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CONTENTS

Editorial.

Indebtedness in Rural Areas. As a result of the Debt Conciliation Bill introduced into the Madras Legislative Council by Dewan Bahadur T. A. Ramalingam Chettiar, Government had appointed Mr. Sathianadhan, I. C. S. on special duty to investigate into the problems of rural indebtedness. The terms of reference to the special officer contained among others, the extent of indebtedness among the agriculturists, the effect of the depression and fall in prices on them, the existence of facilities to afford relief to the agriculturists, the extent to which landed property is mortgaged as security for debts, the passing over of lands from the agriculturists to the non-cultivating classes in recent years, and the need for legislation on the lines of the Debts Conciliation Bill. The report of the special officer which was published last month deals with the question exhaustively and we would like to draw attention to a few of the salient features of the report.

Dealing with agriculture as an industry he refers to the general poverty of the people, the vicissitudes of season, the character of the people, the change in the standard of living, the toll levied by the money lender and the middlemen, overpopulation, fragmentation of holdings and loss from cattle mortality as some of the contributing causes for the indebtedness. It has been found that the return from

the land on which all the staple food crops are grown varies from 2 to 5 per cent. in a normal year and seldom exceeds 6 per cent. even in a good year. It is obvious therefore that the industry must end in bankruptcy when amounts are borrowed on the security of land at interests far exceeding 6 per cent., ranging as it does from 9 to 24 per cent. and often rising to even 36 per cent. The problem thus amounts to finding credit for the industry on terms which the borrower can afford to pay. There must be instituted some financing agencies who will pay off the standing debts of the agriculturists and afford them facilities to repay the same with interest at as low rates as possible in easy instalments spread over a long period of years.

Mr. Sathianathan estimates the debt burden of the agriculturists in Madras at about 200 crores of rupees. The task of converting such a large amount of outstanding debt at high rates of interest, into one with reasonable rate of interest must itself prove a stupendous one. The special officer has studied the indebtedness of 541 families in different parts of the province in order to find out the proportion of debts to assets and finds this proportion has considerably increased, being about 20 per cent. now, as compared to 9 per cent. in the pre-depression days. The increase in the indebtedness would thus appear to be partly due to the economic depression and the fall in commodity prices and to the uneconomical method now available of financing agriculture. In order to bring about relief the special officer has suggested remedies to tackle both the causes. Some of these are those in which the Agricultural Department must be interested. After referring to the good work done by the groundnut co-operative sale society started in Cuddalore two years ago and suggesting the concentration on the same lines to provide facilities for rural help in a few selected centres in each taluq, he chalks out a scheme, wherein he makes the following recommendations; (1) A good warehouse for storing produce, (2) A well stocked agricultural depot under a demonstrator to supply ryots with implements, seed, manure, etc., (3) A small farm of 2 to 3 acres for demonstration purposes, (4) A well informed price-information bureau, (5) A stud bull, etc. While some of these are already being adopted on a small scale, the special officer's recommendations would mean enlarging and intensifying such work. The recommendations about improvement of irrigation facilities, improvement of communications in the rural areas, standardisation of weights and measures, encouragement of transport of agricultural produce by motor lorries, reduction of railway freights etc., are all familiar to our readers and attention has been drawn to them in our journal at various times.

We are interested to note that the special officer considers that the reasons for the low outturn of staple food crops are the limited demand and the unstable prices obtained for the produce. He dwells on the necessity for an effective tariff barrier against the import of

foreign produce into the country and suggests an increase in the production of the commodity within the country sufficient to meet the requirements.

On the legislative side the remedies suggested by the special officer relate to Debt Conciliation legislation, anti-usury measures, regulation of the activities of the money lenders, the enforcement of a proper system of accounting on the part of creditors, the adoption of the principle of *demdupat*, suitable amendments to the civil procedure code to secure for the debtor, proper values for his assets sold in execution of decrees, etc. We may in this connection refer to the comprehensive resolutions on the question of rural indebtedness adopted at the co-operative conference held recently in Madras. Some of these are that Government should not charge more than 5 per cent. interest on loans, that the period of loans should be extended to 40 years and that the maximum limit of the loan should be raised to Rs. 3000. The conference has also suggested the establishment of a Trustee Bank. We are sure these questions will receive consideration at the hands of Government. That the Government is fully aware of the gravity of the situation is apparent from the fact that at its initiative a bill was passed last August in the local council introducing amendments to the Agriculturists' Loans Act of 1884. We are also glad to note that the scheme of giving help to the agriculturists to pay off prior debts is proposed to be introduced shortly in three areas in the first instance as an experimental measure.

Comprehensive in its survey and practical in its recommendations the Sathianathan Report is a very valuable document, and relief measures, carried out on the lines suggested in it, will, we are sure, serve to give greater stability to our basic industry, agriculture ; freed of the shackles of debt which cling to him like a hideous nightmare, the tiller of the soil, will now be in a position to set apart some finance for improved and scientific methods, with ultimate and lasting benefit to the whole country.

Sir T. Vijyaraghavacharya. Sir T. Vijyaraghavacharya, Vice Chairman of the Imperial Council of Agricultural Research has retired from service this month. He has been associated with the activities of the Council from its very beginning and the good record of progress in the work of the Council has been largely due to his wise guidance and zeal. Anyone who has attended the meetings of the Council cannot fail to be impressed with Sir T. Vijyaraghavacharya's genial temper, tact, compromising spirit, and his impartiality in conducting the meetings. Six years ago when the Imperial Council of Agricultural Research was brought into existence, the public did not exhibit much enthusiasm over it and if to day the usefulness of the Council has come to be realised by one and all, it is in no small measure due to the guidance given to its early activities by its Vice Chairman.

The respect and regard he has created for himself is evident from the glowing tributes paid to him by eminent men like Sir Jogendra Singh, Sir Joseph Kay, Sir R. K. Shanmugham Chetty, Mr. B. G. Kaparde, Mr. Carpenter and others on the eve of his retirement. It has been stated that but for the good work of the Vice Chairman, the Imperial Council of Agricultural Research should have suffered much more than it did when the general retrenchments came in 1931. The Government have also accepted the unanimous resolution of the Governing Body of the Council in making Sir T. Vijyaraghavacharya a permanent member of the Imperial Council of Agricultural Research and also of its Governing Body from the date of his retirement. He will thus have an opportunity to be in actual touch with the gradual progress of the edifice in erecting which he has played an important part.

Though only an administrator his interest and enthusiasm for science has been recognised in that he has been elected a fellow of the National Institute of Sciences and the Indian Academy of Sciences. He also presided over the Agricultural Section of the Indian Science Congress in 1931. The Madras Agricultural Students' Union had the good fortune to have him as its President at the annual conference in 1933.

Sir T. Vijyaraghavacharya is proposing to go to Europe for some rest. By his frequent visits to Europe even duriug these six years he has been keeping himself in touch with the latest developments in Agriculture in the foreign countries and making his experience available to the Imperial Council of Agricultural Research.

