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AN IMPROVED ALL-METAL SEED-HOPPER

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The importance of the seed-drill in cheapening the cost of crop production is very well known. It economises labour in sowing a large area. More uniform distribution of seed is assured than in broadcasting. Inter-cultivation of crops with bullock power is rendered possible. Above all, it ensures a better return from the land, which is what is wanted. In the West, seed-drills have been perfected, but their cost is so high that their general use is not a practical proposition in this country at present.

Seed drills are in common use in black cotton soil areas, as the Deccan, Guntur, Nellore, Mysore and other places. Drills must have probably originated in these places on account of the dearth of labour. It may be interesting to note that in places where drill cultivation is in vogue, ryots do not maintain more than one pair of cattle for managing 20 to 40 acres. This fact is enough to prove that the drill is a labour saving implement.

The ryots use different drills for different crops, cholam drill for sowing cholam, cotton drill for drilling cotton, ragi drill for raising ragi etc. But each drill is provided with a seed-hopper with holes to suit the size of the seeds. Seed is dibbled generally by using the hand. All cannot do this work ensuring uniformity of seed distribution which depends on the dexterity of hand—a varying factor.

To obviate the necessity for keeping more than one hopper for sowing different crops the hopper described below has been designed.

This is fashioned after the wooden model but with this difference, the material is brass. It consists of two parts, the top half and the bottom half, the latter resting on the tubes. There are no side holes for fastening with ropes which is the case with the wooden hopper. Vertical pins are fixed instead. The hopper is provided with a number of small discs with holes suited to the size of the seed. By using discs suited to each kind of seed the same hopper can be used for sowing all kinds of seeds, such as ragi, tenai, cumbu, cholam, cotton, paddy, Bengal gram and bunch ground-nuts. This is not possible in the case of the wooden hopper.

The improved hopper is also fitted with a detachable seedbox provided with a stirrer*. Wherever the drills are found necessary the seed box and the stirrer supply a long felt want. The stirrer is provided with a cylindrical wooden piece with three longitudinal grooves for regulating the flow of the seed. Seeds drop when the groove is in a line with the hole of the hopper. No seed drops if there is no stirring. Gaps in sowing when handfuls of seed alternate do not occur by using this hopper. A movable disc is fitted on the top of the bottom half of the hopper; by turning the same clockwise or anticlockwise the holes can be closed or opened.

Counts taken of Bengal gram plants in two plots—one sown with this metal hopper provided with the stirrer and the other with the wooden hopper—have shown that the distribution of seeds is more uniform in the case of the metal hopper.

Particulars of a few trials made by using the metal hopper are given in the table below:

Name	Time taken to empty the seed box	Quantity of seed used in the box	Number of revolutions of the stirrer required to discharge the quantity	Calculated seed rate per acre	Remarks.
Cholam	10 minutes.	2 lb.	600	16·4 lb.	Figures calculated are based on the assumption that the rate of walking of work animals is at 2 miles per hour. The seed rate can be reduced or increased by lowering or increasing the number of revolutions per minute or by using discs with smaller or bigger holes.
Tenai	30 „	11·5 oz.	1832	2 „	
Ragi	30 „	9 „	1733	1·5 „	
Horse-gram	17 „ & 20 seconds.	2 lb.	1175	9·5 „	
Bengal-gram	2 minutes & 10 seconds.	2 lb.	133	75 „	
Maize	1 minute & 5 seconds.	2 „	115	86 „	
Cotton	3 minutes & 20 seconds.	14 oz.	232	10·62 „	

* The writer is indebted to Mr. N. G. Charley, Research Engineer, Agricultural College, for the idea of the stirrer.—

The salient points of this hopper are :-

i. It is made of metal and therefore lasts long. It is always worth its weight of metal. It is elegant in design, fire proof and rat proof.

ii The same hopper can be used for sowing all kinds of seeds only by changing discs. A continuous rope for fixing it on to the drill is not needed.

iii. The bottom half is provided with three projections which fit into the tin tubes, thus giving more stability. Tin tubes work better with this hopper.

iv. It is provided with a seed box and a stirrer which helps in the uniform distribution of seed.

v. There is a disc shutter to open or close the holes as necessity demands.

vi. If the stirrer gets out of order the hopper can be used like the wooden ones for sowing seeds with the hand.

My thanks are due to M. R. Ry., Rao Bahadur C. Tadulingam Avl., Principal and N. G. Charley, Esq., the Research Engineer and to Messrs. A. H. Subrahmanya Sarma and V. Viswanathan for help rendered in making trials.

THE ECONOMIC DANGER IN THE INTRODUCTION OF SOME FOREIGN ANIMALS AND PLANTS

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Introduction. It is well known that, due to the action and reaction of various factors in nature, there is maintained what is called 'a balance of life' in this world. One of the most potent influences which helps to upset this even equilibrium, and bring about abnormal conditions in nature, is the part played by human agency. And, among the many such human activities, one has been the indiscriminate transportation of plants and animals from one country to another, without in the least realising or forseeing the disadvantages and the often disastrous results of many such introductions. We have some examples of how man, without any evil intention, has been responsible for bringing about a very undesirable state of affairs in different regions of the world, by thoughtless introductions of different forms of life from one region into another. Though the geographical position of India is more or less isolated, situated as she is, clearly separated by natural boundaries of mountain walls or seas from other regions, in these days of quick and easy transport facilities for all sorts of animal and vegetable products not only by land and

sea but even by air, there is every likelihood of undesirable and harmful exotic forms, gaining admission into the country without our knowledge. This is the case particularly with insect pests and plants of different kinds. In this paper an attempt is made to survey the present position with regard to some of the important exotic plants and insect pests which are already with us or are likely to be introduced, pointing out the evil effects resulting thereby, and to offer some suggestions in the way of preventing such introductions as far as possible in the future.

Indigenous, Exotic and Cosmopolitan Forms. In the study of the geographical distribution of different forms of life inhabiting the world, it will be found possible in many cases to divide the flora and fauna of any region into two groups, *viz*, those which are natives of the tract, and those which have managed to gain admission into the region from outside—the forms included under these two groups being popularly known as indigenous and exotic forms. Such a grouping however, may not be quite accurate in all cases, unless one has reliable records or the history of each and every plant and animal inhabiting any country. But for all practical purposes, a classification of this kind based on the knowledge, observations, and experiences of scientific workers, might be sufficient and satisfactory to a great extent. In addition to these two categories, we have also to note that some plants and animals have a world-wide distribution and are practically cosmopolitan. To make our knowledge of these different categories of organisms as correct and complete as possible, at least as far as the future is concerned, a biological survey of every country will be extremely valuable not only from the point of view of the pure biologist but also from an economic point of view. The United States Government maintains such an organisation called the United States Biological Survey for such a purpose, an arrangement which every civilised country might copy with great advantage. Of these three categories into which the fauna and flora of any country may be grouped, we are in this paper more concerned with what are known as exotic forms and the influences they exert on the economy of man. It has been found by practical experience in many countries that in the great majority of cases, introduced forms become far more destructive in their new surroundings than in their original native habitats. This is biologically explained by the fact that all organisms in their native surroundings have to contend against many natural enemies which play their role in preventing these creatures from undue multiplication; whereas in their newly adopted homes many of them find that such natural checks are absent, and on that account multiply rapidly and thereby become pests It may be argued that the new insects introduced may not be able to contend against local insects, but the experience so far has been the other way.

Some Experience with Introduced Forms. Before dealing with the probable influences of thoughtless introduction in the future, it will be worth while to have some ideas regarding the results man has, and is gathering, of careless and unrestricted transportations already made of undesirable forms of life from country to country. The introduction of the rabbit by the early settlers into Australia was later found to be a blunder of the greatest magnitude! Within the course of a few years the creature increased abnormally with disastrous results; so much so, that in some parts of Australia sheep began to die of starvation since the rabbits had eaten away all the grass! The same has been the story of the well intentioned introduction of the mungoose into the West Indies. This little carnivorous mammal (*Herpestes birmanicus*) was purposely introduced from Asia to be used as a natural enemy of a species of rat, which was causing serious damage to the sugarcane crop in the islands. Though in the beginning some relief was visible from the rat pest, in course of time it was found that the immigrant mungoose itself began to show evidences of becoming a pest in its turn; a number of useful lizards, birds, etc., were found destroyed by the mungoose and at the present moment the creature is found to be a veritable pest in some of the islands. While such has been the history of higher and bigger animals one can easily conceive how easy it will be for smaller organisms like insects, mites, fungi, seeds of weeds, etc., to get dispersed, or transported with diverse commodities like stores, provisions, live plants, ornamental shrubs, orchids, packing materials, etc., which are now-a-days exported and imported from various regions. The United States of America has been one of the greatest sufferers from damage caused by imported insects. In that country where this subject has been receiving some attention for some decades the names of such imported insects as the Gipsy moth, the San Jose scale, the European corn borer, the Japanese beetle and the cotton boll weevil are dreaded; these are notorious forms which managed to gain entry into the states and have been giving considerable trouble and causing enormous damage to the farmers. Striking examples of introduced insect pests in India are the Potato tuber moth (*Pthorimoea operculella*), the diamond back moth of cabbage and other Cruciferae (*Plutella maculipennis*), the coffee green bug (*Lecanium viride*), the apple wooly blight (*Eriosoma lanigera*), and the fluted scale of orange (*Icerya purchasi*). Potato growers, coffee planters and fruit growers in India will readily testify to the fact that some of these insects have become major pests in their adopted country and some are likely to become a menace if proper measures are not adopted in time. Going to plant introductions of a similar nature we have two well known and notorious examples in the Prickly pear (*Opuntia spp*), and the Lantana (*Lantana spp*) both natives of the New World and introduced into parts of the Eastern Hemisphere with the best of intentions. Some account of the early history of the

Prickly pear in India and its present position may be found in the writer's paper * * on "The Coccidae of the Prickly pear and their economic importance" and the present plight of the plant in the hands of its natural enemy—the *cochineal* (another introduced form by the way) is now in evidence practically everywhere in S. India. Another notorious plant which gained entry into the country more or less as a contemporary of the Prickly pear more than a hundred years ago is the Brazilian Water Hyacinth. (*Eichornia crassipes*) That it is a veritable pest in tanks and lakes, that it causes a good deal of trouble to navigation in inland waters and that it has the honour of having become a subject for Government legislation are facts very well known to all of us. Of recent introductions we have the weed popularly known as the "Khaki weed" (*Alternanthera echinata*) which is said to have been noted in parts of S. India since the days of the Great War and which is now a veritable nuisance in many places covering up sides of roads and foot paths and overgrowing meadows and lawns. We have also observed that within the past ten years or more the "Goat weed" (*Eupatorium glandulosum*) has spread considerably over cultivated areas and hill sides and is becoming a serious weed pest on the Nilgiris. These are only some of the more important examples which have been actually noted by us; it is not, however, possible to state how many smaller animals and plants have also gained entry into India without their attracting any body's attention!

Some Forms which are likely to get in. However 'sufficient unto the day is the evil thereof' with existing and already introduced pests and we are anxious to avoid, if possible, any more unwanted guests; and unless sufficient precaution and care are exercised it is not unlikely that some other pests not present in India at present are liable to find their way in. In a paper, * under the title "Some foreign insect pests which we do not want in India" the writer has already pointed out as far as insects are concerned some of the very serious insect pests which we have to carefully avoid. Some of the most important of those are the Mediterranean fruit fly (*Ceratitis capitata*), the Mexican cotton boll weevil (*Anthonomus grandis*), the West Indian sugarcane weevil (*Sphenopherus sacchari*) and the grape vine Phylloxera (*Phylloxera vastatrix*), insects which have caused terrible havoc in many countries and brought about very heavy losses to the cultivators. A few years ago in a parcel of sugarcane setts received from Antigua, the Imperial Entomologist, Pusa, actually noticed two live grubs and a cocoon of this destructive cane weevil of the West Indies. During the course of his inspections the same officer also came across another cane pest of Java (*Holaniara picesens*), a beetle in a similar parcel from Java. These

** "Agriculture & Livestock in India"—Delhi, Vol. I (3), May 1931.

* Agricultural Journal of India, Pusa, Vol. XIV, 1919, pp. 500–511.

are only a few of the many cases that have come to the notice of responsible individuals while it is quite conceivable that there occur many cases of such imports unknown to most persons. It may be added that since the publication of the writer's paper in 1919 what the writer apprehended did happen unfortunately in the case of at least one exotic pest, *viz.*, the cottony cushion scale (*Icerya purchasi*), the dreaded fluted scale of citrus and other plants in the Australian and other regions. About four years ago this was noted on Australian wattles grown on the Nilgiris and it has not been possible yet to fix the responsibility of having introduced the pest on any individual! The Madras Government, as many readers are aware, had to make special efforts to get the natural enemy (*Vedalia*) of this scale and carry on some special work against the pest on the Nilgiris; though at present the insect has not spread, as far as the writer believes it has come to stay and though it may be kept under some control it may not be possible to completely exterminate the same. Another form which bids fair to get into the country or has even found its way to a certain extent but was promptly checked is the coffee borer beetle of Java (*Stephanoderes hampei*) a very serious pest of coffee beans in the Asiatic Archipelago. The Government having come to know of this have promptly checked the introduction of all unroasted coffee seeds from abroad.

