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Editorial

Fads and Fashions in Field Practices : Changes in feminine fashions have a curious knack of coming round one full cycle from time to time. Thus the long, flowing skirts and puffed sleeves so popular in the Victorian age, gave place to knee-length skirts and sleeveless blouses after World War I, but these in turn got out of date by the time World War II came along and now long skirts and sleeves are once again in vogue. In our country too, we can see a similar trend, only, it takes a slightly different form. Time was, when the borders on ladies' sarees were just a narrow strip of gold or silver lace; but these increased in width until they encroached up to a third of the saree width from either edge and now, in these days of all-round shortages they have dwindled once again to an inch or two.

In a similar manner, fashions change in agriculture as well. There was once a strong belief that tillage improved soil condition. Surface mulching by periodical cultivation and harrowing was deemed essential for success in crop production. It was argued that this mulching broke up the continuity of the capillary columns of soil moisture and thereby prevented the moisture from being lost by surface evaporation. This view was in due course challenged and by 1930, it became the generally accepted opinion that the main value of inter-tillage in growing crops was only for the eradication of weeds that compete with crop plants for soil moisture and plant food ingredients in the soil. Weeds, it was pointed out, transpire large amounts of water and take away considerable plant food and these losses are avoided when weeds are removed. Thus Cates and Cox (912), Mosier and Gustafson (1915) carried out 125 cultivation experiments in 28 states of the U.S.A. from 1905 to 1911, to compare regular cultivation against mere removal of weeds by "scraping". Care was taken in these experiments not to stir the soil any more than absolutely necessary to remove the weeds. The "scraped" plots produced on an average 99·1% as much corn as did the cultivated plots, thus leading to the conclusion that the chief value of tillage was only for weed removal. After this general conclusion was reached, little work was done until very recently, when this view is itself being challanged as a result of weed control studies with the aid of herbicide chemicals.

In all the experiments where cultivation was compared against weed removal, very serious source of error was overlooked, namely that it is next to impossible to remove weeds without disturbing the soil. What had actually happened therefore was that the soil surface had been disturbed in the process of removing the weeds, tending to leave a fine soil mulch on the surface, by which air could easily enter the soil.

With the recent development of growth-regulating chemicals and their use as selective herbicides for weed control, it is now possible to destroy weeds without disturbing the soil surface, and a new tool is thus available for studying the effect of cultivation on crop response. In the latest issue of "World Crops" (Sept. 1951 p.345) an account is given of experiments carried out at the connecticut. Agricultural Experiment Station in 1948 and 1949 and these seem to indicate that cultivation may be beneficial in ways other than by controlling weeds.

The treatments tried were (a) pre-emergence control of weeds in corn (maize) with 2.4–D and post-emergence spray 45 days later (non-cultivated); (b) control of weeds in corn by "flaming" plus cultivation and (c) control of weeds in corn by ordinary cultivation methods. The results show that a combination of herbicides plus cultivation would give the maximum crop production, particularly in seasons when heavy rains pack up the soil surface. In the heavier soils hard rains will pack the soil; the pore spaces in the soil get clogged and the supply of oxygen to higher plants and soil micro-organisims is very much reduced. Silt and clay fractions get washed into the pores by rain water, forming a baked surface on exposure to the hot sun. Unless the crust is broken up by cultivation, anaerobic conditions are set up, and some soil constituents may even become toxic to plants. Nitrate supplies may become insufficient, leading to nitrogen deficiency symptoms in the plants growing on uncultivated plots.

Thus we find that the cycle is now going back to the original viewpoint, that cultivation is after all quite necessary for success in crop production, at least under certain conditions.

Wynad Colonisation Scheme

By

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Introduction: Wynad is a taluk in North Malabar. It is a hilly and forest area, adjoining Mysore, Coorg and the Nilgiris, with an elevation ranging from 2500 feet to about 3500 feet above sea level. There are a few peaks in this region which range from 4000 feet to over 6600 feet above mean sea level. The climate is mild, the maximum temperature being about 80°F. and the minimum being about 66°F. The absolute minimum temperature seldom goes below 52°F and the absolute maximum temperature above 95°F. The average annual rainfall of the region is about 100 inches, of which about 70 inches is received during the South-West monsoon.

The tract, which is about 821 square miles in area, is very thinly populated, unlike the other parts of Malabar, and the population is estimated at 1,15,000. The indigenous population consist of *Chettys, Kurumas, Moopans, Naikkans, Kuruchiars, Uralies and Paniyas.* Some centuries back some families of *Gowders* (Jains) migrated to Wynad from Mysore and made Wynad their home. Among the above communities, *Chettys* and *Gowders* are the main land-owning and moneyed class of people. In spite of the malaria rampant in this region, on account of the availability of very cheap land, suitability of the region for growing various commercial and food crops, low labour charges and the inherent fertility of the land, a large number of adventurous people of various communities from the plains migrated to this region and settled in Wynad during the past few decades, and many of these persons became large land-owners. In addition a very large number of people from the plains have settled in Wynad as labourers in plantations. At present, the majority of the population of Wynad consists of people who have migrated to this tract, and the indigenous population is only a minority.

A wide range of commercial and food crops are grown in Wynad. Tea, coffee, pepper, orange, ginger, rubber and cardamom are the more important commercial crops, while paddy, ragi, samai, tapioca, yam, colocasia, sweet potato and banana are the main food crops. Crops like chillies, turmeric, mustard, tobacco and arecanut are also grown on a limited scale for domestic purposes. There are many tea plantations owned by a few British firms, in this tract. Most of the coffee, pepper and orange plantatations are owned by people who have migrated from the plains and a few *Gowder* families, and only a very small portion of such plantations is in the hands of the indigenous population.

The major portion of the cultivable area is either grassy slopes or thick jungle, containing valuable timber trees like rose-wood, *venga, iyini, marudu* etc. and bamboo. The wetlands in Wynad consists of low-lying valleys between ranges of hillocks, in which a fairly plentiful supply of water is available during the monsoon season and until January – February, in years of normal rainfall.

2. **Objects of the Scheme:** There are very large stretches of Government land, both wet and dry, lying uncultivated in this tract, and prior to 1943, any person could occupy, cultivate and develop Government land by putting in a petition to the revenue authoritis, and the land used to be assigned to the applicant in due course. This was a sort of encouragement to develop the region, adopted by the Government. In 1943, the Government decided to start a scheme of colonisation in Wynad to give useful employment to a large number of service personnel belonging to Malabar and the adjoining districts, who were demobilised after the end of the World War II, and to other people including the local residents and aborginals, and thereby develop the large stretches of lands lying uncultivated in the tract. When this decision was taken, a ban on unauthorised occupation of Government land in Wynad was notified by the Government.

3. **Details of the Scheme:** The Wynad Colonisation Scheme comprises an area of about 33,800 acres (26,000 acres dryland and 7800 acres wetland), in four villages, Muppainad, Kidanganad, Nulpuzha and Nenmeni, divided into six blocks. These four villages were selected for the scheme. as there was a very large and fairly compact area of Government land available in these villages. However, in addition to the 19,290 acres of unoccupied Government land, 7496 acres of dryland and 7014 acres of wetland were acquired by the Government for the scheme.

The total number of colonists to be settled in the scheme is about 3700, consisting of different categories of people, in the undermentioned proportion.

Ex-servicemen ...	...	62·5%
Local residents, aborginals and sivajamdars	...	30·0%
Other civilians (lower middle class, landless poor, ex-tappers and political sufferers)	...	7·5%

Each settler in the scheme is to get five acres of dryland and two acres of wetland or ten acres of dryland. In the addition to the lands to be given to each colonist for cultivation and development, separate areas have been set apart in each block for community purposes like schools, playgrounds, grazing, developing forest belts etc. Though in the early stages of the scheme, financial assistance in the nature of returnable loans was given to all the colonists in addition to the free grant of land, due to financial stringency, it was later decided that only the ex-servicemen settled in the scheme were to get a grant of Rs. 1900/- each, from the Servicemen's Post-War Reconstruction Fund for developing their plots, as detailed below:

For reclamation of dryland	...	Rs. 500/-
For reclamation of wetland	...	Rs. 200/-
For agricultural expenses like purchase of cattle, manure, seed etc.	...	Rs. 500/-
For constructing a dwelling place	...	Rs. 250/-
For domestic expenses.	...	Rs. 850/-
For digging wells and other miscellaneous purposes	...	Rs. 100/-

In respect of plots which were previously developed and for which Government had to pay compensation to the occupants for eviction, the settlers to whom such plots are allotted were to pay to the Government, in ten equal instalments, the amount paid by the Government to the original occupants who were evicted.

4. **Working of the Scheme:** Work on the scheme was started in 1944 by various departments connected with the scheme such as Revenue, Agriculture, Public Works, Public Health, Medical and the Co-operative, though the last-mentioned department has not started functioning to any appreciable extent as yet. The initial work consisted of acquisition of land, surveying, preparing plans, demarcating plots to be allotted to each settler, development of communications by improving the old cart tracks and laying out new roads and anti-malarial operations. By 1948, about 26 miles of pucca road were formed in the colonisation scheme area and the locality was almost completely rid of malaria. After various experiments on malaria control measures, spraying all dwelling places with D. D. T. emulsion of 5·0% strength at intervals of six weeks, beginning from the first week of December to the first week of June was found to be an efficient and cheap method of malaria control, costing only about one rupee per capita of the population in the areas. For the medical aid to the settlers a dispensary with facilities for treating in-patients has been opened at Ambalavayal.

The settlements of colonists in the scheme was started from March 1948 and till the end of December 1950, the undermentioned numbers of persons of the different categories were settled in the scheme.

Ex-servicemen	1168.	Aborginals	251
Ex-I. N. A. personnel	3.	Land-less civillians	6.
Local residents	740.	Ex-tappers	5.
		Political sufferers	1.

5. **The Agricultural Research Station, Ambalavayal:** I. (a) *Objects of the Station:* The general agriculture in the tract being very backward, and the scheme being essentially for the agricultural development of the tract and the climatic and other conditions in Wynad being different from that prevalent in the plains, it was considered necessary to have an agricultural station attached to the colonisation scheme to carry out research on various aspects of agriculture, for the improvement of agriculture in Wynad in general, and the colonisation scheme in particular, to carry out demonstration on improved methods of agriculture and proper developments of the holdings of the settlers in the scheme on sound and scientific lines, to carry out propaganda among the settlers on improved methods of agriculture and proper development of their holdings and to make available superior seeds, plants and planting material of various crops for distribution. Therefore an agricultural research station was opened in Ambalavayal within the colonisation area, in July 1945.

The area of the station is 250 acres, with 215 acres of dryland and 35 acres of wetland. The dryland area is set apart for different purposes as detailed below.

For cultivation of and experiments on fruit and perennial spice crops. ... 100 acres.

For office buildings, stores, labourers' quarters, cattle and manure sheds and paddocks	...	15 acres
Reserve area for extension	...	50 acres..

(II) *Work done so far:* The work carried out so far on different aspects and the results achieved are detailed below.

(i) *Reclamation, laying out etc.:* The work in the Station during the first three years of its inception was mainly preparing the wetlands and drylands for cultivation. The wetlands attached to the station consisted of sloping land with irregular shaped plots at the time of opening of the station. Therefore, to make the land suitable for cultivation and for various field trials, reclaiming the land and laying out into proper plots and levelling have been in progress, and an area of 25 acres has been reclaimed, levelled and laid out into proper plots with suitable irrigation and drainage channels. The dryland at the time of opening of the station was covered with thick growth of scrub jungle, bamboo and small and large-sized trees. Bringing the land into a condition for cultivation and for conducting field trials on different crops by removing by the scrub jungle, bamboo clumps and the smaller sized trees, laying out etc. were in progress, and 110 acres of dryland have thus been reclaimed and brought under cultivation of various perennial and seasonal crops.

(ii) *Research:* Various items of research on different crops have been in progress from 1948, and the results are summarised below.

(1) *Paddy:* (a) *Evolving high yielding strains of local paddy varieties:* The local varieties of paddy contain an admixture of different types resulting in uneven quality of rice and uneven maturing of the crop. Therefore, work on evolving high-yielding strains of the local varieties by pure line selection was started in 1948, and strains of six important local varieties, Palthondi, Marathondi, Velumpala, Maranellu, Chettuvaliyan and Kothandan, recording yields of over 3000 lbs. per acre have been evolved, and will be released for district trials in 1951. These strains give 10% to 30% increased yield over the local bulk in the trials carried out at the station.

(b) *Double-cropping trials:* As the local practice is to raise only a single crop of paddy in a year in wetlands, even though water may be available in sufficient quantity for raising two crops of paddy in some of the plots in most of the valleys, trials were carried out from 1948 to determine if two crops of paddy in a year, could be economically raised in such plots in which sufficient supply of water for the purpose is available. These trials have shown that two crops of paddy can be raised in a year in plots in which water is available and that the system of raising a medium to long-term crop in the first season from June to November–December and a short-term crop in the in the second season from December to April is better than raising a short term crop in the first season from June to October and a long-term crop from October to March. The former system has recorded an increased yield of about 1000 lb. per acre over the latter. Trials with different strains and varieties in the second season from December to April have shown that the strains MTU 3, Co. 13 and PTB 10 and local variety Palthondi are suitable for cultivation in this season, as these strains have recorded yields of over 1500 lb. per acre.

(c) *'Oodu' cultivation trials:* Trials to determine the feasibility of adopting 'Oodu' cultivation in Wynad to utilize the water available in valleys till February were started in 1950. The preliminary trials have not given positive result so far, but there is some indication that with suitable combinations of short and long duration types, 'Oodu' cultivation may prove suitable to Wynad conditions, and result in increased returns from the land.

(d) *Trials of different strains, types and varieties of paddy:* With a view to select the types of paddy that merit popularisation in Wynad, sixty-five strains, types and varieties of paddy including some types from foreign countries have been put under trials from 1946. As a result, it has been found that strains SLO 17, SLO 18, and MTU 19 and the local varieties Kothandan and Maranellu which have consistently recorded yields of over 3000 lb. per acre and merit popularisation in Wynad. The Kenya variety Mankora and two Siamese types of short duration have been found suitable for cultivation in Wynad.

(e) *Trial of 'Punnam' paddy varieties:* Trials to assess the suitability of *Punnam* paddy varieties of Chirakkal taluk in Malabar for cultivation in the drylands in Wynad have been carried out from 1949. These trials have shown that *Punnam* paddy varieties 'Thuthukayama', 'Palian', 'Kozhivalan', 'Vellarian', 'Vella choman' and 'Chemmala' are suited for cultivation in the drylands in Wynad even in preference to the local dry paddy varieties 'Karuthan' and 'Poothakali', on account of their superior quality of rice. Bulk selection of these varieties have been made for comparative trials, and multiplication of the best variety for distribution.

(2) *Fruit crops:* (a) *Trial of different kinds and varieties of fruits:* With a view to select the kinds and varieties of fruits suited for extensive cultivation in Wynad, in addition to the loose-jacket orange which is already under extensive cultivation covering an area of nearly 10,000 acres, plants of various fruits, like Sathugudi orange, Malta lemon, Seville lemon, acid lime, citron, pummelo, plum, peach, litchi, avocado pear, mangosteen, durian, rose apple, cherimoyer, custard apple, bull's heart, pineapple, passion fruit, Queensland nut, cashew nut and a large number of banana varieties have been planted in a total area of about 20 acres from 1947. The study of the performance of these plants has already shown that Malta lemon, passion fruit, pineapple and banana varieties, Gros Michel, Mauritius, Chenkadali, Suganthi, Pedda Pacha Aratti, Mannan, Mysore Poovan and Nendran are suitable for cultivation in Wynad, and work on popularising the cultivation of these has already been started.

(b) *Trials on the orchard performance of budded plants, and seedlings of mandarin (loose jacket) orange:* The practice in vogue in Wynad is to plant seedlings of mandarin (loose jacket) orange. With a view to compare the orchard performance of budded plants of mandarin orange with mandarin orange seedlings and determine if the former is superior to the latter, 100 seedlings and an equal number of budded plants of the same parent trees have been planted in 1950.

(c) *Cultural trials on mandarin orange:* Very little attention in respect of cultivation and manuring is given to the orange plantations and a very large number of trees are affected by 'quick decline' and root

diseases in Wynad. With a view to carry out trials to determine the optimum cultural and manurial practices for mandarin orange trees in relation to growth, fruit quality and prevention of 'quick decline' and root diseases, and an area of 18 acres has been planted to mandarin orange seedlings in 1950.

(d) *Propagation trials on mandarin orange and nursery work:* Trials to determine the possibility of succesful bud propagation of mandarin orange have been carried out, and it has been established that mandarin orange can be successfully propagated by budding on rough lemon seedlings, and that the optimum season for the operation is from January to April, when over 50% 'take' is obtained.

