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.

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Fungicides and Weedicides *

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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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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