Existing checks to Pest importations and suggestions for the future. Till about 1906 there were no restrictions of any kind and any one was quite at liberty to dump into the country any forms of animals or plants; and with the gradual increase of facilities for easy transportation both by land and sea, chances for exotic pests considerably increased not only for reaching the country but even to distribute themselves free into the different parts of the interior. However, we have to thank ourselves that in spite of such easy facilities during these many decades comparatively very few forms have, however, gained entry and this might be attributed to some extent to the climatic conditions of the interior also. In 1906 the Government of India, apprehending the danger of the Mexican cotton boll weevil gaining entry into India with consignments of American cotton, issued orders that all parcels of cotton seeds from the New World should be admitted into India only after fumigation at the port of entry; this did not, however, prevent the danger of small parcels of seed being forwarded by post. Five years after this, the Government of India appointed a committee of experts who went into the question of imports of not only of cotton seeds from America but of all plants which were likely to introduce insect and fungus pests from any outside country and at their suggestion legislation was enacted and the Act II of 1914, an act to prevent the introduction into British India of any insect, fungus or other pest which is or may be destructive to crops, was brought into force and

subsequently in 1917 a more comprehensive order was promulgated to control and inspect imports into British India of various suspected materials. This dealt with the restrictions applying to the admission of things like potatoes, flax seeds, cotton seeds, coffee seeds and plants, Rubber plants, sugarcane, etc., and the penalties for the infringment of the rules. The rules insisted on pest free certificates being got from the consignor in the country of origin on some and fumigation in the case of others. The importation of overseas consignments of plants was restricted to eight important ports in India including Madras, Negapatam, Dhanuskodi and Tuticorin in S. India. Restrictions were also imposed on the import of plants, etc., from abroad by post giving powers to the postal authorities to deal with them in the proper manner. Passengers bringing live plants were also made liable to subject these imports to the same restrictions such as examination, fumigation, etc., at the port of entry. In this connection, it may be interesting to record the writer's experience while on board a passenger steam-ship across the Pacific in 1926, a few hours before the ship entered the harbour of San Francisco; remnants of all vegetables like cabbage, tomotoes, etc., fruits, like bananas, oranges, melons, apples, etc., and similar perishables stocked for use of the passengers and crew on board and those with the passengers were all thrown overboard into the sea before the customs officers admitted the ship into the harbour and only properly treated and certified packages of fruits and other vegetable parcels were allowed to be brought ashore

In spite of such restrictions it must be admitted that there are various chances of pests of different kinds gaining admission, unless these restrictions are thoroughly overhauled and carefully worked out, and properly trained men are deputed to attend to this work at the important gates of entry. A more thorough set of rules covering all possible imports of a suspicious nature should be framed and a regular system of plant quarantine should be established. Last year the National Plant Board of the United States of America issued a set of regulations approved by all the 48 states under the title 'The Principles of Plant Quarantine' which is a valuable contribution setting forth the principles that ought to be applied in the establishment and enforcement of plant quarantines. It may be found valuable to reproduce the same here for guidance of plant pathologists and entomologists who have to play an important role in this matter.

Principles of Plant Quarantine.

1. **Definition.** A quarantine is a restriction, imposed by duly constituted authorities, whereby the production, movement or existence of plants, plant products, animals, animal products or any other article or material, or the normal activity of persons, is brought under regulation, in order that the introduction or spread of a pest may be prevented or limited, or in order that a pest

already introduced may be controlled or eradicated, thereby reducing or avoiding losses that would otherwise occur through damage done by the pest or through a continuing cost of control measures.

2. Basis in Logic. Since the ends to be attained by a quarantine and the measures required by it could not be undertaken by private individuals or groups, involving as they do restrictions on areas, persons, or activities for the benefits of wider interests or the public at large, resort to regulation imposed by public authority is logical.

3. Necessity. Establishment of a quarantine should rest on fundamental pre-requisites, as follows: (1) The pest concerned must be of such nature as to offer actual or expected threat to substantial interests; (2) the proposed quarantine must represent a necessary or desirable measure for which no other substitute, involving less interference with normal activities, is available; (3) the objective of the quarantine, either for preventing introduction or for limiting spread, must be reasonable of expectation; (4) the economic gains expected must outweigh the cost of administration and the interference with normal activities.

4 Legal Sanction. A quarantine must derive from adequate law and authority and must operate within the provision of such law.

5. Validity. A quarantine established for the purpose of attaining an objective other than that which it indicates or defines is open to serious criticism, even though the actual objective is itself desirable.

6. Public Notice. If the circumstances will permit, public notice of a proposed quarantine should be given and those interested should be invited to contribute facts in their possession. But if the objective would be defeated by the delay required for such notice and discussion, duly constituted authorities should assume responsibility for the decision to impose or withhold quarantine action.

7. Scope. The extent of restrictions imposed by a quarantine should be only such as are believed necessary to accomplish the desired end, but on the other hand the objective of a quarantine should not be jeopardized by omission of any necessary restriction.

8. Relation to Eradication. If a quarantine is imposed in order that eradication of a pest from a given area may be undertaken, the restrictions involved may properly be relatively extensive because of the importance of the objective sought, and because of the time through which the quarantine will operative may be expected to be relatively limited.

9. Relation to Retarding Spread. If a quarantine is imposed for the purpose of limiting or retarding spread of a pest, but without expectation of eradication, the restrictions imposed should be such as are in line with the objection of the quarantine and should recognise the fact that continuance of the pest in the area where it is established, or possibly its spread in time to new areas, is expected.

10. Co-operating Authorities. Since quarantines usually involve relations between public authorities, such as those of the government of one country with that of another, or of Federal and state governments, or of state government and local authorities, the co-operative relationship that is necessary to adequate enforcement should be clearly recognised and duly provided for.

11. Co-operation of the Public. Because of the fact that success of a quarantine requires that its restrictions be fully maintained, it is essential that all

persons who are affected by it adhere to its requirements. In order that this end may be obtained the administration of a quarantine should seek the intellegent co-operation of the public affected, rather than depend exclusively on police powers, the imposition of penalties, or resort to court action.

12. Clarity. In order that a quarantine may be administered readily and consistently, it should be designed with care, should be phrased clearly, and should be made as simple as is consistent with legal requirments and the objective to be attained.

13. Information Service. Since the persons affected by a quarantine may not reasonably be expected to possess full or accurate knowledge of the circumstances that make it necessary, or the nature and importance of the aim sought, and since compliance with quarantine restrictions will be more complete if the objective and plans are understood, measures should be taken to set forth the conditions existing, the means to be employed, and the end to be attained, and these measures should be continued from time to time as the undertaking proceeds towards accomplishment.

14. Research. If an emergency requires the establishment of a quarantine before satisfactory biological data are available, provision should be made as soon as possible for extending the fund of biological knowledge. The authority that exercises the right to establish a quarantine should command or secure the means for biological research, both in order that the quarantine may be made more efficient and in order that the restrictions may be lessened where possible. The need for research, however, should not be permitted to delay the establishment of a quarantine believed by authorities to be desirable, thereby jeopardizing the objective that might otherwise have been attained.

15. Modifications. As conditions change, or as further facts become available, a quarantine should properly be modified, either by inclusion of restrictions necessary to its success or by removal of requirements found not to be necessary. The obligation to modify a quarantine as conditions develop is a continuing obligation and should have continuing attention

16. Repeal. If a quarantine has attained its objective, or if the progress of events has clearly proved that the desired end is not possible of attainment by the restrictions adopted, the measure should be promptly reconsidered either with a view to repeal or with intent of substituting other measures.

17. Notices to Parties at Interest. Upon establishment of a quarantine, and upon institutions of modifications or repeal, notices should be sent to the principal parties at interest, especially to Federal and state authorities and to organisations representing the public involved in the restrictive measures.

When rules and regulations based on the above principles are framed and a rational and thorough system of quarantine is established at all the important ports and land gates to the country, and when thoroughly capable and trustworthy men are appointed for this work, and the public properly educated on the necessity for such measures in the interests of the nation, we might rest assured that a considerable part of our anxieties and apprehensions regarding pest imports will gradually disappear and save the country from many undesirable plants and animals.

PASTURES AT THE LIVESTOCK RESEARCH STATION, HOSUR *

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The area of the Livestock Research Station, Hosur, is over 1600 acres of which nearly 1215 acres are laid under grass. The Station was under the Remount Depot for hundred years till 1924 when the farm was transferred to the Madras Agricultural Department. From the records available it is clear that the paddocks were ploughed and laid down to grass and the grass management was similar to that in England. The records of the Remount Depot unfortunately do not mention the types of seeds sown, but some of the old hands who worked on the farm state that they were often detailed to transplant slips of *Cynodon dactylon*. The testimonial analysis of the paddocks bear out their statements. The apparently wild species that are found here have become indigenous and they are harvested, the seeds collected, stored and sown whenever required. The general appearance of the pastures existing at Hosur is comparable to that in Europe despite the differences in species, and very often visitors who are acquainted with European pastures have been struck by the resemblance.

Type of Pastures. The pastures in the farm may be classified as follows:— Permanent, tank bed, tank bund, channel banks, temporary and irrigated. These pastures except in the case of irrigated pastures are periodic in that the growth is governed by the monsoons.

The permanent pastures may be sub-divided into upland and lowland pastures In the uplands in addition to *Andropogon contortus* and *Cynodon dactylon* the following are some of the common species noted:—

Andropogon pertusus, Digitaria sanguinale, Sporobolus diander, Eragrostis bifaria, Eragrostis pilosa, Eragrostis ciliata, Chloris barbata, Desmodium triflorum and Indigofera enneaphylla.

In the lowland pastures similar species including *Panicum javanicum* are found, but in the portions which are likely to be damp *Cyperus rotundus, Andropogon annulatus, Andropogon caricosus, Panicum repens* and *Andropogon halepensis* and also a great number of *Desmodium triflorum* may be seen.

Under the shade of trees and buildings in the uplands and lowlands the following species are likely to predominate:—

Panicum javanicum, Digitaria sanguinale var. ciliare, Digitaria sanguinale var. extensum, Apluda varia, Eleusine aegyptiaca, Setaria intermedia &c.

* Adapted from a paper on 'The Study of Pastures and Meadows at Hosur' read by the author before the Indian Science Congress, January 1932.

These in addition to *Chloris barbata*, *Andropogon pertusus* and *Cynodon dactylon* may also be noticed by the roadsides and under shade where there is certain amount of grazing.

Meadows, as such, are not known to this country. Some of the areas in parks of some of the cities may be classed as meadows. The grass may be mown or cut with sickle, but except under garden conditions no watering or flooding is ever done. When opportunity presents itself they are grazed as well. These are not periodic in that they do not directly depend on the monsoons. As long as there is water in the tanks the growth could be kept fresh and continuous. In the *Panicum maximum* and *Pennisetum purpureum* pastures mainly owing to intercultivation with ridge plough the number of other species that may present themselves are eliminated quite effectively. While the above are more or less pure crops, *Medicago sativa* generally has a mixture of other species like *Panicum repens* and *Cyperus rotundus* among others depending on the seeds brought into the area through irrigation mainly. *Panicum maximum* and *Pennisetum purpurea* areas may be classed as permanent irrigated pastures and *Medicago Sativa* and *Trifolium Alexandrium* when grown as temporary irrigated pastures.

There are two large tank-beds which give an appreciable amount of grazing. Some of the species noted are *Eriochloa polystachya*, *Panicum repens*, *Panicum interruptum*, *Panicum trypheron*, *Panicum colonum*, *Cyperus rotundus &c.*

On the tank bunds and channel sides, *Panicum maximum* has been largely planted and it seems to thrive quite well; more over, the grass is quite useful for minimising erosion. In addition to *Panicum maximum* the following species grow in places laxuriantly:—

Andropogon annulatus, *Andropogon Schoenanthus*, *Andropogon halepensis*, *Imperata arundinacea*, *Leersia hexandra*, *Eragrostis major*, *Panicum fluitans &c.*

Temporary leys are not included in the rotation in this country. At Hosur *Chloris Gayana* and *Pennisetum cenchroides* were introduced with a view to lay down paddocks to permanent pastures. Experience however shows that these grasses are more useful for temporary leys rather than permanent. When the paddocks are sown with either *Chloris Gayana* or *Pennisetum cenchroides*, at first the pasture is pure but in time other species appear and later dominate the situation.

Quantity and quality of pastures. Quantity and quality of pastures are dependent on several factors like season, moisture content of soil, the stage of growth and the flora of the population, the type of pastures and the chemical composition of the herbage. The average yield per acre on this farm for each year is given below. This does

not include grazing which is done prior to the rains and the aftermath which is also grazed.

Year.	*Rainfall.*	*Yield per acre.*	*Remarks.*
1924–25	30·03 inches	1546 lb.	
1925–26	29·37 ,,	1024 ,,	
19_6–27	15·60 ,,	717 ,,	
1927–28	33·81 ,,	1781 ,,	
1928–29	27·93 ,,	726 ,,	
1929–30	33·89 ,,	573 ,,	Crop attacked by
1930–31	33·10 ,,	668 ,,	army caterpillar

When the author worked on the nutritive value of pastures in Oxfordshire in 1925–26 he came to the following conclusions:—

(1) That in general, chemical composition and nutritive value of pastures do not depend on the chemical and mechanical composition of soils alone.

(2) The stage of growth of the herbage is the determining factor in composition and feeding value and in this respect each particular set of conditions p oduce a specific effect. This effect is shown in the establishment of a zenith period whose onset is early and prolonged on the good pastures and late and short on the poor pastures.

(3) Confirmation of high quality from the practical standpoint with phosphorus and calcium has been obtained.

(4) That manurial content of pastures show certain variation which can be related to its reputed quality.

(a) good pastures show high content of phosphorus pentoxide

(b) pastures with high lime contents usually have a large amount of crude protein.

(5) That splashing (sand) has a profuse effect on the nutritrive value of pastures from the point of view of the grazing animal.