Large numbers of seedlings of different kinds of citrus namely pummelo, rough lemon, acid lime, sweet orange, mandarin orange, sour orange, kitchili and Wynad country orange have been raised and propagation of budded plants of mandarin orange on these different rootstocks, for trials to determine the best rootstock in relation to vigour, fruit quality and prevention of 'quick decline' and root diseases, is in progress.

A large-scale nursery of mandarin orange, acid lime, Malta lemon, Seville lemon, jack, passion fruit, coffee, arecanut, silver oak, Gliricidia, etc. have been raised for distribution.

(3) *Spice crops*: (a) *Perennial spices:* To determine if spices like clove, nutmeg, cinnamon and vanilla can be successfully grown in Wynad, an area of about two acres has been planted to these spices during 1950 and the performance of these is being studied.

(b) *Ginger:* Trials to determine the economic seed rate for ginger and the optimum season for planting have been initiated in 1950, and are in progress.

The variety of ginger 'Chernad', which is considered superior to the local ginger in trade circles. has been introduced and is being multiplied for future comparative trials with local ginger.

(c) *Turmeric:* Observational trials to compare 'bulbs' and 'fingers' as planting material and to determine the economic seed rate for turmeric have been started in 1950 and are in progress.

(4) *Root crops:* (a) *Tapioca:* Observational trials to determine the optimum spacing and the method of planting have been initiated.

Six varieties of tapioca have been introduced and the planting material of these are under multiplication for conducting comparative trials with the varieties already under cultivation in the tract, to select the varieties best suited for popularisation.

(b) *Sweet potato:* Four types of sweet potato have been isolated from the varieties grown locally. Five types of sweet potato have been introduced and multiplication of the planting materical of these is in progress for future comparative trials with the four local types to select the types that merit popularisation.

(c) *Potato:* Observational trials with forty types of potato have been carried out to select the types best suited for cultivation in Wynad. All the types failed to show promise, as they were very severely affected by "ring disease'.

(d) *Miscellaneous root crops:* Yam, colocasia, dioscorea, arrow-root, edible canna and koorkan (*Coleus parviflorus*) are under trial to study the performance of these and multiply material for distribution.

(5) *Pulse crops:* Trials to assess the suitability of pulse crops, like cowpea, horse gram, and red gram have been carried out, and it has been found cowpea types, 'New Era' and C. 521 are suited for cultivation in the dryland, either as a pure crop or as an inter-crop in young orange plantations during the South-West monsoon season. These two types have recorded about 150 lb. of seed per acre when grown as an inter crop. From trial of cowpea 'New Era' in high lying wetlands, which is neither too moist nor too dry, during January to May, it is found that this crop can be profitably grown as a catch crop, as an yield of about 2800 lb. of green pods per acre has been obtained within five months of sowing. Horsegram has been found to be suited for popularisation in the dryland, if sown early in September, with an yield of about 300 lb. per acre. It is found that it can be grown in rotation with tapioca after the latter is harvested in August. Attapadi redgram has been found suitable for Wynad and multiplication of the seed of this variety is in progress. This crop can be profitably grown, either as a pure crop or as an inter-crop in young orange and coffee plantations and also along with ginger.

(6) *Millets and other cereals:* Various millets and other cereals like ragi, cholam, cumbu, tenai, maize, barley, oats and wheat have been put under trial to determine those that can be grown with advantage in the tract. The trials have shown, that except ragi, no other crop is suited for large-scale cultivation in Wynad. Bulk selection from the local ragi has been made for multiplication as this variety is found to be superior to the strains Co. 1, Co. 4 and H. 22 is respect of yield and resistance to Piricularia.

(7) *Vegetables*: Various vegetables like brinjal, cucumber, snake-gourd, bitter gourd, ribbed gourd, pumpkin, ash gourd, beans, knol-khol, cabbage and cauliflower have been put under trial during different seasons to select the kinds best suited for cultivation. From a study of the performance of these vegetables, it has been found that snake gourd, bitter gourd, ribbed gourd, cucumber and amaranthus are suited for cultivation in the higher portions of wetlands or the lower portions of the drylands where there is facility for watering during the summer season, pumpkin, ash gourd, and brinjals are suitable for cultivation in the monsoon season; French beans during the latter half of the monsoon season and knol-khol during the cold weather season. Cabbage and cauliflower nave not been found suited for extensive cultivation, due to the fact the plants do not form 'heads' or 'curds' properly.

Two outstanding types of brinjal, 'Wynad Giant White' and 'Wynad Giant Purple Streak' and one type of pumpkin 'Wynad Mammoth' have been selected from the local types and the seeds of these are being multiplied and distributed.

Perennial vegetables, chow-chow and *kovakkai* (*dondakkai*) have been found exceedingly suited for cultivation in Wynad.

(8) *Oil seed crops:* Trials have been carried out on the cultivation of ground-nut and gingelly, to find out if these crops are suited for the tract. It has been found that, while gingelly does not come up well, groundnut makes satisfactory growth and gives fairly economic yields. The latter has recorded an yield of 850 lbs. of pods per acre in the trial carried out in 1950.

(9) *Sugarcane:* Trials have been carried out on the cultivation of sugarcane from 1946, and it has been established that sugarcane, Co. 419 can be very profitably grown in highlying wetland which is not marshy, at well as in the lower portions of dryland along the margins of valleys under purely rainfed conditions. The crops grown in the wetland and dryland have recorded yields of 38 tons and 25 tons of sugarcane per acre, respectively. From monthly planting trials, it has been found that the optimum season for planting in the wetland is April-May and that for the dryland is May-June. The rainfed crop has to be retained in the field for about 18 months for satisfactory yield, while if the crop is planted in November-December and irrigated it gives satisfactory yield within twelve months of planting.

(10) *Plantation crops:* (a) *Coffee:* Arabica coffee selections resistant to leaf disease obtained from the Coffee Research Station, Balehannur have been planted in an area of one acre to study the performance of these and see if any of these selections prove suitable to Wynad. Trials have been initiated to study the economics of growing Robusta coffee as a pure plantation and as a mixed plantation with banana, orange and pepper.

(b) *Pepper*: Different varieties of pepper from Travancore have been introduced and these are being multiplied for comparative trials with the local varieties and to select those best suited for popularisation.

(ii) *Miscellaneous crops:* Plants of various economic crops, like arecanut, coconut, cacao, kola nut, lavender, scented geranium, eucalyptus, camphor, kapok, thin Napier grass etc. have been planted to study the performance of these and select those suited for extensive cultivation in Wynad.

(iii) *Livestock improvement:* With a view to upgrade the local milch cattle, a pure scindhi breeding bull is maintained at the Agricultural Research Station, and the local cows are being crossed by this bull. In addition, four scindhi cows are also being maintained at the station for rearing calves for distribution in the tract.

(iv) *Pisciculture:* Mirror carp has been introduced in the tank attached to the station in 1949, and these have grown very well and started breeding. It is proposed to distribute the fingerlings to the settlers for rearing in small ponds in their holdings.

Total expenditure and receipts of the Station: The total expenditure incurred by the Agricultural Department on the Scheme till the end of December 1950 is about Rs. 4,15,9501/-. The total receipts of the station inclusive of the value of articles transferred to other stations is about Rs. 39,000/-

6, **Conclusion:** The scheme in general has benefited the tract to a great extent, particularly in respect of improved agriculture, better communications, modical aid and freedom from malaria. An area about 5,000 acres of dryland and about 600 acres of wetland lying uncultivated has been brought under cultivation resulting in considerably increased production of food and other crops.

Fungicides and Weedicides *

By

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Diseases of crops have been prevalent from ancient times. But the nature of the agents responsible for the causation of these diseases and the uses of chemicals for controlling them began to be understood only after the middle of the last century. The practice of certain vine growers whose vine yards were on the roadside, of sprinkling a mixture of lime and blue vitriol on the leaves and bunches to keep off thieves led to the discovery of one of the most widely-used and potent fungicides—Bordeaux mixture. To the French Professor, Millardet, is attributed the credit of observations on the effect of this practice on the control of the downy mildew which was causing heavy damage to vines and the formulation of Bordeaux mixture, about the year 1882. Millardet recognised that copper was the active agent in this mixture and not lime and this led to widespread trials with various other combinations of copper compounds. The prevalence of powdery mildew on grapes in America and its control by the use of sulphur led to the development of investigations on sulphur and its compounds as fungicides. From these early stages more detailed investigations on various substances containing copper and other heavy metals, compounds of sulphur and other organic substances have been in progress and much valuable information has accumulated to the advantage of the farmer and to the development of economic plant pathology. The results of all these investigations have shown that compounds of copper, sulphur and mercury have definite fungicidal values. Other metallic compounds also possess this property but their use is not practicable owing to the excessive cost of the fungicide. In recent years attention has been concentrated on the development of organic fungicides, as it is felt that the continued use of metallic fungicides may lead to accumulation of these metals in the soil from the fungicidal drip during spraying operations especially in perennial crops finally reaching toxic levels and becoming injurious to crops.

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* Paper read before the Indian Science Congress held at Bangalore in January, 1951.

Fungicides may be defined as substances which kill the fungal hyphae and spores or which prevent the germination of the spores or growth of fungi (fungistatic). They are usually applied to the foliage as a protectant against infection. Others are used as curative agents to destroy the superficially developing pathogens. Still others are used for the treatment of seeds to destroy the spores sticking to the surface or to prevent infection from soil-inhabiting fungi during the initial stages of growth of seedlings.

Copper Fungicides: As already stated Bordeaux mixture is one of the earliest of the copper fungicides used by the plant pathologist. It is made by mixing solutions of copper sulphate and calcium hydroxide. As originally made by Millardet the proportions of the ingredients were very high and in course of time these have been reduced to a large extent. Bordeaux mixture has been used as acid, neutral or alkaline preparations. The first is very rarely employed being highly toxic to plants. The most common type is the alkaline mixture. A ratio of copper sulphate to lime of 1 : 0·5 will render the mixture alkaline. But in common practice equal weights of the two substances are used. The most popular proportion is 5 : 5 : 50 (representing 5 lb. of each of the chemicals in 50 gallons of water). In South India Bordeaux mixture came into prominence for the control of fruit rot of arecanut in the second decade of this century. In the early days a mixture of the strength of 10 : 10 : 50 was being recommended. Later experiments have shown that this strength was too high and at present only 5 : 5 : 50 mixture is employed. Areca grows in areas where the rainfall is very high ranging up to 250 inches annually. At first it was considered that some adhesive should be added to the Bordeaux to prevent its being washed off from the fruits. An adhesive prepared by boiling together resin, soda and water was the sticker added to the mixture. It was noticed that this affected the mixture producing a curdled effect. Besides clogging the nozzles the quality of the mixture also deteriorated. The resin soda adhesive was followed by the use of calcium caseinate (using casein dissolved in lime water), vegetable oils and soaps. Divergent views were held on the efficacy of each of these adhesives though the consensus of opinion was in favour of the use of oils. Niger oil, groundnut oil or other cheap locally available oils were used.

Extensive field trials were conducted in South Kanara by the Madras Agricultural Department to test the efficacy of various adhesives as compared with plain Bordeaux mixture for the control of areca fruit rot in an area where the annual rainfall was between 150 and 250 inches. The results showed that plain Bordeaux mixture was as good if not better than those to which adhesives had been added. These findings were in line with those of Mr. Mayne who tried the use of Bordeaux with and without adhesives against coffee rust and found that the latter was as good as the former. These findings resulted in economy and saved much of the labour involved in the preparation and addition of the adhesives.

Bordeaux mixture has a world-wide reputation and still holds a supreme position among fungicides for the control of plant diseases caused by Pythiaceous fungi. It is used mostly as a protectant and complete coverage of surface is essential. As a curative it has been

satisfactorily employed against some of the mildews. Its efficacy as a soil disinfectant in destroying soil pathogens and preventing damping off in nurseries e. g., tobacco, tomato, chillies etc., has been established time and again. To protect sugarcane setts from soil infection by *Ceratostomella paradoxa* dipping setts in Bordeaux is being popularised. Thus this ancient mixture is a fungicide *par excellence* and has helped many a plant pathologist in plant protection. Furthermore, this mixture exerts certain physiological effects on the sprayed plants which results in increasing the yield in most cases apart from absence of infection. In potatoes the yield of tubers is significantly increased when sprayed with Bordeaux. However the mixture is toxic to a small group of plants e. g., apples and some varieties of grapes. This defect can be got over by reducing the strength of the mixture to 2—2—50 without loss of efficiency.

But this mixture sorely lacks in keeping quality. It must be used soon after preparation though some workers claim that the addition of small quantities of sugar improves its keeping quality. Again the preparation of the mixture is somewhat laborious. In some tracts especially in plantations the question of providing large quantities of water as are necessary for Bordeaux entails increased expenditure and trouble. These considerations led to the formulation of this fungicide in dust form which could be easily dusted on the plants. A number of firms placed on the market such preparations usually consisting of the dried precipitates e. g., Bordorite. However these have not found favour in South India. In America 'Instant Bordeaux' is recommended where hydrated lime is used in the place of quicklime to obviate some of the disadvantages.

The difficulty of obtaining good quality quicklime is felt in many areas and this led to the substitution of quicklime in Bordeaux by sodium carbonate. This substituted mixture has received the name of Burgundy mixture from the town where it was first employed. The formulae used in practice vary, the ratio of copper sulphate to soda ranging from 1 : 1 to 1·4 (10—10—100 to 10—14—100) the former being considered more toxic to plants. Burgundy mixture is of special significance in tea plantations where the difficulty of obtaining good lime is keenly felt. Its use for the control of blister-blight of tea has been popularised by the tea planters. In other areas it has not become popular and is more expensive than Bordeaux. It has been reported to be useful against potato late blight.

Besides these fungicides, preparations of the cuprammonium group have been employed in specific diseases. Ammonium hydroxide or ammonium carbonate is mixed with copper sulphate. A deep blue solution is obtained and this does not leave any mark on the sprayed plants or disfigure them. Its use as a fungicide is however limited. A fungicide under the name of Cheshunt compound (2) parts of copper sulphate and 11 parts of ammonium carbonate) has been recommended by Bewley for the control of tomato wilt. It can be used with safety for periodical drenching of the soil even when plants are growing. This fungicide may be given a wider use for the control of wilts in vegetables.

Colloidal copper is recommended for soil treatment and for the control of damping off among seedlings. In Ceylon it has been successfully used for the control of the frog eye leaf spot of tobacco. Messrs. Boots. Limited have placed on the market the same fungicide under the proprietary name of 'Bouisol'. Its main defect seems to be the tendency to cake-up on storage.

For seed treatment as seed disinfectants and as seed protectants copper fungicides have been employed from the early years. The most effective among these are copper carbonate for the control of smuts of cereals and cuprous oxide as a seed protectant for various vegetables to prevent pre-emergence damping off. The latter in a dispersible form has been prepared by some firms as proprietary fungicides for spraying, which however do not possess much of residual effect. Thus copper has been largely used as simple salts, as basic salts or as organic complexes in the formulation of various fungicides. But the popularity of Bordeaux mixture is still unsurpassed because it is the least toxic and has the greatest residual value.

Sulphur Group: The use of sulphur as a fungicide was prevalent prior to the study of the fungi against which it was used. Bergmann (1852) controlled powdery mildew in green-houses by painting the steam pipes with sulphur. Its use was extended following the spread of powdery mildew of grapes. It is now the most popular fungicide against this class of fungi. Sulphur is used in a pure form as fine powder for dusting plants and for seed-dressing against smuts of sorghum. The finer the size of the particle the better is its effect. With the modern improvement of grinding machinery it is possible to get very finely powdered sulphur. A modification is seen in the introduction of 'Wettable sulphur' wherein the finely divided or precipitated sulphur can be suspended in water and used as a spray. These are also termed as colloidal or dispersible sulphur. The particle size plays an important part in determining the toxic action and fungicidal efficiency of sulphur.

To the polysulphide group belong a number of fungicides like lime-sulphur, livers of sulphur etc. The most important among these is the lime sulphur which is prepared by boiling together quicklime and sulphur in water in the proportion of 1 : 2 : 1 (gallon). A concentrated solution is obtained which depends on its polysulphide content for its potency. The concentrated solution possesses good keeping quality when kept away from air and has to be diluted before use according to its polysulphide content. The older practice of determining the amount of dilution by its specific gravity has been found to be not reliable.

Lime-sulphur has a curative and protective action and has become popular with orchardists for use on apples, pears etc., and for the control of mildew. In this country however its use is not popular, on account of the laborious preparation, difficulty in obtaining sulphur and the dearth of commercial preparations in the market. Lime sulphur can serve as an insecticide also.

Among other inorganic fungicides may be mentioned mercuric chloride, zinc oxide and silver nitrate. Mercuric chloride solution is of immense value in the laboratory and as a seed-steep for potatoes and

ginger. Zinc oxide is used for seed treatment of some vegetables like crucifers. Silver nitrate solution is recommended for seed treatment of tobacco.

