5 and Karunganni 2 in all respects. It possessed a ginning percent of 33, a staple length of nearly an inch and a spinning value of 34 to 36 counts. Thus, it was possible to recommend a cosmopolitan strain in the *deshi* cotton also for the unirrigated tracts of the state.

Quality improvement associated with other factors like ginning, earliness, resistance to pests and diseases have also been achieved in other states. The L. L. types, P. 216F and H. 14 in Punjab; 134-Co. 2H and 170-Co. 2 obtained from interspecific crosses of Asistic American Cottons in Bombay; 394 of Madhya Pradesh, M. A. 5 in Mysore, Gaorani strains of Hyderabad, etc have all contributed towards the improvement in quality of the Indian cotton. The attempts to introduce special purpose cottons like Sea Island Cambodia x Sea Island hybrids will also go a long way in reducing the import of extra long staple cottons.

Like the other parts of the World, the question of improvement of cotton by transferring desirable qualities from the wild cottons to the cultivated varieties is engaging the attention of cotton breeder in India. Wild cottons like *G. anomalum*, *G. thurberii*, *G. raimondii*, *G. armourianum* are useful to bring desirable qualities like resistance to pests, diseases and drought, fineness of lint, strength of fibre etc. Such long range work is proposed to be included in the programme of the All India Regional Research Stations to be established in the country very shortly.

In the Second Five Year Plan it is proposed to export cotton and earn foreign exchange. The question of increasing the production of harsh cotton in the country for export to foreign market is engaging the attention of the Government of India. As this cotton fetches as much price as the quality cottons like 'Rajapalayam' and as there is great demand for this cotton in foreign countries for various industrial uses, the cultivators will stand to benefit by growing such cotton in suitable areas.

At present, cotton seed is almost exclusively utilised for cattle food and the cotton seed is therefore not given the due value it deserves. In the U. S. A., the seed is crushed and the by-products obtained like cotton seed-oil, cake, etc., are utilised for various industrial uses and the cake is fed to cattle, utilised as manure etc. In the valuation of cotton seed the oil value is considered and better values are offered. Crushing of cotton seed to extreet oil has commenced in India in the recent years in Punjab, Madhya Preadesh and other places and researches are in progress to assess the oil value

of various cottons. Likewise, linters are extracted by special machines in the U. S. A. and the same is utilised for various purposes. In India, such machines are just being tried. Thus the cultivation of cotton not only benefits the growers by supplying raw cotton in the shape of lint but better monetary returns are obtained by enhancing the value of seed on the basis of oil-content, linter value etc. In Madras, the cultivation of cotton in rice fallows, has shown possibilities of getting about 7000 lbs. of supplementary organic matter, in the shape of plant residue, to the succeeding paddy crop, in addition to lint and cotton seed.

Other recent developments like organising co-operative societies to multiply seed of improved varieties on large scale and distribution of the same to the cultivators, establishment of small gin units in the villages to enable the cultivators to get the cotton seeds readily and easy transport of lint to the distant market centres, establishment of regulated cotton markets to benefit the cultivators to get fair price for their produce, are in progress in the various States.

In order to protect the quality of cotton, control the movement of cotton, and price of cotton, to prevent malpractices like deliberate watering, bad ginning, legislations like cotton Transport Act, Cotton Control Act, Market Act, Ginning and Pressing Factories Act etc., are being introduced in States where such provisions do not exist, in the larger interests of the cultivators, trader, and manufacturer.

From the foregoing accounts it is seen that the trends in cotton in India is on the progressive side and there is every hope that ere long India will occupy the foremost rank, not only in area, but in production, and quality as well and above all in bringing a much larger income to the cultivator and also in helping the country in earning foreign exchange by the export of raw cotton, cloth, yarn and cotton seed products.

percentage of protein (13 %) but its yield was poor. By hybridisation, a high yielding white Ragi strain with high percentage of protein has been synthesised. Chasatio, a variety of sorghum of Bombay has been reported to contain 17 % of protein as against the normal of 10 % (Naik & Abhyankar 1956). This variety and other types with high nutritive value will form suitable parents for inducing higher protein content in the improved strains of the State. Preliminary studies done at Coimbatore have shown that environment like season, fertility of soil and the quantity of soil moisture, have been found to play a part in increasing or decreasing the protein content of millet grain. A study on these aspects would go a long way in enriching the millet grain and thus improving the general standard of health in this countary where protein food is scarce.

Nearly 60% of the cattle of the state subsist on millet straw which is preferred to that of paddy. Not only the quality of the millet straw is better but also the quantity is more due to the fact that a larger proporation of straw as compared to grain is obtained in the case of the three major millets. In Cholam, the quality of many of the existing strains has been improved by infusing juicy stalks by hybridisation (Krishna Rao & Mahudeswaran 1955). Evolution of a grain-cum-fodder strains is also possible in the other two major millets and work on this line has been taken up.

Cholam has been known to be a highly drought resistant crop. In the United States of America it has been named as crop–camel as it is able to come up with the minimum quantity of water. A wild relative of Cholam, *S. halepense* is known throughout the world for its super-drought resistance and its tenancity to persist in highly arid regions (Rangaswamy Ayyangar & Ponnaiya 1941). Since it has 40 chromosomes (2n number) it does not cross readily with the cultivated sorghums which have 20 chromosomes. By repeated and persistant trials it was possible to cross *S. halepense* with Periamanjal cholam *(S. durra)*, the popular rainfed variety at Coimbatore (Krishnaswamy *et al.* 1938) The first generation was partially sterile but back-crossing with the cultivated parent has improved its fertility. The progenies of these crosses possess a high degree of drought resistance inherited from the wild parent. Evolution of super-drought resistant economic sorghums with *halepense* blood has been taken up.

In Cumbu practical utilisation of hybrid vigour has been achieved at the Millet Breeding Station, Coimbatore and this is the first record in the world for this crop. (Krishna Rao *et al.* 1951).

Two medium duration hybrids X. 1 and X. 2 have been evolved and they are under distribution. Although these hybrids are giving very high yields the seeds have to be replaced every year. This involves enormous cost and has hampered the progress of seed distribution in this state. A new technique of utilising hybrid vigour by the use of synthetic varieties has been successfully made in maize in America. The synthetic varieties which consist of six or more parent–combinations maintain their vigour for at least three generations and it is enough if the seeds are replaced once in every four years. Evolution of a synthetic variety in Cumbu has just been taken up and the results achieved will make utilisation of hybrid vigour felt in the entire state.

Evolution of pest and disease resistant strains have given encouraging results. Types resistant to the Cholam fly *Atherigona indica* have been fixed (Ponnaiya 1951). A high yielding Striga resistant Periamanjal Cholam *(S. durra)* has been synthesised by hybridising economic Periamanjal Cholom with an African type Bonganhilo which is found to be highly resistant to the parasite but possessing low yield and poor quality of grain. Rust resisting Cumbu and Tenai types have been isolated and their resistance under various conditions are being studied (Ramakrishnan & Sundaram 1955 and 1956). The resistant types will be used for improving the existing strains by hybridisation.

PULSES

The main source of proteinaceous food in the vegetarian diet of the Madras State are the pulses. The production of pulses in the State is very low, and work on the improvement of the crops for high yieid has been in progress. As a result of the work done, one strain in each of redgram *(Cajanus indicus)* Bengalgram *(Cicer arietinum)* and greengram *(Phaseolous aureus)* has been evolved. Release of improved strains of blackgram *(Phaseolus mungo)* and horsegram *(Dolichos biflorus)* is in the final stages. Unlike millets, pulses havé sufficient plasticity and are able to accomodate larger tracts.

Future Trend of Work: As in the case of millets, the genetic and the environmental factors that affect the protein content of pulses have to be studied for enriching their nutritive value. The pulses crops are also useful as rotation crops as they increase the fertility of the soil by forming root nodules. Gentic and environmental factors have been found to influence the formation of these

Modern Trends in Indian Agriculture with Reference to the Cultivation of Oilseed Crops

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India is one of the major oilseeds producing countries in the world and it will not be incorrect to say that oilseeds occupy a very prominent place in the agricultural and industrial economy of the State. The all India acreage is 29·3 million with a production of 53 lakhs tons and the major oilseed crops viz. groundnut, gingellyand caster cover an area of 20·3 million acres, producing 40·5 lakhs tons. In the Madras State they are cultivated in an area of over 20 lakhs acres with an annual production of 8·23 lakhs tons. The area of coconut in India is 1·53 million acres the world acreage being 8·4 million. In this State it is grown in an area of 5·5 lakh acres, producing 1,200 million nuts.

Crop improvement work on the major oilseed crops of this State, is over two decades old. Within this period marked improvement on several aspects of cultivation of the crops has been effected and these may be classified under the following sections. (i) Evolution of improved strains through selection and hybridisation. (ii) efficient agronomic practices, (iii) effective plant protection measures and (iv) development work. A brief review of the achievements in Oilseeds improvement is presented here.

I. Evolution of Improved Strains: (a) *Groundnut:* Four high yielding strains representing long and short duration types have been evolved by pureline selection. Pureline selection undertaken in the bold seeded varieties has resulted in isolating four strains suitable for the table. As a result of hybridisation work undertaken with selected purelines, a dormant bunch strain (A. H. 6481) has also been evolved. Four long duration semispreading cultures, capable of giving more than 20% increased yield over the local spreading variety and suited for mechanical cultivation are under field test. The improved strains are grown by the cultivators in an area of 4 lakhs of acres resulting in an additional imome of Rs. 1·5 crores.

(b) *Gingelly:* Three high yielding strains have been evolved by selection and hybridisation suitable to definite tracts and seasons. These strains are grown in an area of about 80,000 acres bringing an additional revenue of Rs. 16·8 lakhs.

(c) *Castor:* Four high yielding strains, three annual types and one perennial type have been evolved by selection and hybridisation. The strain Co. 1 is rich in oil (55%) and thrives best at elevations of 1,500 to 4000. ft. A technique for the maintenance of vigour and purity of the strains has also been evolved. The improved strains are grown in about 4,000 acres and the additional income works out to Rs. 55,000.

(d) *Coconut:* The production of the hybrid between the tall and dwarf varieties is the first attempt in the annals of breeding of the coconut and it has been a great success. The hybrid plants not only come to bearing early, but also bear heavily.

II. Efficient Agronomic Practices: (a) *Groundnut:* The economic spacing for a raifed crop has been determined as 9″ x 9″ for the spreading type and 6″ x 6″ for the bunch type corresponding to a seed rate of 80 lb. and 120 lb. respectively. Recent trials by increaing the spacing between rows and reducing the spacing within the rows of the spreading groundnut have shown that the yield is not reduced even if the spacing is either 24″ x 3″ or 18″ x 4″ and this modification in spacing facilitates intercultivation with labour saving implements and helps in reducing cost of cultivation. Application of potash and phosphoric acid in higher doses (75 and 50 lb. respectively per acre) over a basal dressing of cattle manure recorded significant increase in yields, Application of 2 to 4 cwt. of lime per acre in lime deficient soils, helped proper development of pods. Growing groundnut mixed with cotton, castor, redgram or cholam is found to be more remunerative than growing groundnut as a pure crop or as a mixture with other crops. Growing cereals in rotation with groundnut was found to be beneficial.

(b) *Gingelly:* The optimum spacing for the rainfed and irrigated crop has been determined as 9″ x 9″ and 1′ x 1′ respectively. In a trial to determine the optimum time of sowing of the irrigated (summer) crop, it was found that early sowing (February or early March) results in good growth of the plants and maximum yield.

(c) *Castor:* The economic spacing for the medium and long duration types was found to be 3′ x 3′ and for the short duration types 1′ x 1′. The proper stage of harvest has also been determined.

(d) *Coconut:* The benefits of systematic cultivation and manuring of the crop have been established. A minimum of three ploughings once in April—May for sowing green manure, a second time in August—September for incorporating green manure and a third time in November—December for ploughing in the ash, should be given. About 10,000 lb. of green manure per acre from a green manure crop grow *in situ*, and for each tree 4½ lb. ammonium sulbhate and 20 lb. of ash, or any other potassic fertiliser preferably muriate of potash per year form the optimum manure. *Calapogonium mucunoides* has been found to be an excellent green manure cumcover crop for coconut.

III. Plant Protection Measures: It is very necessary to adopt efficient control measures against pests and diseases. For groundnut dusting with DDT. 5% at 20 lb. per acre twice or thrice has effectively controlled the Surul pest and resulted in higher yields. Spraying ¾% bordeaux mixture or dusting sulphur at 15 lb. has reduced the incidence of Tika leaf spot disease and increased the yields. dusting BHC. 5% at 10 lb. per acre for gingelly was found to be very effective against the shoot webber caterpillar which is the most common and destructive pest of this crop.

The semilooper caterpillar in castor can be controlled by dusting BHC. 10% in the early stages and spraying DDT or BHC when the caterpillars are grown up.

For coconut spraying Gueserol 550 on the crowns of trees has been found to be effective in controlling the black headed caterpillar and to reduce the incidence of Rhinoceros beetle.