In spite of domestic calamities, he has always been keeping up a cheerful outlook, and for one of his age, his active habits and energetic spirit are amazing. We wish him a well earned rest and we are glad his valuable advice and help would still be available to the Imperial Council of Agricultural Research and to the country when he returns from Europe.

PHYSICO-CHEMICAL STUDIES ON SUGARCANE JAGGERY *

(A Preliminary Communication.)

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Introduction: Jaggery is the most important of the products manufactured from sugarcane in India. The consumption of jaggery is about 2 to 2·5 times that of the total white sugar, the latter comprising of all that is (i) imported, (ii) manufactured in the local factories and (iii) produced by the indigenous '*bel*' method. This proves the still greater hold of the cottage industry of jaggery manufacture.

Jaggery is used for direct home consumption, and for the manufacture of refined sugar. On an average about 2·5 to 3 millions tons of jaggery are used for direct consumption and about 1 to 2 lakhs of tons for refining. But according to the Report of the Indian Tariff Board on Sugar Industry (1931), the return from 100 maunds of cane manufactured into *gur* (jaggery) and then refined is not more than 5·5 maunds as against 9 maunds obtained by direct manufacture from cane, while the amount of the molasses produced is approximately the same per unit of cane in each case. The process is wasteful, and is therefore not designed to make the best use of the country's resources. According to Srivatsava (1) the refinability of jaggeries varies from 42% to 65%, yielding but 4·2% to 6·5% of white sugar calculated on cane, Srivatsava adds that so long as the quality of *gur* (jaggery) does not improve, and the recovery of sugar remains at the present level of 5·5% on the basis of the original cane, the future of the refining industry must remain uncertain. Some measure of co-operation between the manufacturers of *gur* (jaggery) and the refiners, might lead to the improvement in the quality of the product which would not only give a better return to the cane grower, but would also make refining more profitable, thus giving a new lease of life to the industry. Again, even so long ago as 1909 the need for such a cooperation was emphasised by C. J. Mackay, when he said, "if the sugar industry in India is to hold its own against the foreign importer, development will have to be along the line of intense cultivation by the grower to increase the outturn of sucrose per acre and improvements in the making of raw gur (jaggery) by the villager preventing the heavy losses by inversion and adulteration entailed by the crude methods at present employed. If this can be done, the Indian refiner will have nothing to fear from foreign competition in India, and may in time be even able to export to other markets if not barred by prohibitive protective duties."

In spite of this insistent and the long-felt need for the production of uniform and superior quality jaggeries in respect of their colour,

* Paper presented before the Twenty-fourth Agricultural College Day & Conference, August 1935.

hardness, crystalline character, and keeping and refining qualities, the problem does not appear to have received the attention it deserves. The available literature on the subject is scanty, scattered and imperfect, and comprises only of a few casual references. In view of this, therefore, a more systematic study of the problem was started.

While the production of the jaggery is confined to a particular season of the year, its use whether for home consumption, or for marketing, or for refining, extends over the whole year. Some jaggeries keep well during all the seasons without softening or running into liquids, (the good), while others which are normally fairly hard, tend to soften during the damp weather, (the medium); besides these there are others which are damp, soft and sticky even to start with the bad. This therefore points to a necessity for investigating into the probable causes for these differential behaviours of the jaggeries, as a preliminary for a further investigation into the possibilities of producing jaggeries which may be of uniformly good quality or at least of jaggeries which may be as nearly so as possible. Therefore, in the present investigation an endeavour is made to understand the probable causes for these differential behaviours of the jaggeries, and its scope is limited to the study of the physico-chemical characters of the different types of jaggeries to elicit the probable factors that may be governing their keeping qualities.

In this preliminary communication a brief summary of the results of this study is presented while detailed papers will be published elsewhere.

Studies in the moisture relations of jaggeries: As the humidity or the dampness of the atmosphere is generally the main controlling factor, the responses of the jaggeries of different qualities to various humidities were studied. The results pointed to the following:

1. There appears to exist an optimum relative humidity lying between the limits 50 and 60% for all the types of jaggeries to keep well without changing their physical states.

2. The good jaggeries possess comparatively greater openness of texture and absorb smaller amounts of water at greater rates, while under the same conditions, the bad ones take up larger amounts at considerably slower rates.

3. The good jaggeries are capable of holding larger amounts of water in surface solution without themselves collapsing, while the bad ones collapse and change their form even with smaller moisture contents. This property accounts for the retention of the form and the hardness by the good jaggeries during the monsoon weather and for the softening and the running into liquid of the bad jaggeries.

4. Under drier conditions which favour loss of moisture, all the good jaggeries are characteristically capable of quickly parting with

larger proportions of water contained in them, retaining but only a very small fraction of it All the bad jaggeries on the contrary, retain characteristically the larger part of the water giving up but a very minute fraction of it.

Thus these differential properties make it evident that the good jaggeries become quickly dry as the drier atmospheric conditions begin to prevail soon after the monsoon periods, while the bad ones sometimes become worse than what they had been even before the setting in of the monsoon. Once they collapse and begin to run into liquid during the highly humid weathers, even the medium jaggeries having an apparent hardness and solid form, not to speak of the bad ones, cannot regain their original shape, and as such, would continue thereafter to remain as thick pastes, if not exactly as liquids.

It is occasionally observed that some jaggeries develop an ashy appearance on standing for some time. Observations showed that this phenomenon is exclusively confined to the good jaggeries, and that this occurs during the fair weather that immediately follows a damp period. The ashy layer consists of minute but well developed crystals of sucrose formed as a consequence of the evaporation of the water which was taken up in damp weather and held in surface solution.

Studies in the Structures of Jaggeries. The different types of jaggeries also differ very markedly in another important respect, viz., their internal structures. All the good jaggeries characteristically possess an extensive internal core of crystalline sucrose covered on the outside by a thin envelope of a more deeply coloured material with more of the matrix. The core is highly crystalline and extremely hard, while the envelope is also hard, very compact and translucent. Some of the good jaggeries occasionally have very extensive and closely placed patches of crystalline sucrose, separated by very thin veins of the material with more of the matrix, in place of the distinct core and an envelope.

In the bad jaggeries the sucrose disposes itself in rhythmic bands or veins of varying widths and sometimes in widely separated patches of varying sizes bounded by thicker layers of the damp matrix material. While in the good jaggeries it is the material with more of the matrix that constitutes the veins, in the bad ones, on the other hand, it is the crystalline sucrose which exists as veins or bands. The differential structures, characteristic as they are, easily enable the appraising of the jaggeries. The type characters are so distinct.