Organic Fungicides: Next we come to the group of organic fungicides. Formalin was one of the earliest of these to be used for the treatment of seeds and soils in greenhouses or nurseries. But the irritant nature of this chemical causing inconvenience to people handling it and its toxic action on some of the seeds have contributed to its supersession by other fungicides. In this group are included fungicides used for seed treatment and those employed as spray protectants to crops. The most important among those used for seed dressing are the organo-mercury compounds sold under the name of Ceresan, Granosan, Agrosan etc. These are becoming very popular and are used for the control of various seedborne diseases and as seed protectants to kill the pathogens present in the soil round the germinating seeds.

Non-mercurial organic fungicides made up of organic sulphurs, quinones and miscellaneous combinations of phenol, quinoline, chlorine, bromine and other materials have been under trial for various purposes i. e., used as sprays or dusts for the control of foliage diseases and for seed treatment also. Among these may be mentioned Arasan, Fermate, Dithane, Zerlate, Phygon and Spergon. Most of these are of American manufacture. Despite the advertisements of manufacturers the use of these fungicides has not become very popular. A comparative trial with Fermate, Dithane, Perenox and Bordeaux mixture was conducted for the control of the downy mildew of grapes in Madura district. The results showed that Bordeaux mixture was by far the best and that the others did not give efficient protection. The results of State-wide experiments in the United States of America show wide variations of efficiency and that these organic fungicides are at best only of specific use and cannot compare with Bordeaux mixture in wide application.

The use of dye stuffs as fungicides has been investigated. Certain auramines and phosphines were efficacious against powdery mildews. Dilute solutions of Malachite Green were successfully used to control Fusarium Patch disease of bowling greens. They have not come into general use. In years to come undoubtedly more attention will be focussed on other organic fungicides which usually form by-products of other big industries. The use of antibiotics for fungicidal purposes is beginning to engage the attention of plant pathologists. A substance marketed under the name of Actidione by Messrs. Upjohn and Company has been reported to be successfully used against certain powdery mildews. But several other antibiotics have been found to have no fungicidal properties at all.

Weedicides: The presence of weeds in cultivated fields, in lawns, along roadsides etc. has been a source of trouble to man from time immemorial. The various cultural operations like hoeing, interculture, weeding etc., aim at the mechanical removal of weeds from the fields. Removal of weeds before seeding by manual labour was the earliest method of controlling weeds.

In course of time, due to extensive cultivation, dearth of labour and the high cost involved in weeding, attention was directed towards the use of chemicals for destroying weeds. Chemicals toxic to plants and

in heavy doses could be used for destroying weeds on roadsides or uncultivated lands. But the use of these in cultivated lands or when the crop is on is fraught with danger as the chemicals may affect the crops also.

Chemicals of the sulphate group were employed as weedkillers in the beginning. Solutions of copper sulphate, ferrous sulphate and even sulphuric acid were used. Copper sulphate and ferrous sulphate were applied to the soil in powdered form or as solutions. Some weeds were kept down but these substances were not universally adopted for weed control. In Madras copper sulphate has been used to destroy algal growth in rice fields or in tanks when used in dilutions of 1 in 10000 parts. It is too risky for the ryots to handle sulphuric acid and the cost will be prohibitive.

Chlorates have also been used as weedkillers. Both potassium and sodium chlorates were utilised to kill deep-rooted plants. But the residual effect of these in cultivated lands precludes their widespread use. To control prickly pear they have been employed in Australia.

Arsenic compounds have been potent weed-killers especially for the destruction of perennial plants and trees. The "Agro" tree killer a preparation distributed by the Madras Agricultural Department for the destruction of trees had arsenic compounds as the active ingredients. This has been used against *Orobanche* by swabbing the parasitic shoots with the solution. Though these shoots are killed its extended use is precluded as the tobacco plant is affected if it comes in contact with the solution. On the bigger trees it is applied by means of a brush on exposed cambial layers or soft wood. The solution is highly poisonous and has to be handled with care. It has been largely used for the eradication of ***Morinda tinctoria*** from fields by cultivators.

In recent times world-wide attention has been aroused on the class of hormone selective weed-killers which have pronounced phytocidal capacity. These are derivatives of phenoxy-acetic acids. The dichloro and methyl-chloro derivatives have achieved greater distinction than other types of growth hormones. The common 2-4-D (2-4-Dichloro-phenoxy-acetic acid) marketed under different names and Agroxone (2-methyl-4-chloro phenoxy-acetic acid) are now widely known. These are used in dilute solutions or as dusts mixed with inert fillers. In very dilute concentrations they act as growth-promoting agents but in higher concentrations are toxic to certain plants.

Both these substances do not affect grasses or cereals but are toxic to broad-leaved plants among dicots and monocots. They have been used all over the world as efficient agents for destroying weeds among cereals, being sprayed in dilute solutions or dusted. The literature on the action of these is rapidly becoming very voluminous.

In India also they have been tried as weedkillers. Both these are very useful for destroying water hyacinth, when sprayed in solutions containing 0·2% of the active substance. The petioles begin to bend and get distorted and in the course of three weeks the plants are completely killed. 2-4-D is very useful for the eradication of *Striga*, a parasite

growing on sorghum and sugarcane. Many of the dicotyledononous weeds are killed. But some like *Trianthema portulacastrum* and *T. decandra* common in garden lands are not affected by 'Fernoxone', a 2-4-D preparation. "Dicotox" another proprietory preparation containing 2-4-D is however toxic to these weeds. The action on *Cyperus rotundus* is not permanent. The aerial shoots are destroyed, but later new shoots develop from under-ground tubers. Fernoxone has not given consistent results with *Spergula arvensis.* On golf links *Centella asiatica* is completely destroyed by these.

These substances are highly toxic to cotton, cabbages and cruciferous vegetables. Hence the use of these substances has to be undertaken with care and air-drifts towards the susceptible crops avoided. It cannot be said with certainty whether these substances will ever enjoy the same popularity in India as in western countries owing to their high cost and uncertain behaviour. Two of the most troublesome weeds in cultivated lands in India are *Cynodon dactylon* and *Cyperus rotundus* and against these, these substances are not satisfactory. They have no effect on the former and only partial effect on the latter. Another word of caution has to be given. The continued use of these substances may lead to other harmful after-effects. It has been found that when they are applied to the soil they prevent the sprouting of weed seeds and crop seeds for over 2 months. This is a pointer towards the cumulative harmful effect if used continuously.

The Madras City Milk Plan

By

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It is a well-known fact that milk supply in Madras City is not only inadequate but also the quality of milk has no bearing on the very high price paid. From various surveys made with regard to the exact number of milch animals in the City and taking the 2,000 licenses held by the City milkmen into account the total number of animals is computed to be 12,248 cattle and buffaloes. These are distributed in the 50 divisions comprising the City of Madras. Taking an average of about 8,000 female stock in milk and daily average yield at 10 lb. per animal the total milk yield would be about 80,000 lb. The demand of the city is not wholly met by the milkmen. The Government Milk Factory distributes about 8,000 lb. of milk per day. The Co-operative Milk Supply Societies supply about 28,000 lb. collecting from various centres from both within and outside the limits of the city up to 35 miles radius. Added to this, milk is brought by trains, cyclists and buses

and the quantity handled by them would roughly be about 24,000 lb. The total quantity of whole milk distributed within the city would be about 1,40,000 lb. The population of the Madras City was 12·35 lakhs in 1946 according to the City Rationing Officer. It may now be taken as not less than 14 lakhs. Based on the above calculations the average per capita consumption of milk is 1·6 ozs. which is perhaps the lowest in the world. It is therefore imperative in the interest of the nation that the average milk consumption of the citizen should be increased to 16 ozs. per capita per day.

2. I have had the privilege of studying the Bombay Milk Plan drawn up by Dr. Z. R. Kothawalla, Dairy Development Adviser to the Government of India, which is being so ably executed by Mr. D. N. Khurody, the Milk Commissioner of Bombay. The situation at Bombay is remarkable in that there is a dense population and large units of buffaloes in milk are stalled in what are known in Bombay as "Stables". These stables are in varying degrees of insanitary conditions and they are owned by powerful capitalists. There are about 50,000 milch buffaloes within the City. Each owner may have from 250 to 500 milch buffaloes in milk which means an investment of Rs. 2½ to 5 lakhs on animals alone. As the capitalist look only to mere gain there has been callous neglect of young stock and dry animals which has resulted in incalculable loss to the nation. Now the Milk Commissioner with considerable powers and a well-equipped staff is in the process of carrying out the Bombay Milk Plan. The plan is to remove all the stalls out of Bombay and to efficiently co-ordinate production and supply. The Milk Commissioner has already taken over more than 25% of the milk supply of the City. His organisation purchases milk on quality basis from producers including co-operative milk societies. The milk production is not confined to the City. About 50,000 lb. of milk are transported from Anand, about 260 miles from Bombay. Milk is suitably treated and distributed by the Commissioner to various centres. Added to this a very big scheme worth two crores is being completed at a place about 25 miles from Bombay. In this locality a colony of dairy farms for production and processing of milk is being built. When it is complete about 10,000 milch animals will be sent out of Bombay City to be housed here. The capitalists who are producers will live in these farms and give all their production to the Commissioner who will process and supply milk to the consumers. When it is completed, it will be a wonderful achievement in the milk supply problem in the East. In order to solve problems like milk prices and distribution centres etc. the Commissioner has two Advisory Committees, (1) the producer committee which includes owners of cattle and co-operative milk unions and (2) a committee composed of consumers only. This set-up is the beginning of an organisation similar to the Milk Marketing Board of England.

3. The Milk Commissioner is directly under the Ministry of Food, Bombay and is paid about Rs. 2,000/- per mensem. He is almost a dictator on the subject of milk supply. He has an engineering section, co-operative section and a technical section under his control. From what I have seen of the whole organisation and its working, credit goes to Mr. Khurody and to the Hon'ble Minister concerned, who spares no pains to make the scheme a success.

The Bombay Milk Plan in Anand has also become a reality. Out of 30 dairy farm units in an area of 3,500 acres, 17 farms units have been completed and about 8,000 cattle have occupied them. All the activities connected with milk production and distribution are in full swing. The milk producer gets his fodder etc. at reasonable rates and has no need to worry about distribution. Reports given by various experts have already justified the working of the scheme.

4. Coming to Madras, there are certain outstanding differences from Bombay. The density of human population is not the same. The milk trade is in the hands of very small milkmen and none of them can be compared with the capitalists of Bombay. Most of the owners are poor and keep cows as a side business to earn a living. Another remarkable difference is that in Madras the milkmen keep mostly cows and only few buffaloes. Credit is due to these milkmen for experimenting with cattle breeding and producing cross breeds which certainly give high averages of milk as conpared with the over-rated Ongole, breed. The un-hygienic conditions, malpractices practised and the poor quality of milk and the deterioration of cattle are features already known to us and need no elaboration. In addition to individual milkmen, there are the co-operative milk societies and the unions which are contributing, though in an inefficient way, to the milk supply to Madras City. In addition there has been a proposal to evacuate all the milkmen from Madras but in my opinion, it is not only costly but also impracticable. Most of the milkmen do not depend on the milk trade alone. Some are low paid servants, some individual owners have milk surplus over their family requirements and others are adventurers who have a hand in many things. None of them will go out of Madras, because of their multiple professions.

5. The real problem to be solved is to provide adequate and wholesome milk supply to the City of Madras. Having considered all aspects of milk supply, I placed the Madras City Milk Plan before Government November in 1948. Since presenting the above proposals, there have been criticisms from various angles. The Director of Agriculture, the Board of Revenue, the Registrar of Co-operative Societies, Madras, the Dairy Development Officer, the Chief Conservator of Forests and the Commissioner of the Madras Corporation have given their considered views. Bearing all that have been said for and against the original scheme, the following proposals are made for consideration.

6. Unlike Bombay vested interests are not serious and the Commissioner of the Premier Corporation, Madras is enthusiastic to solve the problem of milk supply to the citizens of Madras. I gather from the Madras Milkmen Associations that a scheme on the lines of Bombay City Milk scheme would be welcome in the interest of widespread milk production. The situation in Madras, therefore, makes it easier to launch the programme which I am outlining below.

7. Defore the plan can be launched, it is essential that a first-rate Milk Commissioner is employed. As his powers will be varied and great, to make a real success of the scheme, he should be directly under the Minister for Food as is the case in Bombay. The function of the Milk Commissioner will be to organise milk production outside the city

limits by gradually removing the milkmen from within the city and supply wholesome milk to the citizens of Madras at reasonable rates. All the powers that are vested in the Milk Commissioner of Bombay should be vested in the Milk Commissioner here. He will also take steps for salvage of dry cattle and young stock.

8. The programme for doing this will be as detailed below:

The targets are to see that all milk produced is outside the city of Madras and that milk consumption per capita is increased gradually to 16 ozs. The distance from which milk can be brought is dependent on factors like high production, transport facilities and cost of production.

(i) In view of the inadequate production, it is imperative to step up production of milk. It is not enough to deplete one area to supply another area, as is now done by Co-operative Milk Societies. One common facter throughout India including Anand is the non-availability of milk to the producer and even public the in the areas where milk is produced thereby causing very grave set-back to health in such areas. So, what is required is to step up production wherever possible. This can be achieved by importation of better cattle, judicious breeding in its various aspects which need not be enlarged upon here and scientific management to ensure maximum and continued supply. The beginning for high production will be a large-scale Dairy Farm at Vandalur with dry and young stock farms in the Gudalur Reserve Forest area. The Chief Conservator of Forests is not in favour of deforestation. If the Government agree with his views, the Milk Commissioner will find other areas and even private land for purchase for the purpose.

In view of the fact that Part I-A of Dr. Talati's scheme will be taken up by the Corporation of Madras, it is imperative that the Madras City Milk Plan should be made to start simultaneously and not very far from the area selected.

Each dairy farm should be at least 350 acres in extent. Each farm will have at least 500 animals in milk consisting of 100 Sahiwals or Sindhis or Tharparkars, 50 Cross-breds and 350 buffaloes. The cows are very difficult to get and adjustment has to be made in practice. There are a good number of cross-breds in Madras. The best of them can be taken over from milkmen who do not wish to carry on the trade. This dairy farm will have stalls to house about 100 milch cows of such of the regular milkmen, who wish to continue their profession. All the milk produced by them will be handed over to the dairy which will process and send the milk to the depots in the City for distribution. This dairy will be able to supply about 6,000 lb. of milk per day but will take any quantity of milk from surrounding areas for processing.

(ii) As this programme is in progress, it is for the Milk Commissioner to see which of the wards will be closed to local milkmen. Whiie he will not hinder private owners keeping cows for their household use, he will also assist to organise on private or joint-stock company basis dairy farms outside the City and undertake to purchase all their production on quality basis.

(iii) The Commissioner will also create other farms so as to increase the dairy farms outside the city and give facilities to milkmen, who are not able to house their cattle in the dairy farms. At least ten large-scale dairy farms would be required to maintain the present level of milk supply. When this has been achieved the Milk Commissioner will take over all the milk produced by the Co-operative Societies whether in or outside the city and give adequate time for the Co-operative Societies within the city to move out of the city.

(iv) The Milk Commissioner will encourage the creation of milk societies outside the city limits and purchase all the milk produced by them. When dairy farms are created outside the city the bulls and the surplus female stock from dairy farms will go a long way to increase better cattle and increase the production in the area.

All the loose milk that come by buses, trains, cyclists etc. will be taken over by the Milk Commissioner at convenient points.

(v) There will be three large creameries, one for all milk coming fsom the South, one for all milk coming from West and another for all milk coming from North. These will be located at suitable and convenient places. All the milk received here will be processed and sent to distribution points in the City. These points will be organised according to wards that are being closed down for commercial cow keeping.

(vi) The Milk Commissioner will arrange for the supply of fodder and concentrates etc. to all the dairy farms and milk unions that are under his control.

(vii) It is imperative to organise a number of dry stock farms. The ones already created will be taken over by the Milk Commissioner so that he can regulate admission from different areas. He will also see to the proper disposal of calves.

(viii) When on the one hand milk supply and distribution are being regulated it would be necessary to regulate breeding of cattle and conservation of the same. So the Milk Commissioner will have sections which will deal with maintenance of records of all farms under his control. It is needless to emphasise that the use of various types of bulls will became imperative and artificial insemination will become a routine in the management of stock farms.

(ix) By this method it ought to be possible for the Milk Commissioner to completely organise the milk supply within a period of 5 to 10 years. But in order to achieve this, it is imperative that the best type of man is recruited for the post of Milk Commissioner and each department under him is manned by men suited to the post and he is given full support by the Government as is being done at Bombay. There are different aspects of the dairy industry that need men, who are specialised in the branch to which they are put in charge.

The accompanying statements show the details of the organisation proposed in the light of the above proposals.

