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Editorial

The Centenary of the Government Botanical Gardens, Ootacamund: The Centenary of the Government Botanical Gardens, Ootacamund, was celebrated with great eclat on the 18th and 19th of May 1950. At 10 A. M. on the 18th, the Inauguration Ceremony was performed by the Hon'ble Sri A. B. Shetty, Minister for Agriculture, Madras. In the course of his speech, the Hon'ble Minister traced the history of the Gardens and its important role for the benefit of the Horticulturist, and the Agriculturist as well as the common man who visits Ooty for recreation. There were speeches by Dr. R. K. Shanmugam Chettiar, and Sri T. A. Ramalingam Chettiar. The afternoon Session was presided over by Sri R. M. Sundarm, O. B. E., I. C. S., Director of Agriculture. Papers of Scientific interest were read, one on Potato by Sri Uttaman, Superintendent, A. R. S. Nanjanad, on Cinchona by Sri Mohan Rao, on Tea by Mr. Peter Jong, Tea Experimental Officer, Coonoor, and on the "Wild Flora of the Nilgiris" by Sri S. N. Chandrasekhara Ayyar, M. A., Government Lecturing and Systematic Botanist, on Soil Conservation by Sri Bheemayya and on Wattle Plantations by Sri Raghavan Nair, Provincial Sylviculturist. The President, Mr. R. M. Sundaram said, in winding up the session that indiscriminate destruction of forest trees led to soil erosion and failure of rains and stressed the vital necessity for taking adequate steps in good time for preserving the beauties of the Nilgiris.

The second day's session was inaugurated by the Hon'ble Sri N. Sanjeevi Reddy, Minister for Forests. This was followed by an extremely interesting and thought-provoking speech by Sir C. P. Ramaswami Iyer. Perhaps the most interesting feature of the Centenary was the Free Exhibition, which was kept open to the public from 10 A. M. to 6 P. M. on both the days. Stalls, describing the activities of the Agricultural, Forest, Veterinary, Fisheries and other Departments and some private stalls of interest attracted

huge erowds. His Excellency the Governor of Madras and the Maharani Saheba of Bhavnagar took a very keen interest in the Centenary Celebrations and were also present for the entertainments.

Our Retiring President: Mr. M. C. Cherian, Principal of the College and President of the Madras Agricultural Students' Union retired from the Madras Agricultural Service on 27—4—1949. Mr. M. C. Cherian was closely associated with the Union and served the Union in various capacities, as Secretary, Vice-President, Editor of the Journal and finally as ex-officio President. In these capacities, he did yeomen service and contributed much to the successful running of the organisation. He took up the Secretaryship at a time when the finances of the Union were in a deplorable state and it was mainly due to his efforts, that things were set right and the Union started functioning on a satisfactory basis. As Principal and President, Mr. Cherian again helped the Union, to revive its activities after a period of inaction necessitated during the war years. Gifted with an amiable temperament, courteous to every one, sincere in his efforts in all that he undertook, Mr. Cherian endeared himself to all those who came in contact with him, and the Madras Agricultural Journal takes this opportunity to record its appreciation of the services rendered by him to the cause of the Union, and wishes him long life and all happiness in his retired life. We have no doubt that he will continue to evince the same interest in the affairs of the Union, as hitherto, and support its activities.

Our New Presideent: We extend a hearty welcome to Mr. C. M. John, our new Principal. Mr. John has a deep attachment to the Union and has in the past helped it in many ways. As Principal his opportunities to help the cause of the Union, are extended and we have no doubt, that under his able guidance, the Union will have a period of steady progress, and usefulness to its members and the public.

Suggestions for Stocking Fish Ponds in Madras*

By

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Introduction: Very frequently the questions "How many fish can a pond hold?" or "How many fingerlings of *Catla*, *Labeo*, *Etroplus*, *Mirror*, *Carp*, *Chanos*, etc., can one stock in a pond?" are posed; but satisfactory answers for them have not been received. Although definite data have been worked out for similar American and European fish ponds, there does not seem to be any agreed answer to these questions for tropical waters. Worthington (1943) states in this connection "……But productivity of fish should be capable of even greater development on account of the higher water temperatures and lack of winter. Thus there may be a big future for fish farming in the colonies in ponds specially constructed for the purpose, properly managed and manured. For intensive fish farming in warm climates, we have the outstanding example of the Chinese who see to it that every square yard of water produced a crop of fish. Before such a new industry is started in countries where opportunities for fish ponds are extensive, intensive research work is necessary in order to bring to bear our knowledge of productivity in water, of manuring, and of the life histories of difierent species of fish". Our knowledge about the bionomics of the inland fishes of the Madras State is fairly extensive and therefore it is possible at this stage to arrive at a uniform and standard method of computation per unit area or volume of water for stocking South Indian ponds with fingerlings of various kinds.

Basis of computation: Fish production may be expressed in weight of fish per unit volume of water or as number of fish or weight of fish per acre of water. From a study of the physical, chemical and biological conditions in a pond, it will be seen that the region of biological productivity is usually confined to the top, i. e., the region of photosynthesis or the depth to which the sun's rays can penetrate; and that the bottom region is the zone of biological reduction where the inorganic nutrients required for biological productivity in the upper zone, are being manufactured. Apparently therefore, the depth of water has little effect on the amount of fish that a given pond area can support. So, weight of fish per acre of water surface would appear to be a more accurate measure than weight of fish per unit volume of water. Thus a given area of water will support only a certain weight of fish; and

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productivity of fish is, therefore, more nearly related to its area than to its volume. Hora (1943) has also stated that the number of fish that can be stocked in a given pond depends upon the nourishing power of the water and surface area in contact with air.

Looking thus at the same problem from another angle, fish productivity in a pond depends not on its size but on its nourishing power as stated above. It is not correct to assume that the more small fish added to a water the greater would be the harvest. A pond yields best results according to Hora (*loc. cit.*), when it is stocked according to the nature and amount of natural food contained in it or artificial food that can be supplied to fish. If a body of water can feed only 1000 pounds of fish to the acre it does not make any difference where 1 lakh or 5 lakhs of fingerlings begin life there each year, as the end result will be the same, namely, 1000 pounds per acre. Only that number of fish will grow up that the food supply will support.

Types of waters: There are however different kinds of waters. In order to produce a good fishery a pond must be stocked with the proper kinds and numbers of fish. If a piece of natural water contains a permanent bloom of one or several species of alga, as in the case of a temple tank, it should be stocked with such fishes like the Katla (*Catla catla*), Milk-fish (*Chanos chanos*), Mrigal (*Cirrhina mrigala*), Mirror Carp (*Cyprinus carpio*) and Labeos (*Labeo spp.*), that will feed mainly on them; and if on the other hand, the zoo-plankton predominates in the water, then it should be stocked with such fishes as *Thynnichthys sandkhol, Osteochilus thomassi, Barbus hexagonolepis* and *Barbus carnaticus.* Species of *Labeo Etroplus suratensis,* and *Cyprinus carpio* which feed on debris at the bottom and margin should also be stocked in the economy of pond culture.

Fish associations: The problem of rearing fishes in different types of waters is therefore varied. Naturally, the estimated yield of fish that can be expected in a given piece of natural water will also vary with the species of fish selected for stocking and the nature of the available food. If the fish stocked is a feeder, to a large extent, on phytoplankton, highest production of about 1000 lbs. per acre of water surface can be realised; if they feed on animalcules mainly only half the amount can be expected; and if they are carnivorous and feed on other fish, only about 200 pounds per acre can be expected in temperate waters (Swingle and Smith, 1941). But as biological productivity is nearly twice or thrice that in the temperate region, the above rate of production can be safely doubled, especially in the first case. Our knowledge of the productivity of the waters of this State confirms this. Any pond contains also plenty of detritus or decomposed or dead organic matter upon which certain other types of fishes can feed. Further, different fishes feed at different

levels and have a selected habit of feeding. One of the problems of Fish Farm Management is therefore to work out the combination of species that will produce the maximum yield of edible fish for each type of pond. So a pond should be stocked with surface feeders, column feeders and bottom feeders to get maximum production. As a general rule, it is advisable to stock a pond with 50% of fingerlings of surface feeders, 25% of column feeders and with 25% of bottom feeders.

Growth rate of fish in different types of waters: Before suggesting the formula for estimating the number of fingerlings which can be stocked in a pond, it is necessary to know (i) the rate of growth of fishes suitable for stocking in inland waters of Madras (Table I,) and (ii) types of ponds commonly met with and the nature of fish-food available in them and annual yield of fish in pounds per acre (Table II). The data given in these two tables are based on our own observations made on various departmental and public waters of this State. With the help of the above information, the number of fingerlings, which should be stocked in a pond can be easily estimated.

TABLE I

Showing food Preferences, nature of feeding, growth and mortality of common freshwater fishes of Madras.

Kind of fish	Food preferences	Nature of feeding	Normal growth attained at the end of 1st year			% likely of mortality the during first year
			Length in inches	Weight lbs.	oz.	
Catla catla	Phytoplankton and macro-vegetation.	Surface & colum	15—18	2	0	10
Laebo fimbriatus	do.	Bottom & column	12—15	1	0	10
Labeo rohita	do.	do.	15—18	1	8	10
Labeo calbasu	do.	do.	12—14	1	0	10
Labeo kontius	do.	do.	9—12	0	12	30
Cirrhina mrigala	Phytoplankton	Surface & column.	15—18	1	8	10
Cirrhina cirrhosa	do.	do.	10—12	0	12	30
Cirrhina reba	do.	Column & bottom.	8—10	0	4	20
Thynnichthys sandkhol	Zoo & phyto-plankton	Column	9—12	0	12	30
Osteochilus thomassi	do.	do.	9—12	0	12	30
Barbus carnaticus	do.	do.	6—8	0	4	20
Barbus hexagonolepis	do.	do.	6—8	0	4	20
Chanos chanos	Phytoplankton	Surface	15—18	1	0	10
Etroplus suratensis	Algae & zooplankton	Colomn & bottom	4—5	0	4	20
Ciprinus carpio	Phytoplankton & macro-vegetation	Colomn & & bottom	12—18	1	8	10
Osphromenus gorami	Macroveget-. ation.	do.	9—10	1	0	10

TABLE II

Showing classification of ponds in Madras State.

Pond type.	Nature of food organisms.	Colour of water.	P. H.	Nature of pond bottom.	Average yield of fish per acre (lbs.)
I	Permanent bloom of a blue-green alga, like *Microcystis*, *Anabaena* or *Oscillatoria*.	Greenish	>8·0	Black rotting organic matter.	2000
II	Abundant macrophytic vegetation *Hydrilla*, *Vallisneria*, *Potomogeton*, water-lilies, etc.	Colourless	7·5–8·5	do.	1000
III	Abundance of zooplankton and few plant organisms.	Brownish	7·0	do.	500
IV	Clear throughout with an occasional algal bloom.	Clear	6·5–7·5	Brownish	300
V	Few phyto and zooplankton.	Clear	6·5–7·5	sandy	200

Number of fingerlings to be stocked: From a careful inspection of any pond, it is possible to determine to which of these five types it belongs. Table II gives us a rough indication of the total annual weight of fish which that pond is likely to produce: and Table I gives the annual increase in weight of different kinds of fish at the end of one year and also the percentage of mortality of the fish. From a consideration of the two data and by applying the following formula (Macan *et al*, 1942), one can easily calculate the number of fingerlings with which the pond should be stocked

$$\text{No. of fingerlings to be introduced} = \frac{\text{Total expected weight of fish crop (Table II)}}{\text{Annual increase in weight of individual fish (Table I)}} + \text{\% mortality (Table I)}$$

Applying the above formula, a tank measuring 1 acre can be stocked with fingerlings of the various species as detailed in Table III.

TABLE III

Showing number of fingerlings per acre of waterspread to be stocked in different types of waters. (The figures are corrected to the nearest ten.)