Again, an examination of the microtome sections of jaggeries, the sections being obtained by a modified technique devised to suit the material, revealed marked differences to exist between the bad and the good jaggeries. In all the good jaggeries the sucrose crystals are big and well developed approaching the ideal candy type in form. The crystals in the core are closely packed and cemented together by very thin

films of the matrix. Even the crystals in the envelope are comparatively very big and fairly well formed.

In all the bad jaggeries the crystals are not well developed, either in form or in size. They are very minute. Again, compared with the good jaggeries, the number of the crystals in any given area in the section is enormously large in the bad jaggeries. While again in the good jaggeries most of the matrix is localised in the outer envelope, in the bad ones it is distributed over the whole mass of the jaggery. It forms thick films around individual crystals.

These observations serve to explain the openness of the texture in the good jaggeries. They also afford explanation for the absence of strength in the bad jaggeries to keep water in surface solution, as both the fluid matrix material and the minute sucrose crystals which are very minute in size tend to dissolve in water very readily. Their differential capacities to either absorb or retain water are also easily explainable based upon these observations. Thus it becomes clear that the properties of the jaggeries as revealed by their responses towards different humidities appear to be intimately associated with their internal structures. Again, from the results of the examination of the microtome sections of the bad and the medium types of jaggeries, it becomes obvious that they can be considered as consisting of mixtures of thick fluids with fine solid particles (minute sucrose crystals). Hence it can be expected that they behave as plastic bodies, wherein the relative proportions of the fluid matter and the solid particles, and consequently the fluid film pressures are the main operative forces in governing their physical states. Depending therefore upon the number and the size of the crystals on the one hand, and the relative proportion, the density, and the viscosity of the matrix material on the other, it can easily be realised that various types of jaggeries with different degrees of consistency, ranging from those with mechanical rigidity, mistaken for hardness, to jaggeries which are no more than thick pastes, could be had. It is within experience that jaggeries with different degrees of fluidity and yield values are met with.

In this connection it may be mentioned that while the moistures taken up by the jaggeries, no doubt, control their softening, yet it is not the only cause for affecting this change in the physical state. If external pressures are made to operate on the jaggeries in excess of the forces due to the fluid films, they tend, as do all the plastic bodies, to collapse and become pastes or fluids. This is what actually happens in practice. In the mode of preservation of the jaggeries which consists in piling them up in layers, one over the other, there are caused great stresses to continually operate on the jaggeries in the lower layers, which in consequence, collapse or change their form. The good jaggeries however do not yield so easily under these conditions.

Now these differences in the structures suggest that the conditions in the good are such that the formation of mulli and the growth of sucrose crystals proceeded well and unhampered, while this process must have met with high degrees of resistance in the bad jaggeries.

Studies in chemical composition: In order therefore to elicit information in regard to the probable factors which might be more directly responsible for causing these differential conditions, and therefore the differential properties, a large number of samples of jaggeries of different qualities was analysed for the several constituents and further the influences of these several constituents, were also studied by preparing synthetic jaggeries, adding them severally to pure sucrose solutions in graded proportions. The results showed that independently of the question of purity (high percentage of sucrose), the most potent of the constituents in the jaggery, affecting the crystallisation of sucrose, and so conditioning the physical structures of the jaggeries and their other related properties, comprise of what constitutes the *non-sugar organic matter* fraction.

The properties of this fraction in the good jaggeries differ markedly from those of the corresponding fraction in the bad ones.

These and other independent studies on the boiling of cane juice and the changes taking place during the process, and the experimental observations on the times and the temperatures of the setting of the jaggeries, indicate that the *non-sugar organic matter* in the bad jaggeries contain substances which cause high viscosities, retard the progress of boiling, cause the tenacious retention of moisture, and offer resistance to the formation of the nuclei and the growth of the sucrose crystals. The corresponding fraction in the good samples does not appear to be causing such adverse effects.

A preliminary examination of the juices and the jaggeries from canes raised under different manurial and cultural conditions suggests that the quality and the proportion of the nonsugar organic matter fraction are greatly modified and controlled by the particular conditions under which the cane is grown. For example, juices from canes grown by manuring them with castor cake contain these in least amounts, and in less harmful condition, while those from canes grown by manuring with ammonium sulphate alone are noted to have a larger percentage of these. Again when a cane is grown under absolutely dry conditions, or on saline soils, or when it is irrigated with brackish water, it is observed that this fraction is present in comparatively larger amounts, or in more harmful conditions, than when the same cane is grown under normal conditions.

Further work on this aspect is proceeding.

I take this opportunity to offer my grateful thanks to the Government Agricultural Chemist for the facilities afforded by him, and for his helpful guidance and the sympathetic criticism of the work during the course of the investigation.

CHLOROPHYLL DEFICIENCIES IN *PENNISETUM TYPHOIDES* (Stapf. & Hubbard.) THE PEARL MILLET *

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Chlorophyll deficiencies are a common occurrence in cereals. They have been noted in some millets, *Sorghum*[1], *Eleusine coracana*[2], *Setaria italica*[3] and *Paspalum scrobiculatum*[4]. All stable varieties have attained chlorophyll efficiency of degrees, the deficiencies being eliminated by a process of vigilant mass selection through a number of years. In dry crops where the stand is uncertain, the yield meagre and the seed rate important, no cultivator can afford to sow seed some of which would throw albino seedlings. At the Millets Breeding Station, Coimbatore, where a number of races are brought into an impact with each other, optimum conditions prevail, (especially in a protogynous crop like the pearl millet), for the coming together of factors which in isolation might not be lethal, but whose lethal propensities have been activated by inadvertent association. A number of experiences in the chlorophyll deficiency of this millet have therefore been met with[4]. The pursuit of albinism in this protogynous crop is beset with peculiar difficulty. No useful Mendelian deductions can be drawn except on selfed material; and selfing is particularly difficult in this crop with its protruding stigmas. Nevertheless a number of plants have been selfed and this phenomenon of albinism pursued in some aspects.

The simplest case is a single factor difference that marks out the surviving green from the albino that dies. The albino is pure white. Simple segregations from plants (selfed through two generations) taken from an original segregation of a natural cross, confirm the existence of this factor designated C, whose absence, results in a lethal albino. Of the 30 heads selfed and sown, 20 segregated again, and 10, as expected, proved pure for green.

Table I.

Family Numbers.	Number of Selections.	F_3 Seedlings Segregation Total	
		Green.	Albino.
P. T. 598	5	1,843	675
,, 599	5	2,723	924
,, 600	2	1,022	310
,, 601	3	1,427	477
,, 602	3	1,942	646
,, 603	2	1,144	358
	Grand Total	10,101	3,390
	Expected 3:1	*10,118*	*3,373*

* Tamil—*Kambu.*

Germinations of the small grains of this millet are best done in pots and not in the field. It has been found that splitting the spike in longitudinal halves and setting the split halves in wet sand will give an *in situ* germination, showing the segregation very graphically[5].

