The Madras Agricultural Journal

(ORGAN OF THE M. A. S. UNION)

Vol. XXXVII April 1950 No. 4

Editorial

Development Plans: In order to formulate a co-ordinated scheme for the planned economic development of the country a Conference of Chief Ministers of States and Presidents of Provincial Congress Committees was recently convened in New Delhi. Addressing this Conference the Prime Minister of India stressed the need for securing the whole hearted co-operation of the people in order that the attempt of planned economy may be a success. Without popular support and enthusiasm no scheme could be successfully implemented and to secure these the Prime Minister felt that the people should be taken into the confidence of the Government and have a clear idea of what the Government wanted to do. It was also necessary that the entire mass of workers of the country should be made to realise that they are contributing an important share in a big national undertaking. In recent years a number of paper plans had been drawn up but in all these, the Prime Minister felt, no attempt has been made to define the objectives clearly and to distinguish between primary and secondary things with the result that both were equally neglected. The Conference endorsed the views of the Prime Minister and after much discussion came to the conclusion that before a long-term and comprehensive plan is launched it was necessary that an immediate short-term plan to repair the country's damaged economy should be undertaken and implemented in order to create conditions favourable for carrying out the long term programmes to a successful termination. The immediate need was increased production in Agriculture and Industry.

How best to attain this objective is the question. We have no doubt that the conference will work out the details and formulate definite proposals but we should like to draw attention to one aspect of the question. In recent years there has been a tendency, presumably in an attempt to secure uniformity of effort, to centralise many activities which in our opinion are best handled by the states

themselves. India is a country of vast dimensions and conditions vary from state to state. The imposition from above of a uniform pattern of method of approach throughout the country, while no doubt is desirable in many ways, does not often take into account the various environmental factors in different tracts and the schemes often fail, To infuse a sense of enthusiasm among the people there should be scope for local initiative and enterprise. The constituent states should have the freedom to develop their resources and to regulate their economy, without detriment to the national economy or disturbing the over all picture. In the matter of agricultural production and planning this is of utmost importance and due care should be taken that in an attempt at a co-ordinated plan the existing economy of any tract is not unduly disturbed to its disadvantage.

Fodder problem in Madras

By

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(Received on 23—7—1949)

Introduction: While we are making an all out effort to grow more food and have subsidies for well sinking, grand irrigation projects, an organised supply of manure and seeds, in fact all ways and means that we could muster with all the scientific knowledge at our command to produce enough food for the human population which is certainly a very right thing, have we thought sufficiently of food for the 'Dumb Millions' which form the *backbone* of our agriculture? Fodder scarcity has been more or less a permanent factor in Madras Presidency. During the last one or two decades the severity has been felt more, due to the diversion of the area under food crops into more paying money crops like tobacco, cotton and sugarcane. To add to this, the continued failures of rainfall have resulted in the drying up of the grasses in the grazing areas thereby producing a most alarming state of affairs. How best can this fodder problem for the cattle be faced and how speedily can we avert a crisis which has almost been reached?

Sources of Fodder: 1. *Food Crops:*— In most places the cattle are dependent on the straw of cereal crops like paddy, cholam, maize, cumbu, ragi etc., after the harvest of the grains. While paddy straw is extensively used, the straw of the millets serve as a very important source of fodder. Most of them are capable of cultivation under varied conditions of soil, climate and altitude. The leaves, shoots and pods (bhusa) of all the pulses are eaten by animals and are nutritious feed. In blackgram, green gram and horsegram the whole plant after the harvest of pods are stacked by ryots specially to be fed to animals. The vines in sweet potatoes and the refuse in vegetable crops are also valuable as cattle feed.

It is therefore abundantly clear that the food crops like paddy, millets, pulses, sweet potatoes, vegetables etc., serve to a great extent as fodder crops and efforts to increase the area under them will have to be augmented for many reasons. The tendency to take to money crops must be controlled to limited extent if we have to be self-sufficient in food and fodder.

2. *Fodder crops:* Fodder crops like cholam and maize can be raised in a short period of two to three months in rotation with other

crops and they yield 15 to 25,000 lbs per acre. Further the land is released for raising other valuable crops after the harvest of the fodder. Superior fodder strains of cholam namely Co. 10 and Co. 11 with juicy stalks have been evolved by the Millet Specialist and these are becoming popular with the ryot. On large holdings areas of 25 to 30 cents left permanently for crops like Guinea grass and Napier grass supplement to a great extent the green forage which is very necessary for cattle especially the milch cows. About 8 cuttings can be taken in a year if good irrigation facilities are available and acre yields of 80 to 120,000 lbs. of green fodder can be obtained annually.

There is a great possibility of developing and increasing the area under fodder crops in the vicinities of towns and municipalities where the sewage water is often allowed to go to waste. The experiences gained at the Municipal Sewage Farm at Madura show that guinea grass is the best suited for the purpose.

3. *Pasture grasses and Legumes :*—The village cattle are often let loose to find their own feed and they depend upon the stray clumps of grasses left here and there. Grazing facilities are not provided in most of the villages except in the tracts famous for the breeding of Kangayam, Ongole and Alambadi animals. Only very small percentage of our animals use forest grazing. There are possibilities of getting more fodder by improving the constituents of the existing grazing areas. The field bunds, roadsides, porombokes often outgrown with useless weeds and scrub jungle in many localities can be turned profitable by introducing the suitable grasses.

Indigenous grasses :— The problem of finding suitable grasses for the various parts of the Presidency is being tackled in the Botany Section here for over a decade. From over a hundred speices of indigenous grasses collected and tried, a dozen of them have been selected since being good for fodder purposes. The area under these grasses have been multiplied to enable supply of planting material, With the co-operation of the Madras Forest Department many of the grasses were tried in the forest areas and they have been found to be very successful. *Cenchrus ciliaris* is the best for soils rich in lime ; however it comes up very well under most soil conditions. It is the staple pasture grass for the Kangayam breed of cattle. *Iseilema laxum* and *I. anthephoroides* are important grasses of the Ongole tract. *Sehima nervosum* is a favourite hill species.