Kind of fish	No. of fingerlings be to stocked.				
	Type I	Type II	Type III	Type IV	Type V
Catla catla	1100	550	280	170	110
Labeo fimbriatus	2200	1100	550	330	220
Labeo rohita	1480	740	370	220	150
Labeo calbasu	2200	1100	550	330	220

Kind of fish	No. of fingerlings be to stocked.				
	Type I	Type II	Type III	Type IV	Type V
Labeo kontius	3470	1740	870	520	350
Cirrhina mrigala	1480	740	370	220	150
Cirrhina cirrhosa	3470	1740	870	520	350
Cirrhina reba	9600	4800	2400	1440	960
Thynnichthys sandkhol	3470	1740	870	520	350
Osteochilus thomassi	3470	1740	870	520	350
Barbus carnaticus	9600	4800	2400	1440	960
Barbus hexagonolepis	9600	4800	2400	1440	960
Chanos chanos	2200	1100	550	330	220
Etroplus suratensis	9600	4800	2400	1440	960
Cyprinus carpio	1480	740	370	220	150
Osphromenus gorami	2200	1000	550	330	220

Conclusion: One of the principal problems in raising fish in ponds is the management of the population so that the maximum number reach a desirable table size each year. As already stated, since a pond can support only the weight of fish for which food is available, it can support either a large number of very small fish or a smaller number of large fish in each acre of water. The former condition results in very poor fishing; the latter gives good fishing. It is very important, therefore, to stock a a pond with the correct number of fish that would utilise efficiently the food available. Further, it is necessary that periodic cropping should also be associated with stocking, if one should get full value of the pond. It is hoped that the suggestions given in this article would be of help to the practical fish farmer.

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Recent Advances in the Manufacture and Use of Butterfat or Ghee

By

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Introduction : Butterfat has always been highly valued as a food and much attention has been given to its conservation. The common methods of preserving it have been by the production of and storage of butter, or of the fat from which the other milk constituents have been removed. The problems of preservation of butter or butterfat for any great period of time are mainly related to spontaneous chemical reactions with the oxygen of the atmosphere and to enzymic spoilage and bacterial growth.

Dry butterfat in a variety of forms has long been an article of commerce. Butteroil or milk oil are the terms applied in the United States to the milk fat which remains after the curd and water have been removed from butter. Various other terms are in common use in other countries, — Australia, dehydrated butter (this term is not strictly correct, as dehydration implies only the removal of water); England, clarified butter; Egypt, samna or masli; France, beurre fondu; Germany, Butter schmelz, floss Butter, geschmolzene Butter, Kuhschmelz, Rind schmelz; India, ghee; Iran, Roghan; and Switzerland, eingesottene Butter.

The manufacture of butter-oil is not new to the dairy industry of India or of the world. The pioneers in the manufacture and preservation of milk oil were the Hindus. For more than 1,000 years they purified butter and preserved it in stone jars for the anointing of idols and for use as a medicine (1). This form of preservation of butterfat is a necessity in tropical countries where the temperature is too high for the use of butter. In United States of America over three decades ago butter-oil was made commercially for the use of baking, ice cream and candy industries. But, competition among the manufacturers resulted in the use of low grade butter as a source of butter-oil, and the inferior quality of the product soon ruined the demand for butter-oil in these industries. However, this product was produced in large quantities during the periods of World war I and World war II for the use of armed forces in tropical countries. The manufacture of dehydrated butter in Australia and New Zealand originated early in 1641 because it offered a ready solution to the problem of utilisation of surplus whey and second grade butter, which under war conditions could not be marketed ocally or shipped overseas (2).

The development of the process of manufacture of butter-oil in foreign countries increased the supply of butterfat available to overseas consumers without appreciably decreasing its nutritional properties. Butteroil as compared to butter occupies less shipping space and weight and can be transported in unrefrigerated space without deterioration. The production of butter-oil also prevents the accumulation in cold storage of a product that would deteriorate in long distance transport and make stores available for other products. It has enabled the dairy companies to continue the separation of butterfat from whey, thereby avoiding drainage difficulties and continuous return of apporximately O. 75 $ per lb. for all butter delivered to companies in Australia. The apporximate saving to Australia in the season 1941–'42 was over £ 30,000 (3). The annual production of butter-oil in India amounts to 409,368 tons (4), and we are the largest producers of this food product in the world.

Manufacture: Numerous methods are available for the preparation of butterfat in small or large scale, either from cream or from butter, but they may be divided broadly into 4 main groups, (i) open pan evaporation method, (ii) separation from cream, (iii) vacuum pan drying of the butterfat and (iv) centrifugal separation of butter-oil from the melted fat.

(i) *Open pan Evaporation Method.* This process consists in melting the butter in a shallow pan and boiling it with continuous stirring for a considerable period of time over a free flame. The water is boiled off briskly at first and then more gradually. A scum of solid material forming on the top of the fat is skimmed off carefully from time to time. When all the water has been evaporated the temperature of the fat rises above 100°C and the curd chars to a brown colour. The butter has then been sufficiently boiled and is allowed to cool somewhat while the curd particles settle. The fat layer is carefully removed into suitable vessels as free from solid particles as possible and allowed to cool and crystallise. The hot butteroil may or may not be filtered through muslin into the containers. The method varies in minor details from place to place. In some places the butter is heated till the temperature goes up to 116 or 120°C.

This process of boiling down butter in an open atmosphere on an appreciable scale is relatively a very slow process since careful control is needed to prevent excessive frothing, even if very shallow pans are used. Through the butterfat prepared by this process has a very good keeping quality it acquires a cooked taste or a strong toffee flavour. However, even today this process is commonly used in India and other subtropical countries (5), because of the fact that the economic conditions and small holdings prevent them from using elaborate machincry on a reasonably profitable scale.

Besides boiling down butter as a whole, various modifications have been in use for preparation of butter-oil. Julien (6) melted butter on a water bath at 40°C till the serum containing the solids not fat got settled at the bottom. The liquid fat was separated by gravity and stored for a long period of time. The fat can be remade into butter by adding 20 to 30% of sweet or pasteurised milk and emulsifying under pressure. Since complete removal of water by melting and gravity separation is impossible, the butter-oil obtained by the preliminary gravity separation at a temperature of 60°C is heated to 106°C to remove the last trance of moisture (4). But this product would not be suitable for reconstitution as butter or milk because of the high heat treatment. A method of preserving the butter that will keep for at least one year is described in the International Review of Science and Practical Agriculture (8). Butter was heated at 40° or 45°C, the fat was separated and when still warm, salt was added and the product filtered and stored in a brown bottle. A method of reproducing butter from the stored butterfat is also described.

(ii) *Separation from Cream :* Backhaus & Schach (9) melted butter and mixed skim milk in an emulsor and separated the final product centrifugally. The resulting cream was made into butter. The Milk Oil Corporation (10) produced normal butterfat devoid of taste and odour by separating the cream from whole milk, diluting with water and passing through the separator. The resulting cream was whipped, diluted with water (4 volumes) and agitated with heating till the oil was isolated. The resulting product was passed through a whey separator and through an oil separator to produce a dry oil. French (11) isolated butterfat from cream using several washings with water and re-separation to break the emulsion. These procedures will be obviously slow and expensive for large-scale production. Further, it would involve heavy loss of fat in diluted skimmed serum. Subsequently French (12) proposed a method of souring the cream for 20 hours and boiling down the cream directly without difficulty. Other investigators (7, 9) have shown that the use of once washed cream (dilution with water and re-separation) and ripened cream shortens the time of cooking and increases the out-turn of ghee, thereby reducing the loss of fat in ghee residue. This procedure eliminates the intermediary step of making butter from cream. However, this product would not be suitable for reconstitution.

(iii) *Vacuum pan drying of Butterfat :* This procedure of removal of moisture from melted fat under vacuum speeds up evaporation, but is is difficult to remove the last traces of moisture. Further, the treatment is to be carried out in batches and would involve keeping fat hot for a considerable length of time, which might hamper the keeping quality of the butterfat. Though some patents have been taken on this procedure, it does not seem to have been commercially used to any extent.

(iv) *Centrifugal Separation of Melted Butterfat:* The use of special type of centrifugal separators as a tool for the separation of butterfat has helped the dairy industry a great deal in recent years. Alexander (13) described a process of separating butter-oil from cream, and butter by subjecting them to a temperature corresponding to low steam pressure sufficient to dissolve the casein, and then separating the fat centrifugally North (14) in the year 1924 took a number of patents on the preparation of butter-oil from cream, on the heat treatment of cream, washing and separation of curd matter and on the final dehydration of butterfat: Quite a number of other patents (15–22) were also issued in these years. The modern methods of making butter-oil may be classified under the following heads: (1) New Zealand method, (2) Australian method and (3) American method.

1. **New Zealand Method for the Manufacture of Butteroil from Butter:** For continuous large-scale production of butterfat the use of centrifugal separation is preferable to attempts to separate fat directly from cream or by the use of vacuum pan. McDowall *et al* (23) evolved a process of manufacture of butterfat, wherein (i) the fat was kept hot for the minimum length of time and (ii) the process was continuous so that the work of dealing with the incoming butter and the filling into containers go forward without interruption. Though the procedure is elaborate it serves as a typical procedure for the preparation of butteroil on a large scale and an outline of the working of the plant installed at Kings Wharf, Auckland, is of great use for a clear understanding of the steps involved in the manufacture of butteroil. The butter from 56 lb. prints was extruded from the bulk-butter packer into a closed stainless steel melter-cylinder (4 feet long and 23 inch diameter having a capacity of 3 tons of butter per hour, tilted at an angle of 10° to facilitate the flow of fat) into which steam was injected, the cylinder being provided with a safety-valve to blow off at 0·75 lb. pressure. The melted butter was drawn into a jacketed melter-vat of capacity about 50 gallons. The fat-water mixture from the melter-vat was pumped up to the top into a battery of separating cylinders which has two perforated plates one of which acts as a filter. This cylinder was just a large version of an ordinary laboratory separating funnel. A certain amount of gravity separation of the serum takes place in this cylinder. The serum was run off into a serum tank of about 130 gallon capacity. The fatty portion from the separating cylinder was passed through a first series of two 920M De Laval direct drive model separators with milk top discs at 140°F and then to a steel pasteuriser (Burnard Pasteuriser modified by Murray Deodorisers Ltd.,). The pasteuriser raised the temperature of the butterfat, improved the degree of separation and acted as a pump to lift the fat for delivery into the second series of separators. The fat from these separators was discharged at an equaliser hopper tray into the floating tank. This was necessary because the flow of the dehydrator was much more than that of a single unit series of separators.

The nearly dry fat was run down the steam-jacketed walls of a vacuum pan where it was finally dried at a vacuum of 29″ and at a temperature of 190—200°F. of the fat. This high temperature of evaporation was necessary because, water is soluble in hot fat and its removal necessitates a high temperature. The dry fat was then passed through a specially built rotary cooler to the filler line. Filling was done by automatically controlled drip-proof valves to within a few oz. of the correct weight. The weights were then adjusted and the tins (of four gallon capacity) hermetically sealed and stored at 45°F for crystallisation prior to export.

The serum from the separating cylinders and from the first and second series of separators was reseparated twice before being discarded, the recovered fat being retreated by the above process. The maximum hourly rate of one unit plant was 1·75 tons of butterfat and the daily production was 1002 cases or equivalent to the treatment of 42 tons of butter.

The fat loss in the process of manufacture ranged from 0·9 to 1·3 %. The labour cost for a one unit plant was 2 pies per lb. of butterfat. The total cost of treatment including packaging which was the major item was 1·5 as. per lb. of butterfat. A two-unit plant installed at King's Wharf, working for 120 hours per week has a capacity of 12,500 tons of butter or 10,000 tons of butterfat per annum.

Whey butter was found more easy to handle than creamery butter. The authors advise the use of 4% NaOH to creamery butter to adjust the pH of the serum to 8·5. The bowls of the separator require cleaning once in 8 hours if salted butter is used and 17 hours if neutralised unsalted butter is used. The final product contained moisture 0·02 to 0·04% and acidity 0·1 to 0·33%. They found no loss of vitamin A during the processing. The vitamin D content of the butterfat was increased from 20 to 60 i u.. per oz. by the addition of calciferol dissolved in butterfat at the rate of 1/1300 gm. per tin of 38 lb. capacity. This was added by means of a plunger pump at 110°F. The authors are of opinion that the efficient use of the separating cylinders is the key to the successful high speed drying of the butterfat due to (i) oiling off of emulsion, (ii) removal of the serum diminishes the load of the separators and (iii) less frequent sludging of the separator bowl.