In the second instance the deficiency in chlorophyll has not proved lethal. Seedlings turn pale green, but live and produce weak plants. These pale plants are light green in all parts bearing chlorophyll, such as leaves, stem, glumes, and bristles. Similar pure materials, P. T. 596 (green) and P. T. 597 (pale green) extracted from an original segregate were secured by selfing. These were again artificially crossed. This pale green has proved a simple monofactorial recessive due to the absence of a factor designated E which conditions the efficient manifestation of C. The following table gives the segregates obtained from this family.

Table II.

P. T. 597 × P. T. 596 = Cross No. P. T. XIII

Family Numbers.	F_2 Seedling Segregation	
	Green.	Pale green.
P. T. XIII/1	589	193
„ XIII/2	473	150
„ XIII/3	457	145
„ XIII/4	238	75
Total	1,757	563
Expected 3 : 1	*1,740*	*580*

Three F_1 plants from the cross between green and pale green were back-crossed with the recessive pale green and the following table gives the segregates obtained.

Table III

Head Number	Seedling segregation	
	Green	Pale green
1.	520	488
2.	511	479
3.	341	373
Total	1,372	1,340
Expected 1 : 1	*1,356*	*1,356*

Pale green plants are poor in growth and produce weak heads. The following table gives the economic disabilities of these plants as compared with the normal green and the intermediate F_1 plants.

Table IV

Averages of fifty Readings.

Variety Number	Plant Character.	Height cm.	Number of tillers.	Weight of main head gm	Grain yield of main head gm.	Number of grains in 2 gm. weight. (Density.)
P. T. 43	Green	200	4	15	12	345
P. T. 597	Pale Green	130	1—2	10	4	432
P. T. 43 x P. T. 597 F_1	Green	150	3	13	8	310

A conjoint experience giving greens, pale greens and albinos was also gained from Cross No. P. T. XVI (P. T. 597 x P. T. 43 a heterozygous green), an instance throwing light on the manner in which two apparently healthy plants might, on crossing, produce lethals. The triple segregates obtained from the F_2 families of this cross are given below.

Table V.

Family Number	F_2 Seedling segregation.		
	Green.	Pale green.	Albino.
P. T. XVI/10	122	46	64
„ XVI/13	238	73	95
„ XVI/16	158	50	62
„ XVI/21	268	99	112
„ XVI/24	224	85	102
„ XVI/29	294	106	142
„ XVI/37	183	62	82
Total. ...	1,487	521	659
Expected 9 : 3 : 4	*1,500*	*500*	*667*

In this connection it is interesting to record an isolated instance in our work on this millet in which the stigmas of one variety instead of being hyaline, developed a purple pigment. This purple pigment in the stigma could be perpetuated in some of the progeny by selfing, but such progeny gave evidences of primitive disabilities like albinism, striping in the leaf, hairiness on the leaf, sparseness of grain in the earhead and a general tendency to a wilder condition. This purple seemed therefore a sort of distress purple. Such indices to defective and lethal potentialities are not of a common occurrence, but as one of the ways in which such deficiencies may find expressions, this experience is interesting.

These recessive chlorophyll deficiencies are therefore best handled in a breeding station by their elimination through selfing and breeding, so much so that non-defective seed could be sent out for distribution. Another point to be borne in mind is the possible interaction between latent factors in the introduced and the local variety, so that without

an examination of such possibilities it will be hazardous to indiscriminately introduce and grow new varieties side by side with existing good ones. This risk is very real, especially as many more factors than two are known to exist in the production of efficient chlorophyll in cereals generally.

Summary. Chlorophyll deficiences resulting in pale and albino seedlings have been met with in the pearl millet (Pennisetum typhoides, Staff and Hubbard). A factor C produces chlorophyll. In its absence the seedlings are white and die. C is a simple dominant to c. A second factor E conditions the efficient manifestation of C. C with E produces good green seedlings. Without E, the plants are pale green and weak. E is a simple dominant to e, but can operate only when C is present.

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THE '*SOORAI*' DISEASE OF PADDY

BY

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Introduction. The 'Soorai' disease of paddy is caused by a mealy bug—*Ripersia oryzae*, Green,—belonging to family Coccidae, order Rhynchota. The insects suck the plant sap and, as a result of their attack, the affected plants get stunted in growth. In severe cases of infestation the earheads get smothered and either fail to emerge from the sheath or when emerged do not produce healthy grains. The infestation is seen to occur in patches in the field.

Distribution of the Pest. Numerous reports of the occurrence of the pest are on record in the files of the Government Entomologist, the first one being in 1909, from Salem District. The pest has been reported from the following taluks in the Madras Presidency.—Berhampore, Anakapalle, Peddapuram, Nellore, Trichinopoly, Ariyalur, Mayavaram, Tanjore, Kumbakonam, Palni, Attur, Salem, Dharapuram, Palghat and Walluvanad.

In view of the fact that reports of the pest are being received from the various parts of the Presidency, an attempt is made to present the facts so far ascertained regarding the pest as a result of the studies made at the Agricultural Research Station, Aduthurai.

Description of the pest and its stages. As stated before, the disease is caused by the mealy bug *Ripersia oryzae*. The adult female (vide Plate) is elongate, more or less cylindrical, purplish in color and covered with a mealy covering. It is about 4 mm. long and practically incapable of any movement. The male is a very tiny, delicate, winged creature, very seldom seen. The adult females and their young ones known as 'nymphs' are found between the stalk and the leaf sheaths in the earlier stages of the plant and in the later stages at the harvest time these are found between the earhead stalk and the sheathy leaf.

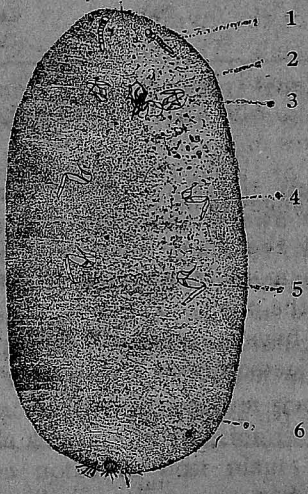
Eggs are laid by the female in groups under the mealy covering, These are about ½ mm. long, cylindrical in shape and light yellow in color. The eyes of the nymphs could be seen clearly through the transparent egg shell. The females are known to lay large numbers of eggs. Ten big-sized females laid 126 ; 140 ; 151 ; 152 ; 165 ; 209 ; 225 ; 292 ; 299 ; and 319 eggs respectively. The egg period ranges from a few minutes up to one day. The newly hatched young and those about a day or two old are found actively moving about. The nymphal period ranges from 17 to 34 days.

Incidence of the Pest. The degree of infestation of affected plants depends on many factors, one of these being the actual number of bugs noted on the plant. In some of the badly infested plants the population of the bugs is rather alarming. The results of the examination of a few affected plants are given below.

Bug population in 'Soorai' affected plants.