Exotic grasses :— Some foreign types tried here have also been very successful. *Panicum antidotale* (the Australian Grass) is best suited for the dry arid conditions of the southern and eastern districts and it

remains green even in summer. The water grass, *Brachiaria mutica* comes up well in places with excessive moisture and as such is the best grass for reclaiming marshy areas. Trials here and at Koilpatti have shown that this is very well suited to be raised under irrigation. The giant star grass, *Cynodon plectostachyum* introduced from Africa as a good spreading habit and as such is becoming popular both as a fodder and soil binder. *Pennisetum polystachyon*, the thin or dry Napier, is getting established in west coast where it has been introduced.

Legumes:— Much has to be done in the selection and introduction of the proper perennial or annual legumes as mixtures in pasture *Phaseolus sublobatus*, (pillipesara) and *P. aconitifolius* (dew gram) are sown along with the *Cenchrus ciliaris* in pastures in Kangayam area. Pillipesara is the most popular leguminous fodder in Kistna, Godavary and Tanjore. It stands two or three cuttings and is adaptable to adverse conditions. After harvesting the green leafy matter for fodder the rest is ploughed as green manure in paddy fields. Sunnhemp is another useful dual purpose crop serving as fodder and green manure in cultivated field. The trials conducted here with over 20 legumes showed that *Glycine javanica* a wild ally of the popular Soyabeans collected locally to be a good spreading, perennial plant, drought resistant nutritious and relished by cattle. Two more promising legumes *Centrosema pubescens* and *Teramnus labialis* are under trial.

4. *Forest grasses*:— Forest areas are important sources of fodder in villages situated near by. According to the forest reports 1938 of the total area of 15,124 sq. miles of forest under the Departmental control about 11·55% were left for grazing. The total area of 3,272 sq. miles under forest panchayats were also under grazing. More attention has still to be paid for developing these grazing areas. Control grazing on block systems and rotational grazing have to be strictly followed if the areas are to provide enough fodder. More palatable and nutritious species of grasses have to be introduced to make them more productive. Above all reserve forest can contribute appreciable quantities of hay; though the cost of transport of these hay from the remote areas in the forest is a complicated problem, trials as pressing the hay into bales or *'brickettes'* have to be undertaken. Forest grasses can also be converted into silage in forests during flush growth period and sent down to villages and towns in summer when fodder is not available.

5. *Fodder trees*:— In times of severe and continued drought the leaves from some of the trees allieviate the famine conditions to a great extent. There are a large number of trees the leaves of which are readily eaten by cattle, sheep and goats. The analysis of the leaves of a few of these trees for feeding value have been found to be very good and as such

efforts have to be taken up in the planting of these trees which are useful in many ways to man and his animals. For the varied climatic conditions and localities there are a good selection of them which can be successfully grown.

6. *Utilisation of other sources :—* (a) *Non-leguminous herbs and shrubs :* While the legumes in general are greatly favoured as fodder, there are a large number of other plants such as the different Amarantaceae, Commelinas etc., which are much relished by cattle. Every effort must be made to utilise the weeds of cultivated fields and waste lands to the best of purpose. Nothing should be allowed to go to waste. Extensive trials have to be made in finding out the possible uses of our vegetable wealth which are often neglected or have not received the proper attention due to them. Some plants may be useful in reclaiming areas not suitable for cultivation as the saline or alkaline areas. In Australia species of *Atriplex* have been successfully grown in alkaline areas as browse plants for cattle, In Russia the sunflower (*Helianthus annuus*) has become a very important multipurpose crop suited for fodder, silage. oil, and oilcake. Hence there is ample scope and possibilities for converting much of so called waste into wealth.

(b) *Hay and silage making :—* With the rainfall the grasses are available in plenty in many places ; but much care is not taken to store them for a future necessity and this is specially the case in areas adjacent to forests. The superfluous fodder can be converted into either hay or silage. The best hay is obtained by harvesting the grass just before flowering and drying them. Most of the grasses tend well for silage also and the particular aroma created during storage is liked by animals. This method is best adopted in areas where heavy rains do not allow drying up of the cut grass. Fodder maize which gives 15 to 18,000 lbs., of green matter in about 45 to 60 days under irrigation is best suited for conversion into silage.

(c) *Avoiding the waste of many of the straws :—* It is often noticed that a good portion of the fodder fed in the stall is wasted by animals if thick culmed as in cumbu and cholam. A lesson has to be taken by the South Indian ryot from North India where wheat and oats straw are cut into small bits by chaff cutters and fed in baskets or well constructed feeding troughs. Power driven chaff cutting mills are quite common in many of the towns in the North. Though this is adopted by a few ryots here, it has to be popularised to minimise waste.

(d) *Processing* of less palatable fodders like the straw of Thalaivirichan cholam, ragi, tenai and many other forest grasses and converting them into nutritious feed by various chemical treatments have to be undertaken to utilise these straws going to waste.

CONCLUSION

We have sufficiently indicated the gravity of the problem and the methods of tackling them. The best of grasses, legumes and fodder trees should be grown in all agricultural research stations and in the fields of enterprising ryots so that the public may come to know about their usefulness. Free supply of seeds will be an inducement for the ryots to take up the cultivation of these fodders. Utilisation of the available material to the maximum extent and the avoiding of the loss by wastage should be other concerted measures. One more possibility to find enough fodder is by the elimination of the unproductive animals; while this is a controversial issue much thought and planning is necessary.