As early as 1922 the Glaxo Manufacturing Company prepared considerable amounts of dehydrated butterfat by melting butter and separating in cream separators followed by treatment in Sharples Clarifier and in 1924 the New Zealand Co-operative Dairy Company used a similar procedure. The production was discontinued because of the poor local demand.

2. **Australian method of the manufacture of butteroil from butter.** A method suitable for Australian conditions of preparing butterfat was developed by Loftus Hills (24) at Longwarry. Based on this work a large commercial plant was installed at Brisbane by the Queensland Butter Board and soon after another one at Sydney by the Producer's Co-operative Distributive Society Ltd. Butter cubes (56 lb.) were melted in half ton lots by direct exposure to steam and then passed by gravity to three stainless steel 250 gallon neutralising vats fitted with agitators where it was neutralised with NaOH to pH 10 in the serum. The melted butter was then pumped to three Titan self-desludging separators. The serum was run through a cream separator to recover small quantities of fat. The fat from the centrifuges was drawn by vacuum into the first dehydrator (a large size modified Vacreator) having a vertical stainless cylinder 22″ diameter and 4 feet high. A vacuum of 29″ was maintained, the butterfat was sprayed in at the top, the moisture content reduced to below 0·2% and the temperature kept below 160°F. The dried butterfat was pumped to a Sharples centrifuge used as a clarifier where traces of salt and curd are removed. The butteroil was then drawn into the second dehydrator similar to the first and the moisture content reduced to less than 0·05%. The second dehydrator was used as deaerator at a high temperature. The fat was then passed through the tubular cooler using water as cooling media, filled in tins, head-space displaced with nitrogen and then sealed.

The differences of this process as compared to the New Zealand procedure are that (i) the melting of the butter in an open chamber by direct steam causes dilution of butter by about 17% and (ii) the serum was adjusted to pH 10 instead of pH 8·5.

3. **American method for the manufacture of butteroil.** Wilster (43) suggested a method of production of butterfat using either cream or butter as starting material. Cream was separated at 120°F by using a specially constructed centrifugal separator to give a high fat product having 90 to 95% fat. This was re-separated to yield an oil containing 1·0 % moisture and passed through a Vacreator at 195°F under partial vacuum, to steam distillation, and to partial cooling in a chamber kept at nearly complete vacuum. This treatment removes all traces of moisture and improves the keeping quality. The time of vacreation was only 3 seconds. The moisture free oil was solidified in a Votator (Vogt Freezer) constructed like a continuous ice cream freezer and stored in tin containers.

The butteroil was also prepared from butter by diluting with warm water, neutralising the free fatty acids and passing through the separators as mentioned above for cream.

Uses of Butteroil: The idea of separating the major constituents of milk and subsequent dehydration of the same with a view to conserve them and reconstitution of the ingredients to milk and other dairy products made great progress in the industry during recent years. Butter-oil properly prepared is a delicately flavoured product that can be used in as many ways as butter is used. It can be used in liquid form in cooking or baking or even as a liquid spread. Pure butter-oil and skim milk powder constitute all the nutrients found in butter and they could be shipped without refrigeration to tropical climates, held for an year or so if desired, and then made into good butter with the aid of little cold water (25).

(a) *Making reconstituted butter:* To produce butter with normal butter characteristics, particularly from body and texture standpoints, it would be necessary to make reconstituted cream and then churn it. Of course, such a method would necessitate an emulsor and churning equipment. Secondly, crystallisation of butter-fat in water could be effected in a mixing equipment containing the liquid oil, skim milk powder, salt and water and then the granules could be worked after crystallisation. Thirdly, skim milk can be added to the butter-oil and the solidification of the butter-oil can be effected by cooling and agitation. It is obvious that there would be pronounced differences between the better prepared from the butter-oil allowed to crystallise without agitation or whon crystallised by dropping into cold water and then solidified as described above (26). The smooth and much more spreadable butter can be obtained only if the emulsion is stirred through the solidification procoss. If this is not done the resultant butter would be short-grained and sandy. A. number of patents have also been granted in this field (27–33).

(b) *Making concentrated hardened butter:* Wiley & Coombes (44) made a successful attempt to produce "tropical spread" which would keep in good condition without refrigeration in tropical climate. This had a compositttion 1 % salt, 2 % skim milk powder, 77 % dry butter-fat and 20 % hydrogenated butter-fat. Later, hydrogenated groundnut oil with iodine value below 2 was substituted for hydrogenated butter-fat. The method

used is as follows. The dry butter-fat was pumped to jacketed stainless steel vacuum mixing vats (34' diameter and 4' high with a capacity 1000 lb) fitted with propeller-type agitators and maintained at 140°F. To this 4% skim milk powder, 2% finely ground salt which had been treated with anhydrous sodium carbonate, 3% hydrogenated groundnut oil and 0. 2 p. p. m., of diacetyl are added, vacuum applied with vigorous agitation. The mixture was then passed through a deaerator at 29" vacuum and pumped to a cooler consisting of a stainless steel drum 20" diameter and 4' long fitted with scrapers, which rotates in a jacketed stainless steel cylinder. The fat wat passed through the space between the drum and the cylinder. The temperature of mixing was reduced rapidly from 140°F to 78°F at the rate of 40 lb. per min. Rate of cooling and agitation are important in determining the texture of the finished product. The mixture was super-cooled and directed to an automatic filling machine (made by D. W. Bsngham & Co., Proprietary Ltd., Melbourne), and worked at a rate of 40 one-pound tins per min. The cans are vacuum sealed. About 11,000,000 lb. of this product was supplied to Allied Forces in the South-west Pacific area during 1945.

(c) *Making reconstituted milk.* (i) *Early attempts:* The making of cream (34) out of melted butter and liquid skim milk with the use of a homogeniser became universal among all milk and ice-cream dealers in America in the beginning of 1906. The cream they produced would not whip, when added to coffee, would rise in the form of a foam, and the milk would not form the natural cream line. In 1912, instead of an homogeniser an emulsor was used for reconstitution. In this case the fat from the reconstituted milk would rise to the top of the bottle forming a hard layer or cake. Thus, the early attempts to produce satisfactory reconstituted milk from dried milk (skim) and butter were failures due to the fact that the dried skim milk produced in those years was only cooler dried (185-200°). Subsequently, attempts to produce reconstituted milk with the nse of spray-dried skim milk was a success.

The character of the finished product depends on the quality of the raw materials used. The butter produced in those years varied enormously in their composition and condition. A milkfat of highest quality and uniformity required control at the source of production complete dehydration and packaging under hermetically sealed condition. To achieve this end, the Milk Oil Corporation concentrated their attention during the years 1918 to 1928, when more than 38 patents were granted to them over foreign countries and America. In 1923 the health authorities found that all milk dealers were using homogenisers in making cream out of butter for ice-cream and sometimes were making cream and milk to make up for occasional shortages. To prevent this, the health authorities prohibited the installation of any type of homogeniser or emulsor in any milk plant except with special permit. Homogenisers were allowed only for ice-cream manufacturers.

However, the discovery by physicians and health authorities in 1939 that homogenised milk had great merit for medicinal purposes restored the use of homogenisers in milk plants.

(ii) *Recent attempts:* In brief, the preparation of reconstituted milk (35) consists of heating and mixing together butter-oil, dried skim milk (spray process) and water in the same proportion as found in normal fresh milk. After heating and holding at pasteurisation temperature (143°F for 30 min.) the mixture is pumped through a homogeniser at 2500 lb. pressure to effect uniform combination of the ingredients. After homogenising, the product is pumped over a tubular cooler. Apart from a cooked flavour, the reconstituted milk compares favourably with fresh milk provided proper ingredients are used. Various other methods for the reconstitution of milk have been proposed (36–42).

As high quality butter-oil and dried milk (skim) properly packaged have an extremely good keeping quality at warm temperatures and for long periods, these ingredients can be used advantageously for reconstituted milk, provided the necessary mixing, pasteurising, homogenising, steam and refrigeration facilities and cooling equipment are available.

The installation of equipments for the large-scale manufacture of butter-oil in some of the main ghee producing centres in India offers great opportunities. Butter which is poor in quality because of high free fatty acids content (a common defect in India) or protein decomposition, or any other physical defect can be used satisfactorily for the production of a fairly good quality butter-oil (45). Butter which is poor in quality because of tallowiness, metallic flavours or excessive oiliness cannot be reprocessed into a butter-oil of satisfactory quality. The butter-oil produced by the large-scale process could be stored for over 9 months without development of oxidised flavour (and for a longer period with certain anti oxidants, particularly those containing catechol nuclei) and suitable for reconstitution in times of need. The reconstituted milk prepared from materials that are comparable in quality and storage conditions are more satisfactory than reconstituted dry whole milk (45).

Summary: The methods of manufacture, properties and uses of butter-oil are discussed.

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How to translate the Results of Research to General Farming Practices with Particular Reference to Sugarcane

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The Magnitude of the Problem: Sugarcane is an important money crop of this province and the area under this crop increased from 1,25,000 acres in 1935-36 to 2,73,000 acres in 1947-48. The total investment on sugarcane is roughly Rs. 25·25 crores, on land and Rs. 1·15 crores on factories. Nearly fifteen lakhs of unskilled labourers are dependent on this crop, not to mention of thousands of middle men, merchants and labourers employed by them. Being a money crop that fetches the maximum profit per acre as compared to other crops, this crop plays an important role in the economic structure of the poor cultivator, saving him from indebtedness. Though, during the present period of food crisis, it is considered less important, any attempt to completely displace this crop, will result in the cultivator's economic ruin. Dr. Burns in his report on Technological Possibilities in India pointed out that Madras is capable of producing over 50 tons of cane per acre, due to its particular adaptability in respect of climate and soil to this crop. But our present average production is only 20 tons of cane i. e. 50% of the potentiality. It is known to every one that the starting of the Samalkot Research Station saved the sugarcane crop of the Godavari Delta from extinction by red-rot, and the starting of the Coimbatore Breeding Station developed the Sugar Industry of the country. If to-day the industry is faced with a crisis by foreign competition, by import of cheap sugar, it is because practically nothing has been done to investigate the possibilities of lowering the costs of production, the research on which, being the only way to save the industry from its total and second extinction. A few of the items in which quick improvements are possible are indicated in the following table to bring home the total value of such improvements when adopted in the entire Sugarcane area of the province.

Name of improvement	Quantum of improvement	Total value of improvement	Remarks
1. Variety	... Introduction of Co. 419 in the province in a normal area 1,44,000 acres taking average increase of yield as ten tons per acre for one year over the displaced variety.	Rs. 36/- Millions.	Taking the average price of cane in (the last decade as round about Rs. 25/- per ton)

Name of improvement	Quantum of improvement	Total value of improvement	Remarks
2. Jaggery preparation ...	Improved methods of jaggery preparation and preservation.	Rs. 59,40,000	Taking 75% of the cane is utilised in the jaggery production and average yield as 2½ tons of jaggery and premium for good jaggery Rs. 0—4—0 per maund.
3. Recovery percent in factories ...	Average recovery for province 8·66 per cent possible level to be raised 10·5 per cent.	Rs. 80,00,000	Taking the value of sugar as Rs. 735/- per ton exclusive of excise duty and 53,000 tons as normal production of province.
4. Other cultural improvements ...	Ten tons of cane increased production per acre.	36 millions.	Present average 25 tons By varietal improvements 10 tons By cultural methods 10 tons 45 tons

It is therefore computed that a net increased income of over 90 millon rupees is possible if these improvements in Sugarcane cultivation are carried out.