No.	Date of examination.	Variety of paddy.	Total No of tillers of plant.	No. of infested tillers.	No. of adult bugs.	No. of nymphs.	Total population of adults & nymphs for the plant.
1	18—11—30	Nellore Samba.	8	8	66	530	596
2	20—11—30	GEB. 24.	13	13	164	430	594
3	12—12—31	Adt. 1	7	5	14	566	580
4	,,	,,	4	4	15	258	273
5	,,	,,	5	5	22	264	286
6	,,	,,	5	5	16	195	211
7	,,	,,	3	3	17	325	342
8	,,	,,	6	5	7	60	67
9	,,	,,	4	4	9	152	161
10	,,	,,	4	4	17	479	496
11	,,	,,	6	6	28	411	439
12	,,	,,	5	5	12	220	232

Loss due to Soorai. It has not been possible to get definite data regarding the loss of yield due to soorai disease. The loss seems to be more in seasons of drought. Again, as in the Tanjore delta, the short duration crop (*Kuruvai*) does not seem to be much affected by the mealy bug. It is the long duration crop (*Samba*) which suffers most.



THE PADDY MEALY BUG (adult female) (Ripersia oryzae, Gr.)

1. Antenna. 2. Mouth parts. 3, 4, 5, Legs. 6. Pygidium.

The yields of a few affected plants were recorded separately and the following table gives an idea of the loss due to this disease in Aduthurai farm.

Yields of affected & healthy plants.

Crop	Variety of paddy	Yield of grains from diseased plants-per 100 plants	Yield of grains from healthy plants calculated per 100 plants	Loss for 100 plants	Number of plants from which yield has been taken.
		(in grams)	(in grams)	(in grams)	
Samba	A. E. B. 65	140	727	587	50
	Adt. 5	190	678	488	50
	G E. B. 24	173	606	433	40
Kuruvai	Adt. 3	241	607	366	100
	Adt. 4	193	469	326	30

It may be stated in this connection that plants from which mealy bugs were mechanically removed, when transplanted, gave fairly good yields.

Host Plants. As a result of the studies at the Agricultural Research Station, Aduthurai, it is definitely known that the following varieties of grasses serve as breeding grounds for the pest— *Andropogon annulatus; Apluda varia; Chloris barbata; Cymbopogon caesius; Cynodon dactylon; Digitiria sanguinalis var. aliaris; Eleusine aegyptiaca; Eragrostis interrupta; Eriochloa polystachyia; Isachne australis; Ischaemum ciliare; Iseilema laxum; Leptochloa chinensis; L. polystachyia; Panicum colonium; P. javanicum; P. prostratum; P. refens; Paspalum scroibiculatum; Saccharum spontaneum* and *Setaria glauca.* In addition to these, the following Cyperaceae have also been noted as host plants *Cyperus rotundus; Fimbristylis argentea; F. miliacea; F. tenera;* and *Juncellus pygmaeus.* The existence of the numerous weeds mentioned above has been one of the factors standing in the way of effectively controlling the pest.

Method of Spread of the Pest. During the off-season when there is no paddy in the fields the pest breeds, as noted before, on a variety of grasses and spreads later on into the nurseries. It is these nurseries which act as the main source of infestation. Seedlings containing bugs are carried from the nurseries into the fields and the pest multiplies in large numbers and gradually spreads the disease. It is known definitely that the bugs can spread from one plant to another if they touch one another. Water and wind also may act as agents in the spread of the pest.

Natural Enemies. A few predaceous and parasitic insects are found attacking the mealy bugs but these are not found in sufficient numbers to check the pest. Two or three Chalcids, one or two lady birds and certain Agromyzid fly maggots have been found as natural enemies of the pest.

Control Methods. This is a pest which is very difficult to control. As stated above, the mealy bugs are found in a secure position between the stalks and leaf sheath. It is not possible, therefore, for any insecticide to reach the pest. So, spraying is out of the question.

Attempts were made to see whether heaping of affected paddy seedlings in bundles (in conical heaps) and covering them with wet gunny bags had any effect on the mortality of the pest. The heaps were examined on the 5th day; the mealy bugs were, however, found healthy.

Manurial and varietal trials have also been tried but have not given any conclusive results.

It is proposed to study the natural enemies of the pest to see whether they could be utilised as a practical method of control.

The only method which can be suggested at present is to watch the nurseries for early symptoms of infestation and pull out the affected seedlings and burn them.

The Government Entomologist will be glad to receive any available information regarding the pest from the District staff and also others interested in the subject.

ESTIMATION OF NITROGEN BY OXIDATIVE DIGESTION.*

When an organic substance containing nitrogen—such as a protein—is continuously boiled with concentrated sulphuric acid, it undergoes digestion, yielding carbon dioxide and sulphur dioxide (together with considerable amounts of acid fume) as gaseous products and leaving a residue, which generally contains all the nitrogen as ammonium sulphate. On this reaction is based the well-known Kjeldahl method,[1] which was first introduced in 1883 and which, in one or the other of its several modifications is still most extensively adopted for the estimation of nitrogen. A conservative estimate would indeed show that in scientific research alone—apart from routine analyses in Government laboratories, factories or private practice—a few millions of determinations are being annually carried out by that method.

With increasing experience, it was realized that the acid digestion did not proceed either so smoothly or so quantitatively as was originally expected. It was also soon recognised that in the case of rather resistant materials like soil, yeast or cereal husk, the Kjeldahl method cannot be depended on for very accurate estimates. There was still no remedy and it was not until 1925 when Bal[2] drew attention to the highly discrepant results which he obtained with the black cotton soils of the Central Provinces that some fresh advance was made. Bal

* A Paper By Prof. V. SUBRAHMANIYAN, D. Sc., F. I. C. Indian Institute of Science, Bangalore.

noticed that the heavy clay soils which he examined were not properly penetrated by the 'dry' (concentrated) sulphuric acid which he used. He therefore first wetted his soils with water and, after ensuring their proper dispersion, followed up with the addition of sulphuric acid. This procedure, which he designated the 'wet' method yielded not only more concordant but also distinctly higher estimates than those obtained by the official Kjeldahl method. This important observation did not, however, receive the attention which it deserved and it was not until 1932 when Sreenivasan[3] observed that the phenomenon observed by Bal was quite general and applied not only to soils but also to a variety of other materials as well. Later researches (4, 5, 6) also showed that in the case of soils - especially those rich in clay—addition of concentrated ('dry') sulphuric acid led to the formation of an impenetrable protective coat of silica around undigested soil particles. Pre-treatment with water or dilute acid prevented the formation of this protective coat and facilitated the digestion proceeding to completion. Other observations also showed that addition of small amounts of oxidising agents such as peroxide, perchlorates, permanganate or dichromate greatly hastened the rate of digestion. With these improvements, digestions which often took 6—8 hours and were generally accompanied by violent bumping, could be easily completed in under 90 minutes.