APPENDIX I

Proposed sources of supply or production of milk, with estimated quantities of milk per day

		Lb.
1.	Milk produced at the ten dairy farms at 5,000 lb. per farm per day ...	50,000
2.	Milk to be purchased though Govt. Milk Factory ...	8,000
3.	Milk to be purchased from Co-operative Milk Supply Societies ...	28,000
4.	Milk to be purchased through cyclists etc. ...	24,000
5.	Production of mi k by female stock in the city ...	80,090
	Total per day ...	1,90,000

APPENDIX II

	Non-recurring. Rs.	Recurring. Rs.
Buildings:		
Milking sheds for 650 animals including cows of Madras city milk-men ...	1,50,000	
Sheds for young stock, store rooms, office buildings Veterinary Hospital buildings, Dairy buildings for processing milk ...	90,000	
Calving pens for 100 animals ...	10,000	
Quarters for the staff, 50 milkmen and milk men from Madras city ...	1,25,000	
Livestock:		
650 animals (milch) comprising of 200 cross-bred cows and 150 pure-bred cows and 200 buffaloes at Rs. 800/- each ...	5.20,000	
10 breeding bulls at Rs. 1,000 each ...	10 000	
10 pairs of work bullocks at Rs. 1,500 per pair ...	15,000	
Other incidental expenses such as transport, sales tax etc. ...	5,000	
Deadstock:		
Agricultural implements and other appliances ...	30,000	
Dairy equipment for clean milk production ...	25,000	
One lorry for transport of fodder, manure etc. ...	15,000	
6 bullock carts at Rs. 500/- each ...	3,000	
1 jeep for general purposes ...	9,000	
Office furniture ...	5,000	
Establishment:		
Cost of feeding of 750 milch cows at Re 1/- per day per cow on an average (650 animals of Dairy farm and 100 animal of milk men.) ...		2,74,000
Repairs and upkeep of plant and machinery and buildings. ...		10,000
Renewal purchase of livestock at 100 animals per year		80,000

Staff :			
One Dairy Manager on 260–700 scale	...		3,120
2 Assistant Dairy Managers (140–250)	...		3,360
1 Agricultural Subordinate (100–220)	...		1,200
4 Fieldmen (45–60)	...		2,160
4 Maistries (40–45)	...		1,920
1 Stockman compounder (35–60)	...		420
50 permanent labourers at Rs. 15 p.m.	...		9,000
1 Cleaner at Rs. 15 p.m.	...		180
1 Driver at Rs. 45 p.m. (45–80)	...		540
10 Watchmen and coolies at Rs. 15 p.m. each	...		1,800
50 Milkmen at Rs. 15 p.m. each	...		9,000
30 Calf boys at Rs. 15 p. m. each	...		5,400
Office :			
One Junior Superintendent (140–190)	...		1,680
One Upper division clerk (80–110)	...		960
2 Lower division clerks (45–90)	...		1,080
One Store keeper (45–90)	...		540
1 Typist (45–90 plus Rs. 10 special pay)	...		660
Peons 4. (18–25)	...		864
Total for one Dairy Farm	Rs.	10,12.000	4,07'884
Total for ten dairy farms	Rs.	1.01,20,000	40,78,840

Note : The cost of land has not been included as it is presumed that Goverument will take an active interest in the scheme and allot Government lands including forest areas or acquire private lands for the purpose.

APPENDIX III

Dry Stock Farms.		Non-recurring. Rs.	Recurring. Rs.
Buildings :			
Sheds, quarters for the staff etc,	...	1,50,000	
One bull at Rs. 1,000	...	1,000	
Deadstock :			
Machinery, transport vehicles, agricultural implements etc.,	...	1,00,000	
Establishment :			
Cost of maintaining dry stock 300 at Rs.15/- p.m.	...		54,000
Cost of maintaining young stock 200 at Rs, 30/- p.m.	...		72,000
Staff :			
One Veterinary Assistant Surgeon (140–250)	...		1,680
One Senior Inspector of Co-operative Societies (90-120)	...		1,080
One Stockman compounder (35–60)	...		420
2 Peons 18–25)	...		432
One head cooly at Rs. 15/-	...		180
8 Cattlemen at Rs. 15/- each p.m.	...		1,440
Two sweepers at Rs. 15/- each p.m.	...		360
One bull attendant at Rs. 15/- each p.m.	...		180
One driver (45–60)	...		540
One cleaner at Rs. 15/- p m.	...		180
Total for one farm		2,51,000	1,32,480
Total for 10 dry stock farms		25,10,000	13,24,900

APPENDIX IV

Vaterinary & Disease Control Centre.

		Non-recurring. Rs.	Recurring. Rs.
Buildings for staff, in-patient ward etc.	...	50,000	
Cost of one jeep	...	9,000	
Medicines and appliances etc.	...	6,000	
Establishment:			
One Superintendent (260-700)	...		3,120
Six Veterinary Asst. Surgeons (140-250)	...		10,080
Six Veterinary & Livestock Inspectors (60-4-120)	...		4,320
Four Stockmen compounders (35-60(	...		1,680
20 mazdoors at Rs. 15/- each p.m.	...		3,600
One head clerk (80-125)	...		960
One Lower Division clerk (45-90)	...		540
One typist (45-90) with special pay of Rs. 10/- p. m.	...		660
Two peons (18–90)	...		432
Medicines and appliances	...		5,000
Total	...	65,000	30,362

Note: This centre will render veterinary aid and other help to all the 10 dairy farms and 10 dry stock farms. The Superintendent will exercise control over the 10 dry stock farms.

APPENDIX V.

Breeding Centre:

		Non-recurring Rs.	Recurring Rs.
Buildings, Sheds, quarters etc.	...	50,000	
Artificial Insemination equipment	...	10,000	
One Jeep well-equipped for the transportation of semen	...	9,000	
Two Motor Cycles at Rs. 4,000/- each	...	8,000	
Artificial Insemination, running expenditure	...		5,000
Establishment:			
One Superintendent trained in Artificial Insemination and Genetics	...		5,120
Four Vety. Asst. Surgeons (140–250)	...		6,720
Two Vety. Livestock Inspectors	...		1,440
One Stockman Compounder (55–60)	...		429
One Head Clerk (80–110)	...		960
One Lower Division Clerk (45–90)	...		540
One Typist with Special pay	...		660
Two Peons (18-25)	...		432
Total	...	77,000	19,292

Note: This centre will do Artificial Insemination work in all the dairy and dry stock farms.

APPENDIX VI.

Creamery:

	Non-recurring Rs.	Recurring Rs.
Buildings for Creamery, Laboratory & Staff ...	2,50,000	
Machinery. epuipment for distribution ...	2,50,000	
Cost of 63,500 lb. of milk per day to be purchased at As. 0—3—6 per lb. ...		50,70,077
Cost of running the plants at 6 pies for 10 lbs. ...		72,430
Establishment:		
One Dairy Technologist (260–700) ...		3,120
Four Asst. Dairy Technologists (140–250) ...		6,720
One Bacteriologist (140–259) ...		1,680
5 Laboratory Assistants (60–3–90) ...		3,600
20 Dairymen at Rs. 15/- each p. m. ...		3,600
One Mechanic (70–120) ...		840
One Asst. Mechanic (45–75) ...		540
Two Watchmen at Rs. 15/- each p. m. ...		360
Three Peons at Rs. 18/- p. m. ...		648
One Head Clerk ((80–125) ...		960
One Lower Division Clerk ...		540
One Typist (45–90) with special pay ...		660
One Sweeper at Rs. 15 p. m. ...		180
Repairs and upkeep ...		10,000
Maintenance charges of equipment ...		10,000
Total for one creamery ...	5,00,000	51,85,955
Total for three creameries ...	15,00,000	1,55,57,865

APPENDIX VII.

Transport Section:

	Non-recurring Rs.	Recurring Rs.
Buildings for Station.ng Lorries, Jeeps, Motor Cycles etc. ...	1,00,000	
Lorries and Workshop equipment for distribution centres ...	4,00,000	
Establishment:		
One Automobile Engineer (250–350) ...		3,000
One Executivc Asst. (150–225) ...		1,800
30 Drivers (45–60) ...		16,200
30 Cleaners at Rs. 15/- each p. m. ...		5,400
Four Mechanics (60–80) ...		2,880
Fitters and Carpenters, Ten at Rs. 90/- each per mensem ...		10,800
Coolies including Boys 20 at Rs. 10/- each per mensem ...		3,600
Four Watchmen at Rs. 15/- each per mensem ...		720
Maintenance Charges for lorries etc. ...		40,000
Repairs and upkeep ...		40,000
Total ...	5,00,000	1,24,400

Note: This section is intended for the distribution of milk in the City of Madras from the three creameries to the 50 distribution centres.

APPENDIX VIII.

Quality Control Centre:

		Non-recurring Rs.	Recurring Rs.
Buildings	...	50,000	
Laboratory equipment	...	25,000	
Transport Vehicles	...	10,000	
Cost of running laboratory equipment	...		5,000
Purchase of Chemicals etc.	...		10,000
Maintenance Charge for lorries	...		2,500
Staff:			
One Dairy Technologist (260–700)	...		3,120
Two Asst. Dairy Technologist (140–250)	...		3,360
One Bacteriologist (140–250)	...		1,680
10 Laboratory Assts. (60–90)	...		7,200
Six Mazdoors at Rs. 15/- each per mensem	...		1,080
One Watchman at Rs. 15/-	...		180
One Head Clerk (80–125)	...		960
One Upper division Cletk (80–110)	...		960
One Lower Division Clerk (45–90)	...		540
One Typist (45–90) with special pay	...		660
One Sweeper at Rs. 15/- per mensem	...		180
Two Peons at Rs. 18/- each per mensem	...		432
One Driver (45–60)	...		540
One Cleaner at Rs. 15/- per mensem	...		180
Total	...	85,000	38,572

Note: System of procurement and system of quality control:

It is proposed to purchase milk at abount 0—3—6 annas per lb. in consultation with the Committees from the producers i. e. the Dairy farms, the Co-operative Milk Supply Unions and Societies and the Madras Milk Factory and the City milkmen besides other private dairy farms. The Milk Commissioner will arrange to conduct tests to indicate the physical, chemical, and hygienic quality of milk. Important tasts like Gerber's test, specific gravity, smell, tosto and the general appearance dirt content, acidity, boiling reaction etc. will be done. Bacteriological examination will also be carried out. Data of the results will be fully recorded aud reported to different sections for guidance. The sale price will be fixed at As. 5/- per lb. under this scheme. Therefore a net profit of an anna and a half per lb. of liquid milk sold, is possible. A statement of anticipated receipts is shown in Appendix XII.

APPENDIX IX.

Distribution Centres:

		Non-recurring Rs.	Recurring Rs.
Buildings for one distribution centre	...	5,000	
Utensils etc.	...	1,000	
Furniture etc.	...	2,000	
Establishment:			
One maistry (45–90)	...		540
Two menials at Rs. 15/- each p. m.	...		360
Total for one centre	...	8,000	900
Total for 50 centers	...	4,00,000	45,000

APPENDIX X.

Milk Commissioner's Office:

	Non-recurring Rs.	Recurring Rs.
Milk Commissioner (2000–3000) ...		24,000
Milk Procuring and distributing Officer (260–700)...		3,120
Milk Accounts Officer (260–700) ...		3,120
Four Milk Supervisors (90–120) ...		4,320
One Deputy Registrar of Co-operative Societies (230–700) ...		2,760
One Asst. Engineer P. W. D. (260–500) ...		3,160
Office:		
One Senior Superintendent (190–240) ...		2 280
One Junior Superintendent (140–190) ...		1,680
Five Upper division Clerks (80–110) ...		4,800
10 Milk Accountants (80–110) ...		9,600
One Cash Keeper (90–175) ...		1,080
One Stenographer (45–90) plus special pay Rs. 35/- ...		960
Two Typists (45–90) plus special pay Rs. 10/- ...		1,320
Five Peons (18–25) ...		1,080
Two Watchmen at Rs. 15/- each p, m. ...		360
Buildings for Office etc. ...	50,000	
Furniture etc. ...	5,000	
Total ...	55,090	63,600

APPENDIX XI.

	Non-recurring Rs.	Recurring Rs.
Cost of 10 dairy farms ...	1,01,20,000	40,78,840
Cost of 10 dry stock farms ...	25,10,000	13,24,900
One Disease Control centre ...	65,000	30,392
One Breeding Centre ...	77,000	19,292
Three Creameries ...	15.00.000	1,55,57,865
Transport Section – one ...	5,00,000	1,24,400
Quality Control centre - one ...	85,000	38,572
Distribution centres – Fifty ...	4,00.000	45 000
Milk Commissioner's Office ...	54,000	63,000
	1,53,12,000	2,12,82,861 or 2,12,83,000

APPENDIX XII

Statement of anticipated receipts:

By sale of 1,90,000 lbs- of milk produced as shown in Appendix I at As. 5/- per lb. per day ...		2,16,72,875
Rent for 100 cattle stalls at Rs. 10/- per mensem each ...		12,000
Receipts by way of sale of 200 animals of female and young stock ...		25,000
	Total	2,17,08,875 or 2,17,09,000

Note: Sales tax and depreciation are not included. This may work out at about 10% roughly and may come to about Rs. 15/- lakhs at the end of the year. It must be borne in mind that it would be unfair to assess profits and loss in the very first year itself. It must, however, be noted that a number of officers with their establishments need not be brought into the scheme.

MADRAS MILK PLAN
MILK COMMISSIONER
Producer's Committee
Consumers' Committee
Dairy Technologist
Milk Accounts Officer
Milk procuring and distributing Officers
Transport section
Co-operative section
Animal health section
Breeding section
Dry stock farm
Dy. Registrar of Co-operative Societies
Creamery (Processing centre)
Quality control centre
Distribution centre
Joint-stock dairy farm.
Government milk factory
Co-operative Milk Union and Societies
Dairy Farms
Private dairy owners
Private dairy farms
Private producers

Land at War

By

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An account in given below of the efforts England made to achieve self-sufficiency of food even under shower of bombs in the World War II, to consider why attempts made in this country on the food front have not yielded similar results even though India has not been a war theatre.

"Produce or Perish" was the challenge thrown to the nation and the whole country, realising the gravity of the situation, produced food even in excess of its requirements and won the war.

During the pre-war period in England, out of the total population of 48 millions only one million was engaged in farming and the rest were crowded in cities. Influenced by the availability of cheap food from other countries, home production fell far below the margin of safety and 60 percent of their requirements had to be imported. Prices dropped and many farmers with little encouragement to grow crops except on the best lands, forgot the use of the plough.

Tumbled-down homesteads, idle tools, fields choked up with weeds were the legacies of bad markets and the slump. Agriculture was left in a state of neglect by the industrial upheaval. The weighty lessons of the World War No. I were soon forgotten. But a few sons of Britain's oldest industry, the inheritors of a complex and highly developed craft survived with their love for the soil, capacity for hard work and their prophetic sense of weather.

Under these stress of War their immediate job was:

1. To get 2 million extra acres under the plough for raising wheat, potatoes and sugar beet.
2. To arm, equip and man 3 lakhs of farmers to win back the neglected soil to fertility, to feed and sustain a nation.
3. To put in to practice the plans of the Agricultural Department.
4. Reclamation by the use of machines of bad lands, which so far resisted reclamation. (by human and horse power)
5. To open a national farm survey of every holding more than 5 acres in extent indicating (a) state of the land and type of the soils, (b) acreage of crops, (c) acreage of grass, (d) acreage of derelict land (e) state of buildings, cottages, cart roads, fences, water, electric supply etc. and a map of all the farms with details.
6. To fight the nation's food robbers viz. rats, squirrels, rabbits, wild birds etc. and also pests and diseases on crops.

7. To increase production of milk and its products manyfold as that alone could protect the nation engaged in a tough war, from malnutrition and the resultant weakness.

8. To improve livestock, to supply draft horses, dairy cattle, poultry and pigs.

To achieve these objects British Government devised a plan by which the improvements could be put through and the food problem solved.

To begin with the Government appealed for (a) leaders with good imagination, (b) men who worked hard on the land, and (c) men who spoke the tongne of the farmer, who knew his life and problems and who could induce the farmer to do an impossible thing.

These persons were grouped to form a committee for every county, and parish. These committees were empowered to enforce the special wartime measures of the Agricultural Minister. Theirs was a form of self-government and their brother farmers knowing that these powers would be exercised not by a band of remote officials but with the sympathy and understanding of their own kind, were willing to co-operate.

Farm workers' representatives who sat on the committees gave helpful advice on labour matters and encouraged the workers in their efforts.

Committees met in village inns, bars, farmhouses etc. The meetings were not mere talks but a useful discussion among hard-bitten fighters who had a very real and critical battle on hand.

From Whitehall to every farm in the country, the committees formed a visible human chain, and a chain that grew stronger with each year of war.

A Women's land army committee was formed for each county and empowered to find local representatives to watch over the welfare of the land girls coming in large numbers to assist the farmers in field operations.