The cultivation of crop in this province may be grouped into ten zones namely (1) Vizag District, (2) Godavari Delta, (3) Kistna, (4) Central Districts comprising N. Arcot, Chinglepet, Salem and Chittoor, (5) Hospet, (6) South Arcot, (7) Coimbatore, (8) Madura, (9) Trichy and Tanjore and (10) West coast. Each one of these ten zones has its own characteristic type of soil, irrigation facilities, climate, cultural practices, and farm economics. If research is to meet the needs of as many cultivators as possible it should be equally extensive. Any advice given based on few fundamental experiments carried out in one or two central Reserch Stations for the whole province will lack in details in its application to individual field practices of the different zones. There were only five Research stations to work on Sugarcane (Anakapalle, Samalkot, Gudiyattam, Palur and Coimbatore) with only nine men as technical personnel spending only about Rs. 72,000/- per annum. It is thus seen, that the research on this crop, is not extensive to go into the fringes of the problems of the different tracts, not to speak of the problems of the individual tracts. This inadequate staff and finance for the immensity of the problem, may be compared with the money spent on sugarcane Research by the other sugar producing countries, as given below :

Hawalii	...	1,082,404 Dollars	(Rs. 4,329,616)
Puerto Rico	...	685,600 ,,	(Rs. 27,42,400)
Florida	...	590,161 ,,	(Rs. 23,63,844)

For a single problem of plant survey in Russia, before World War II, 168 milliom roubles were spent employing 2000 research workers in 1233 research stations. Britain spends annually 74 million pounds, on original research and 10 million dollars to propagate scientific knowledge in countries even outside Britain. Therefore, it is not wrong to say, that research is not adequate enough to appeal and to solve the problems of the different tracts in detail.

Research to be extensive should be in two forms (i) Fundamental to the crop and (ii) its application to field practice. At present, researches on applied aspect of the crop are confined only to the departments of agriculture, universities playing no role in this country as in others. This aspect of the problem was mentioned by Ramaiah who says that inspite of various handicaps, the agricultural officers have contributed valuable knowledge in the field of science while the universities played no role in this. In other countries, universities and other private research institutions engage qualified men to take up research on fundamentals, while the government or subsidised institutions take up the applied field of research. The examples of Rothamstead, Savalof and Hawaiian Planters' Association may be mentioned where research prospered without initiative from the State, while in this country, it is the reverse. State can invest only limited funds for research on the multifarious problems of the cultivator, thus restricting the field of utility. Taking the sugarcane factories of this province, it is not impossible to gather up a capital of one or two lakhs of rupees for research on problems of reduction of sugar price from Rs. 28—8—0 to Rs. 16—12—0 in order to face the present foreign competition. Therefore since research is as productive as any other commercial undertaking greater investments on the same can only spread science to the millions of cultivators in this province.

Why the Cultivator is not Responsive: It is fallacious to argue that the Indian ryot is conservative and slow to know what is good for him. The probable cause for the existing gap between science and the cultivator, are to be sought elsewhere. Taking sugarcane as an example, it may be pointed out that the average holding of a cultivator under this crop is not more than one acre, though in some factory areas it is much more because lands are taken on lease and cultivated. The land tenure system in this province is such that the land is always starved and kept under minimum production level. Maintenance of land at high fertility level, requires investment on manures, soil conservation implements, change of cropping system, which all require long range policy.

In the social structure, most of the sugarcane cultivators take to this crop, to realise some cash and not as an investment of surplus money into productive avocations. In many cases, he borrows money to meet

part of his cultivation expenses and these money lenders not only charge him high rates of interest but also compel him to dispose off the produce at harvest time when there is a glut in the market. A specific instance of such a case namely Chodavaram Taluq of Vizagapatam district may be mentioned. Over 12,000 acres of cane are grown every year in this taluq, and almost every ryot is indebted to the money lender and he is compelled to sell his jaggery straight from the pan at the harvest season. In the 1949 season, nearly 24,000 tons of jaggery were prepared in this taluq, and all of them sold out to middle men at the lowest price of round about Rs. 2—12—0 a maund. The prevailing price in June was Rs. 4/- per maund, and thus the producer of the taluq, lost his legitimate share in the increased market value of about Rs. 15 lakhs. This is the sad story of a jaggery manufacturer in a single taluq.

Taking a ryot in the factory areas, and taking for example, a factory of 800 ton capacity, which produces about 7,900 tons sugar annually, the ryot is in the same plight. It is very well known, that the factory aims at maximum production of sugar, with the minimum of cane with no concern to sugar. Therefore, a factory of the above type compels the ryot to cultivate a poor yielding type such as Co. 527, in preference to a heavy yielder like Co. 419. To produce the 7,900 tons of sugar the factory has to crush about 85,000 tons of Co. 527 cane of 9·26% recovery whereas it has to crush 89,000 tons of Co. 419 of of 8·82% recovery. On the former basis, the factory saves about Rs. 2 lakhs over payment of cane and also by short period of working where as the ryot has to put additional 550 acres under cane and incur an additional 3·3 lakhs of rupees, as cultivation charges while losing nearly Rs. 9 lakhs by low yield of cane. For every increase of 0·1% in the recovery, the Sugar factory makes an increased profit of Rs. 60,000 under the present prevailing prices. The recovery of 8·82% of Co. 419 in a figure for cultivation under almost neglected conditions and if scientific technique of field management is adopted, it is not difficult to raise the recovery percent much more. Still, a factory prefers not to spend any thing on research but would like to take the profits by enforcing a poor yielding cane on the ryot. Therefore a ryot in the factory area also has no share in the benefits of improvements.

A lack of system for the proper distribution of benefits of the scientific improvements, between the various interests, is at the back ground for the apathy or even antipathy of the cultivator to improved method of cultivation. A parity between the different groups of vested interests involved in sugarcane cultivation is necessary.

The state has only limited resources of finance and as such its expenditure on research can be only small. Financing of research entirely from the State Exchequer is also not desirable as it cuts off the cultivators from direct interest. If extensive research, as suggested here, is to be

undertaken it should be by financial aid from the industrialists or private institutions. Just as cess is collected for roads, education and irrigation projects, a cess for research is suggested so that every cultivator may realise his contribution for his improvement and naturally he will take keener interest. Though at present, some of the commodity committees are formed this way, the number of research institutions and research workers are too few to meet the actual need. As a deviation, the Sugarcane Development Scheme of Madras roped in the sugar factories to pay for research into their problems of increased recovery. A similar system for all the other crops is to be devised wherein the cultivatior or the industrialist will have direct concern in research. Organisations for research must be on a much wider scale so that every individual can approach it for easy as well as cheap and quick solution of his problem.

Sugarcane cultivation in Hawaii reached high level of perfection because sugarcane planters themselves organised research institutions and established extensive field laboratories and the problems of the individual plantations were solved to be immediately adopted into field practice.

The Potential value of the press for greater publicity has to be realised in a greater measure. The people are to be widely informed of the efforts that are being made by scientists to enable them to become more appreciative of science. With a more energetic system of publicity, the results will spread through the land more easily and rapidly.

Publication of a larger number of books and other literature in the local languages dealing with the local problems must be encouraged. The State should take direct interest in protecting the interests of the authors and encourage them to publish more and more.

The Intermediate Seasonal Cropping in Godavari Delta

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(Received on 12—11—1949)

The total area under paddy in the Godavari delta is 12,49,000 acres. In the double crop areas the first crop "Sarwa" is grown between June to November and the second crop "Dalwa" between February to May. The area alloted to the Dalwa crop is about 30 per cent of the first crop area of which the western delta alone contributes 1,30,000 acres. The water supply in the second crop season (Dalwa) is limited and in years of low rainfall it may run short before the maturity of the crop.

Further the alternate wetting and drying caused by the inadequate water supply may tend to make the soil more alkaline due to lack of proper drainage especially, in low lying areas. The second crop was grown only in February since it is the firm conviction and experience of the ryots in the tract that paddies planted in the heavy delta clay in the months of November to January, when the cold easternly wind blow, fail and succeed only when planting is attempted when the southernly wind (pyru-gali) begins. The reasons attributed are, that the maturity of the crop is prolonged and the crop is subjected to insect ravages.

The chief problem, that has been engaging the attention of the Agricultural Research Station at Samalkot and Maruteru was in regard to the utilisation of the canal water, otherwise running to waste, in the intermediate season i.e. October to January. If a paddy crop can be raised in the intermediate season, the crop would not run the risk of failure owing to lack of water towards the end of its growth, as it is generally experienced in the case of the second crop at the present. By this means a larger area can be brought under double crop by a judicious use of channel water. To this end intensive work was done in the Agricultural Research Stations at Samalkot and Maruteru for over a period of many years. The various methods adopted are detaild below :

1. Varietal trials in the intermediate season.
2. Broadcasting and transplanting immediately after the first crop.
3. Two crops in the "Sarwa" season, an early variety followed by a long duration variety,
4. Udu cultivation.
5. Raising three crop (i) short duration crop (first crop) (ii) long duration crop (Intermediate crop) (iii) short duration crop (for the second time as the third crop) as against the local method of raising a long duration variety at the normal time of planting.

1. *Varietal trials in the intermediate season :* Between 1909 to 1917 at the Agricultural Research Station, Samalkot several varieties were planted in the intermediate season and the experience in each year had been the same i.e., either the plants withered outright or they rushed into head very quickly. In only a few cases was any thing like a satisfactory yield obtained. Even then, the yields were not consistent for the varieties tried and varied from year to year. In the seed-bed also the seedlings did not thrive well as in the normal seasons due probably to the harmful effect of the cold weather and other factors, like damage by the shoot borer, during the period October to December. Among the

varieties tested at Samalkot *Iswarakora* was found to be less succeptible to shoot borer attack than the rest. Trials at Maruteru indicated that G. E. B. 24 is less succeptible to shoot borer attack than the several other varieties tried. The varietal trials indicated that the performance of *Iswarakora* was uniformly good in September and October sowings and plantings. In 1920 and 1921 the October series failed due to shoot borer attack. These facts are brought out clearly in the yield data given below in Table I.

TABLE I.

Yield of $\frac{\text{Grain}}{\text{Straw}}$ in lb. per acre.

Variety	September Series				October Series		
	1920—21	21—22	22—23	23—24.	21—22	22—23	23—24.
Garikasannam ...	1162	2214	120	194	—	328	560
	1562	2230	1792	1341		1226	1560
Moolakolukulu ...	959	3096	1864	988	—	2574	1512
	2188	5160	2750	2135		2286	1306
Peeshanam ...	1022	3790	2614	994	—	2996	1750
	2038	5312	3084	2160		2666	1888
Iswarakora ...	2516	3666	2848	2434	4184	3360	2390
	2362	5300	3384	3680	11008	4034	2176

2. ***Broadcasting and Transplanting immediately after the first crop :*** Broadcasting at different periods after the first crop was done with medium duration varieties in 1917 and 1918 at the Agricultural Research Station, Samalkot. The general trend of results obtained indicated that a broadcast crop when sown out of season is less subject to stem borer attack than the transplanted crop in the adjoining fields. Series of trials were conducted from 1921 to 1940 to study the performance of broadcasting versus transplanting, method of cropping in the intermediate season. From the results presented in Table II below the following salient points will be evident.

(i) The yield from the two series (September and October series) are quite fair, in spite of the high incidence of the stem borer attack during the season. (ii) No appreciable difference is seen between broadcasting versus transplanting systems of cropping. In water logged areas broadcasting is not possible. (iii) Broadcasting is preferable in normal areas with good drainage to transplanting, both from the point of view of economy and its less susceptibility to the shoot borer attack.

TABLE II.

Grain Yield in lb. per acre.

Year	G. E. B. 24		Co. 2		Co. 3		Co. 4		Co. 8		Adt. 5		PTB. 3	
	*Tpd.	Bcd.	Tpd.	Bcd.	Tpd.	Bcd.	Tpd.	Bcd.	Tpd.	Bcd.	Tpd.	Bcd.	Tpd.	Bcd.
1	2		3		4		5		6		7		8	
						September Series.								
1937—'38	2164	1444	2220	1839	2156	1983	1199	1815	1528	1904	2118	1851	...	...
1938—'39	Cyclone damage		...	...	...	...	...	...	...	...	...	...	...	...
1939—'40	2594	1600	2678	2261	2394	2055	...	...	...	...	...	...	1961	1678
1940—'41	708	797	788	1031	1063	1076	...	...	...	...	...	...	681	1307
						October Series.								
1937—'38	1586	1605	1943	1969	1295	1951	1731	1553	1536	1693	1931	1491	...	...
1938—'39	Cyclone damage		...	...	...	...	...	...	...	...	...	...	...	...
1939—'40	Not significant		Co. 3 broad casted fared better than the rest						...	...	...	...	...	...
1940—'41	703	1075	700	1300	1211	1311	...	...	...	...	...	...	...	...