So far as it has been possible to study under local conditions, some of the conclusions mentioned above seem to hold good in this country as well, but with certain modifications. It is noticed that a particular set of conditions produce a flora suited to those conditions. Even here there is a zenith period for each type of conditions but it is governed directly by monsoons. If there is no rainfall there will be no growth despite the season of the year. It is noticed that cattle will graze the tank bed satisfactorily when there is a fairly good growth but before the grasses have begun to seed. With spear grass (*Andropogon contortus*) the mature awns are a disadvantage and the zenith period for this grass is before the awns are properly formed. It must however be added that the spear grass has only one growing period between September and November while a number of other grasses

like *Cynodon dactylon*, *Pennisetum cenchroides*, *Chloris Gayana* etc. grow right through the year whenever sufficient moisture in the soil is available. While *Andropogon contortus* has one zenith period the grasses which can grow right through the year will have either a series of zenith periods or by judicious cutting, grazing and irrigation the period could be kept continuously throughout the year.

The soil analysis indicated calcium deficiency and calves thrown on the farm, especially among the Ongoles, were not of normal weight. From the animal husbandry point of view it would seem that the pastures are likely to be deficient in minerals. This is being counteracted by the inclusion of bone and lime mixture in the ration.

When examining the highly reputed pastures in England it was noticed that these pastures had a very dense population in any given area. In one or two pastures the clovers were not prominent. Under Indian conditions the same conclusion is applicable. In pastures where there is dense herbage the brousing animal has very little distance to travel before having its fill. The truth of the statement will be brought home if the condition of animals grazing on the so-called common grazing is compared with that of animals grazing on this farm.

In addition to the density of the population the preponderance of certain species will have direct effect on the quality of pastures. While in Europe *Rhinanthus cristajalli L.*, *Bellis pereunis L*,. *Chrysanthemum leucantheum L.* and *Ranunculus bulbosus* like *Souchus oleraceus L*, affect the quality of pastures, in this country weeds like *Tribulus terrestis*, *Alternanthera echinata*, *Amaranthus viridis*, *Achyranthes aspera*, *Oxalis corniculata*, *Mimosa pudica*, *Argemone mexicana* etc.. have the same effect. In the management of pastures the control of weeds is essential especially under tropical and semi-tropical conditions where growth is possible throughout the year.

The species that have been mentioned under different types at Hosur are fairly appreciated by cattle. The pastures here were thought to be devoid of legumes by Littlewood and Narahari Rao (1930), but on careful examination of pastures two useful legumes *Desmodium triflorum* and *Indigofera enneaphylla* can be noticed in abundance in certain paddocks. The former seems to thrive in the lowlands and the latter in the highlands. These are very much appreciated by cattle and their presence will greatly add to the nutritive value of pastures.

Temporary and permanent pastures. Experience here shows that *Cynodon dactylon* and other 'bottom' grasses mentioned above are well suited for a permanent pasture. Among 'top' grasses *Andropogon contortus* is to be preferred to others for drought resistence.

Pennisetum cenchroides and *Chloris Gayana* are well suited for temporary pastures of three years in the case of the former and five the latter. It is noticed that in all pastures there is keen competition between the species. To begin with, the weeds already mentioned above will kill out the fine grasses like *Pennisetum cenchroides*. Among grasses *Cynodon dactylon* and *Andropogon pertusus*, *Panicum repens*, *Paspalum scrobiculatum* and *Digitaria sanguinale* seem to kill out *Pennisetum cenchroides*. The latter is very quick growing and it seems to do very well giving a bulky crop the first year but later it begins to grow shorter and eventually gives way to other species. *Chloris Gayana*, however, does not become shorter but within three years it will be noticed that grasses like *Cynodon dactylon*, *Andropogon pertusus*, *Digitaria sanguinale* and others begin to preponderate. In order to study competition between species, counts were made by the mesh method. The usual quadrats were not used. A circular ring of 4 feet diameter was thrown at random in the paddocks and the species within the ring noted on the spot. The results given below show that competition between species is very real.

No.	Species of grasses found.	No. of grass plants for the 12 countings.	Average per counting.	Percentage grass to plants.	Species of weeds found.	No. of weeds for 12 countings.	Average per counting.	Percentage weeds to plants.
5	*Eragrostis spp.*	18	1·5	13	*Alternanthera achinata* (fully spread)	28	2·3	21·00
	Chloris barbata.	21	1·75	16	*Desmodium triflorum*	5	0·4	3·50
	Chloris gayana	24	2·0	16	*Lagascea mollis*	2	0·24	1·50
	Pennisetum cenchroides	30	2·5	22				
	Panicum flavidum.	8	0·6	6				
26	*Panicum distachyum*	150	12·5	13·6	*Oxalis corniculata*	30	2·5	2·7
	Andropogon pertusus	81	6·75	7·0	*Aristolochia indica*	1	...	...
	Pennisetum cenchroides	300	25·0	27·2	*Calotropis gigantea*	1	...	...
	Cynodon dactylon	210	17 5	19·0	*Alternanthera achinata*	7	0·6	0·6
	Panicum flavidum	25	2·0	2·2	*Lagascea mollis*	8	0·6	0·7
	Andropogon contortus	250	20·8	22·7	*Vinca sp.*	11	0·9	1·0
					Vicoa indica	2	0·1	...
					Eclipta alba	3	0·2	...
					other weeds	37	...	3·0
24	*Pennisetum cenchroides*	136	11·3	22·6	*Argemone mexicana*	10	0·8	1·6

No.	Species of grasses found.	No of grass plants for the 12 countings.	Average per counting.	Percentage grass to plants.	Species of weeds found.	No. of weeds for 12 countings.	Average per counting	Percentage weeds to plants.
	Panicum distachyum	270	22·5	45·0	*Alternanthera echinata*	3	0·2	0·5
	Cynodon dactylon	150	12·5	25·0	*Achyranthes aspera*	7	0·6	1·2
	Other grasses	32	3·0	5·3	*Euphorbia sp.*	6	0·5	1·0
					Other weeds	2	0·1	0·3
23	*Andropogon contortus*	270	22·5	32·7	*Sida sp.*	1	...	0·1
	Chloris barbata	84	7·0	10·5	*Leucas stricta*	1	...	0·1
	Eragrostis spp.	36	3·0	4·5	*Vicoa indica*	1	...	0·1
	Panicum spp.	115	9·6	14·3	*Bidens pilosa*	1	...	0·1
	Cynodon dactylon	24	2·0	3·0	*Euphorbia sp.*	7	...	0·8
	Andropogon pertusus	177	14·75	22·1	*Eclipta alba*	2	...	0·2
	Digitaria sanguinale var. ciliaris	82	7·0	10·2	*Lagasca mollis*	1	...	0 1
					Alternanthera echinata	2	...	0·2
					Achyranthes aspera	1	...	0·1
					Tridax procumbens	2	...	0 2
					Argemone mexicana	1	...	0·1

Grass mixtures. This is a problem not satisfactorily solved for ranching and farm conditions in this country. Mixtures have been no doubt suggested for the lawn. *Cynodon dactylon* is certainly the very best grass for the lawn. It would be quite useful to include *Andropogon pertusus* for the lawns on account of the similarity of the habits.

So far there does not seem to be any recognised classification of Indian grasses for pastures. To begin with what are 'bottom' grasses and what are 'top' grasses in India? *Cynodon dactylon*, and probably *Andropogon pertusus*, *Panicum javanicum*, *Eragrostis ciliaris* and *Eleusine aegyptiaca* may be classed as bottom grasses for pasture purposes. Symonds has stated that he has grown *Cynodon dactylon* several feet high under irrigation. The two legumes already mentioned could be included under bottom herbage. It must however be mentioned that as these legumes are dormant in the very dry periods there will be patches of land devoid of herbage wherever these were present, but soon after rains they make an appearance again.

For top grasses, *Ischemum laxum*, *Chloris Gayana*, *Chloris barbata*, *Pennisetum cenchroides*, *Paspalum crobiculatum*, *Digitaria sanguinale*, *Andropogon contortus*, *Andropogon annulatus* and *caricosus*, *Eragrostis Willdenoviana* and *Panicum repens* will be found very useful.

Pasture study in this country is still in its infancy. Work is being continued here with a view to throw light on the pastures from the point of view of animal husbandry.

Summary:—The pastures at the Livestock Research Station, Hosur, have been classified as permanent, tank bed, tank bund, channel banks, temporary and irrigated pastures and studied. In addition to botanical analysis the quantity and quality of pastures are explained. The competition between species of grasses is explained and those species suited for temporary and permanent leys are mentioned. From observations made at Hosur grass mixtures are suggested.

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THE CULTIVATION OF CUMIN* IN THE PERIAKULAM TALUK.

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Cumin is a crop cultivated in very few places in this Presidency and Periyakulam in the Madura District is one. Approximately it occupies an area of 300 acres in this Taluk. It is a very delicate crop, requiring much attention and care. It requires a mild climate and is grown during the South West Monsoon season in garden lands under wells. The duration of the crop is two months and it is cultivated between June and August.

Good, well drained, rich red loam is best suited for a successful growth of the crop, and it is not systematically rotated with any crop. But it is generally followed either by chillies or late Ragi and cholam.

The soil is ploughed as many times as possible and a good fine tilth is obtained. Usually seven ploughings are given. After the third ploughing, good, well-rotten cattle manure, at 30 to 35 cart loads per

* Latin *Cumin cynumun*; Tamil *Jeeragam*; Telugu *Jilakara*; Malayalam *Jeerakam*.

acre, is applied and covered. Sheep penning is also done usually. One or two more ploughings are given. Small beds about 4 feet broad are then formed so that the sower's hands reach the middle of the bed with ease when he sits in the irrigation channel. The length is determined by the convenience with which they may be irrigated. Small stones, pebbles and bricks are carefully picked out and removed from each bed.

Sowing is done in the beginning of *Ani* (June 15th) and it is a very important operation, requiring much care. The sower sits in the irrigation channel and sprinkles the seed lightly and evenly bed by bed and then covers them with his fingers. The seed rate is 10 Madras measures per 60 cents.

Next comes irrigation, the most laborious of all operations. The water should be let in slowly and lightly, as otherwise the flow of water will spoil the crop especially in the earlier stages if allowed to run fast. The water baled out with a single mhote is divided into two streams and two men are engaged to guide it. The irrigation channels should be half a foot deeper than the bed, so that the water will spread slowly and evenly. For the first 7 days after sowing, the beds are irrigated every day and after that every alternate day till the harvest of the crop. During the growth, three weedings are given.

Pests and Diseases.:—Among the pests and diseases, a leaf caterpillar (*Laphygma exigua*, H.) is known to feed on leaves and tender buds. But the incidence is only occasional. No other serious pest or disease is known.

Harvest:—The crop gets ready for harvest by the middle of August (beginnig of *Avani*). The plants are pulled out, dried, and thrashed with light sticks. Cleaning is another tedious process. The produce is disposed of in the Taluk itself at the weekly markets at Theni where there are dealers and merchants who are ever ready to purchase it.

The cost of cultivation and the value of the produce is given below and the figures are worked out for a 60 cents unit.

Economics of Cultivation of Cumin. Area, 60 cents.

Details	Bullock pairs at Re. 1	Men at 0-4-0	Women at 0-2-0	Cost		
Preparatory Cultivation.				Rs.	a.	p.
7 ploughings	7			7	0	0
Forming beds		4		1	0	0
Picking stones			6	0	12	0
Manuring						
30 cart loads of cattle manure @ 0-8-0 per cart load				15	0	0
Sheep penning—(500 Sheep)				2	0	0
Spreading cattle manure			10	1	4	0

Seeds and Sowing					
10 Madras measures of seed @ Re. 1 per measure			10	0	0
Sowing and covering	4		1	0	0
Irrigation.					
25 irrigations @ Rs. 2 per irrigation (1 pair and 2 men)			50	0	0
After-cultivation					
3 weedings		60	7	8	0
Harvesting					
Pulling, threshing and cleaning	4	20	3	8	0
Miscellaneous			1	0	0
			100	0	0
Gross income 6 kalams of 48 m. m. each @ Rs. 30			180	0	0

Net profit Rs. 80—0—0 per 60 cents (or Rs. 133 per acre).

THE "FOOT-ROT" OF PADDY & ITS CONTROL

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In a previous paper the writer (1931) drew attention to the occurrence of a paddy disease new to the Madras Presidency and described its field symptoms as they were observed on *Garikasannavari* a popular variety grown in the Godavari delta. This disease has been named 'Foot-rot' which signifies the effect of the fungus on the host plant. The disease has since been observed on paddy in other parts of the Presidency also and has been recorded either sporadically or in artificial culture on over fifty varieties of paddy representing all the important paddy tracts of the province.