The committees were helped by a staff of experts under an executive officer to spread modern methods, to explain and popularise them. New personalities appeared on the country side; cultivation officer, technical officers, experts on silage, straw pulping, hay farming, farm drainage, milk production, machinery, fertilizers, pests on plant and animals. Apart from the voluntary unpaid committee-men, the Ministry roped in the best technical brains as well.

Having set up an organisation to push through the schemes for the following production, the Government offered increasing concessions to farmers to serve as an inducement:—

1. Sharing the cost of ploughing every new acre and draining his fields.

2. The county committees organised a contracting service i. e. a nucleus of machinery with crew was sent from place to place. Committee offices became something like military headquarters. Wall maps with flags and coloured pins showed the position of machinery depots, movement of mobile units etc.

3. England quickly built-up her tractor strength and within five years she possessed 1,75,000 tractors as compared with 55,000 in 1939. Tractors played a most important role in the grow-more-food campaign by bringing extensive areas of pastures and waste lands under crops,

4. Farmers could obtain lime at half cost and basic slag at one-fourth the cost.

5. Tracters could be bought on hire purchase.

6. Fixing prices for his produce.

7. Hiring labour and machinery for the farmer and fixing rates for ploughing neighbouring land.

8. Selling him seeds.

9. Supplying with stud bulls, stallions and rams for his stock.

10. Analysing his soils.

11. Giving him expert advice on all his problems, animal, vegetable and mineral.

Buying his produce or at least guaranteeing its sale. Paying 50% of the cost of operations aimed at reclaiming bog land and flooded areas — cleaning streams and ditches, opening hill drains and clearing pernicious weeds from lands.

14. Paying subsidy to hill sheep farmers to help them maintain their flocks and to offset the decreased demand for sheep resulting from ploughing up of ley and grass.

15. In building flax dams so important to the flax industry the Government bore the whole cost. Responsibility for most of the large-scale reclamation fell on county committees for they were national organisations with special facilities for such work. They could command equipment, capital and expert knowledge outside the scope of the private farmer.

16. State protection for sickness and unemployment of labour.

As a result of the keen interest shown by Government and concessions offered to farmers, a thorough change spread over the rural areas, To mention a few, plough up offensive was directed towards pasture grass with all vigour. Men worked seven days in the week all day and even at nights. Night ploughing developed into a special techniqne.

4000 members in Woman Land Army and 90,000 Land Girls came up voluntarily to plunge whole-heartedly in the difficult task of fighting with the land.

One-time shop girls, typists, mill girls, hair-dressers, became tractor drivers, to plough up hard pastures throughout winter and summer struggling with storm and wind, milking, sowing, harvesting, threshing and living in wild parts of the country among strangers.

Schoolboys and girls and every form of available labour were engaged in harvest operations.

The Agricultural Department and the Ministry of Labour threw themselves wholeheartedly into the task of organising this vast and willing force. Camps and hostels were started throughout the country and workers came in thousands.

The Woman's Land Army first batch went straight to the land. The rest received training for their job. but the land girl throve on direct experience. She was engaged by contract which guaranteed her regular employment throughout the year with a minimum of one week's holiday with pay, no deductions for sickness or wet weather.

British farming was changing not merely in its capacity to work more land with less labour but in the type of crops to be grown, the type of cattle to be raised and even in the methods of feeding them.

All British farmers grew new crops between rows of trees. All flower farmers changed over to vegetable and grain growing.

The-war time farmer showed great enthusiasm for the sharing of experience and desire to learn through his neighbours, new crops and methods. The farmer co-operated every way, organising discussion groups, meetings, lectures etc. 'Neighbours day' became a very popular method of contact.

Wages of agricultural labour increased from 30 sh. a week to 70 shillings.

The men and women who worked in the fields were exposed to one of the severest winters within living memory. For many hundreds of land girls fresh from offices and centrally-heated shops of the city, they were an ordeal which only enthusiasm could overcome; the wet winds came from every side along with soaking rains and they felt the whole winter draining through their bones.

The achievement is evidenced by the increased food production namely 109 per cent in wheat, 115 per cent in barley, 58 per cent in oats, 102 percent in potatoes, 37 per cent in fruits, 34 per cent in vegetables and 55 per cent in fruits over the pre-war figures.

The example of the British farmers during the war, and their glorious success in food production and in saving the nation from collapse should induce those interested in Indian national welfare to ponder over our failure in food production. For it is well known that no weapon ever invented is more deadly than hunger. The finest armies in the world, courageous enough in the face of bombs or bullets can be reduced to helplessness and surrender by hunger.

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The Role of Heterosis in Crop Breeding with Special Reference to Hybrid Cottons

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Introduction: The manifestations of increased size, vigour of development, productivity and similar beneficial effects have long been recognised in many first generation hybrids of plants and animals. This increase in size and vigour resulting from hybridisation has been designated variously as the "stimulating effects of hybridity", "heterozygosis" or "hybrid vigour" and Shull (1914) first proposed the use of the term "heterosis" to denote such a phenomenon. "Heterosis" attracted the early attention of the plant breeders through its conspicuous effects on several economic characters of the crop plants studied, notably that of grain yields in maize (*Zea Mays*. L) a crop taken up for pioneer investigations by the American geneticists.

With the advent of Mendelism after 1900, the subject of heterosis evoked considerable academic interest and the advancement of genetical knowledge provided practical applications The years that followed witnessed remarkable progress in the study of quantitative inheritance and applied genetics. In maize breeding in the United States of America, harnessing of heterosis became the main consideration and the achievements gradually revolutionised corn production and made economic history.

The phenomenal success of hybrid maize inspired extensive work on a variety of plants and valuable contributions to both the academic and utilitarian aspects of heterosis have been made during the last forty years. Informative reviews on different aspects of this subject have appeared from time to time, especially those of East and Jones (1919) in their book on Inbreeding and Outbreeding, East (1936), Ashby (1937. a), Whaley (1944), Ashton (1946) and Ashby (1948).

Theoretical Considerations: The phenomenon of heterosis has been recognised as but another phase of quantitative inheritance and the conception of its manifestations is based on the effects of dominance. Fisher, Immer and Tedin (1932) have even referred to this feature of "transgression" as "superdominance". Genetical and physiological researches on the theoretical aspects of the problem have contributed to the following fundamental concepts as the underlying causes of heterosis. A physiological stimulus arising from heterozygosity (Shull 1908, 1911, and East 1908); dominance of linked favourable genes (Jones 1917); cumulative interaction of divergent multiple alleles of non-defective size-determining genes (East, 1936); and monoheterozygote vigour due to gene pleiotropy (Jones 1945, Gustaffson 1946, 1947, and Granhall 1946) have all been advanced as one or other of the genetic mechanisms responsible for heterosis. A physiological school (Ashby 1930, 1932, 1937. b and Luckwill 1937) has also contributed data to show that size

Note: Ramasastrulu Munagala Prize Essay 1951.

heterosis in certain maize and tomato hybrids was nothing more than the maintenance of an "initial advantage" in embryo size. Luckwill (1937) further discussing the question of heterosis in embryo size which conferred this "initial advantage" pointed out, that this in turn might be due to stimulus in the heterozygous zygote or other genetic mechanisms. As both size characters and developmental processes are gene controlled, heterosis may be interpreted as due to the cumulative effect of favourable heredity from both the parents.

Manifestations of Heterosis: The ultimate manifestations of heterosis in the different plants would appear to be determined by their inherent growth habit. Heterosis need not be expressed in all plant characters in a given cross. It varies widely in the different species of plants and between crosses in the same species also. It may be exhibited as increase in height, more profuse branching, larger or greater number of leaves, increased number of flowers, heavier yield of seed or fruit, increased weight of plant, hastening of maturity, higher resistance to diseases and insect attack etc. (Ashby, 1948). It is the agricultural utility of several of these characters that has stimulated the use of heterosis in the breeding of crops.

Practical Applications: The commercial utilisation of the phenomenon for crop improvement is known to depend on several factors like the breeding mechanism of the plant, expression of heterosis in economic characters and facility of large-scale seed production. By virtue of these features, hybrid maize remains the outstanding example of achievement in this field of applied genetics. Scientific breeding in maize started first on orthodox lines of selection within self-fertilised lines. The ear-to-row selection as outlined by Shull (1909) was the method in vogue. It was realised that inbreeding in this highly cross-fertilised organism resulted in a loss of vigour and productivity due to the accumulation of unfavourable recessives in the homozygous condition. On the other hand, hybridisation between inbred lines was found, not only to increase the yields appreciably, but combine other desirable effects as well. The edifice of present day breeding methods in maize, is built up on this fundamental fact, and they follow in all essentials one or other of the following methods; viz. (1) the production of single crosses between inbred lines (Shull 1908, 1909); (2) Synthesis of double crosses between different F1 hybrids (Jones, 1918); (3) convergent improvement through a system of backcrossing (Richey, 1927); and (4) multiple convergence utilising different non-recurrent parents for backcrossing (Richey, 1946. b)

There have been improvements in the methods for determining better stocks as foundation, whether inbred or hybrids and in other details as well. Combining ability of parents has been recognised as a specific heritable character (Hay's and Johnson, 1939) and the knowledge utilised in hybridisation. The practical application of these methods has revolutionized maize production in the United States of America which produced some two billion bushels more corn during 1941—'44 on account of the use of hybrid seeds over 65 per cent of the United States maize acreage (Richey 1946 a) which approximates 90.8 million acres (Pal and Ramanujam 1946).

It is also reported that besides maize, first generation hybrids of tomato (*Lycopersicum spp.* Hill) and tobacco (*Nicotiana* spp. L.) are grown to-day on a commercial scale in America and Russia (Ashby 1948). Heterotic effects in yield of fruits, earliness of maturity, and disease resistance in the tomato, and yield and quality of leaves in the tobacco, combined with the advantage of large number of seeds produced in a fruit, render the commercial utilisation of heterosis practicable, in these cases.

In India, recent researches in Madras have resulted in notable success for hybrid *Cumbu* (*Pennisetum typhoides Stapf et Hub*) as a practical proposition. (Rao, Nambiar and Menon, 1951). Two hybrid strains recording over 40 per cent increase in yields over the local variety have been found suitable for cultivation in nine districts of Madras State. The commercial production of hybrid seeds is rendered feasible due to the protogynous nature of the *cumbu* inflorscence and high natural cross pollination of 76 to 78 per cent that could be secured by planting the desired parents in alternate rows or as mixtures. (Rao, Nambiar and Krishnamurthi, 1949).

In the breeding of Sugar beet (*Beta vulgaris*, L.) crop in Sweden, heterosis is reported to be utilised. (Ramiah 1941). In America, the grain and forage yields of sorghum (*Sorghum spp.* Pers.) have been observed to be increased in many F1 hybrids, but the commercial production of hybrid Sorghums awaits the development of methods for economical seed productlon. (*Bartel*, 1949). The value of heterosis in increasing the yields of (*Solanum melongena*, L.) has been recognised both in Japan (Kakizaki, 1931) and India (Venkataramani 1946, Pal and Singh 1946). In cotton, the utility of heterotic interspecific crosses has been realised by workers at Coimbatore (Ramanatha Iyer, 1936; Balasubrahmanyan and Narayanan, 1948) and Surat (Patel and Patel 1950). In every other crop, the phenomenon has been noted to occur in one cross or another and is increasingly tried to be exploited for economic ends. And it has been well realised that through its careful utilisation the breeder can make a substantial contribution to the World's food and possibly the World's clothes also.

Heterosis in Cotton: The cultivated cottons of the World belong to one or other of four different species of the genus *Gossypium L.* and fall under two distinct cytological groups. The American species, G. *hirsutum* and G. *barbadense* have 52 somatic chromosomes while the Asiatic species G. *arboreum* and G. *herbacum* possess 26 chromosomes. The two groups inter-cross freely, *only* among themselves and give rise to fertile hybrids frequently exhibiting pronounced heterosis in growth, yield and quality attributes. The Asiatic X American crosses seldom succeed and rarely give rise to sterile triploid hybrids. The intra and inter specific crosses within each of the two cytological groups alone offer scope for the economic utilisation of heterosis in cotton improvement.

All the four cultivated species of *Gossypium* have now come to engage the attention of breeders in many cotton growing countries of the World, and notably in the Madras State. The commercial crop of Madras comprises of ten different trade varieties falling under three botanical species viz. G. *hirsutum*, G. *arboreum* and G. *herbaceum*.

Since 1948 attempts are also being made to establish Sea Island cotton belonging to G. *barbadense* as a commercial crop in the coastal districts of Malabar and South Kanara and the initial results have been quite encouraging. During the past two decades, plant breeding work on cotton has generally been switched on to intensive hybridisation and exploitation of the variability thus created. While it may be stated that the chances of success through pure-line selection have almost been exhausted, the potentialities of hybridisation have also been fairly comprehended in recent times. Hence, at this stage, it may be pertinent to examine the possibilities of harnessing this biological phenomenon viz. heterosis, for increasing cotton production and improving the quality of lint.

The frequent occurrence of heterotic crosses particularly in the interspecific group has been observed at Coimbatore and elsewhere, as recorded by many breeders. Very few workers have however attempted a specific study of the problem, Hutchinson, Gadkari and Ansari (1938) indicated the need for a proper understanding of heterosis in cotton for exploiting interspecific crosses in breeding work. More recently, Ramanatha Iyer (1946) pointed to the utility of hybrid vigour for augmenting yields in cotton and stressed upon the importance of determining the right type of combinations of crosses for raising yields to the maximum extent.

Since 1947, comprehensive studies on heterosis in cotton were undertaken at Coimbatore, using homozygous varieties drawn from all the four cultivated species of *Gossypium*. The results of investigations have brought out the great scope that exists for the practical utilisation of certain interspecific crosses in both the American and Asiatic groups of cottons. The data obtained from two such crosses between G. *arboreum* and G. *herbaceum* varieties as also one cross between G. *hirsutum* and G. *barbadense* are presented in this paper.

Material and Methods: The following parent types figure in the crosses.

I. Asiatic Species (n = 13)

1. Karunganni 5 (G. *arboreum*). A selection from interracial hybrid (*indicum* x *cernuum*) isolated at Coimbatore. It is a medium staple, quality cotton, released for general cultivation in the Karunganni tract by the Madras Agricultural Department.

2. Surat 1027 ALF. (G. *herbaceum*). A selection from Kumpta x Goghari hybrid, grown extensively in South Guzerat. It is one of the superior quality, *desi* strains of India.

3. *K F T 12–2–5* (G. *herbaceum*). A selection from Kumpta cotton of Bombay Karnatak. A medium staple, low ginning *desi* cotton, possessing cent per cent resistance to cotton wilt.

II. American Species (n=26)

1. *Cambodia 2* (G. *htrsutum*). A selection from Cambodia bulk, evolved at Coimbatore. A vigorous, prolific, medium staple cotton, widely cultivated in the Cambodia tract of Madras.

2. *Tanguis.* (G. *barbadense*). The commercial variety of Peru, South America. Very late in habit and a potential perennial cotton for South India. Noted for its coarse and strong lint.

The yield and quality attributes of the parent types are furnished in Table I.

Three crosses viz., Karunganni 5 x KFT 12-2-5, 1027 ALF x Karunganni 5 and Cambodia 2 x Tanguis were studied. The F1 hybrids along with the respective parent types were raised in randomised blocks adopting the replicated progeny row design of Hutchinson and Panse (1937).

The two Asiatic crosses and three parents were raised in unirrigated plots in the blacksoil block, while the American cross and parents were raised under irrigation in a red soil field. The agronomic treatments were the same as those given to Karunganni and Cambodia cottons respectively.

Observations on plant growth were made at fortnightly intervals by recording their height in centimetres and number of nodes produced. The plots were harvested plant-war and the yields recorded. The produce was examined for combed halo length in millimetres and ginning per cent (ratio of lint to seed cotton expressed as %).

The lint index (quantity of lint obtained from *Kapas* sample containing 100 seeds) and seed index (weight of 100 seeds) were also determined for each plant. As ginning per cent is largely influenced by seed weight, lint index which gives an exact measure of lint production without the bias of seed weight, was used for the estimation of heterosis in lint quantity.

The lint samples were bulked and examined for mean fibre length, and fibre weight per unit length. Their spinning performance was estimated by applying the formula evolved at the Technological Laboratory, Bombay. (Navkal and Sen, 1949).

The results were tested for significance by the analysis of variance. The manifestation of increased height, yield, lint length etc., in the first generation hybrid, as compared to the higher of the two parental values has been recognised as heterosis in interpreting the results.

Experimental Results: The results of observations are summarised in Table 1. The growth curves (height) of the two Asiatic hybrids exhibiting heterosis in plant height are shown n Figure 1.

I. *Asiatic Crosses:*

1. *Karunganni 5 x KFT 12-2-5.*

(G. *arboreum* x G. *herbaceum*).