* Tpd.—Transplanted; Bcd.—Broad casted.

3. ***Two crops in the "Sarwa" season, a short duration variety followed by a long duration variety:*** A systematic study in raising a short duration crop in the beginning of the first crop season followed immediately by a long duration variety as in the Tanjore delta, so that both the crops are off the ground by February before the water in the canals dry up was initiated in 1928 — 1929 in Meruteru and in 1932 — 1933 in Samalkot and continued over a long period. The results show that the yields from the two crops (vide Table III) at Samalkot were more than that obtained from a single long duration "Sarwa" crop in most cases, whereas at Maruteru the results were consistent in all the years. All these facts go to show that there seems to be no foundation for the popular belief for the failure of the crop in the intermediate season. Despite the incidence of the shoot borer and occasional silver shoot attack the yield data from the two stations are fairly encouraging and in a way supporting my advocacy for raising a crop during October — January.

It is worthwhile to encourage the cultivation of the paddy crop with suitable strains like Adt. 3 followed by G. E. B. 24 which is less succeptible to disease in the intermediate season to solve the acute food shortage facing the country at present. To minimise the borer attack it is suggested that the variety grown in the intermediate season should be such that its harvest synchronises with the harvest of a long duration "Sarwa" crop in the area. Moreover the seed bed for the intermediate cropping should be raised early in the "Tholakari" season.

TABLE III

Yield of grain in lbs. per acre

Maruteru Agricultural Research Station

		Early crop followed by a medium duration variety					
1928—29	(a)	Sawarnalu Krishnakatika	4750 lbs.	(b)	Kasipichodi Krishna-katika.	4050 lbs.	Single Sarwa (Long duration crop) 3020 lb.
1929—30	(a)	Kuruvai 18	2640	(b)	Kuruvai 18	2640	do.
		G. E. B. 24	1000		Garikasanna vari	1726	3233 „
			3640 lbs.			4366 lbs.	
1930—31		Adt. 3. (Kuruvai)	3300				
		G. E. B. 24	1710		...		3270
			5010 lbs.				
1932—33		Adt. 3 (Kuruvai)	3634				2836 „
		G. E. B. 24	1568		...		
			5202 lbs.				

Samalkot Agricultural Research Station:

1932—33	(a)	Rasangi 26	2639	(b)	Rasangi 26	2639				
		Co. 2	1022		G. E. B. 24	1120				
			3661 lbs.			3759 lbs.			2362	„
1933—34	(a)	Rasangi 26	2580	(b)	Rasangi 26	2580	(c)	Rasangi. 26	2580	
		Co. 2	583		G. E. B. 24	471		Adt. 5	533	2507 „
			3163 lbs.			3051 lbs.			3113 lbs	
1934—35	(a)	Adt. 4	1625	(b)	Kasipichodi	1250			...	4475 „
		G. E. B. 24	2400		G. E. B. 24	2950				
			4025 lbs,			4200 lbs.				
1935—36	(a)	Kasipichodi	2219	(b)	Kasipichodi	2219				
		Co. 2	2875		G. E. B. 24	2450			...	3850 „
			5094 lb.			4669 lbs.				
1936—37	(a)	Kasipichodi	1785	(b)	Kasipichodi	1885	(c)	Kasipichodi	1790	
		Co. 3	810		G. E. B. 24	445		Co. 4	595	2011 „
			2595			2330			2385	
1943—44	(a)	S. L. O. 16	2080	(b)	S. L. O. 16	2040				
		G. E. B. 24	487		G. E. B. 24	487		...	...	3300 „
			2527 lbs.			2127				
1944—45	(a)	K. 238/1.	3662							
		Kasipichodi	893		...			...	...	3200 „
			4555 lbs.							
1945—46	(a)	S. L. O. 16	2042	(b)	S. L. O. 16	3700		...	...	2358 „
		Co. 3	2033		G. E. B. 24	446				
			4075 lbs.			4146 lbs.				
1946—47	(a)	S. L. O. 16	4076	(b)	S. L. O. 16	4076				
		Co.3	266		S. L. O. 12	266				4687 „
			4342 lbs.			4342 lbs.				

* Single long duration Swarna crop-

4. *Udu cultivation:* In view of the varying performances of the different varieties and of the heavy toll taken by the stem borer in October and November plantings, the system of Udu cultivation (i. e., growing of an early and late varieties together) common in Cauvery delta, was also introduced. The results (Table IV) indicate that the performance is not so encouraging at Samalkot station as in Maruteru, owing to the inevitable late planting in this tract compared to that of the western delta.

TABLE IV

Yield of grain in lb. per acre

	Early	Late	Total	Yeald of single long duration crops of Sarwa season
1928—29				
Samalkot	1476	1427	2903	2946
1926—27				
Maruteru	2310	1450	3760	2972

At Samalkot it was recorded that an extra cost of Rs. 12/- per acre was incurred in harvesting the kuruvai crop. Further its value was lowered by about 8 annas per bag of 166 lb. than Akkulu, the local variety of medium duration. But for the difficulty felt in the harvest of the kuruvai crop due to heavy rains (12") at the time, the yields are quite appreciable to that of the single long duration crop.

5. *Raising three crops:* (i) Early duration crop (first crop) (ii) long duration crop (intermediate crop) and (iii) early duration crop (for the second time as the third crop) as against the local method of raising a long duration variety followed by a short duration variety at the normal time of planting.

At Samalkot a trial was initiated in 1944—'45 to study whether a crop can be raised in the intermediate season in the existing double crop lands to attain increased production in contrast to the existing practice of raising two crops only. The yields (Table V) indicated that in no case they exceeded those obtained from the normal crops raised as per the local practice.

TABLE V

Yield of grain in lb. per acre

	First crop	Intermediate crop	Second crop	Total
1944—45	Rasangi 26	G. E. B. 24	Kasipichodi	
	3063	797	468	4328
	Yield of two crops (control) : 4555 Lbs.			
1945—46	Kasipichodi	G. E. B. 24	Kasipichodi	
	1450	720	400	2570
	Yield of two crops (control) : 4075 Lbs.			
1946—47	Kasipichodi	G. E. B. 24	Kasipichodi	
	1963	1760	486	4109
	Yield of two crops (control) : 4342 Lbs.			

Discussion and Conclusion: From the several trials it can be seen that a paddy crop can be raised with success in the intermediate season inspite of the prevalence of the shoot borer attack in that season. Work on the prevalance of the shoot borer indicated that the intensity of each

brood increases and reaches the maximum in January. Evidently due to this finding, the early varieties harvested in September are free from attack. Stray patches of attack are noted in October harvests. Thereafter the percentage of attacked earheads increased in sucessive fortnights in the varieties that are harvested in November and December (vide Table VI). In the second crop season the trouble from the pest is experienced in the initial stages in seed beds and fields transplanted before February. Observations showed that egg laying was more in wet seed beds than in semi-dry seed beds.

TABLE VI.

Percentage of stem borer attack.

Variety		Date of Flowering	Percentage of Stem borer attack
G. E. B. 24	...	30—10—1929	3·13
Krishna Katika	...	10—11—1929	6·32
Atragada	...	28—10—1929	17·58
G. E. B. 24	...	12—11—1929	26·00
Krishnakatika	...	15—11—1929	54·19
Atragada	...	20—11—1929	40·76

Statement of month-war catches of stem-borer moths by light trap campaign during (1933—1934)

Period		Number of moths caught
24th February to 31st March 1933	...	Light traps not kept.
1st April to 14th April	...	do.
15th April to 30th April	...	639
1st May to 14th May	...	1824
15th May to 28th May	...	3731
29th May to 11th June	...	755
12th June to 2nd September	...	...
3rd September to 16th September	...	47
17th September to 30th September	...	117
1st October to 14th October	...	799
15th October to 28th October	...	243
29th October to 11th November	...	236
12th November to 25th November	...	400
26th November to 9th December	...	...
10th December to 23rd December	...	196
24th December 1933 to 6th January 1934	...	105
7th January to 20th January	...	575
21st January to 3rd February	...	310
4th February to 17th February	...	1817
18th February to 3rd March	...	209
4th March to 17th March	...	95
18th March to 31st March	...	28

The reason why the same variety when grown out of normal season yields low is evident from the table below;

TABLE VII

Variation in the duration of paddies by planting in intermediate season

Variety	Date of sowing	Date of Planting	Date of flowering	Interval between sowing and flowering	Date of sowing	Date of planing	Date of flowering	Interval between sowing to flowering	Difference in duration
G. E. B. 24			27—10—35	153			27—11—35	85	68
Co. 2			9—11—35	166			9—12—35	97	69
Co. 4	27—5—1935	8—7—1935	2—12—35	189	3—9—1935	2—10—1935	2—1—36	121	68
Co. 8			2—12—35	189			18—12—35	104	83
Adt. 2			3—12—35	190			25—12—35	113	77
Adt. 5			4—12—35	191			29—12—35	117	74
BH. 1.			29—10—35	155			1—12—35	89	66
Mohipalo			30—10—35	556			2—12—35	90	66

Due to the reduction of the duration, the yield will naturally be low. But the popular belief in this connection appears to be not sound as the low yield of crop is mainly attributed to the damage caused by the cold weather and the stem borer. The fact that each variety has got its own season bound habits seems to have been totally ignored. It is suggested therefore, that with suitable long duration varities and judicious manuring the yields can be improved.

The conclusions are that (i) paddy crop can be successfully raised in the intermediate season; (ii) Double cropping with an early duration variety followed by a long duration variety as Kasipichodi and Co. 2, Adt. 3 and G. E. B. 24, in the Sarwa season is successful where the irrigation supply is inadequate in the second crop season. Since the incidence of pest is less in the young crop planted with seedlings from semi-dry nursery as against wet nursery seedlings, it is advocated that semy-dry nurseries are raised for the intermediate crop. (iii) *Udu* cultivation, using Adt. 3 and G. E. B. 24, Adt. 3 and *Krishnakatika* Adt. 3 and *Ataragada* is recommended in places where labour scarcity is felt and when preparatory cultivation could not be conveniently

attended to in the low lying lands due to water logged condition. (v) By careful and timely manuring for each crop it should be possible to have increased yields from every one of the three crops raised in a year. This will go a long way in solving the present food shortage, and (v) If the stem-borer pest can be controlled by fortnightly dusting or srpaying with D. D. T. from October to November there is a certainty of getting another 25 per cent increased yield in bad years and the risk of losing a crop in the intermediate season due to adverse weather conditions will also be avoided.

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On Wrapping and Propping Sugarcane

By

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Introduction: A cane crop standing erect yields more cane and sugar per acre than that which is lodged and broke and otherwise damaged. Besides physiological deterioration due to inversion of juices from fallen canes tending to grow again or rooting at nodes, physical destruction due to attack of rats and other rodents, is responsible for reduced yields from lodged crops. In brittle canes, like Co–419 the damage is all the more great. Hence it is in the interests of increased production to prevent lodging of cane crops. Never-the-less precautions, other than mere tying up of clumps are not taken in most countries of the world to keep the cane crop erect. Even this tying up is not a regular practice in all the plantations of all the countries. The seriousness of this problem varies with the locality. Where cyclonic winds are frequent and regular, it is incumbent on the cultivators to take greater precautions. Hence the ryots of the East coast districts, of this province which are subject to cyclonic winds very often, developed two elaborate practices to a fine art for keeping cane crops erect, (Wrapping and proping of cane). It is proposed to

present a general account of the methods followed to keep cane crops erect and furnish a review of the results of experiments so far conducted in this province to study the efficacy and economics of these operations in this paper.

In wrapping, old and dead leaves are twisted and wrapped around canes. For propping, after partly wrapping the canes, the old and dead leaves are twined round bamboo props planted vertically in the soil near the cane clumps. Propping is done in two ways : central as well as side props are usually put to heavy crops. This will mean two small sized and one big bamboo for every four to six clumps. For moderate crops central cropping will do. For every 4 clumps, one central prop will be put in this method. There are two other types of propping tried at research stations. One is, stretching wire in a loop on both sides of canes and fixing the free ends of the wire to bamboos planted vertically at either end of the cane rows. The other is planting two bamboos at either end of the cane rows and tying cane clumps to a horizontal bamboo stretched along the rows and fixed to the bamboos planted at either end of the rows. Wrapping alone is done twice in North Vizag and rarely in Chittoor district. Wrapping and propping are done for all crops in South Vizag, East and West Godavari districts, except for some neglected crops.