Some problems on Banana Breeding

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(Received on 1—6—1949)

The province of Madras has an estimated area of 1,36,455 acres under bananas, with an annual production of 11,33,000 tons of fruits. Added to this the banana has also numerous other virtues, which entitles it to be classed as the most popular fruit crop in this province. It thrives from sea level up to 5,500 feet and is as equally at home in the arid hot plains as in the tropical humid zones. With a capacity to yield a quantity of food per acre excelled by none and of a type valuable to infants, invalids as well as for all normal persons the banana assumes a special importance in the present context of intensified food production. It is, therefore, appropriate that the Government of Madras, in conjunction with the Government of India have decided to establish the All India Banana Research Station in our province, in the Tanjore District.

In a crop like the banana which has enjoyed popular estimation from time immemorial, it is to be expected that there would be a very large number of types and varieties with special adaptation for different soil, climate or cultural conditions. This is exemplified by the good yields of Sirumalai and Virupakshi on the Lower Palnis and of the Red Banana at lower elevations, while the very same varieties form no match in yielding capacity or quality to the Chakkrakeli of the Circars, Vamanakeli of parts of Rayalaseema, or the Rastali in the southern parts of the province. Thus the desirable characteristics which should go to give us the ideal banana, are now dispersed over a large number of varieties, types and

species spread over all the different parts of this province and even outside. The task of combining these characters to produce the ideal banana for each region naturally, therefore, is the aim of the banana breeder.

Thanks to several workers, notably Jacob (12) and Venkataramani (13) we have now a mass of verietal descriptions recorded on the basis of an intensive study in all parts of this province. Since a taxonomic study of any crop forms an essential prerequiste of any hybridisation project, it is essential to establish a comprehensive verietal collection area for a careful study of the varieties and the distingtishing features and outstanding qualities of each type.

The classification of the genus offers considerable difficulties, since the plant does not lend itself for study except in the field, and the getting together all types, varieties and species at one place presents great complexities. According to the classification of Linnaeus, cultivated varieties appear under two distinct species, *Musa sepientum* and *M. paradisiaca*. On the score of longer usage, *M paradisiaca* may be taken as the most appropriate till more is known of its taxonomy. The arbitrary distinction of banana and plantain is not accepted by any banana taxonomist now though the latter term is curiously enough, still in popular usage in South India.

Genetic and the cytological studies on this crop have been done in Trinidad. The basic chromosome number of banana is 11. The common edible types are triploids and therefore,many of the edible varieties are sterile, due to irregularities in pollen development (4).

For breeding better varieties of banana, the following methods are available:

1. **Simple selection:** Banana, rarely if at all, sets seeds and is usually propagated only by suckers. Consequently, selection of chance seedlings is not feasible. The introduction and trial of new varieties and their acclimatisation are therefore of greater promise, for improvment of the crop. Indeed most of our cultivated varieties, notably the Gros Michael and Vamankeli are only recent introductions, and yet they have large and increasing areas devoted to them in this province now.

2. **Selection of natural bud mutations or sports:** It is considered by Fawcett (9) that Gros Michael, the world's most famous variety, was itself a sport, isolated about hundred years ago in Martinique. The other and equally famous Cavendish variety is a sport from Grenada. Although widely distributed, Cheesman (8) doubts whether the Cavendish is every where the same or whether it has not given rise to sub-types or local races. In its agricultural history, the dwarf banana has thrown bud sports, some easily recognisable, others so different as to pass for new varieties. One type differs from the usual Cavendish in being taller, but especially

in shedding all its male flowers with their subtending bracts soon after they have opened, leaving the rachis bare, a feature common to the majority of the banana varieties other than the dwarf. The fact that like all the dwarf bananas it fails to set seed indicates however, that it is a vegetative sport of the dwarf. As some of the leading banana verieties are sports, this search for natural sports should be one of the points to be kept in mind in any breeding work.

3. *Use of certain treatments* like high temperature, radio-active rays, chemicals like colchicine etc., to induce sports or mutants are also fruitful lines open to the banana breeder Walter (10).

The main object of hybridisation is to create a variable population and then to select types with the desired combination of characters. In addition to the taxonomical and cytogenetical study, another important step is the preliminary investigation connected with hybridisation with the object of selecting varieties and species to serve as potent pollen parents to various cultivated varieties and also to work out the most convenient pollination techinique under our conditions and the most feasible and expeditious way of germinating seeds and raising hybrid progenies.

In large varietal collections of banana, there are found to be individual desirable characters in many of the varieties. But the recombination of these desirable characters are beset with difficulties. They are :

(1) The commericial types are sterile and produce no seeds;

(2) They should be induced to set seed for breeding work ;

(3) the seed breeding character must be eliminated from the selected type. In other words, starting with a seedless plant, a seeded stage must be passed through to provide material for a combination of characters and the seedless form recovered. Hunter and Leake (11) have stated "within the range of species of ***Musa***, all stages are found from forms such as those that supply the bananas of commerce with little or no viable pollen and developing fruit without fertilisation, to forms such as ***M. malaccensis*** with abundant pollen and free formation of viable seeds. In the extreme cases, the reproductive organs of both sexes are abortive upto 99 per cent and failure to set seed is complete. An initial difficulty therefore, is met with in obtaining a sufficient number of seedling plants to provide material for selection, For this purpose, ***M. malaccensis*** and ***M. Ornata*** have been used as pollen parents, but even here the percentage of viable seed is very low. Cheesman found that ***M. malaccensis*** is a diploid and Gros Michael a triploid. This latest interpretation is likely to change the existing classification of the genus and has a direct bearing on the problem of raising a seedless form".

Cheesman (7) concludes the principles of banana breeding as follows : "It is reasonable to conclude that a new seedling of commercial usefulness may be diploid, triploid or tetraploid, but is most likely by analogy with existing varieties to be triploid. Viewed in this light, breeding from edible varities, including Gros Michael, resolves itself into the production of tetraploids which may either prove directly useful or serve as breeding stock in place of their less fertile triploid parents. Breeding from fertile species resolves itself into the production of new polyploids, which again may be directly useful or indirectly valuable as material for further crosses. Triploids, in short, may be produced by synthesis from diploids or by reduction from tetraploids".