IV Development Work: To provide a continuous supply of nucleus seeds of groundnut and castor for organising primary seed farms, four Zonal Nucleus seed farm centres are being run. The nucleus seeds of the four groundnut strains are being multiplied in 190 acres, and castor strains in 10 acres. The Oilseeds Development Scheme envisages an additional production of 70,000 tons of oilseeds at the end of the Second Five Year Plan period by spreading improved strains, by intensive cultivation methods, effective control measures against pests and deseases and by the extention of area.

By adopting the several improvements effected so far, on the four oilseed crops the substantial monetary benefit to the agriculturists of the State that could be achieved has been estimated to be 5·18 crores of rupees as shown below:—

	Additional production in tons.	Value in Crores of Rupees.
1. Spread of improved strains	... 30,000	1·73
2. Intensive cultivation and effective control measures against pests and diseases	... 15,000	0·79
3. Extension of area	... 25,000	1·40
4. Intensive cultivation and manuring of coconut	... ...	1·26
	Total	5·18

Based on the criteria fixed for judging mother palms, seednuts and seedlings vigorous selection is practised in the tall variety of coconut which is recognised to be the most economic and safe for large scale planting. Under a special scheme financed by the Indian Central Coconut Committee nearly a lakh of selected seedlings are supplied annually from the nurseries enough to plant 1,400 acres. These seedlings, when they come up to normal bearing, are expected, on a modest estimate, to bring in an additional production of 20 nuts per tree per year or a total additional production of two million nuts valued at 4 lakhs rupees. This additional income of Rs. 4 lakhs per year increases in arithmetic progression due to the planting of one lakh of seedlings each year and thus by the end of 25 years the income to the State through the extension of area under coconuts would reach one crore of rupees.

Work on Improvement of the Crops Taken on Hand and are Awaiting Solution: (a) *Groundnut:* Evolving forage types, white seeded and other economic types, fixing the best cultural treatment involving minimum expenditure are some of the important problems that still await solution on this crop. Cytogenetical and physiological studies initiated recently are expected to throw light on the genomic make up and nutritional requirements respectively. The study of the problem of seed dormancy is another aspect that is being pursued from the physiological and gentical background. For the last three years, work on the devising of suitable machinery for the cultivation of groundnuts has been taken up under a separate scheme financed by the Indian Central Oilseeds Committee.

(b) *Gingelly:* Evolving cosmopolitan and economic types, evolving high yielding long duration types suitable to the central and southern districts, and determining the optimum manurial and cultural treatments are items of investigation that are engaging attention.

(c) *Castor:* Evolution of short duration types and determining optimum cultural and manurial treatments are under way. The expolitation of hybrid vigour in this crop has been successfully utilised in the U. S. A. and a techinque of producing hybrid seeds on a large scale has been evolved. This item of work is proposed to be taken up in this State for stepping up production.

(d) *Coconut:* The determination of the best combination of parents capable of giving the most vigorous and economic hybrids is an item of investigation that has been engaging attention.

At the end of the Second Five year plan period, when the results of the schemes are expected to be made available, and the targets in the development programme would have been achieved, the additional income to the cultivators would increase appreciably.

Modern Trends in Indian Agriculture : Plant Pathology

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Introduction: Plant diseases constitute one of the greatest obstacles to efficient and steady agricultural production. While the study of plant pathology has progressed by leaps and bounds in foreign countries, its progress in India, though not of the same magnitude, is still, by no means megre. Considerable headway has been made on the fundamental work relating to soil borne pathogens especially of Fusariose wilts and the information now available is of immense value for planning our future programme of research on sound lines. Furthermore the evolution of disease resistant varieties by breeding and the ready availability of a variety of fungicides, antibioties, other chemicals equipment etc. for plant protection work have to a large extent revolutionised Indian Agriculture. Of late the radio-active isotopes have also entered the field of agriculture and offer great promise for future development of Indian agriculture. The modern developmental trends in plant pathology have been mostly on these lines and a brief account of the same is presented in this paper.

Soil-Borne Fusaria: The soil-borne diseases caused by different apeciea of *Fusarium* are important. In recent years considerable attention has been paid to the study of the mechanism of wilting in the infected plants. The conception of vivotoxins as explained by Dimond and Waggoner (1953) has led to a new orientation to the methods of approach to the study of wilt diseases. The recent researches conducted in India and elsewhere have indicated that the emphasis has shifted from the purely quantitative and qualitative routine investigations of soil mioroflera to one of biological and biochemical approach. It is further observed that a closer understanding of the physiology of wilted plants is essential in understanding the host parasite interaction and the consequential changes in the external and internal symptomotology of wilted plants. The actual mechanism by which wilting occurs has been the subject of considerable controversy and two theories are generally put forward to account for the wilting phenomonon viz the vessel plugging theory and the toxin theory. Evidence in support of each are presented by research workers adhering to the 'respective theories; but, in the present state of our knowledge, it is difficult to subscribe categorically to one or other of these views.

Experimental evidence by many workers indicated that the succeptibility of plants to diseases particularly to infection by root disease pathogens is conditioned to a considerable extent by their nutrition (Waiker and Hooker, 1945, Walker and Foster 1946). The control of wilt diseases caused by vascular Fusaria has been reported by amending the infested soils with trace elments especially Zinc and manganese (Sarojini) 1951 and Sulochana 1952). Recent work by Gaumann (1951) with wilt toxins has also indicated that the degree of damage caused by these toxins depends upon the nutritional status of the host, the under nourished being the worst affected. It is reported by Sadasivan and his associates (1954) that the application of many trace elements has brought about profound changes in the soil microflora and the consequent effects on colonisation, survival and pathogenicity of several Fusaria. Investigation carried out by them using wilt sick soil over a pH range of 4–8·3 have shown that the addition of Fe and Mn added individually and in combination to wilt infested soil reduced survival of Fusaria, the Fe Mn combination being superior to individual elements.

Extensive chromatographic studies on the distribution of various constituents in roots and shoots of resistant and susceptible varieties of cotton have shown that cystine was consistently present, besides the other constituents in the resistant varieties whereas it was absent in the susceptible varieties. The possibility of cystine in the resistant varieties chelating with Fe in the host and rendering the iron unavailable for forming the complex with the toxin which appears to be a prerequisite for toxigenic wilting has also been suggested. The important role of chelation of phytotoxins with heavy metals *in vivo* and *in vitro* in the mechanism of Fusariose wilts of plants has been emphasized by several workers. Investigations carried out in Madras have indicated that chelating agents offer a method of wilt control through the removal of free trace elements in susceptible hosts and heavy metal chelation in pathological wilting.

Greater emphasis has been laid on pH changes in soils since pH has now come to be regarded as an important factor in the mobilisation of ions particularly of heavy metals for plant growth and general microbial activity in soils (Stiles, 1946). It is well known that suitable adjustment of pH of the soils has been used for many years for the control of diseases incited by certain soil borne pathogens.

It is thus seen from the foregoing account that future work has undoubtedly to be one of intensive study of the physiological relationships of the pathogene and the host *in vivo*.

Antibiotics: The phenomenon of antagonism or antibiosis among microorganisms dates back to the early days of bacteriology. In earlier years studies were made on mixed infections, accidental contamination of cultures, the effects of one organism or its metabolic products and even attempts to utilise them for disease control all represented a series of uncordinated observations rather than a system which would fit into a new and important branch of science. The new 'antibiotic age' dates from 1938–39 only when a series of co-ordinated studies were made in several laboratories throughout the world. New antibiotics are constantly being discoverd and several of them have already found important applications as chemotherapehtic agents. Many diseases that could not be combated previously have been found to lend themselves readily to therapy. By constant research it has become possible to step up their yield considerably. The potency has also been increased through selection of strains and improvement in culture technique. As the techniques were perfected mass scale preparations were easily undertaken and now several antibiotics have been made available at considerably reduced cost. In recent yeare phenomenal control of several destructive diseases of crop plants has been reported by various workers. To cite a few instances the following may be mentioned. Gregory *et al.* (1952) reported control of damping off of alfalfa seedlings by spraying actidion. Laben and Meitt (1952) found that Helixin, an antibiotic produced by *Streptomyces* sp. was effective in controlling early blight of tomoato when sprayed at a concentration of 6. 5 mgm/ml. Brian *et al.* (1951) have demonstrated that griseofulvin, an antibiotic obtained from *Penicilliam nigrum* acted as a systemic fungicide and prevented infection by *Botrytis cinerea* on lettuce and *Alternaria solani* on tomato. Brian (1952) reported that Gilotoxin another antibiotic obtained from *Trichoderma viride* acted as systemic fungicide in tomato plants and checked infection by *Alternaria solani*. These citations serve to emphasise the tromendous progress made in recent years in the development of a new branch of chemotherapy comprising the utilisation of antibioties frequently referred to as 'antibiotic therapy'. In this connexion it must however be mentioned that although the use of antibiotics offers a fruitful line of investigation for the control of plant diseases the efficacy of these products is to be ascertained by actual experimentation on different crops under our conditions and then specific recommendations are to be made.

Disease Resistant Varieties in Agriculture: The need for the control of plant disease is becoming increasingly recognised all over the world. Among the control method developed, the discovery of fungicides, antibiotics, chemicals and their use, no doubt, marks a distinct advance in the development of scientific agriculture. But such direct methods of control are not of universal application and are bound to be restricted to a few crop deseases only. But by far the most practicable and economical method is the production of disease resistant crop plants combined with other desirable agronomic qualities. This method is no doubt a long range and time consuming process but in the long run is the most effective and feasible method. The control of the disease by the evolution of disease resistant varieties is further complicated by the existence of physiological races of fungal pathogens produced in nature by hybridization, mutation or otherwise. It is a well known fact that a variety known to be resistant to a particular disease in a locality does not always remain resistant and succumbs to the disease in due course. It is, therefore, evident that there can be no end for the evolution of disease resistant varieties and it shoud be a continuous process. But still accomplishments in this line are many and notable advances have been made in obtaining rust and smut resistant varieties of cereals, wilt resistant tomatoes, flax, corn, cabbage, cowpea, mosaic resistant tobacco, legumes, blight resistant potatoes root-rot resistant sorghums, mildew resistant cucumbers and many, others. In india also considerable advance has been made in this line and several destructive diseases like paddy blast, black rust of wheat etc. have been effectively tackled by the evolution of disease resistant varieties.

Although several diseases have been effectively kept under check by breeding disease resistant varieties studies relating to the exact nature of resistance, the various factors governing resistance, the effect of environment on those factors, the physiology of the host in relation to the pathogen etc. require intensive study. Recent investigations of paddy blast disease in this state on the factors for disease resistance have revealed that the silicification of epidermal cells was associated with the resistance to the disease. Similarly morpological charactors like hairinness, presence of bloom, number of stomata per unit area, thickness of the cuticle and epidermis etc. have been correlated with disease resistance in plants. In certain cases the presence of certain organic constituents like acids, esters, tanins, oils etc. in the host plants were found associated

with resistance. During recent years, therefore in all studies relating to disease resistance more emphasis is laid on correctly determining the factors responsible for disease resistance and then superimpose them on the varieties having other desirable agronomic qualities. Further in all breeding programmes for disease resistant varieties, the prevalence of the physiologic race flora should be borne in mind.

Radiation and Radio - active Isotopes: The use of atomic energy for the development of agriculture, although of recent origin, has already made striking progress. The ready availability of radio isotopes of a large number of elements has opened up the possibility of initiating a multitude of fundamental investigations which will lead to greater efficiency in production and utilization of agricultural products. It has been known for many years that radiations cause heritable mutations in plants and animals. With the advent of the atomic energy several kinds of radiations have been initiated and mutants are produced at considerably shorter time. Further the frequency of the mutation is also increased by the use of atomic power. Pathogens of crop plants are also susceptible to mutation and it is possible to produce strains of reduced virulence by suitable radiation which may prove to be of immense value in the control of plant diseases.

The effect of radiation has been studied in great detail with reference to plant diseases, The bacterial wilt in apples, Fusariose wilt in tomato, brown rot in stone fruits and diseases due to nutritional and mineral deficiencies such as chlorosis and necrosis have all been reported to be controlled by proper radiation. Arresting the growth of parasitic plants in fruit trees such as twining of cuscuta on mango has also been recorded. It has been reported that radiations are useful in determining the maximum virulence of plant pathogens and also in the development of newer fungicides. Radio - active elements have been made use of in inducing resistance to oats against rust disease. Besides these, the radiations and radio active isotopes are being utilised for food preservation through sterilization. Thus it is evident from the above citations that the use of radio-active isotopes for the investigation of plant pathological problems is an entirely new development and how far these observations could be translated into practical use under Indian conditions is a matter to be investigated by the future scientists, biologists and agriculturists.

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Modern Trends in Fruit Preservation

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Introduction: Although the subject for today's symposium is 'Modern, trends in Indian Agriculture', I shall confine myself to 'Modern trends in Fruit preservation'.