The cultivation of noble canes which needed very liberal treatment, in earlier days, must have been primarily responsible for the development of these practices. These were soft canes highly susceptible for jackal attack. Wrapping in the first instance might have been commenced to protect the canes against the depredation of the jackals. Propping must have been a later development. Some popular beliefs grew around these practices as days went by and several good points were attributed to them. Some of them are :—

(a) Wrapped canes do not crack ;

(b) grow taller ;

(c) are softer and less susceptible to jackal attack.

As mentioned in para – 2, wrapping and propping practices are peculiar to our Province only and are practically confined to three contiguous districts in the North East Coast. In the agricultural economy of a sugarcane cultivator of these districts, they loom large and cut a large slice of the total expenditure incurred in cane cultivation. According to the latest cultivation statistics collected in these districts wrapping and propping charges ranged between 3·5 to 28·6% of the total cost of cultivation as noted below.

Locality	Expenditure on wrapping and propping expressed as a percent of the total expenditure	Remarks.
1. Seethanagaram	7·5	No propping but only two wrappings
2. Bobbili	3·5	do.
3. Samalkot	2·47	Complete wrapping and propping
4. Kirlampudi	21·4	Do.
5. Ramachendrapur	28·6	Do.
6. Etikoppaka	15·0	Do.
7. Thumpala	24.8	Do.
8. Chodavaram	14·5	Do.

These three districts are very important gur producing tracts where ryots used to feel about a decade back that even if canes slightly bent quality of jaggery was adversely affected. Hence they vied with each other to keep the crop erect. With the advent of the Co. canes, it must be admitted, the cultivation standards have been lowered to a certain extent, since they are hardy and can withstand indifferent treatment.

Apart from wrapping and propping two other methods are suggested for preventing cane crops lodging. It is pertinent to deal with them also here. The object of wrapping and propping is to prevent the crop from lodging and any other method which is more economical and less cumbersome should always be welcome. One of the methods is, trashing canes and subsequently stooking them or not. It is claimed that by removing the leaves wind is allowed free passage between cane rows without any obstruction and hence the possibility of lodging is less. Trashed canes were also supposed to mature earlier. The second method is, planting cane in deep trenches and earthing it up subsequently to a greater height than in the case of a normally grown-up crop. This is supposed to give a greater anchorage to the plants by allowing nodal roots to develop into the earth ridged up around the cane clumps.

This problem of keeping the cane crop from lodging claimed the attention of the research workers of this Province at Coimbatore, Samalkot, Anakapalle, Palur and Gudiyatham. Large scale field experiments done at four of these latter stations are reviewed in the following pages. Experiments on wrapping and propping will be dealt with first and the results of other trials will be considered later on.

Wrapping and propping: (a) Samalkot was the first station at which experiments involving these operations were started. The idea all along had been to see whether it is possible to economise expenditure on these operations or dispense with them altogether. Two experiments which have a direct bearing on this problem were conducted from 1922 to '26 and 1942 to '45 at this station. In the earlier experiment, five

treatments Viz., (1) no wrapping and no propping, (2) wrapping without propping, (3) wrapping and propping on railings, (4) wrapping and propping in the usual manner (5) and propping with wire, were tried. Varieties included in this experiment are now either obsolete or extinct. However the treatment effects are broadly noticeable in the following results.

Variety	Local method of wrapping and propping with Bamboos	Wrapping and propping with wire	Wrapping and propping on railings	Wrapping and no propping	No propping and no wrapping
	Tons	Tons	Tons	Tons	Tons
B. 1529.					
1921 & 22	Cane 30·7	...	27·8	25·0	15·2
1922 & 23.	Jaggery 3·9	...	3·4	9·0	1.8
J. 247.					
1923-24 to	Cane 39·0	37·3	35·1	...	...
1925-26.	Jaggery 4·4	4·6	3·8	...	...

The distinct superiority of the local method over no wrapping and and propping is evident from the above results. The economic aspects of the trial for all the years of experimentation are not available.

In the second of the experiments, the effect of wrapping alone on cane and its economics were studied. Propping was done to both wrapped and unwrapped plots. Variety was Co. 419.

	Average yield of cane in tons per acre.	Average value of out turn per acre.	Average cost of cultivation per acre.	Net profit per acre.
Wrapping	70·89	Rs. 1790	Rs. 938	Rs. 852
No. ,,	63·25	1535	855	680

The results of this experiment were consistent in all the three years and wrapping seems to influence yields favourably. But juice quality of wrapped canes was slightly inferior to that of unwrapped canes.

(b) At Anakapalli a similar experiment as above to test the efficacy of wrapping alone was conducted in 1931—'32 to 33—34. There were other variants such as type of land and seed material. Economics of the treatments are not available and the results do not disclose such marked superiority of wrapping as at Samalkot.

Treatment.	Average yield of cane per acre (co. 213)
Wrapped and propped	75,516 lb.
Propped but not wrapped	73,019 lb.

The second experiment at Anakapalle was conducted from 1937—'38 to 1939—40. Variety was J. 247 (less vigorous than Co. 419) now practically extinct. There were four treatments viz., (1) wrapping and propping with bamboos (local method) (2) wrapping and propping with wire, (3) wrapping and stooking (4) and partial trashing and stooking, with five replications. The following are the average results.

	Average yield of cane in tons per acre	Average cost of treatment per acre.	Total cost of cultivation per acre.	Production cost per ton of cane.	Average juice quality	
					Sucrose.	Purity.
		Rs.	Rs.	Rs.	%	%
1. Wrapping and propping with bamboos.	40·01	83–15—4	333—3—1	8—5—4	15·66	88·09
2. do. with wire	42·16	107—5—5	357—9—8	8—7—6	16·01	89·19
3. Wrapping and stooking.	38·03	83—9—9	331—0—1	8–11–10	15·54	88·58
4. Partial trashing & stocking	36·76	78—7–10	324–13—6	8–12–10	15·44	88·19

The results indicated that the cost of production per ton did not go down by giving up wrapping and propping but was maximum in the case where the two operations were not done. This was because, what was saved by giving up propping, was spent in frequently lifting and tying up canes which lodged to a very great extent in this treatment. The sucrose content of juice from propped canes was higher. Thus the results are in favour of propping and the local method of wrapping and propping with bamboos was most economical. It is quite possible that the out-skirts rows of the more vigorous growing Co. 419 planted at right angles to the experimental plots in this experiment mitigated the adverse effects of the wind on the treatments which were not propped. This is probably the reason for the slight differences in yield between the different treatments. Moreover, all the treatments were completely randomised in this experiment. It is quite likely that treatments (3 & 4) when coming in between plots of the other two treatments came in for less damage than when exposed to wind directly.

The good points attributed to wrapping (vide para 3 supra) were not it was reported, borne out by experimental evidence.

(c) At Gudiyattam an experiment with the same design and treatments as the second experiment at Anakapalli dealt with above, was conducted from 1937—'38 to 1939—'40. Variety was *Thella cheruku*, which is now practically extinct. Average results are furnished below.

	Average yields of cane per acre (tons)	Average cost of treatment per acre.	Average cost of production per ton of cane	Average percent	
				Sucrose in	Purity juice.
		Rs.	Rs.		
Wrapping and propping with Bamboos	24·96	66–15–8	10–10–0	14·93	85·98
Wrapping and propping with wire	25·26	160–7–9	14–1–8	15·69	87·02
Partial trashing and stooking or clumping.	19·96	61–3–9	11–10–9	12·94	83·33
Wrapping and stooking	24·38	58–8–5	11–8–10	13·46	84·04

(Propping with bamboos was not done in this experiment as at Samalkot and Anakapalli. Two bamboos were planted vertically at either end of each cane row and a horizontal bamboo tied to them. To this horizontal bamboo cane clumps were tied). The results furnished above disclosed that treatment wrapping and propping with bamboos, was most economical. Inspite of this finding, canes are not propped in this and surrounding districts, probably because of the non-availability of bamboos.

The experiments to study the direct effects of propping or otherwise on cane yield and its juice quality were not conducted on Co. 419, the present ruling cane of the Province. However indications are that wrapping and propping are beneficial from the point of increased yields and production costs per unit weight are also less than when these operations are omitted.

Trashing experiment: An experiment to test the effect of trashing in minimising lodging was conducted at Palur from 1936—'37 to 1938—'39. Trashing was done twice before the setting in of the North East Monsoon. Results are furnished below. Cost of trashing was Rs. 8—8—0 per acre in one year.

	Average yield of cane in tons per acre,	Percent sucrose in juice	Percent coefficient of purity
Untrashed	53·63	15·84	84·71
Trashed	53·97	15·72	83·93

There was practically no difference either in tonnage or in juice quality. That in other countries like Puerto Rico, Hawaii and in Australia also stripping cane did not improve juice quality was reported by Cross. (Int. Sug. Journ.; Oct. 1946). Pyrilla incidence was stated to be less in the trashed plots. It was also reported from Australia, (Queensland) that there was a smaller borer beetle population in trashed canes. (Facts about sugar Vol. 34) and that hardness of canes was in no way affected by trashing.

Other experiments: Among suggestions to keep the cane crop erect without incurring heavy expenditure on propping, planting in trenches and earthing up to a high level are important. An experiment involving wrapping and propping on one hand and ridging alone on the other hand was conducted from 1914—'15 to 1918—'19 at Samalkot. The following are the results.

	Yield of cane in lb. per acre.	Estimated yield of jaggery
Wrapped and propped	75,352	9.873
No propping but ridging at the base of cane rows.	69,409	8,529

Wrapping and propping gave better yields. A preliminary trial in 1945—'46 with Co. 419 at the Agricultural Research Station, Anakapalli to test the efficacy of planting in trenches (1½ feet deep) and subsequent earthing up as in Java disclosed that inspite of planting so deep cane crop lodged badly. It looks as though wrapping and propping are a necessary evil in this tract.

Summary and Conclusions: Experiments on wrapping and propping sugarcane and other methods for keeping the crop erect and protect it against the onslaught of cyclonic winds were conducted at four Research Stations of this Province. The results of these experiments are reviewed in this paper. The aim of these experiments was to reduce the expenditure on these two operations, either by completely omitting them or by resorting to other methods such as stooking cane clumps or ridging cane rows by earthing up to a greater height than is usual. The economics of adopting these practices were also studied and the cost of production per ton of cane in the various treatments was worked out. The results indicated the beneficial effect of wrapping and propping to sugarcane and were generally in favour of the local method of wrapping and propping with bamboos.

However except in one experiments in which wrapping and no wrapping were the only variants all the other experiments were conducted on canes other than Co. 419, the ruling cane of the day.

Co. 419 is a tall growing top heavy brittle cane which is liable to greater damage by lodging than others. Hence in these days when maximisation of production is the immediate need, it seems advisable for the ryots to continue these age old practices till a better cane is introduced in this tract. In the mean while experiments to estimate the actual loss in tonnage due to lodging when wrapping and propping are not done to Co. 419, have to be conducted and the cost of production of the cane with and without wrapping and propping worked out.

Practical Methods of Improving Paddy Yields

By

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An attempt is made in the following article to discuss some of the main aspects of crop improvement, with particular reference to paddy and the experience gained at the Aduthurai Agricultural Research Station.

Even after a superior strain or variety of crop plant is evolved, the plant breeder cannot rest in peace. The requirements of people and the agricultural conditions are continually changing and as such the plant breeder must be alert to the changing conditions. The strain itself may undergo natural changes and may deteriorate. Ordinarily, the complaints of deterioration from ryots are due to (1) seed admixture due to careless handling and (2) extension of cultivation of the strain to localities not suited to them. Rarely the deterioration is attributable to genetic causes, viz., segregation to inferior type. The admixture may take place in nurseries, transplant fields, threshing floors and seed store. If the deterioration is due to genetic causes, the breeder resorts to reselection to establish purity.