At Trinidad, breeding was undertaken mainly to get a type which is resistant to the "Panama" disease. Work was mainly done on Gros Michael with *M. malaccensis* which is immune to "Panama", as the male parent. "By cross pollination, 49 perfect seeds were secured, of which 17 germinated and 5 seedlings only survived. Of the hybrid seedlings one produced fair-sized fruits of good flavour. This was resistant to "Panama" and was named I. C. I. It had some commercial disadvantages and when propagated by suckers it occasionally set seeds. Further attempts to improve I. C. I. were made by back-crossing to the parents. Gros Michael and I. C. I. proved to be cross sterile and the latter showed a double complement of Gros Michael chromosomes and achievement of practical results by back-crossing was found uncertain". (4).

Coming to our work in India, breeding need not be undertaken for any specific aspect as resistance to any particular disease as in Trinidad. We have a large number of varieties with one or more good and favourable characters in each. We should try to evolve varieties with a combination of these desirable qualities.

We can indicate some of the varieties which may usefully be crossed to get better types in South India :—

1. Poovan and Vamanakeli to get big bunches of 300 fruits or more and the keeping quality of Poovan and the size and sweet fruits of Mauritius, with dwarf plants.

2. Rastali and Chakkrakeli, to combine the good fruit size of Rastali and the sweetness and strong pedicels of Chakkrakeli.

3. Sirumalai or Mala Vazhai with Kapurbale, in order to get the size of fruits of the latter with its adaptability, to different regions, with the sweetness, high flavour and the keeping quality of the former.

4. Mauritius with Nendran for obtaining short plants like Mauritius to withstand high winds, with fruits of Nendran, and with more numerous fruits per bunch.

5. Nendran and Monthan to get hardy plants of the Monthan type with fruits of Nendran quality.

The other items of work as the selection of the best suckers for planting, growth habits and yield of the different varieties, the search for mutants and other aspects on the improvement of banana, like optimum methods of propagation, culture, harvest, packing, transport and utilisation etc., will have to be studied along with the breeding work. It is possible to imagine a day when we will have bunches of the size and number of hands of Poovan with about 300 fruits in each bunch, with individual fruits of the size and keeping quality of Nendran, with the taste and pedicel strength of Chakkrakeli and the strong plants of the size of Muritius.

Summary: South India being one of the leading banana producing regions in India, it is desirable to have a banana breeding station in this part of the country.

2. It is seen that we have a large number of choice varieties of banana and the production of new varieties with combination of desirable characters would enable us to become the main centre of banana production in India.

3. As there are no specific criteria to distinguish the different varieties, taxonomical work should be taken up early. For this purpose a comprehensive varietal collection area should be established first.

4. Search for natural mutants and the work on inducing mutations artificially should be pursued side by side with the work on breeding.

5. The preliminary work of a series of pollination studies with the object of selecting varieties and species to serve as potent pollen parents to other cultivated varieties and to find out the best technique of pollination is as important as any other work in breeding.

6. The difficulty experienced in hybridisation work on banana as shown in Trinidad has been stressed. It is seen that the work though promising is not an easy one. The main point is that we have to start with a seedless plant, induce seeds by crossing with a seeded variety and then finally work to eliminate the seed. Still, with the varieties that we have in South India, we may hope to get good results in our breeding work.

Acknowledgements: The author is indebted to Sri K. C. Naik, B. (Ag.), M. Sc. (Bristol), Fruit Specialist, Madras and Sri U. N. Rao, B. Sc. (Ag.) Assistant Fruit Specialist, Madras for their valuable guidance in preparing this paper.

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Manurial Experiments on Rice

III. Application of green manures in combination with Phosphates *

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To maintain the food supply for an ever increasing population every endeavour for conserving the essential elements of soil fertility will have to be made, more so, in these days of acute food shortage. The productive power of soils is steadily reduced when successive crops are grown and no adequate manuring is made. Organic matter is the sheet anchor of soil

* Parts 1 and 2 were published in M. A. J. XXXV and XXVI 1950.

fertility in this tropical climate. The soils in almost the whole of Madras Presidency are generally deficient not only in organic matter but also in nitrogen. (1) For replenishing the organic matter depleted from the soils green manuring is the cheapest way. Green leaf manures not only supply essential plant nutrients but also improve the physical structure of the soils. The oxidation of manures resulting from the decomposition of green manures is said to assist the rendering of elements already in the soil more available as plant food and has a stimulating effect on the activities of beneficial organisms. Green manure in combination with phosphate fertilisers was found to yield best results in several places notably at Agricultural Research Stations, Samalkot and Manganallur (2). Among phosphatic manures the results with superphosphate and bonemeal was found to be encouraging in their direct and residual effects. Hutchinson and Milligun (3) showed that the addition of superphosphate to green leaf promoted its decomposition better even in a season when the moisture content is not high enough to allow of rapid decomposition of the green manure crop. Work at Pusa indicated that under natural conditions phosphates in organic combination became more available to plants. To test these findings at Anakapalli and to find out:

(1) The optimum quantity of green leaf (sunnhemp) required for recording maximum yields in paddy, (2) whether the application of phosphatic manures is necessary in addition to greed leaf, (3) the from and quantity of phosphatic manures to be applied and (4) the economies of green manuring, an experiment was laid out at the Agricultural Researeh Station, Anakapalle in 1937-38 and continued for a period of five years. The results of the experiment are summarised below:—

Material and Method: There were twenty treatments in all, green leaf and Phosphoric acid treatments being tried alone and in combination (a) 3 levels of green leaf, viz., 4,000 lbs., 6,000 lbs. and 8,000 lbs., sunnhemp per acre, (b) two forms of phosphoric manures as bonemeal-superphosphate, (c) two levels of phosphoric acid viz., 10 and 20 lbs., phosphoric acid and (d) a control, no manure. The layout was a factorial design replicated four times. The planting was done with 6″ spacing either way. The experiment was continued year after year in the same field. Seedlings from a rainfed nursery, which is common in this district were planted every year. Since the raising of the seed bed depended upon receipt of rains and plantings could be done only when water was available in the diversion channels which are full only if the monsoon is favourable, ages of seedlings at planting and dates of planting differed in each year. The experimental plots were dug out and turned in every year and the required amount of green leaf was spread over the surface in the treated plots and trampled in 3 or 4 days prior to planting. Bonemeal was also applied along with the green leaf. Superphosphate was applied at planting time. The variety grown was G. E. B. 24.