The F1 hybrid has recorded significant heterosis in plant growth measured as height, yield of seed cotton and lint length. The increase in yield has been phenomenal, being 158% over the local parent viz. Karunganni 5 whose normal yields in the tract may be placed at 325 lbs. seed cotton per acre which has been realised in this experiment also. In lint production as recognised in lint indices, the hybrid is intermediate. The increase in *kapas* yield, more than compensates for the reduction in ginning per cent brought about through heterotic increase in seed weight of the F1. It is interesting to note that this hybrid has been estimated to spin 4 counts higher than either of the parents entering into the cross, due to its increased average fibre length.

2. *1027 ALF X Karunganni 5 (G.herbaceum x arboreum)*: This hybrid is also significantly taller than either parent and has yielded 151% over the higher parent viz. Karunganni 5. The ginning percent of the hybrid is lower due to increased seed weight, but the lint yield is significantly higher than either parent due to appreciable increase in the yield of seed cotton. In spinning value it is better than Karunganni 5, but does not exceed the 1027 ALF parent which is a finer cotton possessing low fibre weight.

II. **American Crops:** 1. *Cambodia 2 XTanguis (G. hirsutum X G. barbedense)*: In vigour of growth, as measured by plant height, the hybrid does not exhibit heterosis, but compares favourably with the local parent– Co. 2. Significant heterosis in yield of seed cotton and lint length are observed. The lint index of the hybrid is numerically higher than either parent and increased seed weight again exerts a bias towards lower ginning percent. The lint yields are however significantly higher than Co. 2. The improvements in quality are something quite remarkable, The hybrid has recorded higher average fibre length and lower fibre weight than either parent. As the lint is both longer and finer the spinning value has been appreciated to 52's as against 38's — 39's of the parents.

Discussion: All the parent strains utilised in these crosses represent improved, homozygous lines isolated as a result of selection within the respective species. The genetic differentiation of the species in *Gossypium* is consequent on the manifold gene substitutions during isolation (Harland 1936; Silow 1944; Hutchinson and Silow 1947) and subsequent accumulation of modifier complexes due to pressure of natural and artificial selection. It follows, therefore that in interspecific crosses divergent genetic systems are brought together in the F1 generation. There are accumulating evidences to show (Knight 1948) that several economic characters in cotton are controlled at least in part, by major genes, which in their dominant condition are favourable to growth and productivity. It is therefore suggested that the combination in the F1 of dominant favourable genes account for heterosis in quantitative characters like plant growth, yield of seed cotton, lint length and seed weight, observed in these interspecific crosses. The quality of lint has also appreciated due to heterosis in mean fibre length. It has been stressed (Nanjundayya, 1947) that 84% of the variation in spinning value could

be accounted for when it was correlated with average length of fibre, and weight per inch. The Fl hybrids in the two Asiatic crosses have recorded slightly increased fibre weight per unit length than either of the parents. The increase in mean fibre length has however compensated for this 'coarseness' and kept the spinning valne of the Fl's at appreciable levels. In the case of the American cross the mean fibre weight the Fl is lower than either parent. Such a feature was encountered by Balasubrahmanyan and Narayanan (1948) also in a cross between 4463 (*hirsutum*) X Maarad (*barbadense*). It is interesting to find that in this character the dominance bias in the two different groups of cotton is in the opposite direction. Further studies are under way to examine this question in detail.

It is suggested that these interspecific hybrids which have recorded phenomenal yield increases over the local improved strains, and possess appreciable quality attributes also, offer good scope for their large-scale extension towards the practical utilisation of heterosis for increasing the production of quality cottons in Madras State.

It has been realised that in a predominantly self-fertilised crop like cotton, the snag in the proposition lies in a cheap method for the production of hybrid seeds on a mass scale and the organisation needed for the same. Propagation of Fl hybrids by grafting (Vysotkii, 1932), mass production of crossed seeds by hand pollination (Ramanatha Iyer, 1936), and vegetative propagation of hybrid stem cuttings (Balasubrahmanyan and Narayanan (1948) are among the methods considered suitable for the large-scale cultivation of heterotic hybrids in cotton. Ramanatha Iyer (1936) who suggested the device of smearing the staminal column with clay paste for mass emasculation, estimated the additional cost of production of such hand-crossed seeds required for sowing an acre as Rs. 5/- and found that the yield increase of 40% obtained in his *arboreum* x *herbaceum* Fl hybrids left a residuum of extra profit of Rs. 7/- per acre, which was however not very attractive.

With the phenomenal increases of 100 to 150% in yield at appreciable levels of quality improvement, that have been obtained in the three interspecific crosses reported in this paper and with the attractive price levels for raw cotton obtaining now (approximately Rs. 1—6—0 per pound of 1" staple cotton) it will be an economically sound proposition to produce and distribute hand-crossed seeds on a mass scale and intensify production of quality cotton at least as a short-term measure, in concentrated pockets around State farms, which can maintain crossing plots similar to nucleus areas for producing selfed seed.

Due to the perennial habit of the Tanguis parent the Cambodia 2 X Tanguis Fl hybrids can also be kept on the ground for two or three seasons as a perennial in vacant spaces and along bunds in water courses and the seed supply needs to be renewed in alternate years. Any extra pound of long staple cotton in these days of acute shortage of this important fibre crop should prove a valuable contribution to the Nation's wealth.

TABLE—I.

Heterosis in interspecific crosses in cotton

	Plant Growth		Productivity							Lint quality		
	Height in cms.	Nodes	Kapas yield gms./ plant	Percentage on local parent (kapas yield)	Ginning percent	Lint yield gms./ plant	Halo-length m.ms.	Lint index gms.	Seed index gms.	Average fibre lengtgh inches	Mean fibre -6 wt. x 10 oz. per inch	Calculated spinning value
I. Asiatic parents and hybrids.												
1027 ALF	53·0	30·5	5·63	83	29·5	1·26	24·1	2·86	6·75	0·86	0·155	35's
1027 ALF x Karunganni 5 F1	**77·4**	34·5	**16·91**	251	28·2	**3·66**	**26·8**	2·84	7·37	0·95	0 194	32's
Karunganni 5	60·2	35·5	6·75	100	30·4	1·73	25·2	2·63	6 03	0 88	0·189	25·s
Karunganni 5 x KFT 12—2—5	**75·2**	36·3	**17·41**	258	25·7	**3·34**	**26·7**	2·25	6·47	0·95	0·204	29's
KFT 12-2-5	60·7	29·0	7·65	113	24·3	1·51	23·5	1,81	5 57	0 85	0·171	25's
Significance	Yes	No	Yes	...	Yes	Yes	Yes	Yes	Yes			
Critical difference	9·6	...	4·66	...	1·02	0·44	1·04	0·33	0·79		Bulk Samples	
II. American parents and hybrid.												
Cambodia 2	67·3	30·5	8·4	100	34·5	2·90	25·3	5·33	9·88	0 92	0 150	39's
Cambodia 2 x Tanguis F1	63·8	29·8	**16·5**	196	33 8	**5·58**	**30·8**	5·81	**11·37**	1·09	0·121	52's
Tanguis	47·4	38·7	3 0	36	34·0	1·02	25·8	4·53	8·83	0·92	0·176	38's
Significance	Yes	Yes	Yes	...	No	Yes	Yes	Yes	Yes		Bulk Samples	
Critical Difference	11 9	2·8	4 7	...	...	1·60	1·6	0·78	0·82			

N:B.— Bold figures denote significant heterosis.

SUMMARY

1. The beneficial effects of heterosis in agricultural characteristics of crop plants have inspired the economic utilisation of the phenomenon for the improvement of crops.

2. The theoretical concepts underlying heterosis and the role of the phenomenon in the breeding of maize, tobacco, tomato and ***cumbu*** are reviewed briefly.

3. Interspecific crosses in cotton are known to exhibit pronounced heterosis in yield and quality attributes. Their utility in cotton improvement is considered with reference to three hybrid combinations viz. Karunganni 5 X KFT 12–2–5 (G. *arboreum* x G. *herbaceum*) and 1927 ALF X Karunganni 5 (G. *herbaceum* x G. *arboreum*) in the Asiatic group and Cambodia 2 X Tanguis; (G. *hirsutum* x G. *Barbadense*) in the American group.

4. The two Asiatic hybrids have proved to be vigorous in growth and have recorded increases of 151% and 158% over the local parent Karunganni 5, in yield of *kapas* (seed cotton) at appreciable levels of lint quality. The American cross has recorded 96% yield increase over Cambodia 2 and the lint possesses superior fibre properties as well. By virtue of the late habit introduced from the Tanguis parent, this hybrid is fit for retention as a perennial for 2 to 3 seasons.

5. It is suggested that these heterotic hybrids, offer good scope for large-scale cultivation, at least as a short-term measure for intensifying the production of quality cottons in this State.

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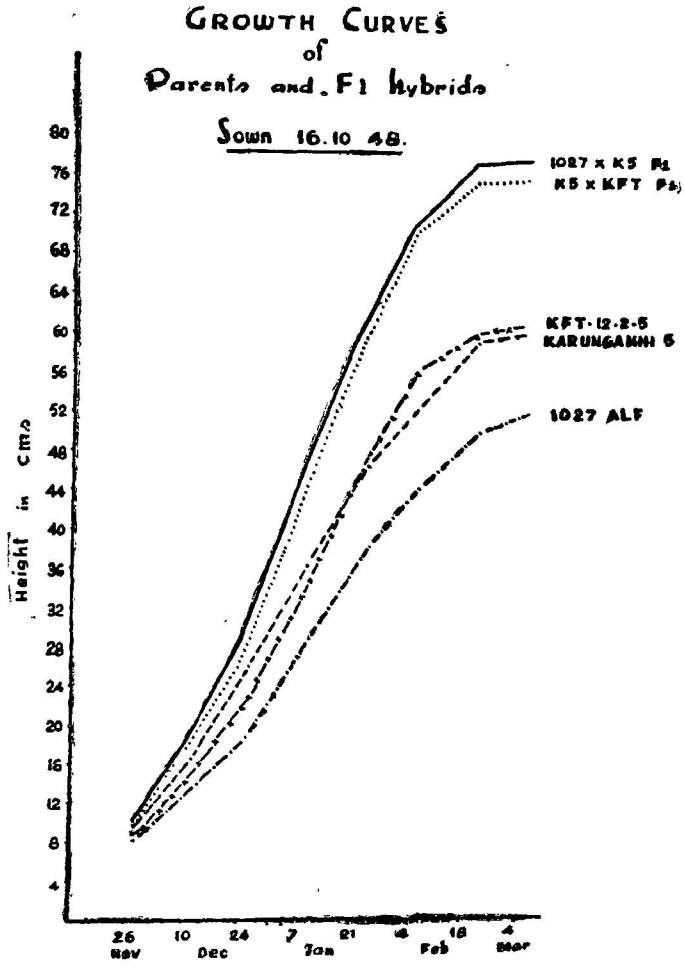
GROWTH CURVES
of
Parents and F1 hybrids
Sown 16.10 48.
Height in cms
80
76
72
68
64
60
56
52
48
44
40
36
32
28
24
20
16
12
8
4
26 Nov
10 Dec
24
7 Jan
21
4 Feb
18
4 Mar
1027 x K5 F1
K5 x KFT F1
KFT-12-2-5
KARUNGANNI 5
1027 ALF

The Interactions of Productive Factors in Rice

By

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1. **The Bowley-Robertson Committe's Crop Census:** The practicability and scope of a census of production was one of the important subjects considered by Dr. A. L. Bowley and Mr. D.H. Robertson, when they were invited by the Government of India in 1933 for a Reorganisation of Statistics and report on the further study of the economic problems of India. They pointed out that excepting in the branches of vital statistics and foreign trade "the Statistics of India have largely originated as a by-product of administrative activities", relating to land revenue, famines and so forth. It was this Bowley-Robertson Committee that first fixed the minimum of villages for each province in India to be selected by random sampling, for the investigation of rural income, almost synonymous with agricultural production or crop census in this country.

2. **Precise estimates for State assistance and drive:** Primary estimates of agricultural statistics emanating from the village accountants except in the ryotward areas and in areas that have a levy in water rate are very wide of the truth. With numerous other administrative and revenue duties in hand, they compile agricultural statistics mainly through their informants, the '*chokidar*' n Northern India and the '*talayari*' in Southern India. In aiming at self-sufficiency in food production, not merely precise estimates of the crops, but the individual contribution by the several factors of production is essential.

3. **The Productive factors:** In tackling rice production, water, manure and improved seed come in as the *direct* factors, and the control of pests and diseases as the *indirect* contributory factors. In the survey of the census of the paddy crop, there is indication of contribution independently by the three factors of water, manure and improved seed, in combinations in pairs and in a very marked way, when all the three acted collectively.

4. To bring out the interactions of the productive factors in the rice crop of 1948–49, three appendices are provided to this paper. The first is a telescopic table indicating the per cent excess in yield of one or more productive factors over one or more other productive factors, under all practicable permutations and combinations. The second is a pictogram showing the distribution and the acre-yields of the productive factors in the province. The third is a belt strata chart showing the distribution of the productive factors in the main rice-growing areas in the province.

5. **The 'O' factor:** Marginal land under the plough, land under shifting cultivation, land under peasantry in penury and land in extensive estates under neglected conditions, do not obtain the facility for irrigation, or manuring and have crops only from non-descript seed. The yields in such are at the lowest ebb. State aid is raising production in the first three kinds of lands and is correcting the moribund state in the fourth by enacting legislation under the Agricultural Bill. Lands under the 'O' factor are estimated at 3% and this is an appreciable figure in a province with land hunger unsatiated. Such areas are confined to the zamindaries in Visakhapatnam, Godavari, Kistna, Madura and Ramnad and to the hillslopes of Visakhapatnam, Godavari and Malabar.

6. **The 'S' factor:** This pertains to land wherein improved seed evolved by the department was made use of to raise the crop. This factor by itself does not draw the particular attention of the cultivator as indicated by the poor dispersion of less than 1% in the sample. With water, it is a helpful adjunct. as proved lower down.

7. **The 'M' factor:** There is 17% of rainfed local paddy that had manuring in the province. Most of it pertains to the districts of Malabar and South Kanara where paddy land is classed as unirrigated. Visakhapatnam and Guntur which are also prominent for this factor, are cattle–rearing tracts and cattle and sheep-penning are common practices in them. With the heavy rainfall in the West Coast and in Visakhapatnam manuring on the 'O' factor and on 'S' have recorded 55% extra yield.

8. **The 'W' factor:** All the figures above the top zig-zag line in the telescopic table, with the exception of the three underlined that have no direct bearing on this factor, speak eloquently of irrigation to the the paddy crop and illustrate the common knowledge that paddy is an aquatic plant. Irrigation by itself and in combination with manuring and with good quality seed, recorded increased yields ranging from 24·5% to 156·2%. It thus takes the first rank amongst the productive factors and is a pointer to the State for taking up irrigation projects on an extensive scale. That the paddy crop has only 4% under this factor indicates that with irrigation water available, no cultivator would grudge to manure or to seek good seed to enhance rice production. The time factor for early planting needing reservoirs and regulators and the labour factor for planting in the central districts are subsidiary factors under this.

9. **The 'MS' factor:** In rainfed paddy, the association of improved seed with manuring is only upto 4%. As indicated under the 'M' factor, this area is confined again to Visakhapatnam and the

West Coast. From the heavier rainfall in these districts, the 'W' factor is indirectly there. But with acute drought in two successive years in the Central districts, specially in Chingleput, manuring acted as an inhibitive factor, as indicated by the negative figures over the bottom zig-zag line, in the telescopic table. The acre-yield of the 'MS' factor (968 Lb) is less than that of the 'M' factor (1026 Lb). This shows that the inhibitive character of 'M' is further augumented by association with 'S' in 'MS'.

10. In years of drought strains struggle to assert their superiority over locals. The following exemplifies this feature.

Percentage increase in yield of 'Biyahunda' strains over local 'Biyahunda' in Visakhapatnam district.

1945–46	...	42%	Years of tidal waves, cyclones and floods.
1946–47	...	42%	
1947–48	...	6%	Years of fewness of freshes.
1948–49	...	7%	

11. **The 'WS' factor:** The wetland crop raised with improved seed is estimated at 6% of the total paddy area. The scope for improved seed to give extra yield on wetlands to the extent of 52·8% is revealed by this 'WS' factor. This zone without the association of manure is confined to the highly fertile mid-region of the Godavari deltas and to some extent to the Krishna and Tanjore deltas. Topping of rank growth and grazing by cattle are practices in vogue in unmanured, silty soils of the middle portion of the Godavari delta, where many fields may be found with the planting of the new 1st crop seedling on the stubble of the previous paddy crop.

12. **The 'WM' factor:** Notwithstanding the depressing effect of manure when associated with inadequate water supply, the popular practice is to apply manure to paddy land, with the full hope of receiving the optimum supply of water. In spite of the lower yield (180 lb.) under this factor, when compared to WS (1584 lb.) and (WMS 1694), still the irrigated manured paddy land has the greatest spread 40%, when compared to WS (6%) and WMS (25%). Thus the manuring of paddy land in all non-deltaic districts is a regular feature as also in the deltaic districts. Manure can pull up yields of paddy on irrigated land by 22·9%, as revealed in the telescopic table, by the interaction of manure in the 'WM' factor on the 'W' factor.