Agronomic Experiments: There is another important aspect of crop improvement, i. e., the agronomic practices which are responsible for increasing the yield. By the improvement of cultural practices in raising proper seed beds by adopting proper spacing between plants at planting time, by planting seedlings of the proper age, by judicious manuring of seed-beds and transplant fields and by harvesting at the proper time, the yield can be raised by as much as 20 to 25%, and this, combined with the growing of improved strains should enhance the yields, still further.

It was observed at the Agricultural Research Station, Aduthurai, that by sowing thin nurseries with a low seed rate, strong and sturdy seedlings are obtained, which when planted in singles or doubles with fairly close spacing, increases the yield, at the same time resulting in the saving of considerable quantity of seed. The cultivators in the Tanjore district even today use for sowing paddy, twice or even three times the quantity of seed actually needed for planting an acre. If the improved method of this sowing were to be adopted, there would be a saving as shown below, of 519 lakhs of pounds of seed to the value of Rs. 34/- lakhs per year, in the Tanjore district alone.

Season.	Seed used for planting one acre.				Excess seed used by the cultivators for planting one acre	
	on the farm.		Local cultivation			
	M. M.	lb.	M.M.	lbs.	M. M.	lb.
Kuruvai	15	37·5	48	108	33	82·5
Thaladi	8	20	24	60	16	40
Samba	8	20	18	45	10	25

It is estimated that out of 11·0 lakhs of acres under paddy in the Tanjore district, 2·5 lakhs are under double crops, i. e., 8·5 lakhs under Samba, 2·5 lakhs under Kuruvai and 2·5 lakhs under 'Thaladi'. The loss of paddy seed by waste in the nursery is:—

Kuruvai: 2·5 x 33 lakhs of M. M. = 82·5 lakhs of M. M. or 206·25 lakhs of lb.
Thaladi: 2·5 x 16 do. = 40 do. or 100 do,
Samba: 8·5 x 10 do. = 85 do. or 212·5 do.

The total loss works out to 207·5 lakhs Madras measures or approximately 519 lakhs of pounds of paddy seed. When valued at Rs. 3—12—0 per Kalam of 60 lb. of Kuruvai and Rs. 4/- per Kalam of Samba paddy, the value works out to Rs. 33,72,396 or Rs. 34,00,000 for the Tanjore district alone. Similarly, by adopting other improved cultural practices, it would be possible to solve the food problem to a very great extent.

The plant breeder's work is concerned with the changing of the characteristics of living plants and as such his work is different from that of a mechanic who can fit in new parts to his machine. The process of fitting in new characters into plants is both elaborate and time-consuming and it takes a long time before a strain can be evolved. The plant breeder must be continually at work because of ever-changing needs of society and also because the strain itself is liable for genetic changes and deterioration.

While the work is elaborate and time consuming, the results are not without adequate rewards. The evolution of 22 strains from the Agricultural Research Station, Aduthurai, far better in quality and yield than the local strains may be taken to have increased the paddy yield in the district by 10 to 25% and this is many times more than the money spent on the Agricultural Research Station. If the Agriculture of our country is to progress, our research stations should be helped to expand their scope of work, and scientifically-minded farmers must make it a point to be in constant touch with these research stations and translate the results observed in such stations, to large-scale practice in their own lands.

After all that is said and done, many persons still do not believe that much benefit has occurred from plant breeding work. They often compare the standard yields of crops per acre as published in the crop statistics of India with those of other countries to support their case. In the case of rice, for instance, the average acre yield in India which was 825 lb. in 1937-1938 is about 1/3 to 1/5 of yields reported from Spain, Italy and Japan. It is not fully realised, however, that India is a very large sub-continent, with a wide range of rainfall and climatic conditions, as compared to countries like spain and Italy where high yields are reported from very much smaller areas. It is hardly legitimate to make such an unfair comparison between these countries and our Indian yields, as the variation in yields obtained in the different tracts of these small countries will not be appreciable and as such the average may be high. But in India the yields range from 300 lb. per acre in the dry areas to about 7000 lb. per acre in fertile deltaic lands, with the results that the average yield gets reduced considerably. Even in the West, the actual increase in yield as a result of plant-breeding is generally not higher than 20%. If Indian acre-yields are still low, the reasons have to be sought elsewhere. In certain areas of Madras where suitable conditions exist, it has been demonstrated by growing improved strains combined with intensive methods of culture, that the acre-yields could be increased to 3000 to 4000 lb. per acre, comparable to those obtained in Japan. The acre-yields recorded at the Agricultural Research Station, Aduthurai, are fairly high and yields between 4000 and 5000 lb. per acre in *Kuruvai* are not uncommon and the yield in the double crop is generally over 5000 lb. per acre as shown below:

Samba: Yields & Cost of Cultivation.

Season.	Acre yield in lb.	Cost of cultivation. Rs. A. P.	Receipts. Rs. A. P.	Profit. Rs. A. P.	Remarks.
1940/41	3191	21 13 7	100 12 0	78 14 5	
1941/42	1714	42 9 6	90 8 6	47 15 0	Severe rat-attack at flowering stage.
1942/43	2697	43 9 0	123 2 6	79 9 6	
1943/44	3374	52 3 9	145 6 4	93 2 7	
1944/45	1856	55 11 3	108 12 10	53 1 7	Severe rat damage.
1945/46	2085	82 8 9	139 4 2	56 11 5	do.
1946/47	2175	80 0 1	175 10 0	55 9 11	Bad season: yet profits high, due to rise in price of paddy and straw; Rs. 4 per 60 lb. of grain and straw at 80 lb. per Re.

A. Kuruvai & Thaladi: Yield Figures

Season	Acre yield in lb.			Remarks.
	Kuruvai	Thaladi	Total	
1940/41	3239	2419	5658	
1941/42	3408	1698	5106	Severe rat-damage at flowering stage.
1942/43	3011	2388	5399	
1943/44	2704	2497	5201	
1944/45	2708	2014	4722	Severe rat-damage in Thaladi.
1945/46	2855	1555	4410	do.
1946/47	3073	1844	4917	Bad season: yet profit high due to rise in price of paddy at Rs. 3-8-0 per kalam of Kuruvai and Rs. 4/- per kalam of Samba grain.

B. Kuruvai & Thaladi: Receipts and Expenditure.

Season	Cost of cultivation per acre									Receipts per acre.									Profit per acre
	Kuruvai.			Thaladi.			Total.			Kuruvai.			Thaladi.			Total.			
	Rs.	A.	P.	Rs.	A.	P.	Rs.	A.	P.	Rs.	A.	P.	Rs.	A.	P.	Rs.	A.	P.	Rs. A. P.
1940/41	40	5	3	25	12	0	66	1	3	100	11	0	93	7	0	194	2	0	128 0 9
1941/42	46	9	10	32	12	9	79	6	7	139	0	9	92	2	6	231	3	3	151 12 8
1942/43	41	11	1	39	3	0	80	14	1	131	1	3	118	4	0	249	5	3	168 7 2
1943/44	49	11	3	51	0	6	109	11	9	137	1	9	131	10	7	268	12	4	168 0 7
1944/45	47	10	0	33	8	9	81	2	8	122	4	0	73	15	1	196	3	1	115 0 4
1945/46	64	11	1	54	2	5	118	13	6	183	2	1	82	0	9	265	2	10	146 5 4
1946/47	97	14	11	62	14	0	160	12	11	207	6	3	141	5	11	348	12	2	187 15 3

The above yield figures show that yields obtained at Aduthurai farm can well be compared with those of other countries in the world ; and the economics of cultivation given above must surely dispel the misconception of some of us, who think that Government farms are spending much more towards raising crops than can be justified by the yields obtained from them.

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(2) do. (1341) Proceedings of the 28th Indian Science Congress, Benares, 1941, Part II.

(3) Annual reports of the Agricultural Research Station, Aduturai, Tanjore district.

A Note on the Nomenclature of Napier Grass

The Napier and the thin or dry Napier are two important fodder grasses introduced into S. India that have been under cultivation since a fairly long time. Thin Napier grass seems to have been first introduced into Mysore[1] and from there it spread to Bombay[2] and later to Madras. There is a certain amount of misinformation regarding the nomenclature of these two grasses. The name thin Napier was first given to it in Mysore— "... a tall thin variety which we have named dry land thin Napier grass. As generally recognized, Napier grass or (*Pennisetum purpureum*) is a tall, heavy-stemmed grass with rank growth, but the one we have chosen is a thin-stemmed variety." Thus the two were taken to be varieties of same species and this nomenclature was adopted where ever the seeds of this drought resistant grass was introduced[3]. The specific name *purpureum* Schum. is applicable only to the thick stemmed tall growing variety. The dry, thin Napier as it has been named, is a different species viz., *P. polystachyon* Schult. The latter species has been reported from India too, collected in the Godavari delta[4]. This species has thin stems with geniculate nodes, highly pubescent and panicles upto 6 inc. long. The anthers in the true Napier is penicellate while in thin Napier it is *non-penicellate*. The thick stemmed Napier is a closer relation of *P. typhoides* Stapf. & Hubb. and easily hybridizes with it. The thin Napier on the other hand does not hybridize with either Napier or *P. typhoides*. The chromosome numbers of Napier is 2n=28 and of *P. polystacyhon* it is 2n=54. The two belong to two different subsections of the genns *Pennisetum*. The application of the specific name *purpureum* to both Napier and thin, dry Napier is wrong.

Cytogenetics Laboratory,
Agri. Res. Inst., Coimbatore.
26th March 1950.

N. KRISHNASWAMY.
N. HRISHIKESAN NAIR.

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1. Indian Farming. 1940. vol. I; part. 2; p. 586.
2. Indian Farming. 1942. vol. III; part 11; p. 590.
3. The Farmer (Bombay) 1950. vol. I; No. 3; p. 7.
4. Flora of the Presidency of Madras. 1934: part X; p. 1792

REVIEWS

IRRIGATED SOILS, THEIR FERTILITY AND MANAGEMENT: *by* **D. W. Thorne,** Ph. D., *Professor and Head, Dept. of Agronomy, Utah State Agricultural College and* **H. B. Peterson,** Ph. D., *Associate Professor of Soils, Utah State Agricultural College. The Blakiston Co., Philadelphia and Toronto.* $ *5·00:* As pointed out by the authors in their preface, there has been no book covering the management of irrigated soils in the last 25 years. The books during this period on irrigation have dealt with the engineering aspects rather than with the soil management aspects.

The book is exhaustive, running to 25 chapters, a glossary and index and and 288 pages. There are numerous very good illustrations and tables which add to the clarity of the text. The subject matter is broken up into convenient short chapters and each chapter is followed by a very full bibliography. Much of the subject matter is divided to deal with particular kinds of crops and the last chapter deals with "Soil Management Around the Home".

The book is particularly suitable for India in that it deals with basic conceptions as well as with details of practice in a way that can be applied to Indian conditions. The material is not only authoritative but is written simply and readably. Scientific terms which are necessary are defined in the glossary or explained in the text so that it is not necessary to be a Doctor of Philosophy in Soils or Agronomy to be able to understand it.

This book should be on the work table or in the deskside book shelf of every teacher of agriculture in our Indian colleges of agriculture and should be in the library of every Agricultural Department worker in the irrigated areas of India. Even for those who are in areas where irrigation is not commonly practiced, it contains much material of general interest. I personally think that every student of agriculture should be encouraged to own and to read the book during his student days, even though it may not be used as the college text. I consider that it is one of the most valuable books to come to my attention in recent years.

— Mason Vaugh.