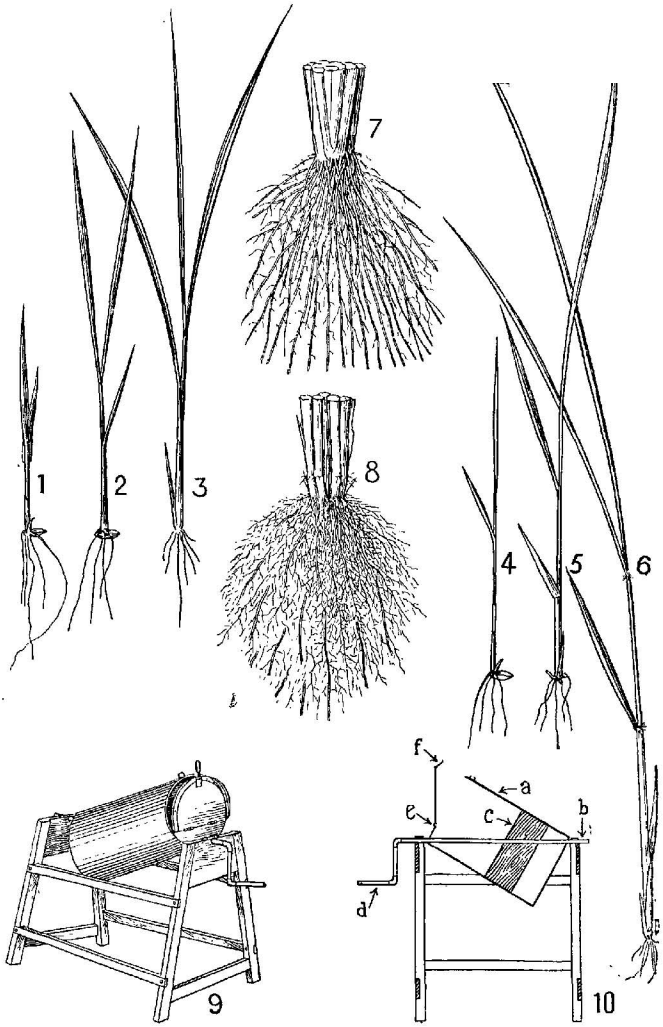
The symptoms of the disease recorded on *Garikasannavari* are essentially the same for all varieties though minor variations are met with in some. The most outstanding and at the same time the most easily detectable symptom of the disease is the appearance of pale, slender and abnormally elongated plants which ordinarily die out within a week of the first appearance of the diseased condition. Though the disease may become apparent in individual plants at all stages in the life of the crop, from as early as the sixth day after sowing to as late as the mature stage immediately prior to harvest, and is followed by wilting in whatever stage it occurs, the largest number of deaths occurs in the nursery stage ranging roughly from a fortnight to six weeks after sowing. This does not, however, account for a varying percentage of seeds which are killed during the period of germination before the plumule has elongated sufficiently to come out of the soil. Besides those described in the previous paper, another symptom which is conspicuous on well established plants is the fasciculation of the

roots caused by an abnormal branching of the main roots which gives the root system a woolly appearance. (Figs. 7 & 8).

The cause of the disease. The causal organism has been isolated and found to be a species of Fusarium. Since the perfect stage has not been obtained either in nature or in pure culture the exact identity of the fungus has not been determined In several respects the disease resembles the 'bakanae' disease of rice recorded in Japan and which was attributed by Kurosawa (1926—7) to *Fusarium heterosporum*, later by the same author (1928) to *Lisea fujikuroi* Sawada, by Hemmi and Seto (1928—9) to *Fusarium sp.*, by Ito and Shimada (1931) to *Lisea fujikuroi*, by Ito and Kimura (1931) to *Gibberella fujikuroi* (Sawada) Wollenweber and by Nisikado (1931) to *Lisea fujikuroi*. It may be mentioned in this connection that some of the field symptoms observed in Madras e g., the production of adventitious roots from the upper nodes of grown up plants when they show infection and the fasciculation of the root system do not find mention by Japanese workers. Again, Ito and Kimura (1931) state that 38 per cent of the infected seedlings recover after transplanting, while in the writer's experience under South Indian conditions, out of several thousands of infected seedlings transplanted during several seasons, not one has so far survived transplanting. Some doubt, therefore exists whether the 'Foot-rot' of Madras is identical with the 'bakanae' of Japan. However, specimens of the disease and cultures of the fungus have been submitted to prominent Japanese workers for reciprocation and their valuable opinion. While the determination of the identity of fungus has to be deferred pending the receipt of cultures from Japan or the opinion of specialists in Japan and elsewhere, the writer felt justified in presenting the results of another aspect of his studies, viz., the methods of control, in the hope that some of the control measures which were found to be effective under laboratory and field conditions may be adopted by paddy growers and the heavy losses sustained on account of 'foot-rot' may be checked.

METHODS OF CONTROL

(a) **Seed treatment**. Following the experimental evidence obtained in the laboratory that the disease is primarily seed-borne and that seedlings take infection at the period of germination, a preliminary field experiment was laid out in December 1930 at the Paddy Breeding Station, Maruter, to study the effect of seed treatment, seed-bed treatment and a combination of the two. Seed collected from an infected crop of *Garigasannavari* was used for the purpose. Seed treatment consisted in the steeping of the seed for 30 minutes in a 2 per cent solution of copper sulphate, while seed-bed treatment was done by the application just before sowing of 1 lb. of copper sulphate to 1 cent of nursery bed. The counts of diseased plants taken up to the time of transplanting showed an average of 0·15 per cent. in the



1, 2 & 3. Healthy paddy seedlings 10 days, 20 days & 30 days old; 4, 5 & 6. Diseased seedlings of the same age. 7. Root system of healthy plant 3 months old. 8. Root system of infected plant of the same age. 9. A seed disinfecting machine for mixing seed with fungicides in dry form. 10. Sectional view of the same (a) drum (b) pipe welded to drum, (c) mixing board screwed to drum (d) handle, (e) hinge (f) hasp for fastening the shutter.

case of seed treatment as against 0·11 in seed and seed bed treatment, 1·06 in seed bed treatment and 3·28 per cent in the control. Even after transplanting, plants raised from the seed treatment plots and the seed and seed bed treatment plots showed significantly better results than the controls.

During the next season (July 1931) a slightly more elaborate field experiment was laid out at Maruter to study the effects of four well known seed disinfectants viz., copper sulphate (2% solution for 30'), copper carbonate (2 gm. per lb. of seed), sulphur (2 gm. per lb. of seed) and hot water (55°C and 60°C for 15'). Provision was made in this experiment to study the incidence of disease in plump and light seeds and the use of chemicals six weeks in advance of sowing, immediately before soaking the seeds and immediately after soaking. Besides using seed collected from an infected crop of *Garigasannavari*, the seed was previously mixed with finely chopped spore-bearing straw collected from diseased plants. The results showed that copper sulphate gave a significant degree of freedom irrespective of the nature of the seed and the period of treatment. Hot water at both temperatures gave almost complete freedom from disease both with plumb and light seed. Copper carbonate gave a certain degree of freedom but not of sufficient value to recommend it as a preventive. Sulphur gave very disappointing results, showing little or no improvement over the controls.

Towards the latter half of 1931 a heavy outbreak of 'foot-rot' was found at Coimbatore involving several local varieties. A crop of *Gobi kar* showed a severe attack of the disease and the variety suggested itself as a suitable material for future experiments. The obvious limitations of conducting prolonged field experiments at a station about seven hundred miles away from headquarters were overcome and the avenue of further field experiments was transferred to Coimbatore. Taking advantage of a favourable second season, a field experiment was launched in January 1932 at the Central Farm, Coimbatore, to study the relative merits of copper sulphate, copper carbonate, formalin, sulphur and hot water. A pure line selection of *Gobi kar* was used for seed. The lay out of the plots and the *modus operandi* were the same as were employed at Maruter, but the counts of diseased plants were taken twice a week or oftener as the situation demanded. On a statistical analysis of the figures obtained it was found that formalin, hot water, copper sulphate, copper carbonate and sulphur took ranks in the order of their mention both in the nursery and post-nursery stages (Vide Tables I, II and III). There was no significant difference between the incidence of disease in the broad-cast and transplant plots.

In the light of the experience gained during the previous seasons, a more elaborate experiment was laid out at Coimbatore in July 1932. The

variety tried was *Gobi kar*. To minimise the element of chance, the seed was steeped in a spore suspension of the pure culture made in distilled water, then drained and air-dried before use. Twenty-three methods of seed treatment were tried. Unfortunately, seven treatments adversely affected the germination of seed under field conditions and were consequently discarded. The results of the remaining sixteen treatments are appended in Table IV.

Though all the treatments show less disease than the untreated controls, formalin, hot water, copper sulphate, Ceresan brand Tillantin, Uspulun, Semesan (wet treatment) and Granosan have produced convincing results.

Considering the applicability of these methods in practice, one has to consider their virtues and defects. Formalin is available in towns but requires correct dilution before use. In slight excess, it has the disadvantage of affecting germination. The use of hot water requires some scientific knowledge and the use of more elaborate equipment than what the average ryot can afford or safely handle. Mercuric chloride is a colourless poison dangerous in the hands of illiterate farmers. Uspulun, Ceresan brand Tillantin, Semesan and Granosan are proprietory preparations and though they are in extensive use in western countries, it would be difficult to induce the average villager to equip himself with any of them. Of these, Ceresan brand Tillantin and Granosan are used in dry form and have the advantage that even if the treatment is done before the period of sowing, they do not affect the germination of seed. Moreover, when treated in advance, the possibilities of reinfection through infected gunnies etc. are eliminated. But for treating large quantities, a seed-mixer of some type would be essential. Copper sulphate, though slightly inferior to these preparations in efficiency, has the advantage of availability in every Indian village. But it has one draw back viz., that it delays germination by 12 to 24 hours Attempts are now in progress to suitably modify the use of copper sulphate with a view to increase its efficiency. Even with its present defects, it would be easier to induce the Indian ryot to use it than other fungicides until such time as when better remedies are made available within his easy reach in suitable packets and at prices well within his means. The departmental agencies which distribute seed-paddy and big farmers may, however, resort to the dry treatments which are more efficient and fool-proof in large scale operations. The efficacy of the treatment depends on thorough mixing. An efficient and cheaply constructed dusting machine is illustrated in fig. 9. A design sketch after the design of the Pennsylvania State College Agricultural Experimental Station is given in fig. 10.

(b). **The utilisation of varietal resistance.** Field observations made at Maruteru station as early as 1930 showed that some varieties were more susceptible to the disease than others. Side by side with

the seed treatment trials, a field experiment was laid out in 1931 at Maruteru to estimate the relative resistance of 12 varieties of paddy grown at the station. The seeds were previously mixed with finely chopped spore-bearing straw collected from infected plants. Weekly counts were taken of diseased seedlings in the 12 varieties, each replicated four times. At the end of the experiment E. B. 24 showed complete freedom from disease. *Akkulu*, *Nallarlu*, *Atragada* and *Vankisannam* showed commendable degrees of resistance, but *Kuruvai* 18 (Adt. 4), *Swarnarlu*, *Kusuma*, *Konnamani*, *Garikasannavari* and *Basangi* showed varying degrees of susceptibility. Having thus established the existence of varietal differences in disease resistance, a more comprehensive experiment was laid at Coimbatore in 1932. Provision was made in this experiment to gauge the relative resistance of 41 varieties of paddy included in which were all the departmental strains and a number of pure line selections, representing the main paddy tracts of the province. As an improvement on the previous trial, the seeds of all the varieties were steeped in a spore suspension in distilled water made from pure cultures. Since all the varieties had equal opportunities of infection and the element of chance reduced to the minimum, it may be inferred that the percentages of disease recorded in this experiment (Table V) represent relatively their inherent susceptibility to the disease. The results show that none of the 41 varieties is absolutely immune, but varietal differences range at one extreme from the verge of complete resistance to almost total susceptibility at the other.

While considerations of yield, duration, suitability of soils and seasons, colour and size of grain, milling and cooking qualities etc. may not favour the growing of resistant varieties to the complete exclusion of susceptible ones, the experiment has brought to light one important avenue of disease control other than direct seed treatment. The reason why some varieties are more resistant than others is under investigation From the knowledge of the varieties experimented with, it is evident that the factors favouring resistance bear no correlation to the duration of the crop or the size and shape of grain.

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Summary.

(1) Further symptoms of the 'Foot-rot' of paddy, a disease new to Madras, are recorded. The disease resembles 'Bakanae' of rice in Japan, but the identity of two has not been established.

(2) Methods of control found successful in South India consist in the use of seed disinfectants and the culture of resistant varieties. Formalin, hot water copper sulphate, Ceresan brand Tillantin, Uspulun, Semesan and Granosan have produced good results under field conditions. Forty-one varieties of paddy were tried under field conditions for the study of relative resistance. A wide range of variation was noticed among the varieties.

(3) Details of the seed treatment and varietal study experiments are furnished.

FOOT ROT OF PADDY. FIELD EXPERIMENTS

Table I. Incidence of Disease in Nursery. 1932.

No.	Treatment.	Nature of Treatment.	Strength of fungicide and duration.	Mean percentage of disease.	Remarks.
1	Copper sulphate	wet	2 per cent. for 30′	14·37	Number of replications – 4
2	Copper carbonate	dry	2 gms. per lb. of seed	16·99	
3	Formalin	wet	2 per cent. for 15′	0·55	Size of plot – 10′ × 3′
4	Sulphur	dry	2 gms. per lb.	43·51	
5	Hot water	wet	55°C for 15′	4·76	
6	Control	...	.....	49·03	

Analysis of Variance.

Variation due to.	Degrees of freedom.	Sum of Squares.	Mean Variance.	½ log$_e$ (M. V.)	Remarks.
Treatment	5	8127·56	1625·51	3·6966	The treatment differences are significant the Z being beyond the 1 per cent. point, while the block effects are not. Differences between treatment mean percentages exceeding 6·58 may be considered real.
Blocks	3	14·22	4·74	0·7780	
Error	15	286·98	19·13	1·4756	

Table II. Incidence of disease in broadcast plots (Post-nursery stage).

No.	Treatment.	Strength of fungicide and duration of treatment.	Mean percentage of disease.	Remarks.
1	Copper sulphate	2% for 30′	12·95	No. of replications—4
2	Copper carbonate	2 gms per lb. of seed	15·95	Size of Plots 10′ × 3′
3	Formalin	2% for 15′	3·14	
4	Sulphur	2 gms per lb. of seed	40·56	
5	Hot water	55°C for 15′	5·14	
6	Control		48·36	

Analysis of variance.

Variations due to	Degrees of freedom	Sum of squares.	Mean variance.	½ log$_e$ M. V.	Remarks.
Treatments	5	7168·66	1433·73	3·6337	The treatment differences are significant, while the block effect is not.
Blocks	3	25·73	8·58	1·0745	Differences between mean percentages exceeding 4·98 may be considered real.
Error	15	163·90	10·93	1·5957	

Table III.

Incidence of disease in transplant plots (transplanting to harvest) 1932.