Results and discussion: The main factors that are responsible for difference in yields of paddy in Vizagapatam district are (a) Manuring, (b) the age of seedlings and (c) time of planting. Each factor is dealt with separately below :—

(a) *Effect of manuring :* The figures presented in the table (1) below indicated that the response to green leaf manuring was marked and that increased doses of green leaf contributed to increased grain yields. Increases due to addition of small quantities of either bonemeal or superphosphate were insignificant and erratic. Superphosphate, however, tended to give slightly better yields than bonemeal on the same phosphoric acid basis. There was no interaction between green leaf and the different kinds or doses of phosphatic manures. Moreover one of the good points in green leaf manuring was reported to be its capacity to bring into soluble form the available phosphoric acid in the soil. The beneficial effect of green manuring on grain yields was more marked in years of belated rainfall and late planting conditions.

TABLE I.

Grain yields in pounds per acre

1. Green leaf.

Treatment.	1937—'38.	1938—'39.	1939—'40.	1940—'41.	1941—'42.
8000 lb. per acre ...	1915	3367	1969	3437	2475
6000 lb. per acre ...	1918	3117	1762	3007	2354
4000 lb. per acre ...	1719	2527	1523	2648	2039
0 lb. per acre ...	1360	2146	954	2182	1521
General Mean ...	1728	2786	1552	2818	2097
Standard error of treatment mean ...	37·00	41·95	37·28	38·48	40·48
Critical difference at P—0·05 ...	54·83	108·64	105·84	109·45	115·00
2. Phosphates.					
Super 20 lb. phosphoric acid per acre ...	1671	2275	1603	2816	2210
Super 10 lb. phosphoric acid per acre ...	1721	2827	1564	2939	2162
Bonemeal 20 lb. phosphoric acid per acre ...	1796	2844	1607	2788	2004
Bonemeal 10 lb. phosphoric acid per acre ...	1707	2777	1505	2747	2080
No phosphoric acid ...	1688	2724	1482	2803	2030
General mean ...	1728	2789	1552	2818	2097
S. E. of Treatment mean ...	41·64	46·88	41·64	43·02	45·26
Critical difference at P—0·05 ...	61·46	132·58	118·23	122·15	129·00

With regard to straw yields in years when plantings were delayed as in 1939 the increases in yields in green manured plots seemed to be more as in the case of grain yield.

TABLE II.

Yield of straw in lbs. per acre.

Treatment	1937—'38		1938—'39		1939—'40	
	Straw yield per acre	% increase over no manure	Straw yield per acre	% increase over no manure	Straw yield per acre	% increase over no manure
1. No manure ...	1760	0	2704	0	1495	0
2. Bonemeal to supply 10 lb. P_2O_5 ...	1863	6	2482	–8	1457	–2
3. Bonemeal to supply 20 lb. P_2O_5 ...	1944	10	2852	5	1634	9
4. Super to supply 10 lb. P_2O_5 ...	1666	–5	2482	–8	1506	1
5. Super to supply 20 lb. P_2O_5 ...	159	–10	2666	–1	1497	1
6. Green leaf at 4000 lb. ...	2130	21	3222	19	1881	26
7. Green leaf – 4000 lb. + bonemeal to supply 10 lb. P_2O_5 ...	2426	38	3481	28	2105	41
8. Green leaf to supply 20 lb. P_2O_5 ...	2204	25	3555	31	2180	46
9. Green leaf + super to supply 10 lb. P_2O_5 ...	2482	41	3777	40	2099	40
10. Green leaf to supply 20 lb. P_2O_5 ...	2222	26	3630	34	2053	37
11. Green leaf at 6000 lb. per acre ...	2444	39	4704	74	2287	–53
12. Green leaf at bonemeal to supply 10 lb. P_2O_5 per acre ...	2555	45	4555	68	2493	67
13. Green leaf at 20 lb. P_2O_5 per acre ...	2640	50	4593	69	2471	65
14. Green leaf + super 10 lb. P_2O_5 per acre ...	2648	50	4744	75	2546	–70
15. Green leaf + super 20 lb. P_2O_5 per acre ...	2611	48	4744	74	2484	–66
16. Green leaf at 8000 lb. per acre ...	2555	45	4777	77	2677	79
17. Green leaf + bonemeal to supply 10 lb. P_2O_5 per acre ...	2963	69	5260	94	2716	81
18. Green leaf + bonemeal to supply 20 lb. P_2O_5 per acre ...	2555	45	5260	94	2716	81
19. Green leaf + super to supply 10 lb. P_2O_5 per acre ...	2611	48	5777	114	2738	83
20. Green leaf + super to supply 20 lb. P_2O_5 per acre ...	2666	51	5000	85	3018	102

The combined effect of phosphates and different doses of green manure was more marked in such seasons, the increase being 41%, 67% and 87% over no manure plots. Even in normal seasons the combined effect of green leaf and phosphates over green leaf alone in the different treatments was marked in the case of straw yields. As in the case of grain yields,

green leaf with super-phosphate was more beneficial than green leaf with bonemeal. Between the different levels and forms of phosphoric acid there was no perceptible difference in straw yields.