The foregoing modifications, though important, did not depart from the principle of the original Kjeldahl method. They also shared some of its draw-backs, especially emission of acid fumes, which is perhaps the most objectionable feature of that method. It was not, however, until recently that any systematic attempt was made to overcome that defect. It had been suggested by some workers (7, 8,) that the residue after the 'wet' combustion of carbon can be utilised for the estimation of nitrogen. The related procedure was however very tedious. The results obtained by that method were also low and discordant. This observation was inexplicable, but subsequent enquiry (11, 12,) showed that (a) some nitrogen is lost in the early stages if proper precautions are not taken, (b) a portion of the nitrogen is retained in the acid digest partly as nitric acid and partly in combination with chromium and (c) if halides are present in the material to be digested —such as in an alkali soil—considerable amounts of nitrogen are lost in elementary form. Loss of nitrogen in the earlier stages can be avoided by adding the oxidising agent (chromic anhydride or dichromate) to the boiling mixture of the material to be digested with water and sulphuric acid. Nitric acid and other volatile forms, if any, can be retained by using an air or water-cooled condenser. They can be included in the estimate of nitrogen by treatment with a suitable reducing agent. The same treatment also helps to release the nitrogen present in combination with chromium. As for the interference of halides, this can be completely prevented by addition of small quantity

of a mercury salt (preferably mercuric oxide or sulphate) to the digesting mixture. Based on these observations, a rapid, fumeless method of estimating nitrogen has been developed. The procedure to be adopted in the case of soil may be described as follows:- The soil (10 g.) is weighed out into a large-sized flask—preferably the one to be used subsequently for distillation with alkali—and treated with mercuric oxide (or sulphate; about 29) and 20 c. c. of water. The suspension is well shaken and then treated with 40 c. c. of pure, concentrated sulphuric acid. The flask is then fitted with an air condenser and the contents raised to boil. After boiling for about 5 minutes, a saturated, aqueous solution of chromic acid (corresponding to about 5 g of the anhydride) is added through the condenser and the digestion continued for 30 mins. The heating is then stopped and the digest treated with pure, solid sodium sulphate in sufficient quantity to completely reduce the excess of chromic acid. A small amount of zinc (2 g.) is then added together with excess of water and the mixture boiled for 15 minutes. It is then cooled, treated with excess of alkali and distilled in the usual way.

The above proceedure has several advantages over the Kjeldahl method.— In the first place it does away with fumes and, with the special type of digestion flasks associated with that method. The digestion proceeds very rapidly and is, in fact, very nearly complete within 5 minutes. after addition of the oxidising agent. The extra boiling is only to ensure complete digestion. A further advantage in the new method is that it includes nitrates in the estimate of total nitrogen. The use of the condenser helps to retain not only the nitrate already present in the soil but also any that may be added to it. Both the digestion and the distillation proceed smoothly and are in fact very much more satisfactory than similar operations in the Kjeldahl method. The related processes are so simple and at the same time, so rapid that a single worker can easily complete about thirty determinations a day.

The method of oxidative digestion though very much in advance of the other known methods, is still capable of improvement. Although reduction in alkaline media has not so far yielded satisfactory results, it should still be possible to so modify the conditions that the need for boiling with sulphite and zinc is obviated. Attempts should also be made to reduce the quantities of reagents used—especially those of acid and alkali. Some indications have already been obtained to show that other oxidising agents such as permanganate or bismuthate act fairly effectively in presence of dilute sulphuric acid. The bismuthate, in particular, also yields a colourless digest so that it should be possible to determine at any stage, whether the digestion is complete. It is hoped that, with these and other improvements, the estimation of nitrogen would be not only very much simpler and more rapid, but also very much less expensive than it is at present.

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THE LEAF-CURL DISEASE OF CHILLIES CAUSED BY THRIPS IN THE GUNTUR AND MADURA TRACTS *

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Introduction Chillies (*Capsicum annum*) is one of the important crops grown widely for use both as a green vegetable and as a dry stored product for condiment, pickles, etc.; it is one of the chief commercial crops in the Guntur district in the Northern Circars and in the Periyakulam area in the Madura district.

In recent years, this crop has been noted to be subject to a serious disease known as the 'leaf-curl' disease. Though there may be other factors causing this leaf curl, one important causative agent noted is a tiny insect called chillies thrips (*Scirtothrips dorsa is*, Hood), about 1/25" in length and having a straw yellow colour. This minute active insect attacks the plant in all its stages, sucks up the sap from the tender portions and causes the leaf to shrivel up. The adult has wings and flies away when disturbed. Specimens of this creature can be easily collected in all stages of growth from plants in any infected field. The description of this insect and some notes on its bionomics are given by Hood (1919) and the senior author (1928.)

The main purpose of this paper is to point out that in additon to proper cultural practices which, of course, influence successful

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chillies production, the control of the most important insect pest of this crop is an equally important and determining factor in this direction. A summary of the investigations carried on on this insect pest to supply fundamental items of information on this subject to the chillies cultivator in South India, is therefore given.

The Insect, its life history and habits. The insect was first noted by the senior author on castor shoots and chillies in Coimbatore in 1916 and was described as a new species by Hood under the name *Scirtothrips dorsalis*. It is generally found in the tender shoots, buds and flowers of chillies plants, the older leaves being rarely frequented. The tender buds and leaf-folds afford not only juicy food for the creature but also shelter during the different stages, which are passed on the plant itself. The eggs are white and very minute and laid on or just under the leaf tissue. The young ones hatch out in four or five days and crawl on to the tender shoots to feed. The just hatched larvae are pale white in color and more or less resemble the adults, only differing in being wingless and smaller. Four or five days later a second moult takes place. The nymphs at this stage wander about in search of suitable places for pupalation and after the second moult enter into a semiquiescent stage known as the prepupa which occupies from 12 to 24 hours. They then enter the pupal stage. Pupation is found to take place largely in the leaf axils, leaf curls, under the calyx of flowers and fruits and in other tender parts of the plant where they could find suitable receptacles. The pupation period lasts from 3 to 5 days after which they become adults with fully developed wings. The whole life cycle is passed within 10 to 15 days. Under humid conditions, the egg and the pupal stages are extended by about two days. A single female was found to lay 2—4 eggs per day for a period of about thirty two days, thus showing that one female is normally capable of laying a hundred or more eggs.

Nature and Extent of Damage. Thrips have a lacerating and sucking type of mouth parts and the wounds made on the tender tissues affect the normal development of the plant, resulting in malformed eaves, buds and fruits. In bad cases of damage, the shoot hardly develops and the leaves drop down. This invariably happens in the Guntur area where the rains cease in December and dry weather sets in and the soil moisture is insufficient to cope with the evaporation from the damaged leaf surfaces. The damage is thus due to the retardation and in severe cases, to the complete cessation of the physiological functions of the chief assimilating organs (leaves) of the plant.