13. **The 'WMS' factor:** 25% or one-fourth of the paddy crop of the State is served by all the three direct productive factors collectively (and has a yield of 1694 lb.) based on 2319 plots,

sampled for all paddy in the State. There is thus scope for augmenting production in 7% of the existing paddy ayacut itself, in the drive toward self-sufficiency.

14. **Cumulative effect of the interactions:** The productive capacity of the factors under interactions are worked out to indicate their cumulative effect and expressed as mean percentages.

Factors	Inter-actions	Per cent excess from the telescopic table	Productive extra capacity of the factors expressed as algebraic mean in %
W	WMS—MS	63·3	
	WM —M	93·8	67·1
	WS —S	53·9	
	W —O	57·4	
M	WMS—WS	7·0	
	MS —WM	46·6	33·0
	WM —W	22·9	
	M —O	55·4	
S	WMS—WM	32·1	
	WS —W	52·8	19·7
	MS —M	5·8	
	S —O	0·0	
MS	WMS—W	63·0	
	MS —O	46·4	54 9
WS	WMS—M	65·5	
	WS —O	139·2	102 3
WM	WMS—S	156·2	
	WM —O	155·9	156·0
WMS	WMS—O	155·9	155·9

15. **Trends of productive factors indicating the absence of correlations:** The trends of production by the several factors in the rice districts of Madras are indicated by the curves drawn for

acre-yields of the factors, in the appended graph. By scanning carefully the multimodal curves, it may be seen that no correlation exists between the factors 'O' and 'S'. There is indication of a positive correlation between 'S' and 'M'. Ryots affording manure also think of improved seeds for further production. Indication also exists of a positive correlation between 'W' 'WS' and in a higher degree between the factors 'WM' and 'WMS'.

16. **Conclusions:** (a) The yield of paddy per acre, for all the crops raised in the State of Madras, during 1948–49, is estimated under the stratified random sample survey at 1326 Lb per acre.

(b) Three percent of the area under paddy, or 3,23,200 acres are raised without any irrigation, manuring or improved seed. This is mostly confined to the zamindari areas and the "*podu*" cultivation in the Circars and the "*kumri*" and "*modan*" on the West Coast.

(c) There is 17%, or 1,831,700 acres of rainfed local paddy receiving manuring, confined mostly to Visakhapatnam, Guntur and the West Coast.

(d) Four percent, or 431,000 acres occur as rain-fed paddy under departmental strains receiving manuring.

(e) The rest of the crop comprising 76% is under irrigation. Of this, only 4% does not get associated with the other productive factors of manure and improved seed. This shows that the ryot is aware that wetland paddy yields can be increased by manuring and growing departmental strains.

(f) The estimates from the random sample surveys on paddy set the extra productive capacity (i) by irrigation alone at 67%, (ii) by manuring alone at 33%, (iv) by manuring and using quality seed at 55%, (iii) by resort to improved seed only at 20%, (v) by growing departmental strains under irrigated conditions at 102% and (vi) by irrigation combined with manuring or with manuring or with manuring and good quality seed at 156%. Association of the factors in the phases (v) and (vi) increase the yield by 15% and 36% respectively than when built up from their individual attainments under the phases (i) to (iii).

(g) Only two-thirds of the crop is under the last phase (vi). In the intensification drive under "Grow More Food", the other one-third, or 3,591,540 acres have potentialities to raise the crop to the limit of the 156% capacity, given the supply of the deficient productive factors.

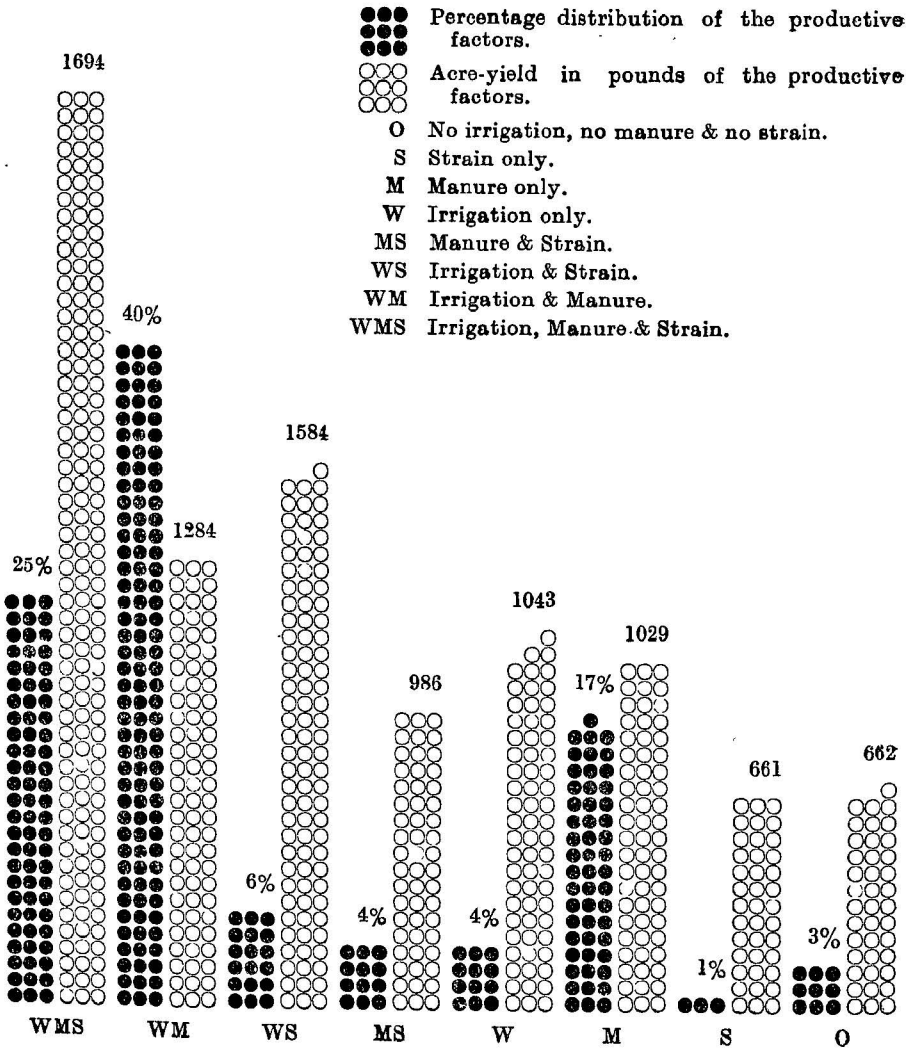
APPENDIX I.

Telescopic Table Indicating the Interactions of Productive Factors, in Rice, in the State of Madras, During 1948-1949.

	No water No manure No strain	Strain only	Manure only	Irrigation only	Manure & strain	Irrigation & strain	Irrigation & manure	Irrigation manure & strain	Remarks for minus figures
Symbol	O	S	M	W	MS	WS	WM	WMS	
Acre-yield in lb.	662	661	1029	1043	969	1584	1282	1694	
Percent excess in yield									
on O	...	O	55·4	57·4	**46·4**	139·2	93·6	155·9	
on S	...	...	55·3	57·7	**46·6**	139·5	93·8	156·2	
on M	...	...	...	1·0	5·8*	53·9	25·5	65·5	*West coast treated as unirrigated but heavy rainfall is as good as irrigation.
on W	...	...	...	...	7·1*	52·8	22·9	**63·3**	
on MS	...	...	...	...	...	62·4	32·3	74·8	†Bad season & inadequate water supply in tanks & wells in Chingleput & N. Arcot pulled down this figure.
on WS	...	...	...	...	...	...	19·1†	7·0	
on WM	...	...	...	...	...	...	...	32·1	

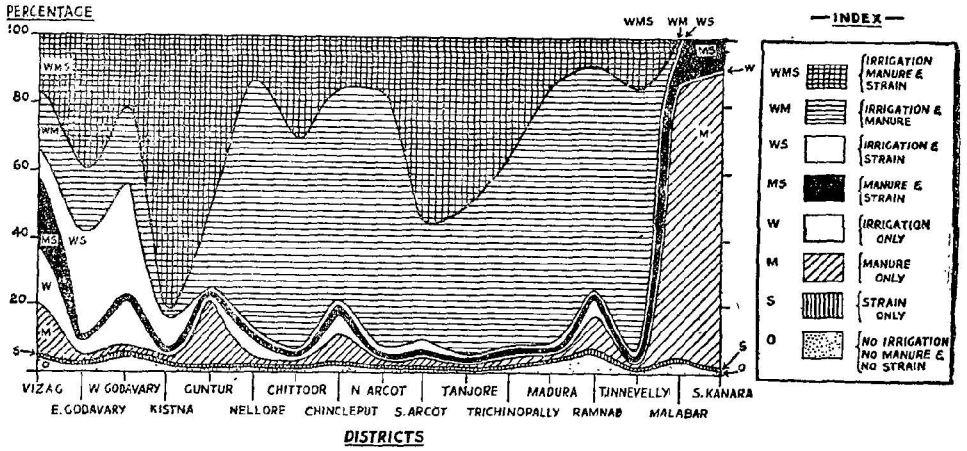
APPENDIX II.

Picto-Gram of Percentage Distribution and Acre-yields of Productive Factors in Paddy, in the Madras State, 1948-49.



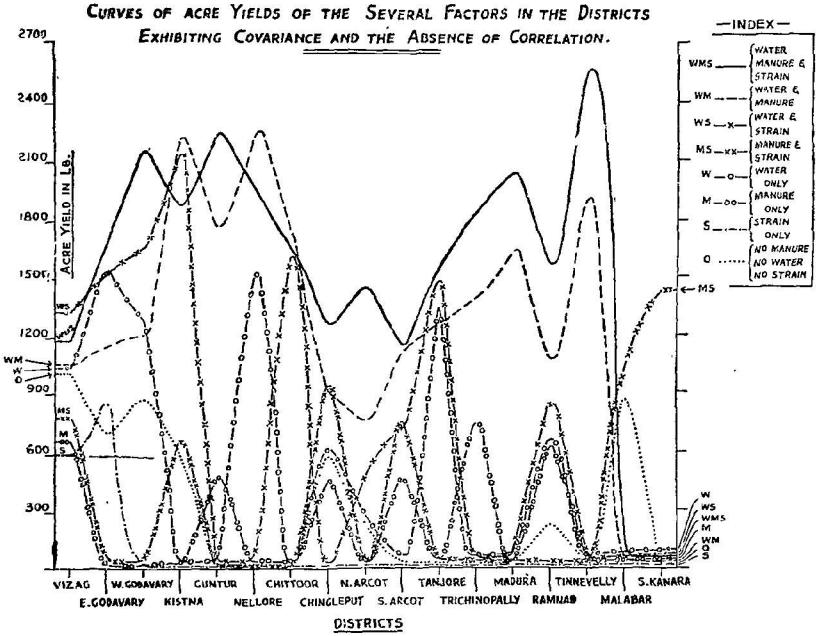
APPENDIX III

BELT STRATA CHART FOR 1948-49 SHOWING THE DISTRIBUTION OF THE PRODUCTIVE FACTORS IN THE DISTRICTS IMPORTANT FOR RICE IN THE MADRAS PROVINCE



APPENDIX IV

CURVES OF ACRE YIELDS OF THE SEVERAL FACTORS IN THE DISTRICTS EXHIBITING COVARIANCE AND THE ABSENCE OF CORRELATION.



Proceedings of the General Body Meeting of the Madras Agricultural Students' Union

The business meeting was held on the 31st July 1951 in the Freeman Hall with Sri C. S. Krishnaswami, Vice-President in the chair, in the unavoidable absence of the President, Sri P. D. Karunakar.

There were 51 officers and 41 student members present.

The Minutes of the General Body meeting held on 31—7—1950 were read and adopted.

The Annual Report of the Managing Committee for the period 1—6—1950 to 31—5—1951 was read adopted. Sri M. A. Sankara Ayyar thanked the Editorial Board for bringing out the journal regularly every month.

The Auditors' Report was scrutinised and adopted. In the discussion that ensued it was proposed by Sri S. Sampath and seconded by Sri M. A. Sankara Ayyar that the exchange journals received by the Madras Agricultural Journal be kept bound and a sum of Rs. 50/- be allotted for getting this done, if funds were available. It was agreed that the next Managing Committee should do the needful in the matter.

Then the question of renewing the curtains was taken up, in view of the G.O. granting the sum of Rs. 1,000/- towards the item. The General Body authorised the Committee to make an appeal to all members for donations. It was decided that the Union be authorised to incur from its own funds an expense of Rs. 1,000/- made up of the donations to be realised from the members so as to utilise the maximum Government grant for renovating the stage fittings.

The next question was about the free supply of the Madras Agricultural Journal to all demonstratoors who were not members of the Union. The Government desired to know about the subsidy required to balance the budget under this sort of supply. The members after a long discussion agreed to accept the offer of a subsidy by the Government and to supply a copy of the Journal to the office of each Agricultural Demonstrator in the State as desired by the Government, at the usual subscription rates specified on the Journal.

The question of contributory provident fund for the Union clerk was considered next, on his representation. It was decided to accept the principle and the rules etc. were to be worked out by the Managing Committee on the same lines as in other Institutions of a similar kind within the limits of the finances of the Union.

The Election of office bearers for the year 1951—'52 was taken up. The following were elected to the different posts.

Managing Committee

Vice-President	:	Sri G. V. Narayana
Editor	:	,, T. R. Narayanan
Secretary	:	,, K. Kuppamuthu
Manager	:	,, C. R. Venkataraman
Treasurer	:	,, M. Vaidyanathan
Member	:	,, C. S. Krishnaswami
,,	:	,, T. S. Lakshmanan
,,	:	,, S. Gopalakrishan
,, (Student)	:	,, K. Kandaswami
Club Secretary ex-officio	:	,, C. D. Samuel

Editorial Board

Editor
Secretary
Manager

Member	:	Sri M. A. Sankara Ayyar
,,	:	,, K. Meenakshisundaram
,,	:	,, F. L. Daniel
,, (Student)	:	,, S. Mahadevan
Club Secretary ex-officio	:	,, C. D. Samuel

Council (16 Members)

President Ex-officio	:	Sri P. D. Karunakar (Principal)
Vice-President	:	
Editor	:	
Secretary	:	

Mofussil Vice-Presidents:

Sri S. N. Venkataraman
,, G. Sakharama Rao
,, P. N. Nair

Mofussil Members:

Sri K. B. Viswanathan
,, M. R. Balakrishnan
,, K. V. Natesan
,, P, Satyanarayana

Resident Members:

Sri S. Varadarajan
,, G. Rangaswami
,, C. Balasubramaniam
Club Secretary
Sri. P. S. Ranganathan, (Student)

The Association of the Upper Subordinate Officers of the Madras Agricultural Department

The General body meeting of the Association was held on 30-8-1951 and the following were elected as office bearers for the year 1951—'52.

President	:	Sri M. Vaidyanathan
Secretary	:	,, N. Ranganathachari
Treasurer	:	,, P. Krishnaswamy
Member	:	,, V. Srinivasan
,,	:	,, D. M. Samuel

CORRESPONDENCE

In the July 1951 issue of the Madras Agricultural Journal, page 347, in the para on the "Cultivation of *Gros Michel* variety in South India" it is stated that the wilt diseases of bananas "has not so far made its appearance here". This statement is not correct. A perusal of the Administration Reports of the Government Mycologist, Coimbatore for the years 1927-28 to 1934-35 and the administration reports of the Plant Protection Officers (Mycology) for the year 1948-49 will reveal that the wilt disease caused by *Fusarium oxysporum* var. *cubense* (E. F. S.) W & R has been recorded in several districts of the State (Vishakapatnam, Chittoor, Cuddapah, Salem, Coimbatore, Malabar, Tiruchirapalle, Madurai, Tinnevelly etc.) in several years. The varieties affected are *Mondan, Chinnamondan, Rasthali, Chakkarakeli, Neyvannan, Peyan, and Poovan.* Fortunately this disease has not spread very much, probably due to the resistance of the local varieties or the system of culture adopted locally.

3—9—1951.