Fruit Preservation Industry in India: Fruit preservation was not a profitable enterprise so far due to the high cost of fruits and sugar and for want of capital. One of the main objects of the five year plan was to achieve substantial industrial development during 1951-56. Taking the industrial aspect, the trend is towards establishing more factories and also cottage scale industries which would utilize the surplus fruits that might otherwise go to waste and thereby encourage the fruit grower and the businessman. The industry aims at producing a variety of fruit products and make them available to the general public during the off-season at a cheaper rate. It is well known that malnutrition among the people can be combated by distributing fruit products like tomato juice among the school children and also by making the fruit products available to the public at cost price.

Fruit Products Manufactured in India: Fruit products such as synthetic beverages, syrups, shirbats, vinegar, brewed or synthetic, pickles, dehydrated fruits and vegetables, squashes, crushes, cordials, barley water, barelled juice, ready to serve beverages or any other beverage containing fruit juice or fruit pulp, jams, jellies, marmalades, tomato ketchup, sauces, preserves, candied and crystallized fruits and peels, chutneys, canned and bottled vegetables frozen fruits and vegetables, aerated waters containing fruit juices or pulp, and other items related to fruits and vegetables are manufactured and sold but due to the exhorbitant rates, they are not within the reach of even the middle class. In the household it is a common practice to prepare products like pickles, dried vegetables and fruits, jams, preserves cheese, mango lether, fruits preserved in brine, jack fruit and sweet potato pappadams and such other products. The aim in fruit preservation is to prepare nutritive products of good keeping quality, good taste, possessing the characteristic flavour of the original fruit. Besides the products are to be attractive, cheap, easy to prepare, profitable, involve less of labour and encourage thrift. This can be facilitated by the use of modern scientific methods, equipment, machinery, good packing, and transport facilities.

Modern Trends in the Preparation and Preservation of Fruit Products:
(a) Jams, jellies, marmalades preserves, and chutneys: The techniques and methods adopted in fruit preservation have undergone certain changes. The modern trend in Germany is to do away with preservative or to restrict their use to the minimum. Years back it was a common practice to preserve jams by covering their top surface with a coating of wax. This practice has gone out of existence. The use of chemical preservatives to prevent spoliage of such fruit products was also in vogue. Now the practice is to prevent spoilage by making the sugar concentration of the product reach 70 percent. The products such as jams, jellies and marmalades are poured into sterilized bottles, closed air-tight and sealed. Such products keep for a long time. But the keeping quality can be assured if the bottles are processed in water or steam for a short time. The fruit control order has laid down the specifications for different products. The specifications for jams say that there should be at least 45% of fruit in the jam and that the total soluble solids in the final product should be at least 68%. It is said that dry or canned fruit, preserved pulp or juice may be used. Pectin derived from fruit may be added. The use of preservative is allowed. The order requires that the use of dry fruit should be prominently shown on the label. Combining fruit pulp with pectin or apple juice is becoming a more general practice in the commercial manufature of fruit jam. Similarly for jellies the minimum fruit content is to be 45% and the total soluble solids in the final product 65%. The use of preservative is allowed but not the use of an artificial sweetening agent. Commercial pectin has come into rather a widespread use in the making of a jelly. Its addition should be declared on the label. The jelly is to be called synthetic jelly. At one time commercially prepared jellies were preserved generally by the use of sodium benzoate. Since public sentiment has turned against food products containing preservatives, manufacturers have adopted pasteurization. Such jellies need not be concentrated to a high sugar content and so the saving in sugar content and so the saving in sugar may pay for the added cost of pasteurization. For preserves, the fruit portion is to be 55% and the total soluble solids 65%. Preservative is allowed. For fruit chutneys, the minimum percentage of fruit required in the final product is 40, and the total soluble solids 50. Preservative is allowed.

(b) Juices and squashes: Juices and squashes are preserved by one of two methods either by pasteurization or by the addition of a preservative. Two preservatives are in use, pottassium metabisulphite and sodium benzoate. The former is added at the rate of one oz. per 100 lbs of the total product and the latter at the rate of 0.1%. The latter is used for coloured squashes, since the sulphur dioxide formed in the former bleaches the natural colour of the coloured squashes, like tomato ketchup. Usually squashes from limes, oranges, mango and pomegranate are preserved by the addition of a preservative. Squashes from fruits like the plum, cashew apple and pine-apple can be preserved either by pasteurization or by the use of a preservative. By pasteurization is meant that the squashes are heated to a temperature of about 180 to 185°F, poured into sterilized bottles, closed with crown corks and then either pasteurized at a temperature of 180°F or sterilised in boiling water for half an hour. It can be preserved by the addition of a preservative as well. The juice thus prepared keeps well. The flavour is well retained. The juice which is kept for settling is decanted, filtered and then used in the preparation of cordial. The preserved juice can be made use of in the preparation of cordial. The preserved juice can be made use of in the preparation of squashes and other beverages like Lime-barley water. It was a common practice in early times to prepare clear squashes devoid of pulp. Though such a product may keep better, the trend now is towards squashes with fruit pulp. Fruit pulp has food value and should not be filtered off. Moreover since it gives a realistic appearance to the squashes, it is customary to introduce some juice sacs in lime and orange squashes when the product is bottled. Certain fruits like wood-apple, plum, guvava and certain varieties of mangoes do not have any juice. So the pulp is diluted or in certain cases heated with water to prepare the juice. From apricots, peaches and tomatoes, pulply juices are prepared. Consequently the raw or the cooked fruits is passed through some sort of pulper to give a puree like liquid, containing a large proportion of finely divided solids. At present most of the juices preserved in the market are coloudy or pulpy. At one time it was customary to separate tomato juice from the insoluble solids by discarding the juice. This practice has since been discontinued, as this leads to lower yield and injury to the quality. Orange juice was at one time prepared by crushing and pressing the whole fruit and separating as much of the essential oils from the juice as possible by centrifugal separators. It is now believed that essential oils from the rind should be excluded as it spoils the flavour of the product. Recently

in other countries fruit juices have been preserved by cold storage for shipment over a distance of 500 miles in glass lined tank cars by precooling the juice to about 28°F and placing in well insulated tanks of several thousand gallons capacity. Orange syrups are used as a base for carbonated and non-carbonated bottled beverages. In both cases the syrup or concentrate is diluted with water before bottling and then preserved with sodium benzoate. According to specifications in the fruit control order a beverage which does not contain 10% of fruit syrup, juice, squash, cordial or crush shall be described as a synthetic syrup. The minimum quantity of fruit juice required to be present in syrup is 10% in crush, squash, cordial lime-barely water 25% in unsweetened juice 85% and in ready to serve beverages 5%. Similarly the minimum quantity of total soluble solids in the above beverages have been fixed at 65, 55, 40, 30, natural, 10 and 10 percent respectively.

(c) Tomato products: According to food regulations, it is said that tomato juice may contain finely divided insoluble solids from the flesh of tomatoes but should be free from pieces of skin, seeds, bits of coarse tissue and any extraneous matter. The specifications for tomato juice is that it should contain atleast 5 percent of total soluble solids. The minimum quantity of soluble solids required to be present in tomato ketchup is 25%. It is said that tomato ketchup if filled boiling hot, need not be sterilized, but in actual practice the product is sterilized in boiling water for half an hour. At one time it was preserved with 0·1% of sodium benzoate. It is not now used in any of the leading brands of ketchup. The present day manufactures depend upon the acetic acid of the vinegar and the preservative action of the spices to prevent spoilage after the bottle is opened. Canned tomato juice is very generally used in restaurants and hotels for flavouring and for soups. Hot sauce and chillie sauce are much in favour in recent years. Canned tomato juice is very popular. In former years it was customary to store tomato pulp in wooden barrels with distilled vinegar or sodium benzoate as a preservatiue. This method has since gone out of existence and has been replaced by sterilization in 5 gallon or No. 10 cans.

(d) Bottled and canned products: With regard to bottling and canning, syrup strengths have been worked out for each variety and grade of fruits. So also the temperature and time of sterilization. For vegetables the optimum time, temperature and pressure required for processing is worked out. Now the vegetables are

processed at 240°F corresponding to 10 lb. steam pressure. Only the time is varied for different vegetables the fruit control order has set up a standard for the quality and fill of bottled and canned fruit and vegetable products. The use of preservative is not allowed and so also any artificial colouring matter except in the case of cherries and strawberries where harmless food colours are allowed.

(e) Dehydrated products: Primitive method of drying which was practiced in India consisted of exposing fruits and vegetables to the sun for a number of days. According to the modern process dehydration is done by passing a current of hot air through them, the degree of heat employed and other details of the operation varying according to the nature of the food stuff. The dehydrated products are ready on boiling in water for three or four minutes. Methods, treatments, safe-finishing temperatures, have been worked out for the dehydration of fruits like apples, apricots, bananas, cherries, berries, dates, figs, grapes, peaches, pears, plums, prunes and vegetables such as beans, cabbage, carrots, sweet corn, onion, peas, potatoes, sweet potatoes, pumpkin, spinach and tomatoes. Modern forms of dehydration have opened up opportunities for the development of the industry on a wider scale. Besides drying the whole fruit it is possible to preserve even fruit juices in a dehydrated form. Like powdered milk, powdered lemon juice and powdered mango juice are now prepared without affecting much of their food values.

Modern Equipment and Machinery: Science has made good progress with regard to equipment and machinery. Labour saving devices have been invented for crushing, pressing, extraction of the juice, filtering, grading, cooking, concentration, filling and sterilisation. For example, for the extraction of juice from tight skinned oranges, the cone type or the electrically worked juice extractor is used. For loose skinned oranges the screw type of juice extractor is used. For limes the lime squeezer or basket press is used. For lemons the mix master is in use. In the case of mango, the pulping machine is used for the extraction of the pulp. Superior type of sealing machines has been invented. For sterilizing cans in retorts under steam pressure continuous agitating pressure sterilizer has been perfected.

Containers: Both glass and tin containers are in use as containers for preserving fruits and vegetables and the products prepared. Screw type bottles with metallic lids or air-tight glass top bottles are used successfully. The metallic lids are coated with lacquer to prevent metallic contamination and corrosion.

Regarding the cans, in the present century, several important advances have been made. Some of these are invention and perfecting of the sanitary double seam can, improved baked enamel coatings, cellulose lacquer linings, special wax linings, zinc oxide containing enamels for corn cans and the recently developed cold rolled plate which is very resistant to corrosion. The fruit control order has specified the containers for the different fruit products.

Colours and Essences: Harmless food colours like carmel, cochineal, chlorophyll, saffron and some synthetic organic food colours, fruit essences and flavouring materials are allowed in the preparation of fruit products in order to make them attractive and appetizing.

Conclusion: The intelligent application of scientific methods and principles in the fruit and vegetable product industries has been comparatively recent. Although notable advances have been made in the knowledge of the fundamental principles underlying the processes used in these industries, there remains to be done a vast amount of research before the manufacturing processes are placed upon a high plane of efficiency. The opportunites for investigation by Chemists, Physicists, Bacteriologists and Engineers in the fruit and vegetable field are almost unlimited.

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Modern Trends in Indian Agriculture

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Introduction: When the implementation of the various suggestions included in the Second Five Year Plan has just begun in the country, it is but proper that the Department of Agriculture should take into account the modern trends in Indian Agriculture. Naturally any research plan, more so of that of Agriculturre, should have as its ultimate object the fulfilment of the various aspects of national development incorporated in the current five year plan. India being mainly an agricultural country, her prospects depend chiefly on the sound plan of agricultural research.

With the end of March, 1956 the first five year plan period was successfully covered. The level of food production in 1955–56 has increased by 15% when compared with that of 1949–50. In the first plan period irrigational facilities, supply of manures and seeds of high yielding strains of cereals and reclamation of land were considered and improved considerably in the country. In the second five year plan, the following targets are aimed at in agricultural production :—

Commodity	Unit	Estimated Production in 1955–56	Tragets of additional production	Estimated production by 1960–61	Percentage increase
Food grains	Millon tons	65·0	26·0	91·0	40·0
Oilseeds	do	5·5	1·5	7·0	27·3
Sugarcane (Gur)	do	5·8	1·6	7·4	27·6
Cotton	Million bales	4·2	1·3	5·5	31·0
Jute	do	4·0	1·0	5·0	25·0

How it is possible to achieve these targets and how the modern trends in Indian Agriculture are favourable for this great achievement are briefly discussed in this paper.

Increased Production in Crop Yield: The main crux in agriculture is a steady maintenance of high and profitable level of crop porduction. It, in turn, involves various factors like proper maintenance of soil fertility, evolution not only of high yielding but also disease resisting strains of food and commercial crops, improvement of irrigational facilities, adoption of improved agronomic practices and prevention of heavy damage to crops by sudden and violent changes in weather.

Soil Fertility: 'Good soil means good crop'. This is an old adage. Maintenance of soil fertility implies foremost the maintenance of soil structure and then replenshing the soil with the essential plant nutrients that have been depleted from the soil due to the previous cropping.