Studies on the Pest and its Control. This pest was first reported to be serious in the Guntur area in 1926 and observations on the occurence and extent of damage caused by the same were first stated in 1927. In the Madura district, the disease was in evidence as

a serious pest in a few villages in the Periyakulam taluk three years ago and as a result of representations to the Agricultural Department made by the local cultivators, investigation of this malady was started. As these two areas represent diverse conditions of soil, weather, agricultural practices and varieties of chillies grown, the investigations carried on are given in two separate parts referring mainly to the peculiarities of each area which have a bearing on the pest and its control.

THE GUNTUR AREA

In this tract chillies form one of the major crops occupying an extensive large area of about 71,000 acres. This is grown under dry conditions in rotation with cereals as *jonna* (*Andropogon sorghum*) or *variga* (*Pennisetum typhoideum*) preceding it and tobacco (*Nicotiana tabacum*) or groundnut (*Arachis hypogaea*) following it.

Pest incidence: The leaf curl which disease is known as '*Mudatha*' (leafcurl) or 'Korivi' (burnt faggot) is prevalent in the whole area, every field being attacked without exception. The pest appears in two distinct periods, with an interval of two months; in the nurseries in August-September when it is not serious, and in the planted field from the third week of November till the end of March when the crop is removed (harvested). The loss due to the attack of this pest is appreciably high. In bad seasons whole-sale destruction of the crop results whereas in other seasons loss of 25-50 per cent of the total yield is quite common. In the nurseries, the pest appears in a mild form, early in August, when the young shoots appear slightly curled. In the second half of August and early in September, when dry weather prevails, the pest increases in seriousness and may often assume serious proportions. The method of hand-watering the seedling beds by pouring water over the seedlings, checks the multiplication of the thrips to a great extent in the nurseries. Their numbers are further reduced when the seedlings are topped, a practice prevalent in these parts before transplanting. The monsoon which follows keeps them under check in the field till the middle of November. It is about this time when the monsoon would have spent itself, the leaf curls begin to appear on stray plants in the field. They spread out to other plants as well and, by the end of December, there may not be a free plant left in the field. After this period, the development of the pest proceeds at an accelerated pace. In adverse cases, the leaves are shed, fresh formed buds become brittle and drop down and the plants present a stag-head appearance. This stage is called '*Korivi*' stage whereas, during the earlier stages, it is commonly defined as '*Mudatha*'.

Factors influencing pest appearance in the tract. *Weather*: Heavy rains check the pest multiplication whereas dry weather promotes it. October and November are crucial months for this crop and during this period it reacts to a great extent both to an excess of

moisture and lack of it. In years of sufficient rainfall the plants are able to withstand the pest and when the rainfall is insufficient they easily succumb to it. A well distributed rainfall in November assures a good yield and checks this pest. Very often it happens to be abnormal, heavy downpours are received and the plants die of water logging in the field. When the rains are late, heavy shedding of flowers is notified.

Soil: As regards other factors like soil, drainage, manure and rotation, the variations observed cannot be said to be of a conclusive nature, In red soil areas, where the effect of heavy rains was minimum and in slightly alkaline fields, the plants were noted to resist the attack of thrips to a greater extent as judged by their bushy and vigorous growth. The same was observed in the case of plants situated at a higher level in a few fields.

Manures and rotation: Periodical observations made in plots with different manurial treatments on the Agricultural Research Station, Guntur, did not show any differences in the extent of attack. As for rotation, the system adopted is somewhat indefinite, but a chillies crop after a cereal was always found to be better than any other crop. Chillies grown in rotation with ground nut was always found to be a poor crop.

Varieties: No difference was noted in the extent of damage by these insects in the different varieties of chillies grown in this tract.

Groundnut cultivation: Enquiries from several places have shown that the pest is of recent origin and dates back to the period of introduction of groundnuts. This might be a probable explanation to the recent appearance and spread of the pest. The thrips found on chillies is found in considerable numbers on groundnut leaves also. In addition to chillies and groundnuts, castor, pomegranate, beans, mango, cotton, *Cassia* sp. and various weeds in this tract provide alternate food for this insect. A continuous supply of host plants is thus available throughout the year enabling the pest to appear season after season.

Control measures and economic aspect. From the vear 1926 onwards this pest has been in evidence in the tract though the insect was noted by the senior author as early as 1916 in the course of his systematic studies. Experiments in the control measures which consisted of insecticidal methods were started in Guntur in 1928 and have been going on for over five years. The details of the early trials and failures and of the gradually encouraging results during these years are omitted here. Several substances and combinations were tried and after these different experiments it was found that dusting with fine tobacco powder was found to give the best result so far obtained. Many of the other insecticides tried had to be given up, some because

of their prohibitive cost and some because they were not effective. Uniformly successful results have been obtained by the application of tobacco dust. This method has given an increased yield of 34%, 13% and 50% to 60% in the seasons 1931--32, 1932--33 and 1933—34 respectively. Even during the year 1934—35 when the crop was a thorough failure, the increase from dusted over control plots was 18% to 26%

The cost of tobacco dust and the charges for its application are comparatively very low. Tobacco is largely grown in this area and waste tobacco is available in plenty. From a candy (500 lbs.) of waste tobacco costing not more than Rs. 5, 350 lbs. of fine tobacco powder can be obtained and this quantity is found sufficient for an acre. It has been found that three applications of the dust gave equally good yields. The dusting can be commenced at the end of November or early in December and a second dusting may have to be applied a fortnight later. The third application can be deferred to a period of 15 to 20 days depending on the seasonal conditions. In years of severe attack and heavy rains resulting in high shedding of early formed flowers, a fourth dusting in third week of January may be necessary. Each application requires 100 to 150 lbs. of dust per acre depending on the growth of the plant and an acre can be covered in 2 days of 8 hours each. The results have so far shown that the treatment is quite cheap and an appreciable extra yield could be obtained. The seasonal conditions of this tract also favour this operation as plenty of dew is deposited in the cool mornings in November, December and January and dusting can be done early in the mornings.

THE PERIYAKULAM AREA

The chillies tract in the Periyakulam area is situated in the midst of numerous hill ranges with the Cumbum valley enclosed in the middle. The average annual rainfall in this area comes to about 30″, the greater part of the rain being recorded during the season—September to January. In this region, about 5,000 acres of this crop are grown under irrigation, chiefly covering the areas about Andipatti and Uthamapalayam. The crop is planted in two seasons in this tract; the early or *Kodai* crop planted about the end of April and the late or *Kalam* crop planted about the middle of July. But, of late, to ward off the leaf-curl disease caused by thrips the ryots are trying all seasons and the seedlings are planted from the end of April to July in quick succession in one place or another. This indiscriminate practice gives the pest good facilities for breeding throughout the season. The crops generally grown in rotation with chillies are *cholam* and *ragi*. Tobacco is included in the rotation if the irrigation water is brackish. Some ryots round about Andipatti grow chillies after chillies with heavy manuring and good cultivation.