No.	Treatment.	Nature of Treatment.	Strength of fungicide and duration.	Mean percentage of disease.	Remarks.
1	Copper sulphate	wet	2 per cent. for 30'	13·10	Number of replications – 4. Size of plots – 3' × 10'
2	Copper carbonate	dry	2 gms. per lb. of seed	20·36	
3	Formalin	wet	2 per cent. for 15'	5·17	
4	Sulphur	dry	2 gms. per lb. of seed	43·48	
5	Hot water	wet	55°C for 15'	8·74	
6	Control	...	.....	49·32	

Analysis of Variance.

Variation due to.	Degrees of freedom.	Sum of Squares.	Mean Variance.	½ log$_e$ (M. V.)	Remarks.
Treatment	5	6949·81	1389·96	3·6185	The treatment effect is real, but not so the block effect. Differences between treatment mean percentages exceeding 7·11 may be considered real.
Blocks	3	3·17	1·06	0·0268	
Error	15	333·81	22·25	1·5513	

Table IV. Incidence of disease in seed treatment plots 1932-'33.

No.	Treatment	Nature of treatment	Strength of fungicide and duration	Mean percentage	Remarks
1	Formalin	wet	1 per cent for 15'	0·36	
2	Hot water	wet	55° C. for 30'	7·49	
3	Copper sulphate	wet	2 per cent for 30'	9·55	
4	Mer. chloride	wet	1 in 1000 for 30'	12·00	
5	Pot. permanganate	wet	3 per cent for 30'	49·51	
6	Ceresan brand Tillantin	dry	1 gm. per lb. of seed	9·25	Made by Bayer Products, Ltd., London. Indian Agents: Havero Trading Co., Calcutta.
7	Lime-sulphur	wet	1 in. 20 for 30'	22·46	
8	Germisan	wet	0·25 per cent for 30'	45 80	Ronsheim & Moore 11 a Wormwood Street, London E. C. 2.
9	Uspulun	wet	0·5 per cent for 30'	1 68	Made by I. G. Farbenindustrie A. G. (Havero Trading Co. Calcutta).
10	Semesan	wet	0·6 per cent for 30'	15·47	E. I. Du Pont de Nemours & Co. (Wilmington, Delaware) U. S. A. (Indian branch Sasoon buildings, Bombay.
11	Granosan	dry	1 gm. per lb. of seed	2·87	Do.
12	Tillantin	dry	1 gm. per lb. of seed	46·44	I. G. Farbenindustrie A.G. (Havero Trading Co., Calcutta.)
13	Sulphur	dry	2 gms. per lb. of seed	46·41	
14	Semesan	dry	1 gm. per lb. of seed	37·82	E. I. Du Pont de Nemours & Co., Sasoon buildings, Bombay.
15	Copper carbonate	dry	2 gms. per lb. of seed	49·57	
16	Semesan Jr.	dry	1½ gms. per lb. of seed	34 87	E. I. Du Pont de Nemours & Co. Sasoon buildings, Bombay.
17	Control	...	...	88·85	

Analysis of Variance.

Variation due to	Degree of freedom	Sum of squares	Mean Variance	½ $\log_e$ (M. V.)	Remarks.
Treatment	16	37654·45	2353·40	3·8818	Treatment differences are real but not the block differences. Differences between mean percentages exceeding 6·68 may be considered real.
Blocks	3	42·28	14·09	1·3226	
Error	48	1116·45	23·26	1·5734	

Table V. Incidence of disease in varieties.

No.	Variety.	Mean percentage of disease	Remarks.	No.	Variety.	Mean percentage of disease	Remarks.
1	Co 1	19·20	Coimbatore strain	21	Adt 8	66·61	Aduturai strain
2	Co 2	85·11	do.	22	*Paonkar*	77·78	Aduturai selection 615
3	Co 3	95·56	do.	23	A. E. B. 65	30 43	Aduturai selection
4	Co 4	79·36	do.	24	*Korangu samba*	50·33	Aduturai selection 954 B K
5	Co 5	82·45	do.	25	*Sornavari*	91·76	From Palur
6	Co 6	85·27	do.	26	*Garika samna vari*	92·12	Maruter selection 925
7	Co 7	89·71	do.	27	*Basangi*	49·78	do. 614
8	G. E. B 24	4·83	do.	28	*Akkalu*	90·83	do 6
9	*Gobikar*	93·51	Coimbatore selection	29	*Wateribuna*	1·13	American variety recently introduced at
10	*Gobi Ayyan Samba*	83·30	do.	30	*Vankisannam*	38·26	Maruter
11	*Tinnevelly Kar*	30 00	do. 10375	31	*Krishnakatukulu*	15·51	Maruter selection 3259 do. 89
12	*Tinnevelly Anaikomban*	95·12	do. 7566	32	*Atragada*	29·14	do. 1837
13	*Jeerka Samba*	19·83	do.	33	*Kusuma*	64 32	do. C
14	Adt 1	61 61	Aduturai strain	34	*Thavalakannan*	59·18	Pattambi selection 999 N
15	Adt 2	47·73	do.	35	*Kayama*	43·07	do. 558 N
16	Adt 3	72 63	do.	36	*Athikraya*	66·13	do. 907 N
17	Adt 4	84·89	do.	37	*Aryan*	1·85	do. 323 N
18	Adt 5	86·61	do	38	*Thekkanchera*	53·18	do. 38 N
19	Adt 6	74 20	do.	39	*Jeerakasala*	70·31	do. 1181 N
20	Adt 7	76·92	do.	40	*Black Puttu*	13·88	Coimbatore selection glutinous variety
				41	*Chitrakali*	91·56	From Palur

Analysis of variance.

Variation due to	Degree of freedom	Sum of squares	Mean variance	½ loge (M V.)	Remarks.
Variety	40	139569·27	3489·232	6248·11	The varietal and block effects are real the Z's being beyond the 1% level. Differences between varietal mean percentages exceeding 6·21 may be considered significant.
Blocks	3	154·74	51·58	59·38	
Error	120	2421·00	20·18	23·23	

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Notes and Comments.

Honour to an Agricultural Officer. We congratulate Mr. N. S. Kolandaswami Pillai, our headquarters Deputy Director of Agriculture on the title of Rao Sahib recently conferred on him as a Birth-day honour. Mr. Pillai is one of our experienced and popular officers who was till lately the Deputy Director of Agriculture in the fifth circle. In that capacity he has done considerable work in helping the delta agriculturists in various ways and was recently deputed by Government to Ceylon on special duty to investigate the possibility of finding out some easy markets for Tanjore rice in Ceylon. We have no doubt that this is a well merited distinction and we wish Mr. Pillai many more honours in the future.

Another batch of Agricultural Graduates. The recent University examinations have produced a fresh batch of Agricultural Graduates (B. Sc., Ag.) adding to the already decent number of such men remaining unemployed. It is found that the problem of unemployment appears to hit these young men much more seriously than many other University graduates and unless ways and means are found to get some work for these agriculturally trained men the Agricultural College may not attract suitable applicants in sufficient numbers during the coming years. There is no doubt that an agricultural graduate is more suitable for the subordinate executive posts in the Survey, Settlement, Forest and Revenue Departments than many a raw Arts graduate and it is high time that our men are preferred for all such posts, and openings created in this way for men trained out of the Agricultural College year after year. At the same time we would also suggest to such of those young men who have sufficient lands of their own to take to improved methods of agriculture in their own lands and try to eke out an honourable living with profits they are sure to make by the utilisation of their agricultural knowledge.

Short Agricultural Courses for Gentlemen Farmers. We are sure that among the landed aristocracy in South India there must be persons taking some special interest in one aspect or another of Agriculture and to these people there is nothing like undergoing a short course in their hobby at an agricultural institute. To provide facilities for such short courses the Government are, we understand, making arrangements in their various Government Agricultural Research Stations. We would invite all young landholders to take advantage of the opportunities offered and contribute to the advance and encouragement of the particular aspect of agriculture in which each of them has special taste. Subjects like Dairying, Poultry, Beekeeping, Sericulture, Vegetable farming, Fruit growing and Horticulture are some of the many which offer excellent fields for young and enthusiastic land-holders. This work will not only add to the knowledge of the specialists in each of these subjects but would also go to encourage and improve these different industries adding to the material prosperity of the country.

Training and Research in Animal Husbandry. In a very interesting article entitled "The organisation of Training and Research in Animal Husbandry in various countries" by Prof. S. Tanssig in the *International Review of Agriculture* for February 1933, appears a very succint and interesting account of the facilities offered for animal husbandry training and research in the various countries of the world. The countries dealt with include Germany, Australia, Belgium, Bulgaria, Denmark, France, Great Britain, Italy, Canada, United States of America, India, Japan, Africa, Australia and a few minor countries.

The information given under each country deals chiefly with (1) whether training and research in each country is separate or co-ordinated (2) whether training and research are in charge of Universities or other independent institutions (3) whether the subject is dealt with in special institutes or in institutes which deal with other agricultural or other branches and (4) whether institutes exist which specialise in instructions or research in the established branches of animal husbandry. To those of our graduates who contemplate specialising in this line a perusal of this article will be found very advantageous.

Prizes for Agricultural Research Keeping in view the suggestion of the Royal Commission on Agriculture in India that a valuable stimulus to agricultural development in India would be given if the Government of India were to award an annual prize for the most striking Agricultural improvement of the year. The Imperial Council of Agricultural Research has after ascertaining the views of the Provincial Governments and the constitutional Indian States, now decided to award each year one gold medal and two or three silver medals for improvements of distinct merit and of all-India importance in the science and art of Agriculture and Animal Husbandry. The medals are to be awarded for one of the following groups every year beginning from the year 1934. (1) Veterinary scientific instruments and appliances. (2) Dairying and care of animals. (3) Field implements and Appliances. (4) Machinery for preparing crops for market for food or for storage, and (5) Water lifts.

While we welcome such a stimulus, looking at the subjects for which the awards are announced we are inclined to think that the grouping has not been very happy and that a chance has not been given to all the aspects of the Science of Agriculture and Animal husbandry.

ABSTRACTS

Flowering, Pollination and Natural Crossing in Rice. W. Poggendorff. (*The Agricultural Gazette of N. S. Wales, 1932, vol. 43, part 12*). Five years' field observations at Yanco with medium to long-grained varieties like Caloro, Colusa, Carolina Gold, Carolina White and Lady Wright brought out the following interesting relationships regarding flowering, pollination and natural crossing in rice, *Flowering* shows a sensitive response to environmental factors like temperature, humidity, wind etc. Thus:— (1) temperature and humidity show within limits, an inverse relationship to flowering. (2) The minimum temperature at which flowering occures is 72° F, if the humidity is not less than 62% (3) Maximum flowering occurs when the temparature is 85° to 90° F and humidity 55 to 70%. (4) The highest temperature at which flowering has been observed to occur is 102° F, humidity 60%. (5) The response of all varieties observed to a given set of conditions was the same (6) The time of flowering varies with weather conditions; it usually commences at 8-30 a. m. reaches a maximum between 11-30 a. m. and 12-30 a. m. and ceases about 3-30 p. m. (7) Observed

extremes in flowering time are 6 a. m. and 5-30 p. m. (8) Wind, clouds and rain adversely affect flowering. (9) Relative humidity is the most important factor governing the amount of flowering between temparatures of 72° and 100° F. (10) The normal humidity during the flowering period of rice is unusually low at Yanco in comparison with published data for other countries. In regard to pollination (1) three types were found to occur, viz., (a) before the florets open the temperature is high (about 95° F) add humidity low (about 35%) rare; (b) at opening of the florets, or within a few seconds—when the temperature is 80° to 100° F and humidity 45 to 50%; usual; (c) after the florets have opened—when the temperature is between 72° and 90° F and humidity high (over 60%); not infrequent. (2) The glumes open to a maximum angle of about 30 degrees in from one to three minutes, and remain open for 13 to 75 minutes. This time is apparently governed by the relative humidity of the air. (3) Cleistogamy has not been observed to occur. (4) Pollination is more likely to occur after, rather than at opening of the florets in long-glumed varieties than in short-glumed varieties. *Natural crossing* is known to occur at Yanco (1) by the discovery of occasional heterozygotes in supposedly pure lines; (2) by the diversity of variant types increasingly occuring in commercial crops; (3) by experiments in the stud plots; 0·044% natural crossing observed at 2 links (40 cm). (4) In addition to temperature and humidity, wind is an important factor. The author discusses the above results in comparison with those obtained in other rice growing countries. (C. N.)