The structure of the soil can be maintained only if all the causes of soil erosion are successfully controlled. The problem of prevention of soil erosion is now being actively solved in twenty-two States in close collaboration with the Central Soil Conservation Board. Four Regional stations have been set up for intensive research and imparting training to technical personel. Well-planned work is already progressing in this line. In the second five year plan an amount of rupees twenty-five crores have been provided for soil conservation work. A detailed and comprehensive programme, drawn up already envisages the possibility of effectively adopting soil coservation measures over a total area of three million acres of different types of land.

An indispensable adjunct to successful conservation is judicious afforestation. The Russians have already instituted a twenty year programme and they are at it now. In India also creation of shelter belts has already been taken up. The importance of afforesation is already gaining ground and the farmers are realising that they must know their forests. In the second five year plan an amount of Rupees Twenty-five crores has been allotted for this purpose with the intention of having afforestation in an area of 6,00,000 acres.

In short, the problem of soil conservation has gained great importance in the trends of modern Indian Agriculture.

Apart from the protection to the structure of the soil, supply of adequate manurial ingredients to the soil is very essential. Intensive research in this direction is engaging the attention of agricultural research workers in every State in India.

The mass-scale production of the various manures and fertilisers is also engaging the attention of the Central Government. The production of ammonium sulphate and superphosphate have respectively increased from 46 and 55 thousands of tons in 1950–51 to 380 and 100 thousands tons in 1955–56 as a result of the adoption of the measures included in the first five year plan. These limits will further increase respectively to 1600 and 600 thousands tons in 1960–61, i. e., at the end of the seond five year plan period. When the production is stepped up, timely availability of fertilizers can be actually had at reasonable costs, perhaps well within the means of the ordinary farmers.

Designing of effective agricultural implements to maintain the fertility of soil in an advantageous condition for successful crop production is also being considered in agricultural research.

Evalution of high yielding and disease resisting strains: It has been the policy of the agricultural research workers in the various States to improve the yielding capacity of cultivated crops by careful breeding. Achievement has been remarkable in this direction. Of late the problem of producing disease resistant strains is being considered with all seriousness and realisation of itsecconomic importance. The paddy Specialist of the Madras State has successfully evolved two short duration cultures 6517 and 6522 of cross Co 13 x CO 4 and one culture 6538 of cross GEB 24 x CO 4 for blast resistance. In the case of long duration varieties he has already released two blast resistant strains, namely, CO 25 and CO 26. Similarly the Millets and Pulses Specialist is engaged in evolving blast resistant ragi strains, rust resistant Tenai and so on. Likewise other crop Specialists also are actively engaged and fairly successful in evolving disease resistant strains in their respective crops. Systematic data are being collected in the Agricultural Meteorology Section, Coimbatore for the past two years on irrigated crops. Suitable field techniques are being evolved at Coimbatore. In the case of Jassids on cotton the data collected reveal tentaively that the sampling unit should include 60 plants when the incidence is serve and 90 plants when it is othewise. This is a very useful line of work, which has to be encouraged on an all India basis. When sufficient data are collected, it may be possible to predict the incidence of major pests and diseases on crops based on the meteorological conditions as it is being done in Japan for paddy crop and in America for potato and wheat crops.

Improvement of Irrigational facilities: Apart from the improvement of the existing irrigational facilities - major as well as minor - the agricultural research workers are trying to assess experimentally, the minimum water requirements of crops. Perhaps, the adoption of 'Waste Not and Want Not' theory may amply pay in this direction. If the wastage of water under field conditions is controlled and at the same time the minimum amount of water is given to the crop to grow normaly, it will immensely augment the present slender water supply in irrigational sources. In the first five year period the irrigated area was increased to 67 million acres in 1955—'56 from 50 million acres in 1950—'51.

Trapping of cheap sources of power for irrigation like wind power is also slowly engaging the attention of the authorities A provision to the tune of seven crores of rupees has been made in the Second Five Year Plan with the basic idea of installing low and medium capacity windmills in the wind swept areas. These windmills will be used for the working of pumps for the small scale irrigation from wells, ponds and streams and also for electrification in rural parts.

Adoption of Improved Agronomic Practices: Under this heading comes the adoption of Japanese method of cultivation of paddy. The relative study of the Japanese method when compared to farm method was in progress in eight Agricultural research stations in Madras State. This method of paddy cultivation has won the patronage of the farmers with the result that in India an area of twenty million acres had already been brought under this method in 1955—'56. In the second five year plan this area is proposed to be doubled by 1960 — '61. It is felt that the extension and wide adoption of this method will substantially increase the average yield of paddy. An analysis of this method will reveal that it involves three basic principles of crop production, namely, careful selection of seed material, adequate manuring and judicious intercultivation. The first precaution gives a good start to the crop. The second one meets adequately the manurial requirements of the crop. The third and the last one creates an ideal and favourable condition in the field for the crop to grow luxuriantly. An useful trend in Indian Agriculture may be the adoption of similar improved agronomic practices for other cultivated crops as well.

Prevention of Damage to Crops by sudden and Violent Changes in Weather: The sudden and violent changes in weather include floods, droughts, cyclones, hurricanes, gales etc. A scheme is being worked out as to how best the Madras Agricultural Department, in close collaboration with the Indian Meterological Department, can help the farmers to minimise the heavy damage done at times to crops by these sudden and violent changes in weather. For effective dissemination of news and warnings to farmers the co-operation of the All India Broadcasting department is also felt as a necessity.

In the second five year plan effctive flood control measures like improvement to the existing revetments, spurs and embankments as short term measure and construction of new embankments and channel improvement as long term measures have been included.

To overcome drought stimulation of clouds, known otherwise as artificial rain-making, is also engaging the attention of the Madras Agricultural Department with the co-operation of the Chief Engineer for irrigation. The preliminary experiments conducted in Nilgiris district in 1955 and 1956 indicate the possibility of getting rains whenever heavy could formations exist in the sky. The crop Specialists are also trying to evolve drought resistant strains of cultivated crops.

Modern Trends in Agriculture — Atom in Agriculture

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Introduction: Though it may appear paradoxical it can still be said that the birth of the atomic age has brought peace and prosperity to us, peace in the sense that the first atomic explosion brought the end of World War II and the fear of the atom bomb is keeping off another major war; and prosperity in the sense that tools like radio-active isotopes have been of immense help in the field of medicine and biology. Thus it has helped the diagnosis and alleviation of human suffering in the field of medicine and in the economic use of fertilisers and in solving problems of Plant nutrition in the field of Agriculture.

Radioactive tracers: During the past ten years the use of radioactive isotopes has attracted the attention of scientists. Particularly since an abundant supply of artificial radio isotopes was possible as a result of atom bomb production in America, its use has widely spread not only in America, but in other countries also. The isotope of an element has the same chemical properties but varies in mass. The radioactive isotope has in addition, radiation. For instance P. 32 emitting P. ray (election particle) is a radioactive isotope of P. 31. The radioactive isotope P. 32 is more in use since it has an half life of 14·3 days while K. 42 the radioactive isotope of K. 41 has only 12·4 hours half life. The radioactive isotope of Nitrogen is very short lived, the half life being only 9 minutes. The half life of the isotope used must be sufficiently long so that decay does not remove tracer faster than it can be extracted and assayed. The production of the radioactive isotopes is accomplished by neutron bombardment.

The central feature in tracer methodology is the preparation of labelled samples of elements involved in biological processes. With such samples it becomes possible to distinguish and trace any molecule or atomic grouping the behaviour of which is of interest in connection with biological function. A direct approach to many

important problems in intermediary metabolism had been denied to biologists because it is necessary to discern the biological wanderings of a given atomic grouping once it had disappeared into the organism. In the labled sample the tracer specimen will undergo the same chemical reactions as the normal samples of the element with which it may be mixed while still remaining distinguishable because of the difference in mass or radio activity. The general procedure in tracer methodology involves the preparation of the labelled compound, into the biological system and later separation and determination of the labelled elements in various fractions. The method is based on the validity of the assumptions viz. (1) that elements exhibit consistancy of isotopes composition and (2) that chemical identity of isotopes is maintained. In case of the first assumption it may be noted that minor fluctuations have been reported for some elements only such as carbon, oxygen, potassium and in particular hydrogen. In the case of the second it holds good only in the case of hydrogen for which extreme isotope mass ratios exist.

There are at least two merits in the utilization of istopes. Firstly, they enable us to exactly trace these elements which we gave or applied purposely. Suppose we wish to measure the availability of phosphatic fertilizers for crop plants, the usual experimental method would be to lay out plots receving that fetilizer and the check. By substracting the amount of P_2O_5 absorbed by the check plot from that of the treated plot we would obtain "the availability of phosphoric acid" of the pertinent fertilizer. By using P32 there is no necessity for the check plot. The mere determination of P32 absorbed from the labelled fertilizer is sufficient to deduce definite conclusion on the availability concerned. The second point is the outstandingly high sensitivity of the detection of radiation through the use of Geiger Muller counter, and its simplicity which is in striking contrast to the microchemical analysis. For example 10^{-17}g. of K. 42 can be detected by the Geiger Muller Counter while the limit for microchemical analysis is only 10^{-6}g.

Highly interesting results have been achieved in the field of Agriculture through the use of these isotopic tracers. To cite a few, using P32 it has been found that wheat utilizes 48–68% P from fertilizers previously believed to be only 10–12%, that the tobacco plant does not utilize any P from the fertiliser added, and that in placement of phosphates, if placed in contact with roots P32 appears in leaves within 20 minutes, if placed 3–4 cm. below seed, P32 appears in leaves in 2 to 3 days after germination and if placed 5-6 cm. away from seed, it is absorbed in 3-4 weeks. Using C 14 labelled Co. 2 for sugar beets it was found that sugar moves downwards at the rate of 70 cm. per hour along phloem and penetrates even smallest rootlets. In the case of herbaceous plant, organic acids formed in roots from carbonic acid in soil moves upwards at the speed of 3 cm. per minute and penetrate green fruit, growing apices and leaf laminae. Using N 15 in ammonium sulphate for rye it was found that protein material is constantly being renewed in plants some lasting only a few hours and that more than half the nitrogen in chlorophyll is replaced in 2 to 3 days. The enormous possibilities of tracer methods cannot be summarised adequately in any treatise. Even a casual survey of the literature reveals that despite a shortage of tracer material and general unavailability of assay instrumentation much literature has already accumulated.

In India, we are just on the very elementary stage in the use of radioactive isotopes. Some work has been started at the Indian Agricultural Research Institute only recently. However, in the field of plant nutrition and soil chemistry the modern Scientific worker in India as in other countries looks up only to the use of the radioactive tracers for solving his problems.

Modern Trends in Agriculture: Water use and Irrigation Problems

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Water and nutrients are more often the limiting factors in maintaining or improving crop production. The capacity of soil to hold water, the movement and subsequent release of this water by the soil and its ultimate use by the plant have all been subjects of intensive study by agricultural scientists and irrigation engineers for a long time. Naturally a peep into some of the problems in this soil plant-water relationships will be most proper in a sequence of discussions on Modern Trends in Agriculture.

Irrigation history: The artificial application of water to soils to supplement natural rainfall for crop production is an old art, as old as civilisation itself and has been practised by man from time immemorial in some of the older countries. An examination of the irrigated regions of the world shows that India, Pakistan and China are the oldest countries where irrigation has been extensively pracised from very ancient times and indeed today, these countries have between them, more than half the irrigated areas of the world. Out of over 200 million acres about 110 million acres are situated in these three countries. Every available source of water, both surface and underground, is tapped for use in crop production.

In our own country, we have nearly 30 per cent of the world's irrigated acreage. Our ancient rulers evinced keen interest in irrigation development as witneesed in the great projects like the Cauvery and the innumerable tanks for storing water for crop production.

While this is so, it is surprising that sufficient attention has not been paid all these years to the several problems of irrigation economy, as for instance, the studies on water use of crops, irrigation efficiency and the agronomy of irrigated soils. This last aspect is an important one, as soil crop relationships in an irrigated system is basically different from that of any other. It is well known that the productivity, the nutrient removal, biological activity, the concentration of nutrients, the accumulation of harmful and other salts and the oxidation-reduction phenomena in an irrigated soil system are characteristic of themselves, and therefore a special approach is needed in their study. The reasons for such apathy if any, was possibly because, till recently, irrigation project development and utilisation of water were synonymous with paddy cultivation in a situation of assured and abundant water supply and that these aspects were not considered sufficiently important in that set up.

But this situation has now changed. The expansion of irrigation and the utilisation of water resources of the country to the maximum extent possible is one of the accepted objectives of the plan periods. Such expansion of irrigation facilities are only possible at higher costs as all the cheaper sources have been exploited to the full already. For instance, the relative capital outlay per irrigated acre for the Krishna and Godavery systems constructed during the last century happened to be around Rs. 23 while the Mettur Irrigation System constructed during the recent thirties cost around Rs. 195/- per acre. The capital cost per acre under the recently constructed Lower Bhavani Project was Rs. 458/-, more than double the cost of Mettur.