T. S. RAMAKRISHNAN,
Government Mycologist.

DIPLOMA IN INDIAN HORTICULTURE

Results of the Final Examination — August 1951

Register No.	Name of the candidate	Rank	Class in which placed	Distinction
1.	Sri S. Ramamohana Rao	15	III	
2.	,, C. Venkatesan	1	I	Fundamentals in Horticultural Science. Individual fruit crops, fruit pests and fruit products.
3.	,, K. V. L. Narasimha Dutt	8	II	Fruit Products.
4.	,, N. Anjaneyalu	3	II	Fundamentals in Horticultural Science. Fruit products, fruit diseases, olericulture, ornamental gardening, plantation crops.
5.	,, C. D. Chockalingam	13	III	...
6.	,, C. R. Muthukrishnan	19	III	...
7.	,, K. N. Doraiswamy	6 (A)	II	Fruit diseases.
8.	,, S. Madhava Rao	11	III	...
9.	,, N. V. Raman	18	III	...
10.	Janab S. A. Ebrahim Ali	7	II	Individual fruit crops, fruit pests.
11.	Sri G. Kanaka Rao	12	III	...
12.	,, K. Padmanabha Rao	10	II	...
13.	,, P. N. Raghavan	4	II	Fundamentals in Horticultural Science. Fruit products, fruit diseases.
14.	,, M. Venkata Rao	6 (B)	II	...
15.	,, D. I. Edwin Mangaladoss	17	III	...
16.	,, N. Suryanarayanamurthy	16	III	...
17.	,, S. Muthuswami	2	I	Fundamentals in Horticultural Science. Individual fruit crops, fruit diseases, fruit products, olericulture, ornamental gardening and plantation crops.
18.	,, P. V. Rajappan	9	II	...
19.	,, K. P. Kuppuswamy	14	III	...
20.	,, R. Balasubramaniam	5	II	Fruit pests.

CERTIFICATE OF PROFICIENCY IN HORTICULTURE

Results of the Final Examinations — August 1951

(REPEAT EXAMINATION)

1.	,, K. Subba Reddy	...	III	...
2.	,, A. Antoniswamy	...	III	...

Coimbatore
12th August 1951.

U. NARASINGA RAO,
Fruit Specialist.
Chairman of the Board of Examiners.

Weather Review — For August 1951.

RAINFALL DATA

Division	Station	Total rainfall for the month	Departure from normal in inches	Total since 1st January in inches	Division	Station	Total rainfall for the month	Departure from normal in inches	Total since 1st January in inches
Orissa & Circars	Gopalpur	7·7	J.N.	28·0	Central Contd.	Coimbatore	0·2	—1·0	10·3
	Calinga-patnam	3·4	—3·4	24·9		Tiruchirapalli	2·3	—1·8	17·9
	Visakha-patnam	4·5	—0·7	26·5	South	Naga-pattinam	1·5	—2·6	16·4
	Araku Valley*					Aduturai*	4·2	—0·1	11 7
	Anakapalle*	12·5	+7·7	34·2		Pattukottai*	1·3	—2·3	12·0
	Samalkot*	6·0	+0·6	26·4		Madhurai	5·5	+1·4	18·9
	Kakinada	8·0	+2·4	27·2		Pamban	Nil	—0·6	14·3
	Maruteru*	7·9	+2·0	36·8		Koilpatti*	1·8	—0·4	14·0
	Masulipatnam	4·5	—1·8	26·7		Palayam-cottai	1·3	+0·6	12·1
	Guntur*	2·8	—3·1	21·4		Amba-samudram*	Nil	—0·5	16·7
	Agri. College, Bapatla*	4·9	—0·6	19·2					
	Agri. College, Farm, Bapatla*	5·9	X	21·7	West Coast	Trivandrum	0·9	—3·8	39·3
	Rentachintala	2·8	+0·7	14·9		Fort Cochin	5·0	—8·9	70·1
Ceded Districts	Kurnool	3·6	—0·9	19·8		Kozhikode	7·4	—9·7	81·7
	Nandyal*	3·5	—1·2	19·5		Pattambi*	4·7	—9·1	58·1
	Hagari*	0·8	—1·8	11·2		Taliparamba*	11·5	—12·5	93·7
	Siruguppa*	2·2	—1·5	10·3		Nileshwar*	10·7	—14·4	92·6
	Bellary	1·1	—1·3	12·9		Pillicode*	12·4	—9·1@	91·7
	Cuddapah	1·8	—3·4	13·2		Mangalore	14·6	—10·9	100·1
	Kodur*	3·7	+0·3	12·8		Kankanadi*	14·1	—9·4	96·9
Carnatic	Nellore	1·9	—1·1	9·9	Mysore & Coorg.	Chitaldrug	0·6	—2·8	13·1
	Buchireddi-palem*	1·0	—1·2	6·6		Bangalore	1·9	—3·1	18·1
	Madras (Meenam-bakkam)	5·2	+0·6	14·2		Mysore	1·4	—1·9	14·1
	Tirurkuppam*	7·1	+1·3@	15·8		Mercara	23·0	—3·8	97·5
	Palur*	9·7	+4·6	19·4	Hills	Kodaikanal	4·0	—3·0	47·7
	Tindivanam*	7·1	+3·0	12·3		Coonoor*	2·6	—2·0	36·6
	Cuddalore	7·6	+2·8	15·4		Ootacamund*	2·9	—2·8	30·4
Central	Vellore	1·8	—3·9	21 8		Nanjanad*	2·1	—5·1	42·2
	Gudiyatham*	1·7	—3·2	10·7					
	Salem	3·5	—3·1	17·0					
	Coimbatore* (A. M. O.)	0·2	—1·1	7·3					

Note:—

1. * Meteorological Stations of the Madras Agricultural Department.
2. @ Average of nine years data for Pillicode, eight years data for Tirurkuppam, and seven years' data for Araku Valley is given as normal.
3. Average of ten years' data is taken as normal.
4. X The farm was started only this year.
5. J. N. — Just Normal.

Weather Reviw for August 1951.

The month began with fairly widespread rains in the West Coast and Coorg. Localised showers were also received in other parts of the State. This sort of weather continued upto 13—8—1951 with mild diurnal unsteadiness. On 14—8—1951 the monsoon became weak over the whole country. Five days later the monsoon became fairly active along the West Coast and remained so for four days. On 24—8—1951 the axis of the monsoon shifted further northwards and was found over the foot of the Himalayas. During the subsequent three days the monsoon trough lay at sea level very close to the foot of the Himalayas with the result that the monsoon was generally week over the country outside Assam. Then on 28—8—1951 the axis of the monsoon trough shifted southwards at its eastern end. The remaining three days passed with only unsettled conditions in the North Ray of Bengal, which also become feeble on the last day of the month. But the associated trough of low pressure was found on 31—8—1951 still extending into the North West Bay of Bengal.

Bay temperature was fairly above normal throughout the State almost all through the month barring now and then regions like Mysore, Coastal Andhradesa and Rayalaseema.

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

S. No.	Date	Place	Rainfall in inches for the past 24 hrs.
1.	2—8—1951	Mercara	2·2
2.	12—8—1951	Mangalore	2·3
3.	13—8—1951	Cuddalore	2·4
4.	21—8—1951	Visakhapatnam	3·1
5.	23—8—1951	Madras (Nungambakkam)	2·4
6.	25—8—1951	Arogyavaram	2·2
7.	29—8—1951	Kallakurichi	2·9
8.	30—8—1951	Madhurai	3·3
9.	31—8—1951	Madras (Meenambakkam)	2·5
10.	31—8—1951	Ponneri (Tamilnad)	5·1

ZONAL RAINFALL.

S. No.	Name of the Zone.	Total Precipitation.
1.	Orissa and Circars	Just Normal
2.	Ceded districts	Below Normal
3.	Carnatic	Above Normal
4.	Central	Below Normal
5.	South	Below Normal
6.	West Coast	Far Below Normal
7.	Mysore and Coorg	Below Normal
8.	Hills	Below Normal

Agricultural Meteorology Section
Lawley Road Post, Coimbatore
Dated, 8—9—1951.

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

Departmental Notifications.

APPOINTMENTS - POSTINGS & TRANSFERS.

Appointment.

Sri V. V. Kumara Sastri, a candidate selected by the Public Service Commission is appointed as Assistant Agricultural Chemist, Agricultural College, Coimbatore.

Posting & Transfers.

Names	From	To
GAZETTED SERVICE:		
Sri Govindakutty Kurup, P.	On leave	Supdt. Wynad Colonization Scheme, Wynad
,, Krishnamurthi, R.	Asst. Cotton Extension Officer,	
,, Krishnan, K.	Addl. D. A. O., Tanjore,	Addl. D. A, O., Kakinada
,, Narasimha Rao, M. P.	Supdt. A. R. S., Maruteru,	Secretary, Krishna Dt. Tobacco & Groundnut Market Committee
,, Ramabhadran, G.	Asst. in Millets, Tirupathur,	Seed Dev. Officer (Millet) Bellary
,, Raghavendrachar, C.	Asst. Agrl. Chemist, Coimbatore,	Soil Survey Officer, Bellary
,, Syed Ibrahim,	Seed Dev. Officer, (Millet) Bellary,	Supdt. A. R. S., Samalkoi
,, Satyanarayana, M.	On leave	S. L. A. Agrl. College, Bapatla
,, Subramania Chetty, M.	Spl. A. D., Cotton Scheme Koilpatti,	Asst. Cotton Extension Officer. Bellary
,, Venkateswara Iyer, P. A.	S. L. A., Agrl. College, Bapatla,	S. L. A., Agrl. College, Coimbatore
,, Verghese, E. J.	Asst. Agrl. Chemists, Coimbatore.	Analytical Chemist, Indian Central Coconut Committee
SUBORDINATE SERVICE:		
Janab Abdul Khader, S.	Inspector of Fruit Products, Kodur,	Canning Asst. Kodur
Sri Bakthavatsalu, O. M.	Asst. in Fruits New Delhi,	Statistical Asst. in Meteorology Section, Coimbatore
,, Bhaskara Rao, M. V.	A. D. Eluru,	P. A., to D. A. O., Eluru
,, Balakrishnamurthi, S.	On leave	Addl. A. D., Rajampeta
,, Chacko, G. I.	A. D. Kozhikode,	F. M. Live Stock Farm, Bhimanad
,, Chandrasekhara Reddy, D.	A. D. Chilanathur,	Addl. A. D., Kumbakonam
,, Devasikhamani, T.	On leave	P. A., to D. A. O., Anantapur
,, Damodara Nambiar, M.	Asst. in Chemist, Coimbatore,	Analytical Asst. in Chemistry Coimbatore
,, Govinda Kurup, K.	P. A., to D. A. O., Kozhikode,	F. M., A. R. S. Satya-mangalam
,, Gopalakrishna Gokhale, V.	On leave	A. D,, Kurnool.
,, Gopalan, B.	Cotton Asst. Nandyal,	Addl. A. D., Tiruvellore.
,, Hanumantha Rao, D. C.	A. D., Srikakulam,	F. M. Phaghavodi Farm, Bellary
,, Jagannathan Patnaick, P.	Spl. A. D. Tune,	F. M., A. R. S. Sereeguppa

Names	From	To
Sri Kannan Thathachari, R.	A. D., Villuppuram,	Field Asst. Manurial Expts. Puttukottai
,, Kaliappan, R.	Asst. in Chemistry, Coimbatore,	A. D. Gobichettipalayam
,, Krishnaiah, V. V.	A. D., Guntur,	F. M., A. R. S., Lam, Guntur
,, Kaliyana Raman, A. V.	Addl. A, D. Tiruvellore,	A. D., Chingleput
,, Kamalakara Rao, M. A.	Spl. A. D., Kanigiri,	Fruit Asst., Banana Res. Station, Aduthurai
,, Kunhi Raman Nambiar, P. A.	On leave	P. P. A, (Mycology) Tellicherry
,, Kumari Indra Moosad	Asst. in Chemistry, Coimbatore,	Analytical Asst. in Chemistry, Coimbatore
,, Krishnamurthi, N.	A. D., Tiruvarur,	Field Asst. Manurial Expts. Nannilam
,, Marappan, I.	Addl. A. D., Tirunelveli,	Spl. A. D , Kadambur.
,, Madhavachari, M.	Addl. A. D., Saidapet,	Marketing Asst. Madras
,, Nataraja Iyer V.	On leave	Dairy Manager, Coimbatore
,, Nagabhushanam, D. V. J	Addl. A. D., Puthur,	Addl. A. D., Tirunelveli
,, Narasimhaswami, V.	On leave	A. D., Atmakur
,, Prabhakara Reddy, G.	P. A., to D. A. O., Anantapur,	A. D., Chilanathur
,, Patnaick, V. J.,	A. D., Atmakur,	Addl. A. D., Kovvur
,, Perraju, A.,	On leave,	A. D., Madakasira
,, Prasada Rao, D. M. V.,	F. M., S. R. S., Anakapalle,	Asst. in Chemistry, Coimbatore
,, Pullayya, K.	Addl. A. D., Rajampeta,	Addl. A. D., Tiruvar
,, Ravikumar, P.	Addl. A, D., Kumbakonam,	Field Asst. Manurial Expts, Papanasam
,, Rajagopalan, M.	,, Mannargudi,	,, ,, Mannargudi,
,, Ramachandra Rao, K.	F. M., Bhavani Farm,	F. M., A. R. S., Hagari
,, Rangaswami Iyengar,	F. M., A. R. S., Gudiyattam,	Seed Development, Asst. Nellore
,, Ramalingam, M.	Seed Dev. Asst. Nellore,	A. D., Gudur
,, Rajagopal Reddy, V.	Asst. in Paddy, A. R. S., Tirurkuppam	Asst. in Paddy, A. R. S., Buchireddipalem
,, Radakrishnamurthi, K.	Soil Conservation Asst.,	A. D., Tuni
,, Ranga Reddy, P. V.	Spl. A. D., Nellore,	Addl. A. D., Kurnool
,, Ramachandra Reddy, T. K.	,, Kavali,	,, Chandragiri
,, Ranga Rao, K.	On leave,	P. A , to D. A. O , Srikakulam
,, Rama Rao, D.,	P. A., to D. A. O., Srikakulam,	P. P. A., (Mycology), Srikakulam
,, Rama Rao, V.	A. D., Venkatagiri,	F. M., A. R. S., Anakapalle
,, Raghurami Reddy, B.	A. D , Modikasira,	Addl. A. D., Mannargudi
,, Rama Dass, P.	Asst. in Plant Physiology, Anakapalle,	Addl. A. D , Mayavaram
,, Srinivasan, V.	Addl. A. D., Mayavaram,	Field Asst. Manurial Expts., Mayavaram
,, Sivagnanam, L.	Spl. A, D , Cotton, Ellayapuram,	F. M., A. R. S., Koilpatti
,, Sambandam, R.	F. M., A. R. S., Koilpatti,	Spl. A. D., Cotton, Koilpatti

Names	From	To
Sri Satyanarayana Raju, V.	Soil Conservation Asst.	A. D., Elluru
,, Sundar Singh, M.	,,	A. D., Adoni
,, Shiva Rao, Y.	Spl. A D , Manures, Amalapuram,	A. D., Puttur
,, C. Subba Rao, C.	F. M , A. M. S., Siruguppa,	Addl. A. D., Villuppuram
,, Suryanarayanamurthi, C. H	A D., Tuni,	Fruit Asst Kodur
,, Somayajulu, P. L. N.	On leave,	Asst in Plant Physiology, S. R. S., Anakapalle
,, Suryanarayanamurthy, B	On leave,	Pulses Asst. Vizayanagaram
,, Sangameswara Sarma, S	On leave,	F. M., S. R. S , Anakapalle
,, Sambamurthi, M.	Supdt. Wynad, Colonization, Scheme,	Inspector of Fruit Products, Kodur
,, Thirumal Rao, W.	Asst. in Plant Physiology,	Asst. in Chemistry, Coimbatore
,, Thomas, N. K.	Spl. A. D., Palladam,	P. A., to D. A. O., Calicut
,, Venugopalaswami, S.	A. D., Kovur,	Cotton Asst. Adoni
,, Vamsavaradam, B. B.	Spl. A. D., Kolhapeta,	A. D., Venkatagiri
,, Venkata Rao, A	A. D., Nellore,	Addl. A. D , Saidapet
,, Velmurugan, R.	Computer Paddy Section, Coimbatore	F. M., Mewani

The following lower subordinates promoted to upper subordinates are ordered with effect from 1—4—1950.

Names	To
1. Sri Ayyaswami Ayyar, T. V. ...	Asst. A. D., Kumbakonam
2. ,, Antony, J. S. C. ...	Seed Dev. Asst. (Paddy) Sattur.
3. ,, Balaraj, G. J. ...	Asst. A. D., Paramakudi (Retd. on 15—3—1951)
4. ,, Krishnaswami Sarma, M. C. ...	Asst. F. M., A. R. S , Palur
5. ,, Krishnamurthi Iyer, A. R. ...	Spl. A. D., Sugarcane, Virudachalam
6. ,, Kunhiraman Nambiar, P. A. ...	Asst. A. D., Tellicherry
7. ,, Lakshminarayana, P. ...	Asst. A. D., Vijayavada (Retd. on 2—5—1950)
8. ,, Narayanan Nambiar, P. A. ...	Asst. F. M., A. R. S., Taliparamba
9. ,, Narasimhapattathan, B. ...	Asst. A. D., Kasaragode
10. ,, Suryanarayana, K. ...	Asst. A. D., Salur