The Influence of Fertilisers on Crop Quality. B. L. Hartwell (*Published by the National Fertilizer Association of U. S. A, Washington 1932*). This is a report presented to the National Fertilisers Association of America, by the committee on Fertilisers of the American Society of Agronomy, and reviews the important American and German literature bearing on the relation of quality of produce to chemical composition as influenced by the application of fertilisers. The following are some of the main conclusions which are derived from a study of the current literature:— (1) The quality of a crop may be impaired either by an excess or by a deficiency of a plant nutrient. *Nitrogen* because of the solubility of many of its compounds, is frequently absorbed to such an extent that growth becomes too proteinaceous in proportion to the non-protein constituents or too vegetative. When quality depends upon a high content of non-nitrogenous constituents, an increase in protein may decrease these compounds. Outstanding deleterious crop influences of an excess of nitrogen are observed in sap impurity in sugar plants; lodging, quality of fibre crops, immaturity, red fire of tobacco, smoking quality of tobacco, keeping quality and color and odor of hops. A deficiency of nitrogen results in a light green foliage, or chlorosis, such as is exhibited in, frenching, of tobacco. Lack of magnesium or manganese or potassium affects the leaves by characteristic departures from a homogenous dark-green foliage; but an extreme deficiency of phosphorus may darken the green foliage and change its shade. (2) Although *phosphorus* generally increases protein content even of the non-phosphorus proteins, its beneficial effects on carbohydrate metabolism is more pronounced. Phosphorus appears to influence favourably certain vitamins in wheat. It has a favourable influence on the supporting and fruiting tissues of plants. By promoting especially the formation of non-vegetative tissues, phosphorus is outstanding as a hastener of maturity, thereby improving keeping quality. (3) *Potassium* seems to be necessary in the initial stages of the metabolism of protein, and to be useful in offsetting to some extent the deleterious effects of excessive nitrogen. Its outstanding influence, however, is in promoting the metobolism of the non-nitrogenous constituents of plants. Potassium reduces the susceptibility of crops to a number of afflictions, discolorations of potatoes, for example. It also improves the cooking

quality of potatoes when mealiness is desired. The smoking quality of tobacco is improved by potassium carriers which do not contain too much chlorine. Potassium may enhance the quality of fibre plants, and strengthen the tissues which prevent lodging, as would be expected because of its property of promoting the formation of all carbohydrates. The size of the kernels is increased by potassium, whereas phosphorus is more likely to augment only the number of kernels. Potassium, like phosphorus may improve the keeping quality of fruits and vegetables. (4) *Calcium and Magnesium* influence crop quality mainly because of their alkalinity, thereby changing the susceptibility of crops to certain afflictions. Magnesium specifically improves the ash of smoking tobacco, and, if insufficiently applied, sand-drown results. (5) *Manganese* is associated with the formation of certain of the vitamins and its lack affects foliage so unfavourably under some farm conditions that its inclusion in fertilisers is beginning to receive attention. (6) *Sodium*, although not an essential element, may be useful when plants are suffering from an insufficiency of potassium (C. N.)

Normal Growth in Dairy Cattle. (*Research bulletin No. 154 of the Iowa Agr. Exptl. Station, 1932*). The present bulletin offers data on the rate of growth in different breeds of dairy cattle, which might offer certain standards of normal growth of use to those interested in dairy research or breeding work or to those raising and caring for dairy cattle. The study was limited to Western breeds in use in dairy farms in America, and covered the period 1912 to 1931. The data obtained showed that:— (1) Male calves of all the breeds studied weighed more at birth than female calves. The birth weights of female calves were as follows: Holsteins 89 lbs. Guernseys 65 lbs; Ayrshires 63 lbs, and Jerseys 50 lbs. (2) There was considerable variation among individuals in their live weights. Co-efficients of variation ranged from above 15% in calves to less thon 10% in 2 year old heifers. (3) The time of first freshening marks the greatest change in the rate of growth in live weight. (4) Very little difference could be observed in the relative at which animals of the different breeds approach mature size. (5) Mature growth values are approached most rapidly in height at withers; this measurement is not even doubled from birth to maturity. (6) The average weight for mature Hosteins in the Iowa station herd was 1,405 lbs. Ayrshires 1,111 lbs; Curnseys 1072 lbs; and Jerseys 950 lbs;. (7) Gestation and lactation have considerable influence upon live weight. Late freshening heifers (freshening after 2 years) weigh more than heifers calving at the usual time but after freshening, the weights of both groups are quite comparable. (C. N)

Factors Influencing the Vitamin Content of Food. Dutcher, R. A. (*Bulletin No. 275 of the Pennsylvania Agr. Exptl. Station, U. S. A. 1932*) This is a survey of recent literature regarding the variation of vitamin contents of foods in response to environmental changes and formed the subject of a De Lamar Lecture delivered by the author at Johns Hopkins University in 1931. The following are some of the interesting facts emerging out of such a survey. (1) Air dry seeds and cereals as a group are deficient in vitamins A, C and D, but flax and millet seeds, Georgia velvet beans and yellow corn contain appreciable amounts of the growth factor, vitamin A. The cereals, especially the embryo and germ portions, are rich in the antineuritic factor, vitamin B. Tomato and citrus fruits (oranges and lemons) are particularly rich in the antiscorbutic factor, vitamin C, while pigmented tomato and yellow corn are rich in vitamin A. Codliver oil is rich in vitamins A and D. (antirachitic) (2) The vitamin content of leafy plants and vegetables appears to be correlated with greenness, metabolic activity and maturity. Old mature tissues tend to be less valuable as sources of vitamins (particularly A and C) than the young rapidly metabolising tissues. Rapid drying of hay to prevent enzymatic action, conserved vitamin content. (3) The vitamin content of fresh vegetables and fruits becomes depleted during storage,

due to oxidative and enzymatic changes. Butter and codliver oil show progressive loss of vitamin A during storage which can be prevented to some extent by storing these foods in an atmosphere of hydrogen gas in order to reduce oxidation to a minimum. Dried spinach lost about 70% of vitamin A content during a storage period of 12 to 15 months, which was correlated with loss of green color and carotinoids. The presence of rancid fat, unsaturated fats, iron salts and copper salts hasten the destruction of vitamin A during storage. Acidity preserves vitamins B and C, while alkalinity destroys them; the presence of natural or artificial antioxidants of the type of hydroquinone prevents or delays vitamin destruction during storage. (4) If plant tissues are dried rapidly at relatively high temperatures to insure the inactivity of enzymes. it is found that vitamins A and C are preserved much more efficiently than when the drying process is conducted over longer periods at lower temperatures. If it is possible to eliminate atmospheric oxygen, the amount of original vitamin preserved will be even greater. (5) The antiscorbutic value of milk is slowly destroyed by heating, but intense heat for a short time was less destructive; the destructive effect is greater in presence of oxygen or ozone. Milk could be pasteurised for 30 minutes at 63°C without appreciable destruction of vitamin C. Evaporation in vacuo conserved the vitamin C content of orange, tomato and other fruit juices. (6) Overcooking of food destroys vitamins A and C especially in presence of oxygen. Quick drying. short periods of cooking, elimination of oxygen and preservation of acid medium and storage at low temperatures under dry conditions go a long way to conserve vitamin potency. (7) Irradiation with ultraviolet light and the feeding of irradiated foods increased the vitamin D content of cow s milk. (C. N.)

The use of Chlorates as Weed Eradicators. Clouston D and Hill A (*The Scottis'h Journal of Agriculture 1933, vol. 16 pp. 196—208*). Chlorates have come into prominence in recent years for the destruction of obstinate weeds especially those growing among cereal crops, where the orthodox cultural methods have proved ineffective, and even chemical herbicides like copper sulphate, iron sulphate, Kainit, calcium cyanamide and sulphuric acid have proved to possess limited value. In Switzerland, extensive use has been made of chlorates by railway companies in the control of weeds along the permanent way and in England, the London, Midland and Scottish Railway company have recently adopted chlorates for a similar purpose.

Though the use of chlorates as herbicides suffers from two serious draw backs viz inflammability and high cost, it has been found to be very effective in the suppression of permanent weeds. The authors report in the present paper the results of their experiments under field conditions with various weeds like the common chickweed (*Stellaria media,*) Groundsel. (*Senecio vulgaris*, L.), Daisy (*Bellis Perennis, L*) Coltsfoot (*Tussilago farfara. L*) Couch *Agropyrum repens, Beauv*), Common nettle (*Urtica dioica*, L.) Gomfrey (*Symphytum officinale. L.*) Creeping thistle (*Cirsium arvense*, Scop), Sheep's Sorrel (*Rumex acetosella, L*) etc. The writers recommend the application of the chlorate (of sodium or potassium), in the form of a solution of 2½% concentration (5 lb. per 20 gallons water) in the form of a spray over the foliage parts of the weeds. A period of 3 to 4 months (under Scottish conditions) should elapse before the sowing of the next crop, to facilitate the removal of the chlorates; otherwise the succeeding crop is prejudicially affected. The lethal dose of chlorate for weeds varies from 15 to 100 lbs. per acre, depending on the density and nature of weed population, and experimental details are given in the paper of treatments given to individual weed plots. Chlorates applied in solution in the doses above mentioned are not poisonous for stock if a month or two be allowed before cattle are turned in. As chlorates are likely to explode or catch fire especially in presence of organic matter, care should be taken in their handling; and clothes moistened with chlorate solution should be washed free of chlorate before being dried. (C. N.)

Gleanings.

Hardness of Rice. "A machine has been constructed to measure the hardness of rice in terms of pounds pressure required to crack the grain. All the commoner local varieties were examined, and the fact emerged that there is no varietal difference in hardness. Rice varies in hardness according to the method of preparation. Thus white rice (4·28 lb.) is softer than parboiled rice (11·14 lb.). Parboiled rice increases in hardness with the lapse of time after parboiling (from 11·14 lb. to 19·14 lb. in six months). This process, however, is a slow one. Methods of hastening the hardening have been investigated. When rice is placed in a desiccator (calcium chloride) the hardening is proportional to the loss of moisture upto a point where the rice has lost 50 per cent. of its water content and has reached a hardness of 35 lb. This point is reached after 70 hours in the desiccator. Beyond this point, there is no further hardening, though there is further loss of water It is not possible to harden rice by this method beyond 35 lb. If desiccation be continued, the grains disintegrate. Heating drives off the moisture and hardens rice (from 10·7 lb. before heating to 19·7 lb. after heating). (From the Rice Weevil investigations in British Guiana, vide *Bulletin of the Imperial Institute, London*, XXXI, p. 77).

Cotton seed meal rich in vitamins. Cotton seed meal, valuable cattle feed by-product of the cotton industry, is a rich source of vitamins B and C, according to Professor, May L. Whitsitt, of the Southern Methodist University. She found cotton seed meal richer in these two important factors than an equal weight of whole wheat, dried yeast or skim milk powder. Cotton seed oil shows no trace of either of these two vitamins, while the hull bran has a varying amount of the vitamins depending on the way it is extracted. Vitamin B is necessary to prevent the development of beriberi in man or a condition known as polyneuritis in birds. Vitamin G, also known as vitamin B_2, is said to be the factor in certain foods, notabily yeast, that prevents pellagra in man and a similar condition, black-tongue in dogs. (*Science News*, March 31, 1933).

Sewage Treatment and Disposal—A New American process. A new process emanating from the U. S. A. developed by G. H. Gleason and A. C. Loonam working on behalf of Guggenheim Brothers, combines, a modification of the well known method of chemical precipitation with a novel use of the base exchange material Zeolite for purifying the effluent. Preliminery experiments showed that ferric iron was the best tervalent Kation for coagulating raw sewage, and that lime was the best alkali, being the least expensive and producing the densest precipitate. The sewage is passed through coarse and fine screens, to remove the coarser suspended solids, into a tank where ferric sulphate is added, and air is passed continuously through the liquid to keep the iron oxidized. Lime is added in a second tank, equipped with a flocculating mechanism, and the time of flocculation, as well as the hydrogen-ion concentration, is rigorously controlled. The liquid is passed into a clarifier where the sludge settles and the supernatant liquor overflows on to the zeolite beds. The sludge is pumped to a suction filter, where its moisture-content is reduced by about 80%, and is then completely destroyed in a rotatory Kiln incinerator consisting of two sections: one in which the sludge is dried (at 110°–150° C) and one where it is burnt (at 650°–700° C). The calorific value of the sludge is, when the scale of operation is sufficiently large, adequate to ensure complete combustion. From the ash, containg about 41% of ferric oxide, ferric sulphate is regenerated by treatment with sulphuric acid at 150° C, and the regenerated material is found to be a better precipitant than the original, or any other purchasable salt.

In the zeolite bed, the supernatant liquor from the clarifier is deprived not only of remaining suspended matter, but also of putrescible organic compounds that have escaped precipitation. The basic nitrogen of these compounds is exchanged for the sodium in the zeolite. About 16,000 lb. of zeolite are required per million gallons of sewage treated and the rate of loss is very small. After remaining from 10 to 12 hours in contact with the zeolite, the liquid is passed to a second bed of the same material, and the original bed is regenerated by washing with a concentrated (20 %) solution of common salt. The basic nitrogen is transferred to the salt solution and this is treated with lime and distilled. The salt solution becomes available for further use and the ammonia liberated is also recovered. The degree of purification attained on a small plant with a daily capacity of 2500 gallons of sewage, which was operated continuously for 8 months at New York, is shown by the following data.

	Crude sewage	Purified effluent
Suspended solids (average)	200 parts per million	1 part per million.
B. O. D (average)	150 ,,	5 ,,
Total Nitrogen ,,	24–28 ,,	2–3 ,,
Ammonia ,,	12–14 ,,	0·5–10 ,,
Bacteria per c. c. ,,	3–6 ,,	
	Million colonies	
Total Bacteria removed	——	99·1 %
B. Coli removed.	——	99·6 %

These results are considered so satisfactory that a plant to treat 25,000 gallons per day has been ordered for Chicago.

Little that is definite can be said at present regarding the cost of plant and treatment. It is thought that the plant will not occupy more than about one-half of the area demanded by other types of plant giving equal purification, and that a plant of 50 million gallons capacity or more, will cost, in the eastern states or in the Lake cities, about two thirds that of an activated sludge plant of similar capacity. Operating and maintenance costs are estimated at 22 dollars per million gallons of sewage treated in a plant of the above mentioned capacity, but this figure does not include interest or amortization charges, nor any credit for the value of the ammonia recovered.

(*Chemistry and Industry*, April 21, 1933).

Chemical composition of the Mango. The chemical composition of the fresh pulp of the mango fruit has been determined by R. Yamamoto, Y. Osima and T. Goma (Tokyo Institute Scientific papers, 1932, vol. 19, p. 122) who have reported the following data. The water content of the pulp is 81·7 % and the sugars consist of sucrose (5·5), fructose (4·9) and glucose (1·5). The acidic taste is due to citric acid (0·5), and the yellow colour to xanthophyll (0·9) and carotene (0·1). The last named substance, isolated from mango fruits, was found to cure avitaminosis A in rats, and therefore confers a valuable food property on the fruits. (*Tropical Agriculture*, (Trinidad) May 1933.)