The New Irrigation Policy: The construction of irrigation projects at such high capital cost is possible because, the national government after independence departed from the old criterion of productivity in the selection and execution of irrigation projects. As a result of the old policy, all the remunerative projects had been executed and they provided a reasonable return on capital, but the more difficult and unremunerative schemes were left out. Adherance to the narrow principle of direct and remunerative return was found to militate against the general economic benefit of the people and national well being. In the newer irrigation policy enunciated by government, the old productivity test of an expected return greater than the rate on the capital borrowed is no longer the overwhelming criterion in sanctioning an irrigation scheme, but only one of the criteria. Projects are now examined primarily to ensure that there is water enough in a normal year to irrigate the area envisaged, that the soil is amenable to irrigated cultivation and the crop production reasonably commensurate with the outlay on the scheme. Naturally this raises important issues like betterment levies and the reassessment of irrigation rates which are beyond the scope of this paper.

Effective and economic utilisation of water: Apart from the high capital cost of the irrigation systems, sources of water supply are also getting short. Even if every possible source of irrigation water

were to be developed and strict economy imposed in the use of this water, still the water so exploited may not be able to meet the water requirements of all the cultivated acreage of this State. In Madras, the irrigated area is around six million acres out of a total cultivated area or our 15 million adres. Greater enthusiasm in recent times in irrigation farming coupled with the above fact of shortage of water resources, make effective and economic utilisation of the existing water sources imperative. This involves considerations of the water requirements of crops, the consumptive use of water and irrigation efficiency.

The ultimate objective in water use is the production of maximum yield with minimum amounts of water diverted from storage reservoirs. Irrigation efficiency can be represented as the ratio of the consumptive use of water for a crop to the total water supplied for that crop from an irrigation source. Relatively little in the way of data of application efficiencies are available. In our State, the efficiency of irrigation is low where the source of water supply is a river irrigation system or tank, whereas there is high efficiency when the water is lifted by the farmer for field irrigation. As early as 1928, the Royal Commission on Agriculture stated as follows:

"Judged however by modern scientific standards there is generally a great loss of water due to wasteful and unscientific application and there is room for improvement in the matter of getting the most out of the available supply without deterioration of the fertility of the soil".

The low efficiency is largely due to engineering difficulties in the method of distribution and the system of paying for irrigation water from a river or tank irrigation system based on the acre per season. Naturally therefore, there is no incentive on the part of the consumer to economise in the use the water. This straight per acre rate tends to stimulate use of more water than is needed. In some countries and also under tube well irrigation in North India, there is a system in vogue to charge for the water on the basis of quantity used. Such measured distribution is impractical in the irrigation projects of our State and so there is an urgent need to educate the farmers on economic water use. Yet another reason contributing to inefficiency in water use is the ryot's fear that at some time during the crop period, water supply may be cut off or reduced due to unforeseen seasonal conditions. Naturally therefore, he keeps his fields well supplied with water at all times to meet any situation that may or may not arise at a future date. There is however, a high rate of efficiency in water use under well irrigation, because the cost of lifting water is high and also involves considerable effort. Further, the conveyance and delivery losses are generally reduced to the minimum in a farm.

Time of Irrigation and Frequency: The general purposes of irrigation is to supplement rainfall by supplying water just when the crop needs the same in the right amount and in the right place, where the roots can absorb the water. This would involve a knowledge of soil moisture conditions, the water holding capacity of the soil and the needs of the crop and eventually balancing this requirement with requisite supply.

In Madras, paddy is the major crop under irrigation from the various irrigation projects and the comsumptive use of water is difficult to assess as the water use is more related to the available supply rather than the actual needs of the crop. There is more or less, a stationary ayacut fixed by past experience and the whole ayacut is cropped and the available water is distributed through the cropped area. In favourable years, more water is consumed and in years when the season is unfavourable, the water supply is shared among the ayacutdars. The utimate crop production is influenced by a plethora or shortage of water supply. A number of irrigation experiments have been carried out in the past to study the consumptive use of water by the paddy crop and the data indicated that the water consumption varies from 80 to 100 acre inches for a medium duration crop under certain standard conditions. Unfortunately our data is incomplete and it has not been possible to predict the influence of varied supplies, because of the difficulties involved in such a study by large scale field experiments. Further, the data obtained in one place is not useful for general application as a number of local factors decide the consumptive use. Even so, a study of the consumptive use of water is necessary as we have yet no answers to many irrigation questions connected with paddy cultivation. Does the paddy crop need to be flooded as is being done now in many places? If so, what is the depth at which water should be maintained in the field, 1 inch, 2 inches or 3 inches or even 6 inches as is being done in many places now? What is the effect of reducing the suppy to field capacity or super field capacity as is being done when paddy is cultivated under gardenland conditions? Should water flow be encouraged all the time? It is possible that the belief in wild flooding

is rooted on the theory that waters in irrigation systems carry plenty of silt and other dissolved nutrients which help in increasing yields. There is no chance of this happening now in the reservoir projects where any slit that may be carried is deposited in the reservoir itself and not carried to the cutivator's fields. The study of water use by the paddy crop is thus a complex problem and has to be tackled in a special manner by co-ordinated large scale experiments in a number of places.

Consumptive use of Water for other Crops: The study of the consumptive use of water by other crops is also equally important as the growing of crops other than paddy under irrigated conditions is extensively practiced in the State. Further, the newer irrigation projects like the Lower Bhavani and some others are planned for crops other than paddy. Studies on the consumptive use of water of sugarcane, cotton, millets etc. have been made. For sugarcane it is found that 70 to 80 acre inches is a satisfactory amount including rainfall; for cotton it is around 30 acre inches including rainfall. For millets like sorghum and ragi, the water requirement has been estimated at 25 acre inches including the rainfall received during the crop period. Though some experiments have been conducted to decide the frequency of the irrigations, it has not been possible to draw positive conclusions though some arbitrary recommendations have been made based on indications from these experiments.

The data from various irrigation experiments show that the consumptive use of water to produce one pound of produce is as follows:

Ragi	—	193	gallons
Cotton kapas	—	653	,,
Cholam grain	—	237	,,
Paddy	—	605	,,
Sugar	—	170	,,

It must at once be said that considerable variations can occur in these figures due to variations in the fertility status of the soil.

Concepts on soil moisture availability: The main problem in the application of water to crops is to decide the optimum level at which moisture has to be maintained in the soil to obtain maximum crop growth. This introduces the availability concept and this availability concept is related to the soil moisture tensions that are allowed to develop. In general it is presumed that all moisture above the wilting percentage in a soil is available for plant growth. There is some controversy among different workers as to whether all this moisture is equally and freely available and there is recent evidence to show that the availability is greater when the moisture is held at lower tensions. The importance of the soil moisture tension measurements to indicate availabilities of moisture for plant growth has now been accepted and this has resulted in the development of several types of equipment for measuring soil moisture tensions. The use of tensiometers and other moisture measuring meters are now in common use for deciding the time of irrigation. These equipment assist in the direct measuring of the moisture status and what the farmer has to do is only to read the meter to decide when he has to irrigate the crop. Such equipment costing under Rs. 300/- can give more or less a picture of moisture status even for a layman. Experiments have been planned on the use of similar equipment in irrigation practise here.

Weather data to predict irrigation need: A recent approach to decide when to irrigate is the use of weather data, particularly evaporation which is related to potential transpiration rate. This is possible because evaporation of water is controlled by the weather conditions. In the United Kingdom, Penman of Rothamstead and later Schofied have proposed the irrigation of grass from weather data and suggested that this procedure might apply to other crops as well. The Meteorological service there issues an estimate for maximum evaporation from crop land as a guide to irrigation based on Penman's method. In the United States, recent studies at the Washington Agricultural Experimental Station have shown that the quantity of water consumed by a crop in the field is directly related to the rate of evaporation from a free water surface. The indications are that it may be entirely feasible for a farmer to use an evaporation tank on his farm to tell when to irrigate using a K coefficient which may vary from crop to crop.

This formula, $U = KE$ was applied to the Ragi and Sorghum crops in the Central Farm raised in an irrigation experiment. The optimum consumptive use of water "U" was 25 acre inches for these two crops including rainfall and the evaporation "E" from an open pan evaporimeter in the Agricultural Observatory was 27·29 inches during the ragi crop period in the South West monsoon period and 33·09 inches during the Sorghum crop period in summer. The 'K' coefficient thus was 0·92 for Ragi and 0·76 for Sorghum respectively.

This is in consonance with the popular view that Sorghum requires less water for maturing than Ragi, which was not reflected in the consumptive use data as both crops required 25 acre inches.

Water scarcity and restriction of consumption: A matter of grave concern connected with irrigation is the frequent need to restrict water use in the irrigation systems as a result of monsoon failures. All the major river irrigation systems and tanks depend on the success of the South West and North East monsoons for their water supply. Indeed, in spite of the development of large irrigation projects, our agriculture still continues to be a gamble with the monsoons only with the risks considerably reduced. Two things emerge out of this situation affecting ultimate crop yields. Firstly, there is a delay in the letting in of water in the canals for agricultural purposes, resulting in delayed or late plantings with consequent fall in yields. Results spread over a number of years have indicated that a fall in yield of 10 to 12 per cent or more may result by late planting of paddy and as much as 30 per cent in the case of irrigated cotton. Secondly, in many small irrigation systems and ayacuts under tank irrigation, the uncertain supplies and increased ayacut areas have resulted in restricted water supplies leading to fall in crop yields. Irrigation authorities can certainly help by considering the agricultural aspects of crop production in supplying water. The possibility of altering the cropping pattern wherever fęasible to suit the water supply is an idea worth pursuing in some of these irrigation systems.

The Receding Water Table: The demand for underground water is always heavy and is increasing. Heavy draft on available supplies have come as a result of mechanical pumping which has replaced human and animal lifts. Low rainfall as a result of monsoon failures also has contributed to this recession of deep underground water levels. From the experience of the College Farm wells, the recession in water level has been to the extent of 30 to 40 feet during the last 25 years, that is, over a foot per year. The demand for underground water supply is steadily increasing with electric power availability in rural areas. If the underground water supplies are thus depleted, restriction of crop areas under lift irrigation would result. Already large areas in the Coimbatore region which normally would have been put to irrigated crops are cropped dry. Where power pumping is not so such concentrated the position probably is not so bad.

The issue to ponder over is about the future of these areas. They would very soon become problem areas and so have to be tackled urgently. There are possibly two courses open; one is to adopt a system of water spreading as is adopted in some parts of the U. S. A, and the other is to plan irrigation systems to supplement water supplies from wells. Water spreading on agricultural lands with a view to recharge underground water reservoirs is adopted successfully in some parts of the U. S. A. But the main criterion for success is the easy permeability in these regions. It is well known that the permeability factor and the rate of infiltration are notoriously low in the black soils and the underlying parent material; so much so, one comes across empty wells adjacent to well filled tanks. Such spreading systems may however be feasible in red soil regions. Areas adapted to specially designed systems of water spreading are worth a survey.

Quality of irrigation water: The quality of the water used in irrigation has always been considered important. The approach to the problem of quality has so far been to ascertain the deleterious effects if any, in the use of a particular source of water to a particular type of soil. A new approach has been made to examine the waters for their pH. The opinion is widely held that slightly acid waters influence crop production in soils of high pH and improve their permeability and also productivity. There appears to be considerable reasoning in this theory as witnessed by the high productivity in the Tambraparani valley, where the waters of the Western Ghats having low pH soils are directly used for irrigating the heavy black soils of the Tinnevelly district with their pH ranging between 7·2 and 8·5. Investigation on these lines may probably lead to fruitful results.

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Modern Trends in Indian Agriculture

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Rapid advances have been made in the application of scientific principles to Agriculture in our country and there has been large scale modernization of Agriculture in recent years. The food shortage experienced sometime ago was overcome in remarkably quick time and the position is now satisfactory although it warrants no complacency in the face of increasing population and natural calamities like floods and drought. It has been possible to achieve the additional production through increased irrigation facilities, use of manures and fertilizers, improved seeds and improved implements and better plant protection measures. The gap between the researcher and the farmer has considerably narrowed down and the results of research are now quickly conveyed to the farmer through the National Extension Service and Community Development Organization. The innumerable demonstration trials conducted on ryots' fields have carried the results of research to the very doorstep of the farmer who is now showing better appreciation of expert advice.

The use of manures and fertilizers in increased quantities undoubtedly dominates Indian Agriculture as in any other country. Fertilizer production has registered phenomenal increase in the world and newer types of fertilizers are being manufactured. Remarkable improvements have taken place in fertilizer technology and fertilizers are now available in excellent physical condition safe for handling. Our country imported large quantities of such fertilizers and the expansion of fertliser industries in our country capable of meeting the increasing demand of new and improved fertilizers is rapidly taking place. The farmer is now using more and more of these fertilizers especially where there are irrigation facilities, for the research has shown that irrigation agriculture to be successful must be supplemented by liberal amounts of nutrients. New and high grade fertilizers like Urea, Ammonium Sulphate, Nitrate, Ammonium chloride, Ammonium Nitrate, Triplesuper, Hyperphosphate, etc., are popularised. Being concentrated they are required in much smaller amounts and thereby reduce the transport bill. Fertilizer practice has changed considerably. Proper placement of fertilizers is very well recognized especially in the case of Phosphatic fertilizers. The application of fertilizers through irrigation water is quite new and it is possible to adopt this method with advantage under controlled conditions for horticultural crops. Liquor Ammonia and other fertilizers in poor physical condition, which cannot otherwise be handled satisfactorily, are eminently suited for this purpose. Where employed under controlled conditions this method, is advantageous in that less fertilizers is required, more uniformity in the distribution of fertilizer is achieved and fixation by soil is greatly reduced. Fertilizer mixtures with definite amounts of ingredients for specific crops especially, cash crops are becoming popular. Some fertilizer mixtures are fortified with minor elements in appropriate amounts and in some others insecticides are added allowing no opportunity for pests and diseases.