(b) ***Age of seedlings and time af planting:*** At Anakapalle it was observed that seedlings whose ages ranged between 5 to 9 weeks did not show significant difference in yields in case of early and late varieties. In the case of season bound varieties like G. E. B. 24, it was noticed that seedlings aged 6 to 7 weeks were best suited for this locality. In this experiment G. E. B. 24 was planted and the ages of seedlings and yields of grain from manured and unmanured plots are furnished below:

Age of seedling	Yield of grain in lb. per acre		% increase over no manure
	Manured	Unmanured	
40 days	2927	2493	17
46 days	2905	2435	19
56 days	1788	1524	17
61 days	2202	1776	24
76 days	1661	1218	36

Forty to forty-six days old seedlings gave good yields. The results are in exact conformity with those recorded previously on this station.

(c) ***Time of planting:*** It was observed under Anakapalle conditions, that for medium duration varieties the effective tillering phase is between the 30th and 60th day after planting, provided that, the plants are normal, the seedlings are young and the post transplantation period is long. These are conducive for better crop performance as the results (1938 and 1940) in this experiment indicated. As mentioned already due to the absence of regular irrigation system, lack of assured water supply and because of the seasonal visicitudes paddy plantings in this district are often delayed and at times uncertain. In this experiment the beneficial effects of manuring were felt more in the seasons when the post transplantation period till flowering was short. Results are furnished below:—

Year	Post transplantation period (from planting to flowering) in number of days	% increasec in yield over no manure
1940 ...	82	17%
1938 ...	80	19%
1937 ...	60	17%
1941 ...	48	24%
1939 ...	42	36%

In view of these results the advisibility of green manuring paddy in this district cannot be over emphasised.

Economics: The economics of manuring are presented in table V. The indications were that (1) increased doses of green leaf enhanced the margin of profit which ranged between Rs. 10/- and Rs. 21/- for the five treatments but the increased profits over no manure recorded by treatments 8000 lb. and 6000 lb. per acre were practically similar. (2) application of phosphatic manures as benemeal and superphosphate alone at 10 lb. P_2O_5 and 20 lb. P_2O_5 per acre resulted in loss. From the above data the following inferences are drawn: (i) that application of P_2O_5 resulted in loss and (2) increased doses of green leaf varying from 4,000 lb. to 8,000 lb. enhanced the margin of profit.

The experiment could not be treated as a serial experiment since the error varied widely from season to season.

TABLE V

	Treatments			1937—38 to 1941—42 Average figures for 5 seasons		
	Green leaf (Sunn-hemp)	Bone meal	Super phosphate	Value of extra yield of paddy over no manure (control in one acre)	Cost of manuring one acre	Profit or loss incurred in manuring over one acre
1. Control	...	...	...		...	...
2.	...	10 lb. P_2O_5	...	2—3—0	1—3—5	3—6—5
3.	...	20 lb. P_2O_5	...	0—15—7	2—6—10	3—6—5
4.	...	...	10 lb. P_2O_5	1—11—1	2—0—7	3—11—8
5.	...	...	20 lb. P_2O_5	1—13—9	4—1—2	5—14—11
6.	4000 lb.	...	...	13—15—11	4—6—6	9—9—5
7.	4000 lb.	10	...	15—11—6	5—10—0	10—1—6
8.	4000 lb.	20	...	14—15—0	0—13—4	8—1—8
9.	4000 lb:	...	10	17—5—11	6—7—2	10—14—9
10.	4000 lb.	...	20	16—14—11	8—7—9	8—7—2
11.	6000 lb.	...	...	26—9—4	6—9—10	19—15—6
12.	6000 lb.	10	...	24—13—11	7—13—3	17—0—8
13.	6000 lb.	20	...	28—12—9	9—0—8	19—12—1
14.	6000 lb.	...	10	31—13—1	8—10—5	23—2—8
15.	6000 lb.	...	20	28—0—11	10—11—0	17—5—11
16.	8000 lb.	...	...	30—2—0	8—13—1	21—4—11
17.	8000 lb.	10	...	35—11—1	10—0—6	25—10—7
18.	8000 lb.	20	...	35—7—9	11—3—11	24—3—10
19.	8000 lb.	...	10	38—6—3	10—13—7	27—8—7
20.	8000 lb.	...	20	38—14—11	12—14—3	26—0—8

CONCLUSIONS

In order to determine the optimum quantity of green leaf manure (as sunnhemp) that is necessary for paddy and to assess the relative merits of phosphatic manures alone and in combination with green leaf, an experiment was laid out at the Agricultural Research Station, Anakapalle during 1937-38 and conducted for five successive years. The following conclusions are drawn from this experiment.

(1) Increased doses of green leaf upto 8000 lb. resulted in increased yields. However 6000 lb. seemed to be the economic limit.

(2) In adverse seasons when there was delayed planting increased yields due to green leaf manuring were more marked than in normal seasons.

(3) Application of phosphates alone in 10 and 20 lb. doses per acre as bonemeal or super phosphate has not increased the yields. But their combination with green leaf resulted in slightly increased grain yields. The effect of the combination was more beneficial on straw yields.

(4) Hence in districts like Vizagapatam which suffers from lack of assured water supply the adverse seasonal effects on grain yields can be minimised to a great extent by green leaf manuring.

ACKNOWLEDGEMENT

I am greatly indebted to the superintendent, Sugarcane Research Station, Anakapalle and to my other colleagues in the station for the valuable help rendered in the conduct of the experiments. I am also thankful to Sri M. B. V. Narasinga Rao, Paddy Specialist, Coimbatore, for his valuable suggestions in the preparation of this paper.

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2. —Ibid— Do. Vol. 2. P. 3.
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Cultivation of Elephant Yam (Amorphophallus companulatus) in Sivakasi (Ramnad Dt.)