Correspondence.

I. Another Appreciation.

Rao Bahadur M. R. Ramaswami Sivan, writes to us;—

It gives me great pleasure to join Mr R. Cecil Wood in his felicitations to you on the Journal having attained its 21st year—the age of majority. It was when Mr. Wood was Principal of the College that the Madras Agricultural

Students' Union was started, and I had the honour to serve as General Secretary of the Union and Editor of its journal for some years. Started as a year-book, developing into a quarterly and expanding later into a monthly, the journal has amply justified its existence, in catering to the old boys of the College, the officers of the Agricultural Departments in India and the general public interested in Agriculture. Managed and edited by an enthusiastic staff of honorary workers, who have their own breadearning work to do and who, by the rules of election often change from year to year, it is indeed creditable that you have overcome all difficulties and anxieties, financial and otherwise, incident to a juvenile journal and have entered on a robust adult life. All honour to you. Your readers gratefully appreciate the labour of love and sacrifice you have all bestowed on the Journal.

It is my affection for the Union and its Journal that makes me claim the privilege to make the following appeal. The *Madras Agricultural Journal* is still the organ of the Madras Agricultural Student's Union. The Union was started primarily for bringing old boys into constant touch with the College and the Research Institute, and the Journal was and continues to be the medium. The bulk of the editorial work is done, and will always be done cheerfully by the residents of the College. All the same, I want all old boys to shoulder the burden. May I, therefore, appeal to old boys in the mofussil stations to send a larger number of contributions to the Editorial Board than appears to be the case so far? To say the least, it is your duty.

Once more, dear Editor, I wish to congratulate you all on the successful working of the Journal hitherto, and pray for its increased prosperity in the future.

II. The International Year-book of Agricultural Statistics.

The Director, International Institute of Agriculture, Rome, writes :—

The International Institute of Agriculture at Rome has recently published the 1931—32 edition of the "International Year-book of Agricultural Statistics".

This volume of about 800 pages is the result of the most extensive and detailed inquiry made in the domain of international agricultural statistics and constitutes a work of the greatest importance to all those who are interested in questions having a direct or indirect relation to production and commerce of agricultural products.

In the first part of the Yearbook are classified the figures for area and population in the years nearest to 1927 and 1931 for 208 countries: the presentation of these figures throws light upon the world situation from the geographical, political and demographical points of view during the post-war period. The second part is composed of a series of tables comprising for nearly 50 countries the available data concerning the uses for which the total area is employed, the apportionment of cultivated areas between the different crops, agricultural production, numbers of the different kinds of livestock and the products derived from them. In the tables constituting the third part of the volume, have been indicated for nearly 40 agricultural products, the area, production and yield per acre in each country during the five years 1923—1927 and during each of the years rom 1928 to 1931.

For each kind of livestock all available figures in the different countries have been grouped for the years 1927 to 1931. A large part of the volume is devoted to statistics of the commercial movement of 43 vegetable products and 13 products of animal origin. The figures published relate to the imports and exports during the calendar years and for the cereals also during the commercial seasons.

It may be added that the tables of production and commerce not only specify details for each country but also the totals for the different continents and hemispheres and for the whole world, allowing the formation of a general idea of the changes taking place during the periods under consideration in the area under each crop, quantities harvested and the commercial movement in each product.

The part devoted to prices contains the weekly quotations of 25 agricultural products on the principal world markets for the period January 1927 to July 1932. In the freights section will be found the quotations for the transport of wheat, maize and rice on the most important shipping routes, and in the section reserved for fertilizers and chemical products useful in agriculture are published statistics of production, trade, consumption and prices for 15 products. In the Appendix have been brought together special chapters on the distribution of agricultural holdings according to their size and mode of tenure. The Forestry Statistics have been extended and developed and will be published in a separate volume under the title of: International Year-book of Forestry Statistics.

Crop & Trade Reports

Review of the Sugar Industry of India during the official year 1931—'32. The following are extracts from the report submitted by R. C. Srivastava, Sugar Technologist to the Imperial Council of Agricultural Research, India:—

1. Introductory. The year 1931—32 marked another period of severe depression in the history of the sugar industry of the world. Excess of production over consumption was the principal cause of this. Since 1919—20, with one important exception in 1926—27, the world sugar production has increased steadily from year to year and this has resulted in accumulation of stocks in all the principal sugar markets of the world. As a result, ruling prices became low, markets remained lanquid under a dead weight of stocks and the consuming centres became sluggish with a disappointing off-take. The stagnant condition of the Indian sugar market was clearly reflected in the course of sugar prices in India. That the prices did not decline still further was due to the fact that the low levels already ruling did not permit of any further fall, and a major portion of the stocks was held by a few strong dealers who had formed a sort of ring to maintain prices.

2. Agricultural. According to the Final General Memorandum on the sugar cane crop of 1931—32, the area planted with sugar-cane was estimated at 2,886,000 acres as against 2,797,000 acres in 1930—31 or an increase of 3% and the total yield of raw sugar (*gur*) is estimated at 3,880,000 tons, (highest on record) as compared with 3,218,000 tons last year, or an increase of 21%. The condition of the crop was on the whole, reported to be good. Towards the total production of raw sugar (*gur*) in India, the contributions of the different Provinces were as follows:— United Provinces 45·3%, the Punjab 10·7%, Bihar and Orissa 9·8%, Madras 9·5%, Bombay 7·9%, Bengal 7·3%. The area under improved varieties in the Provinces of India amounted to about 39% of the total area during the year under review, as against 28% of the total area in the preceding year.

3. Manufacturing. 29 factories making sugar direct from cane worked in India during the season 1930—31, as against 27 in the previous season, while 10 factories refined raw sugar or *gur* in the year 1931, compared to 11 in the previous year. The production of sugar direct from cane totalled 119,859 tons during the

season 1930—31 as against 89,768 during the previous season, while the total quantity of sugar refined from *gur* increased from 21,150 tons in 1930 to 31,791 tons in the year 1931. Thus the total factory production of sugar in India in the combined seasons amounted to 151,650 tons in 1930—31, as compared with 110,918 tons in 1929—30. The number of factories producing sugar direct from cane, and the sugar produced, have increased from 25 and 17,16,426 maunds in 1926—27 to 29 and 32,62,574 maunds in 1930—31. The estimated production of white sugar by Khandsaris and indigenous methods of manufacture in India during 1930—31 is 200,000 tons. Of the 31 cane factories which worked in 1931—32, 12 are in Bihar and Orissa, 14 in the United Provinces, 2 in Madras and one each in the Punjab, Bombay and Burma. 27 new factories are in course of construction in the season 1932—33, of which 20 are in the United Provinces and 7 in Bihar and Orissa.

4 Technical and Scientific. It was noticed from the manurial experiments on Co. 223 with potassium nitrate, superphosphate, ammonium sulphate and ammonium phosphate at Gurdaspur Agricultural Station (Punjab) that (1) the weight and the period of maturity of sugar cane are affected by the use of fertilisers, while the sugar content changed slightly; (2) sugarcanes manured with potassium nitrate matured early and were least affected by frost while the application of ammonium sulphate and ammonium phosphate delayed the ripening; and (3) Potassium nitrate and ammonium sulphate were found to be comparatively more economical than the other two fertilisers. The effect of flowering—a rare phenomenon in the Punjab—was studied on Co. 285 and it was observed that the weight of a cane in flower was actually more than that of a flowerless cane without any difference in the percentage or quality of juice. Regarding various methods of preparing *gur*, it was confirmed that brisk boiling is superior to slow boiling and that inversion of sugar depends more upon the pH value of the juice and the time during which boiling is continued than on the temperature. In the Madras Presidency research work on sugar cane is being done at Anakapalle, Samalkota and Palur Agricultural Stations. Manurial experiments showed that a combination of artificial with organic manures gives a better result than organic manures alone. One third the quantity of the usual quantity of farm yard manure together with less than 2·5 cwts of ammonium sulphate gave a net increase of 13% over the application of farm yard manure alone. At Samalkota attempts are being made to replace J. 247; and P. O. J. 2878, the wonder cane of Java, is showing promise. At Palur J. 247 seems to lead. From an irrigation experiment it was concluded that planting early in February is not an advantage and that Co. 213 can be grown with the normal rainfall supplemented by only 4 acre inches of irrigation at the time of planting Further research work on mosaic showed that out of 19 varieties under trial, a number of Coimbatore canes evolved at the Imperial Breeding station, P. O. J. 2714 and P. O. J. 2878 and Cossier showed either complete freedom from disease or a high degree of resistance.

5. All India Sugar Trade. The present duty on imported sugar is Rs. 9—1 per cwt and on imported molasses 31¼ per cent. *ad valorem*. The value of sugar machinery imported into India in 1931–32 is Rs. 30,14,149 as against Rs. 13,68,716 in the preceding year, the imports being mainly from the United Kingdom (Rs. 26,22,991). The net production in India of *Gur* and jaggery both cane and palm during 1931–32 is estimated at 2,795,000 tons compared with 2,368,000 tons in the preceding year. The production of refined sugar by modern factories and refineries in India was 151,650 tons in 1930–31 as against 110,918 tons in 1929–30. Adding to this total an estimated production of 200,000 tons of sugar manufactured by the indigenous process, we arrive at a total production of 351,650 tons as against 310,918 tons in 1929–30. India's import of sugar, excluding

molasses during the year under review amounted to 516,100 tons valued at Rs. 601 lakhs as against 901,200 tons valued at Rs. 1,054 lakhs during 1930-31. This decrease was specially due to the considerably smaller imports of Java sugar which amounted to 367,000 tons during the year under report against 802,200 tons in 1930-31. Imports of molasses decreased from 102,024 tons valued at Rs. 42,63,995 during 1930-31, to 40,191 tons valued at Rs. 15,82,250 during the year under review. India's own production of molasses may be estimated at 366,000 tons during the year 1931-32 as against 269,000 tons in the preceding year.

According to the latest estimate of Mikusch, the world production of sugar in 1931-32 amounted to 27·8 million metric tons as compared with 30 million metric tons in the previous year. The consumption of the same period, was 27·6 million metric tons as against a little under 27 million metric tons in the preceding year. Thus the production of the year 1931-32 exceeded the consumption by 0·75 million tons.

6. Conclusion. The movement for local development of white sugar manufacture within India has gathered increasing momentum during the last few years and the progress achieved surpasses the most sanguine expectations. An approximate indication of the development expected within the next few years can be had from the following table:

Particulars.	1930-31 tons	1931-32 tons	Estimated 1932-33 tons	Estimated 1933-34 tons	Estimated 1934-35 tons
(1) Total production of factory sugar. ...	155,000	228,000	351,000	586,000	646,000
(2) Production of Khandsari sugar. ...	200,900	250,000	275,000	300,000	300,000
(3) Total production of all kinds of sugar (excluding *gur*).	355,000	478,000	626,000	886,000	946,000
(4) Estimated consumption of sugar. ...	...	982,540	940,000	940,000	940,000
(5) Difference between consumption and production representing the margin for imported sugar. ...	...	504,540	314,000	54,000	- 6,000

The above forecast is based on the numbers and capacities of factories which have been definitely ordered, and all cases in which there was any doubt have been eliminated. The statistical position which this estimate reveals for 1934-35 is particularly noteworthy. It shows that even assuming that no new factories are built for operating during the crop 1934-35 and assuming that the productien of Khandsari sugar ceases to increase, the home production of sugar from cane and gur during 1934-35 will fully cover home consumption. (*Supplement to the Indian Trade Journal, May 1933*).

Final estimate of the Cotton crop of India.

Provinces and States.	1932–33 (Provisional estimates)		1931–32 (Final figures)		1930 31 (Final figures)	
	Area (1,000 acres)	Yield (1,000 bales)	Area (1,000 acres)	Yield (1,000 bales)	Area (1,000 acres)	Yield (1,000 bales)
Bombay.	6,587	1,457	6,462	1,301	6,296	1,277
Central Provinces and Berar.	4,216	740	4,620	460	4,750	1,136
Punjab.	2,268	652	2,541	615	2,489	767
Madras.	1,976	412	2,228	424	2,071	381
United Provinces.	527	170	753	207	845	324
Burma.	320	62	228	34	373	87
Bengal.	76	24	75	17	77	19
Behar and Orissa.	65	13	68	14	69	14
Assam.	37	15	37	15	41	15
Ajmer-Merwara.	33	11	27	11	31	11
North-West Frontier Provinces.	16	3	18	4	13	3
Delhi.	2	1	4	2	4	1
Hyderabad.	3,602	534	3.644	5 9	3,527	651
Central India.	1,007	135	1,172	129	1,284	214
Baroda.	722	144	673	136	731	140
Gwalior.	597	76	639	76	619	103
Rajputana.	419	57	437	62	520	73
Mysore.	88	10	83	9	72	10
Total.	22,558	4,516	23,722	4,025	23,812	5,226

Raw Cotton Position in India.

	Year Ending 31st August.	
	1932 Thousand bales (400 lbs.)	1931 Thousand bales (400 lbs.)
Exports—		
To United Kingdoms.	125	274
Continent (Europe excluding United Kingdoms). ...	424	1,003
China.	243	626
Japan.	757	1,753
Other Countries.	33	73
Total. ...	1,582	3,729
Home Consumption—		
In Mills	2,346	2,271
Extra factory of local.	750	750
Total. ...	3,096	3,021
Approximate crop.	4,678	6,750
Estimated in Forecast.	4,025	5,226
Excess (+) or deficit (–) neglecting carry over. ...	+653	+1,524

(*From the Indian Trade Journal May 4, 1933*).

College News & Notes.

Reopening. The College reopened after the midsummer holidays on the 15th June. The second and third year classes have begun their work in full swing and the hostels and play grounds are full of liveliness after a long lull.