The research on the assessment of the micronutrient status of Indian soils and their requirements for various crops has not made as much progress, perhaps due to the complexity of the problem and lack of adequate equipment. The micronutrient determination require highly specialised and costly apparatus which only few institutions could afford to have and trained staff in the work. The maintenance of favourable reacation in soil by proper management is essential for the availability of micronutrients and any slight disturbance upsets their nutrition. A satisfctory solution to deal with such a delicate situation appears now possible since the recent discovery of certain organic metal complex compounds known as chelates and chelated compounds. The chelated compounds supply micronutrients and are eminently suited for localised application. In U. S. A. and Britain, the chelated compounds have been successfully used to correct physiological disorders like chlorosis, attributed to trace element deficiency in crops like citrus, garden beans, tomatoes, coffee, etc. on a wide range of soils. These compounds are only now appearing in Indian market and they may prove invaluable in improving the quality of horticultural crops and increasing the yield.

Of all contributions to the advancement of Agriculture the application of Atomic Energy to Agricultural Research is most striking and for reaching. The radio-active istopes of a large number of elements available as by-products of nuclear reaction are proving to be of greatest value in fertilizer research and plant biochemistry. By using the so-called labelled fertilizers it is possible to obtain answers to problems such as the need for fertilizer, times of application, amount to be applied and how to apply, in quick time. The advanced techniques such as tracer studies and autoradiography enable us to trace the path and ultimate fate of any particular element in soil or plant material and thereby helps at a better understanding of the complex soil-plant relationship. Investigations on this aspect have advanced very much in some foreign countries and a modest beginning was made about an year or two ago in our country at the Indian Agricultural Research Institute, New Delhi, where preliminary studies with radioactive phosphorus have yielded some useful information on its (P) fixation and availability. As more Research Institutions in the country get the benefit of the material and the technical know-how, the studies can be extended to wide areas and the results will no doubt throw more light on many problems.

It is generally recognized that one of the causes of poor yields in India is due to the poor quality of the seed. By judicious selection and scientific breeding new varieties of crop, of better quantity, more resistant to pest and disease and high yielding, are being continually added to the list. The atomic energy has a useful role to play in this respect also. There are possibilities for producing economic mutants by radiation although it was generally believed that radiation would produce only deleterious effects. For instance in U. S. A. high yielding strains of groundnut and barley, and rust resistant variety of oats, are claimed to have been produced by radiation. In our country the investigations on the radiation effect have made some progress at Bose Institute, Calcutta, and preliminary results are promising. Investigations on the radiation effect on perennial crops like coconut in producing desirable mutant plants is worth pursuing.

Pests and diseases take a heavy toll of crops. Plant protection methods have made good progress and a number of new and more efficient insecticides and fungicides are increasingly used. Weeds are also controlled by weedicides and herbicides.

In any programme of permanent agriculture, conservation of soil is most essential. Due to various causes erosion of rich top soil takes place leaving behind an inert sub-soil. Conservation measures like contour bunding, strip cropping, terracing, afforestation and such other steps are now adopted on a large scale, whenever essential.

The reclamation of saline and alkaline lands has long been attempted by conventional methods like adding soil amendments in the form of gypsum and lime and flooding the land. As a biological approach to the problem, which has hardly received any attention, a beginning can be made by growing plants which remove salinity from the soil and in this respect certain species like Atriplex are very suitable. These species growing in saline areas leave organic matter in the soil, improve the properties of soil and form the nucleus for afforestation which has numerous direct and indirect advantages.

There has been considerable increase in area under irrigation in recent years and more area will be brought under irrigation on the completion of multipurpose reservoirs. The necessity for the economic use of water needs no mention. Losses due to seepage and other causes have to be avoided. Evaporation loss from the surface of the irrigated soils is not taken serious notice of, although in areas like orchards this loss is quite significant especially due to wind in areas unprotected by wind belts. Planting in wide areas of casuarina, sesbania, will greatly arrest wind velocity and minimise evaporation losses. It has been reported from work in other countries that by the use of Ceytel Alcohol, in the form of cakes, the evaporation loss could be reduced considerably. This method can be tried in limited areas in our country.

The progress in the development of improved Agricultural machinery has helped in the mechanization of Agriculture which is clearly noticed. Improved and efficient implements like tractors. bull-dozers, fertilizer drills, etc., are made use for agricultural operations. Modern implements have increased the efficiency and reduced labour requirements.

The loss that occurs during the storage of the crop is next in seriousness to pests and diseases. It is beyond the means of the farmer to have modern storage facilities when he is already over-burdened with increasing indebtedness. In this connection the proposals of the Government of India, to set up in rural areas, during the Second Five Year Plan period, Agricultural Co-operative Societies with sufficient warehouse space and banks to advance loans for meeting immediate agricultural needs, like the purchase of fertilizers and implements, on the security of the prospective crop, will be of invaluable assistance to the farmer. The farmer can keep his produce in safe storage and dispose it when conditions are favourable to him and thus he is protected from the vagaries of market conditions.

Thus it may be seen that much improvement has been achieved in all aspects of Indian Agriculture. But the crop yields are still low compared with advanced countries and there is, therefore, immense scope for further progress. Although the emphasis is shifted to industrial development in the Second Five Year Plan, Agriculture still occupies an important place. In the rapidly expanding economy as a consequence of industrialization there should be an abundance of consumer goods like food and clothing, for any scarcity in them (goods) will result in disastrous inflation. To reach the targets in Agricultural production, namely, 10 million tons or 15% more than the present production for food grains and 25–30% more than the present production for other cash crops, fixed for the 2nd Five Year Plan, it is imperative to strive at the establishment of scientific and improved methods of cultivation throughout the country and we research workers are bound in duty to ceaselessly work for the advancement of Indian Agriculture.

Modern Trends in Multiplication and Distribution of Improved Seeds of Groundnut

by S. G. AIYADURAI, B. Sc. (Ag.),
Assistant Oilseeds Specialist.

Introduction: Commercial crops cover about a fifth of the area under cultivation and form the bulk of our country's exports. They are oilseeds, jute, tea and tobacco. Among these, oilseeds, occupy the foremost place. In the Madras State, oilseed crops viz., groundnut, gingelly, castor and coconut are grown over a total area of about 28 lakhs acres, representing nearly 16 per cent of the total cropped area. Of these, groundnut is the most important one as it covers nearly 78 per cent of the total area under oilseed crops and earns the much needed foreign dollars for the country.

In oilseed crops, yield and oil content are the most important factors which determine the merits of a strain. The different improved strains of groundnut, gingelly and castor evolved by the State Department of Agriculture combine the above economic attributes and they are acclaimed as superior to the local varieties. Seed purity is one of the fundamental principles in Agriculture. To maintain this purity, the farmer, the plant breeder, the seed organisations and the Government strive hard alike. The production of nucleus seeds of improved strains marks the beginning of the seed multiplication programme.

Present Position: In the Madras State four nucleus seed farms for large scale production of seeds of improved strains of groundnut and castor are being run in a total area of 200 acres and the nucleus seeds produced every season are distributed among the growers to raise primary seed farms. The nucleus seeds produced at these centres are just enough to raise primary seed farms of groundnut in about 1140 acres and of castor in 600 acres. Assuming that nucleus seeds of groundnut are produced in an area of 200 acres evey year, only 2 lakhs acres will be covered with the improved variety at the end of the fifth year, provided the course of development programme is not interrupted due to unforeseen natural causes. It is also evident that to cover a targetted area with improved strains within a specified period, the establishment of larger numbers of nucleus seed farm centres would be necessary.

At present the nucleus seeds of groundnut are distributed by the district officers for raising primary seed farms in the ryots' holdings. The produce from these seed farms is procured and distributed again for organising secondary seed farms on an extensive scale. Unlike in other crops, the running of secondary seed farms becomes necessary in the case of groundnut as the rate of seed multiplication is only 6 to 8 times at each stage. With a view to encourage seed farm ryots a price premium of about 10 per cent is offered. The nucleus seeds are sold to the ryots at all-in-cost rate to cover packing, transport and handling charges involved in the process of distribution. The inclusion of these extra charges swells up the price of the improved seeds at the consuming centres, making it uneconomic for the grower to go in for them, thus defeating the very purpose of the seeds multiplication organisation. The addition of this distribution cost is a serious bottleneck in the popularisation of the improved seeds. It is, therefore, essential to sell the nucleus seeds at market rates for the successful implementation of the seed multiplication programme. The loss accruing thereby should be met by the agency sponsoring such development work and it should on no account be recovered from the grower.

Normally the produce of the groundnut crop is summarily disposed off by the ryots after harvest. They go out for seeds only at the time of sowing of the subsequent crop. Even well-to-do ryots do not sometimes preserve seeds for their own use. Only in rare cases seed pods are either sold for cash or loaned. There is no reliable agency or organisation to procure, store and distribute the seeds during the sowing season. As the seed-rate for groundnut is very high, the problem of providing accommodation for storage comes in the way. Merchants engaged in groundnut trade and oil mill owners however, store some stocks of good seed pods of only the local variety and sell them during the sowing season to their clients. Except a few bags of improved seeds kept for sale in the Agricultural Depots there is no departmental source from which the ryots can obtain their requirements of improved seeds. Even though the common ryot is well aware of the superior qualities of the improved strain he is unable to get his seeds for sowing, due to his poverty. This, in short, is the back ground in which the procurement and distribution of seeds of the improved strains of groundnut is being done in this State.

Future Lines of Work: In many a country like the United States of America for example the multiplication and distribution of improved seeds are taken up by reputed firms or seed associations, the technical aid alone being provided by the Research Department of the State. The breeder has no responsibility, therefore, for the multiplication and spread of the improved strains evolved by him. Besides undertaking the multiplication phase to a large extent, these private organisations certify to the purity of the seed material and the State Government recognizes such firms. The grower, therefore, obtains his requirements from these firms and he is assured of the quality. These seed associations also play an important part in the furtherance of research by earmarking a portion of their profits for solving problems relating to the seed production and distribution.

Considering the conditions prevailing in our country and the conservative habits of the ryots the following suggestions are put forward for the successful multiplication and distribution of seeds of improved strains of oilseeds. It is hoped that these recommendations when implemented would work efficiently and contribute to increasing the production of oilseeds in the State as contemplated under the Second Five Year Plan.

(i) Nucleus seeds of the improved strains should be produced in larger quantities at a large number of centres for organising primary seed farms on an extensive scale.

(ii) As the rate of multiplication in groundnut is very low (6 to 8 times), to obtain maximum quantity of seeds for further stages of multiplication the primary seed farms should be run only by the State.

(iii) Seeds procured from primary seed farms should be stored in Government godowns at central places.

(iv) The seeds required for organising secondary seed farms should be made available to the ryots at the prevailing market rate, the difference if any, due to the market fluctuations being met by the Government. The principle of seed distribution on "no loss – no gain" basis is not desirable in the interest of spread of improved strains.

(v) The sale of the produce should be done on weight basis only, and standardisation of grade specifications should be introduced.

(vi) Reliable private agencies must also be encouraged to undertake seed distribution work by offering attractive terms.

(vii) The regulated markets instituted under the commercial crops markets Act in a number of centres now help the farmer to market their produce for consumption. It is possible and feasible for these agencies to undertake the production of improved seeds and their distribution. The Act may be amended, if necessary, to enable these organisations to take up this work.

(viii) To meet the increasing demand for improved seeds of groundnut in the Community Project and National Extension Service blocks of this State, the possibility of raising primary and secondary seed farms, and the distribution of seeds within the areas or regions covered by these two extension schemes, may be considered. The Community Project and National Extension Service blocks will however, be supplied with the requisite nucleus seeds anaually. It is hoped that vesting responsibility on the Community Project and National Extension Service areas will not only kindle an interest and spirit of competition in them but also enable to concentrate more on the seed multiplication programme in the areas not covered by the Community Project and National Extension Service Schemes.

Conclusion: The Second Five Year Plan emphasises the importance of the production of more commercial crops not only to become self sufficient in them but also to earn the much needed foreign exchange to carry on our developmental activities under the plans. Improved strains have a very important part to play in this programme of increased production side by side with better manuring and efficient plant protection. In this connection it may be mentioned that it appears necessary to work the seed development programme with special reference to the peculiarities and limitations of any particular crop.