By

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(Received 15—3—1950)

Elephant yam "*Senai Kiyhangu*" as it is called in Tamil, is an important root crop noted for its high yield and keeping quality. It is cultivated to an extent of 1855 acres in Ramnad District, mainly concentrated in Sivakasi and surrounding villages. It is largely exported to various places up to Madras in the north and Tirunelveli in the south.

Season and Soil: It is mainly cultivated in April-May, though it it can be cultivated in other months also. It is chiefly grown in garden lands in rich loamy soil. Red loam is preferred to black loam as the keeping quality of the produce is said to be higher in the former. Like other root crops, it is a heavy feeder and hence a high fertility is essential.

Preparation of the land: A good tilth is aimed at. Hence ploughing begins sufficiently early and continues at intervals until the surface soil has been thoroughly broken up to a depth of 6″ – 9″. five ploughings are necessary, if it is done by country plough. A basal dressing of 50 cart loads of Farm Yard Manure is applied after second ploughing and worked into the soil by subsequent ploughings. When the crop is four months old, a top dressing of 4 bags of groundnut cake or 10 cartloads of well rotted cattle manure are applied through irrigation water.

Planting: It is followed by onions and ragi in a two year rotation in garden lands. Bed system of planting is in vogue. Beds of 7′ length and 3½′ width are formed with irrigation channels. Planting starts from April onwards and continues till the middle of May. About 1,200 beds are formed per acre. Seed material is prepared from selected corms which are cut into 4 to 6 bits, each containing a portion of the bud ring at the centre deppression. Small pits 6″ – 9″ depth are made with *manvetties* (harrow) giving a spacing of 1¾′ on either side. The cut bits of corm are so placed in the pits that the bud portion comes into contact with the soil and then covered over with one inch layer of soil. About 3000 lb. of seed material is required to plant an acre. Sprouting takes place after a month. Usually each bit will give rise to 3 shoots, one after another.

Irrigation: First irrigation is given immediately after planting and second irrigation on the 3rd day. A judicious method of irrigation according to the needs of the crop is adopted. For the first 3 months, irrigation is given at intervals of 10 days, at intervals of 6 days for the next 2 months and for the last 3 months, it is given twice a week.

After cultivation: Three weedings are done in the first 3 months by means of a small hand hoe called "***Kalaikilli***" followed by a earthing up by *manvetti* in the 4th month. Afterwards, practically no hoeing or weeding is done.

Harvest: The crop will be ready for harvest by the end of the eighth month when the shoot portions of the plants begin to wither indicating the maturity of the crop. Harvest is done by means of an implement called "*vachatthu*" (sickle). If the prices are high, the corms will be lifted even in the 6th month and if the market is dull, the harvest will be postponed by a month or so. It is said that corms will not be affected if they are allowed to remain in the soil even for a longer period. As a matter of fact the seed corms are allowed to remain in the soil till required for the planting.

Yield: The yield of a good crop ranges from 40,000 to 45,000 lb. per acre. Generally harvest is done by the merchants at their cost who purchase the entire crop in the field itself. The weight of a single, well developed corm will be about 10 lb. the average being 5 lb.

Pests and diseases: There is no serious pest or disease affecting this crop. Occasionally termites (white ants) attack the seed corms planted. This could be prevented by mixing crude oil emulsion in irrigation water. As regards diseases, *Alternaria* leaf blight is noted in the later stages of the crop. This can be controlled by spraying 1% Bordeaux mixture.

Cost of cultivation:

		Rs. A. P.
Preparatory cultivation:		
5 ploughings-10 pairs at Rs. 4/- per pair		40—0—0
Forming beds and channels		18—8—0
Manures and Manuring:		
Cost of 50 cartloads at Rs. 4 per cart load		200—0—0
Cost of 4 bags of groundnut cake		70—0—0
Seeds and Sowing:		
Cost of 300 lb. of seed corm		200—0—0
Planting charges		14—0—0
After cultivation:		
3 weedings - women		15—0—0
Manvetty hoeing		15—0—0
* *Irrigation charges:*		
44 irrigations at Rs. 12/- per irrigation by Mhote		528—0—0
Harvest:		
On contract at 4 as per bag 112 lb. for 400 bags		100—0—0
	Total	1,200—0—0
Receipts:		
By sale of 400 bags of 112 lb. each at Rs. 6/- per bag		2,400—0—0
Net profit per acre		1,200—0—0

* Irrigation charges can be reduced very much, if irrigated by pumpset.

THE MADRAS AGRICULTURAL JOURNAL

HINTS TO CONTRIBUTORS

The pages of the Madras Agricultural Journal shall be open ordinarily only to the members of the Madras Agriculural Students' Union.

All articles for publication should be submitted addressed to the Editor, Madras Agricultural Journal Lawley Road P. O.. Coimbatore.

In view of the high cost of printing contributions should be as concise as possible and should conform to the best usage in the leading Journals published in India and abroad.

Manuscripts should be typed with double spacing on one side of the paper only and with wide margin. They should not ordinarily exceed 5000 words or 12 pages of printed matter including tables and illustrations in the Journal. Manuscripts should be carefully revised; numerical data and calculations checked. Main headings in the text should be typed in capitals with paragraph indentations and followed by a period and two hyphens.' Sub-heads should be lower case and be underlined to indicate italics. Latin nomenclatures and local terms etc., should be in italics. Original papers must conclude with a summary of not more than 300 words drawing attention to the main facts and conclusions.

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The responsibility for statements, whether of fact or of opinion rests entirely with the author of the article and not with the Editorial Board of the Madras Agricultural Journal.