Selection of Students. The Government have appointed a Committee consisting of the following for selection of students to the College:- The Director of Agriculture, the Principal of the Agricultural College, Dewan Bahadur, T. Raghaviah I. S. O ; Mr. N. Sivaraj M. L. C., and Mr. Yahya Ali, M. L. C. The Committee sat at Samalkota, Madras and Coimbatore on 19th, 21st and 23rd respectively, and selected out of 130 applicants 48 students in all, of whom 24 are *Telugus*, 15 are Tamilians, 5 are from Malabar, 2 from S. Canara, 1 from Coorg and 1 from Nilgiris.

Appointments for Departmental officers. Dr. C. J. George M. A., Ph. D. of the Entomological section who was last year acting as Professor of Zoology and head of the department of Biology at the Wilson College, Bombay has been confirmed in his post and has left for Bombay resigning his appointment in the Madras Agricultural Department. It is understood that Dr. T. R. Seshadri M. A. Ph. D., Soil Physicist has been appointed as University Lecturer in Chemistry in the Andhra University and will be leaving Coimbatore in July. Messrs. S. N. Venkataraman B. A., B. Sc. Ag., and C. Jaganatha Rao B. A. of the Cotton Section are selected by the Indian Central Cotton Committee for training in Statistics and Plant Physiology respectively. The former will take his training under Professor P. C. Mahalanobis in Calcutta and the latter under Dr. T. Ekambaram of the Presidency College, Madras.

Ladies' Club. The construction of the club buildlng which was started in February has been completed and the formal opening of the building will take place in due course.

Cotton Research. It is learnt that Government are negotiating for leasing a plot of land at Perunturai in Erode Taluk for opening a Station for research in Nadam Cotton.

B. Sc. (Ag.) Examination Results. We regret, that in the results published in the May issue, we included by mistake, the name of C. Vadamalai a failed candidate, amongst those who were given 'reference' in chemistry.

Weather Review (MAY — 1933)

RAINFALL DATA

Division	Station	Actual for month	Departure from normal	Total since January 1st	Division	Station	Actual for month	Departure from normal	Total since January 1st
Circars	Gopalpore	1·5	−0·4	3·4	South	Negapatam	2·4	+0·5	8·8
	Berhampore *	3·1	+1·0	5·4		Aduthurai *	5·3	+2·8	8·1
	Calingapatam	0·4	−2·0	0·8		Madura	5·2	+2·2	8·5
	Vizagapatam	1·4	−0·8	2·0		Pamban	0·6	−0·4	4·0
	Anakapalli *	4·0	+0·7	7·9		Koilpatti *	2·6	+0·5	5·5
	Samalkota *	1·8	+0·5	2·6		Palamkottah	5·1	+3.4	11·8
	Cocanada	0·8	−1·2	1·4					
	Maruteru *	2·8	+1·2	3·0					
	Masulipatam	0·8	−0·4	0·9					
	Guntur *	2·2	−0·1	2·3	West Coast	Trivandrum	41·6	+34·5	47·7
						Cochin	42·4	+30·7	52·9
Ceded Dists.	Kurnool	2·5	+1·2	5·5		Pattambi *	25·8	+17·5	30·3
	Nandyal *	3·5	+1·9	4·0		Calicut	36·6	+27·1	47·5
	Bellary	5·4	+3·5	7·2		Taliparamba *	18·4	+8 8	22·4
	Hagari *	2·2	+1·6	2·9		Nileshwar *	23·3	+16·4	26·6
	Anantapur	4·7	+2·9	5·7		Kasargode *	...	...	...(a)
	Cuddapah	2·6	+1·0	2·7		Mangalore	18·8	+12·4	21·5
Carnatic	Nellore	1·1	−0·1	1·1					
	Madras	0·1	−1·7	3·6	Mysore and Coorg	Chitaldrug	3·6	+0·6	7·0
	Palakuppam *	4·2	+2·5	11·3		Bangalore	7·6	+3·3	9·0
	Palur *	4·9	+3·7	17·3		Mysore	9·3	+4·3	12·5
	Cuddalore	1·3	...	13·3		Mercara	17·1	+11·7	20·1
Central	Vellore	1.6	−1·5	2·9					
	Salem	2·2	−2·6	4·3					
	Hosur Cattle Farm *	4·7	?	6·6	Hills.	Kodaikanal	13·8	+7·5	23·6
	Coimbatore	3·7	+1·3	6·4		Coonoor	8·0	+3·6	17·9
	Coimbatore Res. Inst. *	4·4	+2·2	8·3		Kallar *	...	...	...(a)
						Ootacamund *	13·9	+4·9	17·7
	Trichinopoly	4·2	+1·2	6·8		Nanjanad *	11·1	+4·8	15·8

N. B. * Stations of the Agricultural Dept; (a) Reports not received.

Summary of General Weather Conditions: Normal hot weather conditions with thunder-storms over the western half of the presidency prevailed till the 15th of the month. Thunder storm activity was rather marked on the West coast and the Deccan. On the 16th, weather was disturbed of the Malabar coast and on the next day a storm formed about 100 miles to the west of Bombay, and moving rapidly crossed the Kathiawar coast on the 18th. The storm induced a flow of moist winds from the south west and general rain fell on the west coast from the 17th till the 20th, extending into Mysore and Deccan. On the 21st, conditions became unsettled in the south-west and centre of the Bay, and a storm formed on the next day centred at 12° N and 89° E. The storm moved in some northerly direction and crossed the Burma coast near Akyab on the morning of the 26th, and weakening rapidly disappeared by the 27th. This storm caused an advance of the monsoon in the Bay and the Arabian sea and by the end of the month the monsoon had established itself as far north as Ratnagiri on the Konkan and had reached the North of the Bay. The advance of the monsoon was accompanied by rough seas, squally weather and very heavy rain on the Malabar coast. Thunder-storms also occured on the North Madras coast between the 28th and the 31st under the influence of the monsoon. Rainfall was in very large excess in

Travancore, Cochin and Malabar; in large excess in S. Kanara, the Deccan, Mysore, Coorg and the Hills; in moderate excess in parts of the Central districts and South and locally in the Circars. The rainfall was exceptionally heavy in Travancore and Cochin States and much damage was caused to crops and property. The chief falls were: Irinjalakuda 12·4" (25th); Cochin 10·0" (28th); Peermade 9·9" (27th); Cranganore 9·8" (26th); Peermade 9·7" (29th); Calicut 8·5" and Cochin 7·3" (26th) and Mangalore 7·8" (29th). As a result of the early advance of the monsoon, day temperatures were generally below normal and most markedly so in the regions of heavy raniall

Weather Report for the Research Institute observatory :

May 1933: Report No. 5/33.

Absolute Maximum in shade	97·5
Absolute minimum in shade	70·0
Mean maximum in shade	91·5
Departure from normal	− 3·6
Mean minimum in shade	73·6
Departure from normal	+ 0·2
Total rainfall	4·44"
Departure from normal	+ 2·21"
Heaviest fall in 24 hours	2·36"
Total number of rainy days	6
Mean daily wind velocity	2·5 M. P. H.
Departure from normal	− 2·0 M. P. H.
Mean humidity at 8 hours	76·7 %
Departure from normal	+ 7·7 %
Total hours of bright sunshine	203·9
Mean daily hours of bright sunshine	6·6

General weather conditions: Rainfall was in large excess and conditions were generally of an unusual type for the month. Weather was thundery almost throughout the month and with the advance of the monsoon in the Arabian sea temperature fell to far below normal during the last week of the month. Severe local storm of a line-squall type passed over the observatory on the 22nd evening and gave 2·36 inches of rain. P. V. R. & T. S. L.

Departmental Notifications.

I Circle. P. V. Somayajulu Asst. in Mycology l. a. p. for one month from 5—6—'33 S. Suryanarayana A. D. Bobbile l. a. p. for two months from 1—6—'33. **II Circle.** V. Ratnaji Rao A. D., Naidupet, extension of l. a. p. for 2 days in continuation of leave already granted. T. Paramanandam, F. M. Guntur l. a p. for one month from 22—5—'33. **III Circle.** P. Subrahmaniam A D., Siruguppa, extension of 10 days leave on m. c. in continuation of leave already granted. M. Narayana Iyer A. D. Kurnool l. a. p. for three weeks from 8—5—'33. M. K. Gopalan offg. A. D. Prodattur l. a. p for 10 days from 5—6—'33. K. Jagannatha Rao A. D., Anantapur, extension of l. a. p. for 10 days in continuation of leave already granted. **IV Circle.** M. Gopalan Unnithan A. D., St. Thomas Mount, l. a. p for one month from 15—5—'33. R. Venkatarama Iyer A. A. D. Viridachalam l. a. p. for one month from 1—6—'33. K. E. Viswam Iyer A. A. D. Tiruvannamalai, l. a. p. for two months from 22—5—'33. N. Krishna Pillai A. D., Tiruvettipuram extension of l. a. p. for 2 days in continuation of leave already granted. **VI Circle.** C. S. Rajaratnam Mudaliar A. A. D. Koilpatti, l. a. p. for three months from 1—6—'33. L. Sankara Kumar Pillai A D. extension of leave on half average pay for one

month from 11—5—'33 on m. c. A. K. Ganesa Iyer A. D. Nilakkotta, l. a. p. for one month from 1—6—'33. **VIII Circle. Transfers.** S. S. Kachepeswara Iyer A. D., Ootacamund to be A. D. Annur. K. G. S. Bhandari F. M. Nanjanad to be A. D. Ootacamund. E. Raman Menon to be F. M. in charge of Nanjanad. S. Rajaratnam Chetty to be probationary F. M. Nanjanad. L. Krishnan A. D. Palladam posted to Coimbatore for undergoing training in office and district work. K. Kuppamuthu to join duty at Coimbatore on 15—6—'33. K. G. S. Bhandari A. D. Ootacamund l. a. p. for 10 days from 5—6—'33. **Principal's Section.** V. Viswanatha Iyer, A. F. M., l. a. p. for 19 days from 29—5—'33. K. K. Raghavan F. M., extension of 1 a. p for 10 days in continuation of leave already granted. **Millet Section.** P. Krishna Rao Asst. l. a. p. for two months from 17—5—'33. **Paddy Section.** M. K. Padmanabhan Asst. extension of l. a. p. from 26 to 30—5—'33 on m. c. **D. A's. Office Orders.** L. Krishnan will continue to officiate from 11th May to 2nd July '33. Vice A. Rangaswami Iyer A. D on leave. E. R. Gopala Menon Asst. l. a. p. for 2 months and 15 days from 1—6—'33. Muhamad Moinuddin who had previously officiated as assistant in the Entomology section is to officiate as assistant in the Entomology section from 1—6—'33 to 19—6—'33. E. R. Gopala Menon temporary Assistant Entomologist, will be reverted to his permanent appointment as Assistant in the Entomology section from 1—6—'33. V. Margabhandu, Assistant, Entomology section is appointed as temporary Assistant Entomologist from 1—6—'33. K. P. Sankunni Menon F. M., Coconut Research Station, Nileshwar, l. a. p. for 4 months from the date of relief. M. J. David, whose officiating appointment as Assistant in the Mycology section will terminate on 31st May 1933, is appointed to officiate as Assistant in the Millet section from 1—6—'33, vice P. Krishna Rao. John A. Muliyil, Asst. leave for 2 years for higher study in Entomology from 1—7—'33; l. a. p. in India for 2 months from 1—7—'33 and leave on half average pay *out of India* for 22 months in continuation thereof. M. C. Menon, F. M. Live Stock Research Station, Hosur, transferred to IV Circle.

ADDITIONS TO THE LIBRARY, DURING MARCH 1933.

(Including Books for the Students' Library.)

A. Books.

1. *Comber N. M.* (1932) An Introduction to the Scientific Study of the soil. 2. *Emerson P.* (1930) Principles of Soil Technology. 3. *Robinson G. W.* (1932) Soils: Their origin, constitution and classification. 4. *Passmore J. B.* (1930) The English Plough. 5. *Israelson O. W.* (1932) Irrigation Principles and Practices. 6. *Powers W. L. & Teeters T. A. H.* (1932) Land Drainage—2nd Edn. 7. *Watson W. (Ed.)* (1925) The Gardner's Assistant—6 Vols. 8. *Gourley T. H.* (1927) Text Book of Pomology. *Hedrick U. P.* (1925) Systematic Pomology. 10. *Smith J. R.* (1929) Tree Crops. 11. *Margaret J. M. Watson* (1926) Home Preservation of Fruits and Vegetables. 12. *Rockwell F. F.* (1927) The Hand Book of Shrubs. 13. *Rockwell F. F.* (1928) The Hand Book of Evergreens. 14. *Rockwell F. F.* (1928) The Hand Book of Rock Gardens. 15. *Rockwell F. F.* (1930) The Hand Book of Lawns. 16. *Ramsay L. W.* (1930) Landscaping the Home Grounds. 17. *Culter J. L.* (1932) A Simple Guide to Rock Gardening. 18. *Thompson H. C.* (1931) Vegetable Gardening—2nd Edition. 19. *Hardenburg E. V.* (1927) Bean Culture. 20. *Bourne R.* (1931) Regional Survey and its relation to Stock taking of Agricultural and Forest Resources of the British Empire. 21. *Jull M. A.* ,1930) Poultry Husbandry. 22. *L. Van. Es.* (1932) The Principle of Animal Hygiene and Preventive Veterinary Medicine. 23. *Marshall F. H. A. & Halan E. T.* (1932) Physiology of Farm Animals. 24. *Gatger S. H. & Davies G. O.* (1932) Veterinary Pathology & Bacteriology. 25. *Lindsey A. W.* (1932) A Text Book of Genetics. 26. *Sinnot E. W. & Dunn L. C.* (1932) Principles of Genetics: A Text Book with Problems. (2nd Edn. Revd. 27. *Hunter*

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