Considering the enormous importance of the seed multiplication programme this appears to be the most opportune moment to create a separate administrative wing to organise the production and distribution of all seeds of improved strains on a large scale. That alone would contribute to more efficient running of this very important and essential programme of agricultural improvement. Unless modern trends in the seed multiplication and distribution work in the agriculturally more advanced countries in the west are followed, I venture to submit that we cannot make rapid progress in achieving increased crop production.

S. No.	Name and present Designation of the Upper Subordinate	Section and subject for which selected	Officer under whom he is now working
19.	Sri G. Subbiah, Farm Manager State Seed Farm, Namasivayapuram, Pattukottai Division.	Agriculture	District Agricultural Officer, Pattukottai.
20.	„ R. Perumal Raja, Cane Assistant, Cuddalore.	Research Sugarcane	Sugarcane Specialist, Cuddalore.
21.	„ K. Parthasarathy, Chemistry Assistant, Coimbatore.	Research Chemistry	Government Agricultural Chemist, Coimbatore.
22.	„ K. M. Jesudasan, Agricultural Demonstrator, Kadambur.	Agriculture	District Agricultural Officer, Tinnevelly.
23.	„ P. Shanmugham, Agricultural Demonstrator, Wallajah.	Agriculture	District Agricultural Officer, Vellore.
24.	„ C. V. Kothandaraman, Oilseeds Assistant, Tindivanam.	Research Oilseeds	Superintendent Agricultural Research Station, Tindivanam.
25.	„ P. R. Ananda Rao, Cane Assistant, Gudiyatham.	Research Sugarcane	Deputy Director of Agriculture, Vellore.
26.	Kumari V. Savithri, Oilseed Assistant, Coimbatore.	Research (Oilseeds)	Oilseed Specialist, Coimbatore.
27.	Sri P. Veluswamy, Certification Inspector, Rajapalayam.	Research (Cotton)	Certification Officer, Rajapalayam.

28.	Sri V. Srinivasan, Millet Assistant, Koilpatti.	Research Millets	Superintendent, Agricultural Research Station, Koilpatti.
29.	„ B. Vasandaraj David, Plant Protection Assistant (Entomology) Madurai.	Agriculture	District Agricultural Officer, Madurai.
30.	„ B. S. Viswanathan, Extension Officer Agriculture, Ootacamund.	Agriculture	Block Development Officer, Ootacamund.
31.	„ K. Marappan, Agricultural Demonstrator, Velur.	Agriculture	District Agricultural Officer, Salem.
32.	„ P. P. K. Laxmanan, Agricultural Demonstrator, Aruppukottai.	Agriculture	District Agricultural Officer, Sattur.
33.	„ V. K. Rangaswamy, Agricultural Demonstrator, Punjapuliampatti, Coimbatore District,	Agriculture	District Agricultural Officer, Ootacamund.
34.	„ K. Navakodi, Oilseed Assistant, Tindivanam.	Research Oilseeds	Superintendent Agricultural Research Station, Tindivanam.
35.	„ P. Chelliah, Extension Officer, Tuticorin.	Agriculture	Block Development Officer, Tuticorin.
36.	„ S. K. Murugayyan, Farm Manager, Rural Extension Training Centre, Bhavanisagar.	Agriculture	Principal, Rural Extension Training Centre, Bhavanisagar.
37.	„ R. P. Sethumadhavan, Extension Officer in Agriculture, Arcot.	Agriculture	Block Development Officer, Arcot, His name is deleted from the list as per Madras Public Service Commission Memorandam No. 3649-G1 56/14—8—57.

S. No.	Name and present Designation of the Upper Subordinate	Section and subject for which selected	Officer under whom he is now working
38.	Sri A. Muthumangiah Muthiah, Agricultural Demonstrator, Vadasandur.	Agriculture	District Agricultural Officer, Madurai.
39.	,, B. T. Nanjan, Soil Conservation 3—3—1934 Assistant, Tiruchirapalli.	Agriculture	Assistant Agricultural Engineer, (Soil conservation Scheme) Kodaikonal.
40.	,, A. Thiagarajan, Agricultural Demonstrator, Tittagudi, South Arcot.	Agriculture	District Agricultural Officer, Cuddalore.
41.	,, K. M. Padmanaban Nambeesan, Fruit Assistant, Aduthurai.	Research Fruits	Banana Research Officer, Aduthurai.
42.	,, N. Sundaram, Oilseeds Assistant, Tindivanam,	Research Oilseeds	Superintendent, Agricultural Research Station, Tindivanam.
43.	,, K. Bhanu, Agricultural Demonstrator, Chidambaram, (Kumarakshi)	Agriculture	District Agricultural Officer, Cuddalore.
44.	,, S. Hydross, Agricultural Demonstrator, Vaniambadi.	Agriculture	District Agricultural Officer, Vellore.
45.	Kumari R. Yogambal, Ex. Entomology Assistant, Coimbatore (since resigned)	Research Entomology	Government Entomologist,
46.	Sri P. Ramalingam Chetty, Farm Manager, Sheep Farm, Chinglepet Dt.	Agriculture	Sheep and Coats Development Officer, Vepari, Madras-7.

47.	Sri G. A. Sivaraman, Extension Officer in Agriculture, Kodumudi	Agriculture	Block Development Officer, Erode.
48.	,, G. Surendran, Agricultural Demonstrator, Alangudi.	Agriculture	District Agricultural Officer, Kumbakonam, (The selection of candiate is provisional subject to verification of his community by M. R. S. C.
49.	,, K. Sivasubramaniam, Chemistry Assistant, Coimbatore.	Research Chemistry	Govt. Agricultural Chemist, Coimbatore.
50.	,, C. S. Sathyamoorthy, Farm Manager, Coimbatore.	Agriculture	Superintendent, Central Farm, Coimbatore.
51.	,, N. Bagavathiappan, Extension Officer, Kodavasal.	Agriculture	Block Development Officer, Kodavasal.
52.	,, R. N. Bathrachalam, Agricultural Demonstrator, Tiruvannamalai.	Agriculture	District Agricultural Officer, Vellore.
53.	,, P. Kandaswamy, Oilseeds Assistant, Anamalai.	Research Oilseeds	Assistant Oilseeds Specialist, Pollachi.
54.	,, R. Sundararajan, Agricultural Demonstrator, Manalmedu.	Agriculture	District Agricultural Officer, Mayuram.
55.	,, A. Damodaran, Certification Inspector, Rajapalayam.	Research (Cotton)	Certification Officer, Rajapalayam.
56.	,, M. Nagarajan, Agricultural Demonstrator, Pullambadi.	Agriculture	District Agricultural Officer, Tiruchirapalli.

S. No.	Name and present Designation of the Upper Subordinate	Section and subject for which selected	Officer under whom he is now working
57.	Sri M. Raman, Special Agricultural Demonstrator, Cotton, Palladam.	Agriculture	Assistant Cotton Specialist, Tirupur.
58.	,, N. Mahalingam, Agricultural Demonstrator, Cuddalore.	Agriculture	District Agricultural Officer, Cuddalore.
59.	,, M. K. Ramanathan, Agricultural Demonstrator, Mannargudi.	Agriculture	District Agricultural Officer, Tanjore.
60.	,, N. V. Rangaswamy, Agricultural Demonstrator, Acharapakkam.	Agriculture	District Agricultural Officer, Guindy.
61.	,, V. Venugopal, Extension Officer, Perundurai.	Agriculture	Block Development Officer, Perundurai,
62.	,, P. K. Ramakrishnan, Cotton Assistant, Koilpatti.	Research (Cotton)	Assistant Cotton Specialist, (Karunganni, Koilpatti.
63.	,, D. V. Ranganathan, Special Agricultural Demonstrator (Cotton) Coimbatore.	Agriculture	Assistant Cotton Specialist, Srivilliputhur.
64.	,, C. Ravindranath Menon, Agricultural Demonstrator, (Vegetable) Madras.	Agriculture	District Agricultural Officer, Guindy.
65.	,, K. Balakrishnan, Extension Officer, Perianaickenpalayam.	Agriculture	Block Development Officer, Perianaicken-palayam, Coimbatore Dt.

66.	Sri T. Sivasankaran, Special Agricultural Demonstrator, Cotton, Srivilliputhur.	Agriculture	Assistant Cotton Specialist, (K. 2. Co. 4) Srivilliputhur.
67.	,, P. Muthumani, Extension Officer in Agriculture, Chetpet.	Agriculture	Block Development Officer, Chetpet, North Arcot District.
68.	,, S. T. Viswanathan, Agricultural Demonstrator, Peravurni.	Agriculture	District Agricultural Officer, Pattukottai.
69.	,, G. Srinivasan, Agricultural Demonstrator, Tiruvarur.	Agriculture	-Do-
70.	,, S. Syed Fazlullah, Agricultural Demonstrator, Jeeyapuram.	Agriculture	District Agricultural Officer, Tiruchirapalli.

Weather Review — For August, 1957

RAINFALL DATA (IN INCHES)

Division	Station	Total rainfall for the month	Departure from normal	Total since 1st January 1957
North	Madras (Meenambakkam)	7·8	+ 2·9	14·9
	Tirurkuppam*	6·7	+ 3·0	15·6
	Vellore	2·6	— 3·1	14·8
	Gudiyatham*	1·4	— 2·8	18·5
East Coast	Palur*	1·7	— 2·2	9·5
	Tindivanam*	4·5	— 0·6	16·3
	Cuddalore	1·7	— 3·1	11·8
	Nagapattinam	5·2	+ 2·1	11·5
	Aduthurai*	5·0	+ 0·4	12·7
	Pattukottai*	1·5	— 3·1	8·9
Central	Salem	3·7	— 2·9	12·7
	Coimbatore (A. M. O.)* ..	0·4	— 0 9	8.4
	Coimbatore	0·2	— 1·0	6·8
	Tiruchirapalli	1·2	— 2.9	6·9
South	Madurai	3·2	— 0·9	7·9
	Pamban	0·2	— 0·4	3·4
	Koilpatti*			
	Palayamcottai	0·5	— 0·2	9·2
	Ambasamudram*	0·1	— 0·3	6·1
	Nagarcoil	Nil	— 1·2	29·2
Hills	Kodaikanal	5·6	— 1·4	27·4
	Coonoor*	0·8	— 2·5	36·1
	Ootacamund*	3·0	— 1·5	43·0
	Nanjanad*	6·6	— 0·2	42·5

Note:— 1. * Meteorological Stations of the Madras Agricultural Department.

The effect of the South West monsoon was felt very feebly in Madras State during the month of August 1957. For seven days from 1—8—57, rain or thundershowers occured at a few places in Madras State. Due to the temporary weakening of the monsoon along Kerala and Coastal Mysore, mainly dry weather prevailed in Tamilnad on 8—8—57 and 9—8—57. There was a general strengthening of the monsoon over the country on 12—8—57, the effect of which was felt as local rain or thundershowers on that day, and as scattered rain or thundershowers for three days from 13—8—57. On 16—8—57, the monsoon became weak over the country, and consequently only a few showers were received in Tamilnad on that day. The Madras State received localised rain on 17—8—57, and scattered rain or thundershowers on 18—8—57 and 19—8—57. For two days from 20—8—57, weather was mainly dry in Tamilnad. After revival of the wetspell on 22—8—57 and 23—8—57, elt as scattered showers, there was a short span of one day with mainly dry weather on 24—8—57. On 25—8—57, rain or thundershowers occurred at a few places in north Madras, while dry weather prevailed in south Madras. For four days from 26—8—57, rain or thundershowers were received at a few places in Tamilnad, while on 30—8—57 rain or thundershowers occurred at a few places in south Madras and weather was mainly dry in North Tamilnad. On the last day of the month, a few showers were received in Madras State.

Regarding the fluctuation of the day temperature, they were practically mild in Tamilnad throughout the month under report.

Rainfall: The noteworthy rainfalls and the Zonal rainfall for the month are furnished below:

Noteworthy Rainfalls for the month.