Weather Review — For April 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	Nil	—0·7	4·5	Central—*Contd.*	Coimbatore	0·7	—0·9	2·6
	Calinga-patnam	0·5	—0·3	3·4		Tiruchirapalli	Nil	—2·4	3·4
	Vizagapatnam	Nil	—0·7	0·5	South.	Negapatnam	0·5	—0·6	3·6
	Anakapalle*	0·4	—0·9	0·8		Adutural*	Nil	—1·7	2·6
	Samalkot*	Nil	—1·4	2·6		Pattukottai*	0 5	—1·8	7·0
	Kakinada	0·1	—0·5	1·8		Mathurai	0·5	—1·7	5·1
	Maruteru	Nil	—0·9	2·5		Pamban	1·1	—0 7	7·0
	Masulipatnam	Nil	—0·7	1·9		Koilpatti*	0·9	—2·5	7·7
	Guntur*	Nil	—0·9	1·7		Palayamcottai	2·1	—0·4	8 0
	Agrl. College, Bapatla*	0·2	—0·1	1·7		Amba-samudram*	0·8	—3·0	9·1
	Veeravanam* (College Farm)	Nil	(x)	2·2	West				
Ceded Dists.	Rentichintala	Nil	—1·2	1·3	Coast.	Trivandrum	4·7	+0·1	9 3
						Fort Cochin	5·1	+0·2	11·5
	Kurnool	Nil	—0·7	0·3		Kozhikode	0·9	—4·0	2·1
	Nandyal*	0·1	—0·8	0·5		Pattambi*	1·1	—2·0	6·0
	Hagari*	Nil**	—1·2	(£)		Taliparamba*	1·4	—0·9	1·5
	Siruguppa*	Nil	—0·7(a)	0·2		Nileshwar*	0·7	—2·0	0·7
	Bellary	Tr.	—0·8	0·1		Pilicode*	0·1	—2·8 @	0·1
	Cuddapah	Nil	—0·6	0·1		Mangalore	0·2	—1 7	0·2
	Anantha-rajpet*	Nil	—0·6	0·4		Kankanady*	0·3	—1·0	0·3
					Mysore				
Carnatic.	Nellore	Nil	—0·5	0·1	& Coorg.	Chitaldrug	Nil	—1·0	0·1
	Buchireddi-palem*	Nil	—0·4	0·1		Bangalore	Tr.	—1·6	0·1
						Mysore	Nil	—2·3	0·8
	Madras (Meenam-bakkam)	Nil	—1·6	1·3	Hills.	Mercara	0·6	—2·0	3·1
	Tirurkuppam*	Nil	—0·6 @	0·3		Kodaikanal	1·1	—3·7	5·9
	Palur*	Nil	—1·4	0·5		Coonoor*	1·0	—5·1	0·5
	Tindivanam*	Nil	—0·8	0·8		Ootacamund*	0·4	—3·7	2·2
	Cuddalore	Nil	—1·0	0·7		Nanjanad*	0·4	—4·3	4·5
Central.	Vellore	Nil	—1·0	1·2					
	Gudiyatham*	Nil	—0·5	0·2					
	Salem	Nil	—1·9	2·2					
	Coimbatore (A. C. R. I.)*	1·1	—1·4	2·5					
	Coimbatore (C. B. S.)*	1·4	—1·3	3·1					

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 0·92″ and Rainfall is 0·17″.
(6) ** Actual fall is 0·02″.
(7) £ Total is 0·03 ″.
(8) Actual fall is 0·04″.
(9) Tr. Trace i. e., fall between 0·01″ and 0·04″.

Weather Review for April 1950.

The month began with a western disturbance over Rajastan and the neighbourhood. It persisted over Punjab for about three days.

The discontinuity in the extreme South of the Bay of Bengal was noted on 5—4—1950. It became feeble the next day and again active on the subsequent two days with the result that a depression in the South-West Bay of Bengal was found to be centred at 03 Greenwich Meridian Time within one degree of Lat. 8° N,. Long. 83½° E. on 9—4—1950. The depression was active and found to be moving North-Eastwards for about four days. On 13—4—1950 it crossed the South Arakan Coast, thereby filling up the lower Burma. On the same day and the day next to it also a steep pressure existed over the North Arabian Sea. This gradient was fairly steep on 15—4—1950 in South Rajastan, North Sourashtra and neighbourhood. On the next day it became feeble over the same region. Punjab was under the effect of a low pressure for about four days from 15—4—1950.

On 20—4—1950 the upper winds over Minicoy became westerly below 3000 ft. above sea level, and moisture increased considerably over Trivandrum, especially below 800 Millibar level.

Three days hence, north-westerlies were found to be fairly strong over the Gangetic plain.

In regard to the weather in the Madras Province it was fairly dry practically throughout the month except for a few localised thundershowers in isolated localities. Travancore-Cochin side had good showers towards the end of the first week. On 10—4—1950 certain places in the West Coast had very heavy downpours.

From the middle of the month onwards summer was fairly severe, especially in Nellore, Guntur and Cuddapah districts. Particularly Cuddapah recorded, as usual, maximum temperature, ranging between 106° F. and 111° F. from 16th April onwards. Similarly Rentachintala in Guntur district had maximum temperature in the range of 108° F. to 111° F. during the last four days in the month.

Details regarding the noteworthy falls in the month are presented hereunder:—

S. No.	Date.	Place.	Rainfall in inches.
1.	7—4—1950	Trivandrum	2·2
2.	10—4—1950	Alleppey	11·0
3.	,,	Minicoy	5·0
4.	,,	Fort Cochin	4·0
5.	,,	Nagarcoil	2·0
6.	,,	Palayamcottah	1·5
7.	,,	Irrinjalakuda (Cochin)	6·3

Agricultural Meteorology Section,
Lawley Road Post, Coimbatore
Dated, 13—5—1950

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

Departmental Notifications

GAZETTED SERVICE — APPOINTMENT

The following three Assitants in Chemistry appointed as Assistant Agricultural Chemists, under emergency provisions and posted as noted against them :

Sri	Lakshmana Iyer, T. S.	Assistant Agrl. Chemist, Coimbatore.
,,	Krishna Rao, D. V.	Assistant Agrl. Chemist, Coimbatore.
,,	Raghavendrachar, C.	Assistant Agrl. Chemist, Coimbatore.

Postings and Transfers

Name of Officers	From	To
Sri Somayya, N.	Sugarcane Inspector, Samalkot,	D. A. O., Vijayawada.
	Subordinate Service	
,, Annaswami Iyer, N.	A. D., Avanashi	A. D., Crop Cutting Experiments, Mathurai.
,, Anantham Pillai, S.	A. D., Villuppuram,	F. M. A. R. S., Palur.
,, Antony, C.	Orange disease Scheme, Waynad,	P. P. A., (Mycology), Mathurai.
,, Bindhumadhava Rao, R. S.,	Dt. Live Stock Farm, Koila,	A. D., Puthur.
,, Chidambaram Pillai, K.	Assistant in Cotton, Koilpatti,	Add. A. D., Dindugal.
,, Dhasaratha Ramaiah, V.	On leave,	Assitant in Fruits, F. R. S., Kodur.
,, Jaganatha Rao Patnaik,	On leave,	Soil Conservation Assistant Contour Bunding Scheme, Bellary.
,, Krishnamurthi, C. S.	P. P. A., (Mycology) Mathurai,	Orange disease Scheme, Wyanad.
,, Kalyanasundaram, N. V.	On leave,	P. A. to D. A. O., Pattukottai.
,, Krishnaswami Iyer, A.	P. A. to D. A. O., Pattukottai,	A. D. Mathurai.
,, Meenakshisundram, M. N.	A. D., Mathurai,	A. D., Uthamapalayam.
,, Md. Baug,	A. D., Palavaram,	A. D., Bhimavaram.
,, Md. Hameed,	A. D., Bhimavaram,	A. D,, Polavaram.
,, Prabhakara Reddy, G.	On leave.	F. M. A. R. S., Farm, Guntur.
,, Ranganathan, R.	Special A. D., Tobacco Station Cuddalore,	A. D., Erode.

Name of Officers	From	To
Sri Surya Rao, M. V.	A. D., Parvathipur,	A. D., Bhimavaram.
„ Srinivasa Rao, P.	A. D., Vayalpad,	A. D., Pathapatnam.
„ Subba Naidu, T.	F. M., Elayirampanni,	Assistant in Cotton, Koilpatti.
„ Srinivasa Rao, O.	A. D., Tiruvur,	A. D. Vijayawada.
„ Subramania Iyer, K. H.	Teaching Assistant Coimbatore,	P. A. to D. A. O., Vellore.
„ Vaidyanathan, R.	F. M. A. R. S., Palur,	A. D., S. Arcot.
„ Venkateswara Rao, Y.	A. D., Markapur,	A. D., Vayalpad.
„ Venkata Raghava Raja, M.	A. D., Kalyandrug,	A. D., Tadepalligudam.
„ Venkataswamy, S.	A. D., Harur,	A. D., Aruppukottai.
„ Vedachalam, C. D.	A. D , Aruppukottai,	A. D., Harur.

AGRICULTURAL COLLEGE AND RESEARCH INSTITUTE, COIMBATORE

List of additions to Library for April, 1950.

1. IGNATIEF (Utadinir) : Efficient use of fertilizers. 1949. U. N. F. A. O.
2. JAIN (Charter Sa im) Farm Books and Practice of Book-Keeping, economics and management applied to Agriculture and Livestock 1950. (C. S. Jain, Ind. Agri. Res. Inst., Delhi).
3. KUILMAN (L. M.) Rice during and after the war: a bibliography of the literature on Rice during the period 1940—'47. 1949 (Comm. General Agri. R. S. Stn. Buiten-Java No. 87.
4. LOSLON (J. M.) and SHANI (Birbal) Lowson's text book of Botany 1949.

D. B. K.

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 Agricultural Students' Union.

All articles for publication should be submitted addressed to the Editor, Madras Agricultural Journal, Lawely 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 5,000 words or 12 pages of printed matter including tables and illustrations in the Journal. Manuscripts should be carefully revised; numerical data and calculation 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.

Tables: The number of tables should be restricted to those absolutely necessary, as numerous tables detract from the readability of the article. Each table should be numbered consecutively from 1 up and must have a heading stating its contents clearly and concisely. The tables are to be typed on separate sheets, with their positions marked in the text.

Illustrations: Wherever possible illustration should be made with pen and Indian ink for reproduction as line blocks. The name of the author, title of the article and figure number should be written on the back of each figure in black lead pencil. Each figure should have a legend typed on a separate sheet.

Photographs: Photographs and wash drawings are more expensive as half tone blocks are necessary. The cost of blocks is chargeable to the author of the article. Photopraphs submitted as illustrations should be unmounted, glossy prints of good quality, with strong contrasts, trimmed so as to include only the essential features to be illustrated. They should preferably be of the same size as desired in the printed paper. Photographs should always be packed flat, never rolled or folded.

Line drawings: Line drawings, and charts should be prepared in twice the scale desired in the printed form. All letterings, figure numbers and explanatory letters in graphs should be light face and large enough to be 1/16" high in the ffnished illustrations.

Graphs: Graphs should be drawn in India ink co-ordinate paper ruled with blue lines. Any portion which is desired to appear in the reproduction should be drawn over with Indian ink.

References: References and reviews of literature should relate only to closely pertinent papers. The list of references should come at the end of the article, after the summary and should be arranged in alphabetical order of authors' names followed by the years of publication in brackets, and then the title of the paper, name of periodical, volume number in bold face type and then the page number, e.g. Darlingtioh. C. D. (1944) Heredity, development and infection. *Nature* **154**; 164–9. Abbreviations for names of journals are to be in the approved form as given in the World List of Periodicals.

The responsiblility 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.

ANNOUNCEMENT

The Ramasastrula-Munagala Prize, 1950.

1. The prize will be awarded in July 1950.

2. The prize will be in the form of a Medal and will be awarded to the member of the Union who submits the best account of original research or enquiry, on any agricultural subject.

3. The subject matter shall not exceed in length twelve foolscap pages, type-written on one side.

4. Intending competitors should notify the Secretary of the Madras Agricultural Students' Union with a covering letter showing full name and address of the sender. The author's name should not be shown on the paper, but should be entered under a *nom-de-plume*.

5. Four type-written copies of the essay should be sent.

6. The name of the successful competitor will be announced and the prize awarded at the time of the Conference.

7. Paper or pepers accepted will become the property of the Union and the Union reserves to itself the right of publishing all or any of the papers.

8. All reference in the paper to published books, reports or papers by other workers must be acknowledged.

9. The last date for receipt of papers has been extended upto 15th June, 1950.

10. Any further particulars may be obtained from the Secretary, the Madras Agricultural Students' Union, Lawley Road P. O., Coimbatore.

U. Achutha Wariar,
Secretary.