Weather Review — For March 1950

RAINFALL DATA

Division	Station	Total for the month in inches	Departure from normal in inches	Total since January 1st in inches	Division	Station	Total for the month in inches	Departure from normal in inches	Total since January 1st in inches
Orissa & Circars.	Gopalpore	2·2	+1·6	4·5	Central—*Contd.*	Coimbatore	0 0	—0·5	1·9
	Calingapatnam	1 0	+0·6	2·9		Tiruchirapalli	0·3	—0·1	3·4
	Vizagapatnam	0·2	—0·3	0·5	South.	Negapatnam	0·0	—0 8	3·0
	Anakapalle*	0·1	—0·7	0·5		Adutural*	0·0	—0,5	2·6
	Samalkot*	0·2	—0 5	2 6		Pattukottai*	1·7	+0·3	6·6
	Kakinada	0·5	J. N.	1·7		Mathurai	0·7	J. N.	4·6
	Maruteru	2·1	+1·6	2·5		Pamban	2·1	+1·4	5·9
	Masulipatnam	0·1	—0·3	1·4		Koilpatti*	0·1	—1·3	6·8
	Guntur*	1·5	+0·7	1·7		Palayamcottai	1·6	+0 6	5·9
	Agrl. College, Bapatla*	0·1	—0·7	1·5		Ambasamudram*	1·8	—0·4	8·4
	Veeravanam* (College Farm)	0·6	(x)	2·2	West Coast.				
Ceded Dists.	Rentichintala	1·3	+1·2	1·3		Trivandrum	3·2	+1·7	4·6
						Fort Cochin	1·2	—0·8	6·4
	Kurnool	0·2	J. N.	0·3		Kozhikode	0·1	—0·3	1·2
	Nandyal*	0·1	—0·3	0·5		Pattambi*	0·0**	—0·8	4·9
	Hagari*	0·0	J.N. £	tr.		Taliparamba*	0·0	—0·5	0·1
	Siruguppa*	0·0	-0·1(a)	0·2		Nileshwar*	0·0	—0·3	0·0
	Bellary	0·0	—0·2	tr.		Pilicode*	0·0	-0·5 @	0·0
	Cuddapah	0·0	—0·2	0·1		Mangalore	0·0	—0·5	0·0
	Anantharajpet*	0·0	—0·6	0·3		Kankanady*	0·0	—0·6	0·0
Carnatic.	Nellore	0·0	—0·2	0·1	Mysore & Coorg.	Chitaldrug	0·0	—0·2	0·1
	Buchireddipalem*	0·0	—0·3	0·1		Bangalore	0·0	—0·4	0·1
	Madras (Meenambakkam)	0·4	+0·1	1·3		Mysore	0·0	—0·5	0·8
	Tirurkuppam*	0 2	-1·0 @	0·3		Mercara	0·0	—0·8	2·5
	Palur*	0·0	—0·6	0·5	Hills.	Kodaikanal	1·1	—0·7	4·8
	Tindivanam*	0·0	—0·6	0·8		Coonoor*	2·9	+1·4	8·4
	Cuddalore	0·0	—0·7	0·7		Ootacamund*	0·0	—1·3	1·8
						Nanjanad*	1·7	+0·8	4·1
Central.	Vellore	0·4	+0·1	1·2					
	Gudiyatham*	0·0	—0·3	0·2					
	Salem	0·3	—0·2	2·2					
	Coimbatore (A. C. R. I.)*	0·0	—0·2	1·4					
	Coimbatore (C. B. S.)*	0·0**	—0·4	1·7					

Note:—

(1) * Meteorological Stations of the Madras Agricultural Department.
(2) Average of ten years data is taken as the normal.
(3) (x) Readings are recorded only from February, 1948.
(4) @ Average of seven years data for Tirurkuppam and eight years data for Pilicode is given as normal.
(5) (a) Taluk office normal is 0·22″ and Rainfall is 0·0″.
(6) J.N. Just Normal.
(7) tr. Trace viz., fall between 0·01″ and 0·04″.
(8) J.N, £–Actual deviation is 0·03″.
(9) ** Actual fall is 0·02″.

Weather Review for March, 1950.

The month commenced with a western disturbance over North Baluchistan and the adjoining area. A number of mild western disturbances, formed throughout the month over different portions of the country, became unimportant in short spans of existence, say, a day or two.

On 9—3—1950 the dry air spread further into the central parts of the country and the Northern Deccan. On the same day a feeble incursion of maritime air took place over South-East Madras, East Mysore and the Madras Deccan.

Colder and drier air spread over the North-West India, Madhya Bharat and West Central Provinces.

The rainfall in Madras Presidency should be considered as fairly normal in the Andhradesa. In the Tamilnad and Kerala it should be considered as slightly sub-normal.

Very few notable falls were received in the last week of the month under review. Particulars of these falls are given hereunder :

S. No.	Date	Place	Rainfall in inches.
1.	24—3—50	Gopalpore	2·0
2.	25—3—50	Kallakurichi	2·0
3.	27—3—50	Pamban	1·5
4.	28—3—50	Trivandrum	2·3
5.	28—3—50	Palayamcottai	1·5

In Kallakurichi, 4·7" of rain was received during the period 25th to 28th March, 1950.

Agricultural Meteorology Section.
Lawley Road P. O., Coimbatore
Dated 14—3—1950.

C. B.

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,, Muthuswami, S.	Fruit Assistant, Mettupalayam,	Fruit Assistant, Coonoor.
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,, Muthuswamy, S.	Teaching Assistant in Agriculture, Coimbatore,	P. A., to D. A. O., Mathurai.
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,, Narayana Rao, K. L.	Teaching Assistant in Agriculture, Bapatla,	Teaching Assistant in Botany, Bapatla.
,, Nagarajan, K. R.	Ento—Assistant Nellikuppam,	Assistant in Entomology, Coimbatore.
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,, Venugopal P. K.	Pepper Asst.. Mattanur.

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Agricultural College and Research Institute, Coimbatore.

LIST OF ADDITIONS TO LIBRARY FOR MARCH 1950.

1. ATKINS (J. D.): Tomato diseases and pests in Newzealand. 1949. John McIndoe Ltd., Dunedin. Newzealand.
2. AVERY (G. S.): Survey of Biological progress v. I. 1949. Academic Press Inc. New York.
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