S. No.	Date	Name of Place	Rainfall in inches
1.	2—8—57	Nagapattinam	2·68
2.	12—8—57	Nanjanad	2·64

Zonal Rainfall for the month (in inches)

Name of Zone	Rainfall for the month	Departure from Normal	Remarks
North	4·6	Nil	Just normal
East Coast	3·3	— 1·3	Below normal
Central	1·4	— 1·9	Far below normal
South			
Hills	4·0	— 1·4	Below normal

C. B. M., & M. S. D.

Agricultural Meteorology Section,
Lawley Road P. O.
Coimbatore, 16—9—57

Departmental Notifications

Gazetted officers — Madras Agricultural Service

Name and Designation	Posted as
Sri C. V. Govindaswamy, Lecturer in Mycology,	Deputed to United Kingdom for advanced training in Plant Pathology under Colombo Plan.
,, B. W. X. Ponniyya, Millets & Pulses Specialist,	Deputed to United States of America for advance training. He will hand over charge immediately to the Paddy Specialist, Coimbatore.
,, N. Sankaranarayana Reddy, Asst. Agricultural Engineer, (Civil) Coimbatore.	Deputed to United States of America for Advance Training and who will hand over charge immediately to Additional Lecturer in Engineering Agricultural College, Coimbatore.
,, S. Joshua Moses, Non-Gazetted Block Development Officer, Bhavanisagar, Coimbatore Dt.	Appointed as Gazetted Block Development Officer with effect from 18—4—1957.
,, A. H. Subramania Sarma, Lecturer in Agriculture, Agricultural College, Coimbatore.	Appointed to act as Deputy Director of Agriculture, Vice Sri K. Varadachari.
,, T. B. Krishnaswami Rao, Assistant in Cotton.	Appointed to act as Asst. Cotton Extension Officer, Madurai Vice Sri A. Raghavan who has been granted leave.
,, T. D. Muthuswamy, Upper Subordinate,	Appointed and to act as temporarily as Cane Development Officer, Nellikuppam.
,, J. Vaidyanathan, Upper Subordinate.	Appointed to act temporarily as Assistant Agronomist Vadapathimangalam, Tanjore District.
,, C. R. Thiruvengadam, Upper Subordinate.	Appointed to act temporarily as Assistant Agronomist, Nellikuppam.
,, C. S. Krishnan, Gazatted Asst. to the Cotton Certificating Officer, Rajapalayam.	Transferred and posted as Asst. Cotton Specialist (Winter Cambodia Scheme) Coimbatore.
,, S. Sethuraman, Asst. in Cotton.	Appointed to act temporarily as Assistant Cotton Specialist and posted as Gazetted Asst. to the Cotton Certificating Officer, Rajapalayam.
,, K. Kannian, Asst. Cotton Specialist, Koilpatti.	Transferred and Posted as Asst. Cotton Specialist, Srivilliputhur Vice Sri L. Neelakanthan, Promoted as Crop Specialist.
,, Dr. A. Mariakulandai, Govt. Agri. Chemist, Coimbatore.	Granted leave for 9 days from 16—9—1957 with permission to prefix the holiday 15—9—1957.
,, G. K. Chidambara Ayyar, Asst. Agri. Chemist, Coimbatore.	To hold Addl. Charge of the post of the Govt. Agri. Chemist, Coimbatore.

Name and Designation	Transferred or Posted or leave
Sri A. Raghavan, (Asst. Cotton Specialist), Assistant Cotton Extension Officer, Madurai.	Is Posted as (in anticipation of orders of Government) as Asst. Cotton Specialist, K. 2 and Co 4 Scheme, Koilpatti Vice Sri K. Kannian.
,, A. R. Bhaskaran, D. A. O., (Direct recruit) under going Training Central Farm Coimbatore granted earned leave for 15 days from 17—8—1957 to 31—8—1957 with permission to avail holidays 15th and 16th 1957 and 1st September, 1957.	On the Expiry of the leave Sri Bhaskaran will resume his training in the Central Farm, Coimbatore.
,, Dr. K. C. Naik, Principal, Agricultural College and Research Institute, Coimbatore.	Granted leave for 2 months on average pay from the date of relief so as to enable him to proceed to United States of America.
,, M. Bhavani Sankara Rao, Vice Principal, Agricultural College, Coimbatore.	Will be in full addl. charg of the post of the Principal, Agricultural College and Research Institute, Coimbatore.
,, T. Rajagopala Iyengar, Retired Compost Development Officer, Madras.	The Govt. sanction the re-employment of Sri T. Rajagopala Iyengar, Retired Compost Development Officer, Madras in the same post for a period of one year from the date of re-employment.

Postings and Transfers

Upper Subordinates — Agricultural Department.

Name & Designation	Posted to or Transferred.
Sri K. A. Seshu, Oilseeds Assistant on completion of his training at the Indian Council of Agricultural Research, New Delhi.	As coconut Assistant, Coimbatore.
,, S. A. Radhakrishnan, Agricultural Demonstrator, Uthangarai.	Plant Protection Assistant (Ento.) Salem Vice Sri. N. Annaswami, due to retire on 12—9—1957
,, P. Ramachandra Marar, Farm Manager — State Seed Farm Nattur, Trichy Dt.	Extension Officer in Agricultural Kulitalai Vice Sri Samu Ayyar.
,, W. R. Nargunam, Paddy Asst. Aduthurai	Farm Manager State Seed Farm. Kakuppam Villupuram Vice Sri. Sreyankumar.
,, K. Nagappan, Chemistry Asst. Coimbatore.	Posted as Agri. Demonstrator, Uthukuli. Coimbatore District, Vice Sri. T. Venkatachalam.
,, S. R. Gangolly, Upper Subordinate in foreign Service under I 'on Central Cocoanut Committee, Kasargod.	Transferred to Mysore State.
,, G. Purushothaman, Paddy Assistant, Coimbatore.	Transferred to the Govt. of Pondicherry for launching a campaign for adopting Japanese Method of Paddy cultivation.

Name & Designation	Posted to or Transferred
Sri A. Damodaran, Cotton Certification Inspector, Rajapalayam.	Special Agricultural Demonstrator (Cotton) Kadambur Vice Sri T. R. Padmanabha Rao.
,, Narashiman, Cotton Certification Inspector, Rajapalayem.	Cotton Assistant Periakulam Vice Sri. A. Narayanan.
,, A. Narayan, Cotton Assistant, Periakulam.	Cotton Assistant, Coimbatore, Vice Sri. K. Ramanujam.
,, S. Annaswamy, P A to the D. A. O. Tirunelvelly.	Agricultural Demonstrator, Tirunelvelly, Vice Sri. V. Lakshmanan.
,, V Lakshmanan, Agricultural Demonstrator, Tirunelvelly	Farm Supervisor, Kallupatti Vice Sri. V. Meenakshisundaram.
,, V Meenakshisundaram, Farm Supervisor, Kallupatti.	Special Agri. Demonstrator (Cotton) Vice Sri K. A. Krishnamoorthy.
,, K P. Srinivasan, Potato Assistant, Nanjanad.	Posted as Agricultural Demonstrator, Sulur.
,, V. V. Balasubramaniam, Asst. Coconut Nursery Scheme, Muthupet.	Assistant Coconut Nursery Scheme, Pattukottai.
,, T. Ramachandran, Asst. Coconut Scheme, Pattukottai.	Posted as Coconut Nursery Assistant, Tindivanam.
,, Kelappan, Farm Manager, Fruit Farm, Cape Comorin.	Posted as Agri. Demonstrator Kuzhi Thurai Vice Sri K. S. Subramaniam.
,, G Kumaraswamy, Oilseeds Development As[illegible] Madras.	Posted as Extension Officer in Agriculture Valathy Block S. Arcot, Vice. V. Veeraraghavan.
,, T. M. Cha[illegible]rthy, B Sc.	[illegible]ppointed Chemistry Asst. Coimbatore.
,, R. Rodriq[illegible]x	A[illegible]ointed and Posted as Agri. Demonstra-[illegible]or, Ramanathapuram Dist. against [illegible]he vacancy of Extension Officer in [illegible]gri. Tindivanam.
,, N. S Sun[illegible]rarajan	[illegible]p[illegible]inted and posted as Chemistry Asst. [illegible]udiyatham. He should report himself to duty at Coimbatore to Govt. Agri. Chemist for Preliminary Training.
,, P. Muhamm[illegible] B[illegible]heer	Appointed and posted as Entomologist Asst., Coimbatore Vice Sri P P. Vasu deva Menon.
,, V. S. Krishnan	Appointed and posted as Asst. in Chemistry Coimbatore
,, S. Dinaka Rao, B Sc.	Appointed and posted as Agri Demonstrator, Conjivaram Vice Sri K. A. Shanmugam.
,, K. Dyanchand, B. Sc.	Appointed and posted as Potato Asst. Nanjanad.
,, S. Vijayaraghavan	Appointed and posted as Entomology Asst. Coimbatore.
,, Raiba Seshadri	Appointed and posted as Asst. in Botany Coimbatore.

The Madras Agricultural Union.

PATRONS.

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23. ,, M. R. Balakrishnan, F. A. O., Irrigation Agronomist, Thailand
24. ,, S. Raja Iyengar, Landlord and Agriculturist, Madurai
25. ,, K. Rangachari, Landlord, 16, Old Munsiff's Court Street, Saidapet, Vellore
26. ,, R. Ramakrishna Naidu, Palamalai Ranganathar Mills, Perianaickanpalayam
27. ,, C. M. John, Agricultural & Technical Adviser, The Potash Scheme, India, 7, Lavelle Road, Banglore-1
28. ,, S. N. Venkataraman, 33, Third Main Road, Gandhinagar, Madras - 20
29. Dr. T. S. Sadasivan, Director, Botany Laboratory, Madras University, Triplicane, Madras
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39. ,, S. Kothandapani Pillai, Purnasugaipalayam, (Via) Pallianellur, Villupuram

in other countries fruit juices have been preserved by cold storage for shipment over a distance of 500 miles in glass lined tank cars by precooling the juice to about 28°F and placing in well insulated tanks of several thousand gallons capacity. Orange syrups are used as a base for carbonated and non-carbonated bottled beverages. In both cases the syrup or concentrate is diluted with water before bottling and then preserved with sodium benzoate. According to specifications in the fruit control order a beverage which does not contain 10% of fruit syrup, juice, squash, cordial or crush shall be described as a synthetic syrup. The minimum quantity of fruit juice required to be present in syrup is 10% in crush, squash, cordial lime-barely water 25% in unsweetened juice 85% and in ready to serve beverages 5%. Similarly the minimum quantity of total soluble solids in the above beverages have been fixed at 65, 55, 40, 30, natural, 10 and 10 percent respectively.

(c) Tomato products: According to food regulations, it is said that tomato juice may contain finely divided insoluble solids from the flesh of tomatoes but should be free from pieces of skin, seeds, bits of coarse tissue and any extraneous matter. The specifications for tomato juice is that it should contain atleast 5 percent of total soluble solids. The minimum quantity of soluble solids required to be present in tomato ketchup is 25%. It is said that tomato ketchup if filled boiling hot, need not be sterilized, but in actual practice the product is sterilized in boiling water for half an hour. At one time it was preserved with 0·1% of sodium benzoate. It is not now used in any of the leading brands of ketchup. The present day manufactures depend upon the acetic acid of the vinegar and the preservative action of the spices to prevent spoilage after the bottle is opened. Canned tomato juice is very generally used in restaurants and hotels for flavouring and for soups. Hot sauce and chillie sauce are much in favour in recent years. Canned tomato juice is very popular. In former years it was customary to store tomato pulp in wooden barrels with distilled vinegar or sodium benzoate as a preservatiue. This method has since gone out of existence and has been replaced by sterilization in 5 gallon or No. 10 cans.

(d) Bottled and canned products: With regard to bottling and canning, syrup strengths have been worked out for each variety and grade of fruits. So also the temperature and time of sterilization. For vegetables the optimum time, temperature and pressure required for processing is worked out. Now the vegetables are

rocessed at 240°F corresponding to 10 lb. steam pressure. Only ae time is varied for different vegetables the fruit control order has et up a standard for the quality and fill of bottled and canned fruit nd vegetable products. The use of preservative is not allowed and o also any artificial colouring matter except in the case of cherries nd strawberries where harmless food colours are allowed.

(e) Dehydrated products: Primitive method of drying which was practiced in India consisted of exposing fruits and egetables to the sun for a number of days. According to the nodern process dehydration is done by passing a current of hot air hrough them, the degree of heat employed and other details of the peration varying according to the nature of the food stuff. The lehydrated products are ready on boiling in water for three or four ninutes. Methods, treatments, safe-finishing temperatures, have been worked out for the dehydration of fruits like apples, apricots, bananas, cherries, berries, dates, figs, grapes, peaches, pears, plums, prunes and vegetables such as beans, cabbage, carrots, sweet corn, onion, peas, potatoes, sweet potatoes, pumpkin, spinach and tomatoes. Modern forms of dehydration have opened up opportunities for the development of the industry on a wider scale. Besides drying the whole fruit it is possible to preserve even fruit juices in a dehydrated form. Like powdered milk, powdered lemon juice and powdered mango juice are now prepared without affecting much of their food values.

Modern Equipment and Machinery: Science has made good progress with regard to equipment and machinery. Labour saving devices have been invented for crushing, pressing, extraction of the juice, filtering, grading, cooking, concentration, filling and sterilisation. For example, for the extraction of juice from tight skinned oranges, the cone type or the electrically worked juice extractor is used. For loose skinned oranges the screw type of juice extractor is used. For limes the lime squeezer or basket press is used. For lemons the mix master is in use. In the case of mango, the pulping machine is used for the extraction of the pulp. Superior type of sealing machines has been invented. For sterilizing cans in retorts under steam pressure continuous agitating pressure sterilizer has been perfected.

Containers: Both glass and tin containers are in use as containers for preserving fruits and vegetables and the products prepared. Screw type bottles with metallic lids or air-tight glass top bottles are used successfully. The metallic lids are coated with lacquer to prevent metallic contamination and corrosion.

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