Pest incidence and factors influencing it: The pest is often serious and during certain very bad seasons 50 % or more of the normal outturn is lost and there have been cases where the crop has proved a complete failure.

Rotations: Chillies crop coming just after cholam does not grow healthy and vigorous and hence easily succumbs to thrips attack. A mixed crop of onions and chillies is predisposed to thrips attack and as such both suffer badly.

Weather: Chillies come up best during warm rainy weather. Gentle, light, frequent showers just after planting and heavier rains later induce healthy and vigorous growth. The pest thrives best and multiplies rapidly in dry warm or slightly humid weather. The summer plantings are over by the end of May and during June and July which are dry months the tender plants are more susceptible to thrips attack and demand attention. The ryots of some villages having realised the injurious effect of this season do not often raise a *Kodai* crop. The mal-influence of adverse seasons may be slightly modified by profuse, frequent irrigation and better cultivation and thus the plants kept healthy and vigorous.

Control methods and economics: In this particular tract the trials of past two years lend favour to the following suggestions regarding thrips control:—Cultural: During normal seasons the plants may be protected and kept free from leaf-curl disease by giving better preparatory cultivation, heavy manuring, frequent irrigation, clean cultivation and above all, getting healthy seedlings for planting. These latter can be protected against thrips attack by immersing them in tobacco docoction before planting. The preventive measures noted above go a great way to minimise pest incidence during the rest of the season. During adverse seasons and conditions, however, the plants may be given a few timely applications with tobacco to keep them vigorous and deter thrips from gaining the upper hand. Tobacco may be applied in the form of a dry dust or as a spray liquid. Dusting is, though easier and cheaper, not possible when there are strong winds and moisture is absent on the foliage. Dusting the seedlings in the nursery is economical and efficient but in the field it is found better to spray under the above conditions. The plants are sprayed first about a month after planting and repeated every fortnight depending upon the rainfall. The total number of sprayings required for the crop right through from the time of planting to harvest depend upon—the season and time of planting, the duration of the crop and its vigor which often depends upon the manure it has received and the treatments given. In general, the early planted crop requires more sprayings than the late planted ones as the former has not the advantage of the monsoon showers during its early growing period. A vigorous growing, well manured crop may be protected with a minimum of three sprayings as was done at one of our trial plots (Ranganathapuram).

Economic aspect: Taking on an average that four sprayings are required to keep the crop free from thrips the cost of spraying does not go beyond Rs. 10 per acre, including tobacco, labour, soap, etc., etc The cultivator generally spends from Rs. 80 to Rs. 120 in raising a crop of chillies and Rs. 100 may be taken as the average cost of cultivation. The cost of treatment to give protection to the plants from thrips attack comes to only Rs. 10 per acre and it is found that this cost is only one tenth the cost of cultivation. A treated plot has given an increased profit of Rs. 189−13−4 per acre over that of an average plot for the tract.

General considerations. Having given some idea of the conditions and trials in the two tracts we may make some general observations on this subject. Though the investigations carried on in the two areas on the same insect reveal certain variations in the different features which influence the incidence of the pest, especially because in the one tract the crop is cultivated under purely dry conditions as contrasted with an irrigated crop in the other, the habits of the pest are found more or less similiar in both and the control measures tried and found successful are almost similar in both. The experiments carried on in this connection for the past few years have shown that, out of all insecticides tried, tobacco in different preparations has proved the best stuff for controlling thrips on chillies. It has also been found that waste tobacco for this purpose is easily available in large quantities and at cheap rates in both the tracts and as such, there is absolutely no difficulty in procuring the insecticidal material whenever needed. It may also be noted that the application of tobacco dust has an advantage over the other forms of nicotine treatment due to the slow liberation of nicotine fumes in lethal quantities over an extended period of time. This protects the plants from daily reinfestation. It is also known that it has a fertilising and stimulating effect on plant growth. It is also an effective material against other insects like plant lice, mealy bugs and scales which might infest the plant now and then.

The application of tobacco preparations, as has been refered to before, may be made in two ways, according to local conditions, viz., either as a dry fine powder or as fine liquid spray. The latter method of spraying with tobacco decoction will have to be resorted to in localities where strong winds prevail and dusting becomes impracticable and ineffective. For this purpose, chillies growers cultivating fairly large areas will be well advised in owning a spraying machine which will be useful not only for use against chillies pests but for many pests on various garden crops. It will also be found very advantageous if several cultivators of a village maintain a large sized spraying machine on a co-operative basis and give it on hire to various applicants. In judging the effect of applying tobacco for the leaf curl disease due to thrips a number of things has to be remembered. The

severity of the disease depends a good deal upon the general treatment the crop is given, such as the cultural attention, the quantity and the time of application of manure, the season in which it is grown, the previous crop and the interval between these, other diseases such as the vermicularia of chillies and finally, the co-operation and the willingness of the ryots to carry out the suggestions in time and effectively.

Before concluding, it may be added that under some very favourable and optimum conditions of soil, weather, moisture, etc., it might be possible to find in the same village a few plots which might fare as well or even better than the sprayed plots. This means that these plots due to favourable seasonal conditions and proper cultural attention have withstood the pest ; while others, due partly to nature's freak and often to the cultivator's indifference suffer from the pest and have, therefore, to pay the medical bill, viz., the cost of spraying. As the ideal conditions cannot be expected always and in every area, it is believed that cultivators will be well advised to protect their growing chillies crop not only by proper cultural methods but also by precautionary and curative measures against thrips attack which may occur any time. The trials for the past two years have more than confirmed this view and our suggestions for control measures have satisfied the nemerous chillies growers who are enthusiastically taking our suggestions.

Though the solution of the chillies thrips problem has been successful so far, further fiield scale trials will go a great way not only to confirm or modify these conclusions but might add a good deal to the experiences so far gained. It is therefore hoped that further trials may be carried out in this direction by district officers whenever opportunities offer themselves.

The writers take this opportunity of expressing their thanks to the local agricultural officers, viz. the Deputy Directors of Agriculture of the second and sixth circles for the help and facilities they kindly placed at the disposal of the writers for these investigations.

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SELECTED ARTICLE

CONTRIBUTIONS OF BOTANY TO TROPICAL AGRICULTURE.

Among the sciences that contribute to agricultural and horticultural progress, none has closer or more multifarious contacts with practical crop production than botany. If such contacts are apparent only to those most intimately concerned with agricultural research, the reason is to be sought in the comparative neglect of botany in the general educational system, which leaves the average lay man under the impression that its main function is to give plants long names.

The science of knowing plants has inevitably been connected from the earliest times with the art of growing them. Its development can in fact be traced from the "physic gardens" of the Middle Ages, which served both medicine and horticulture, to the botanic gardens of later times with a distinguished record of services in the collection, identification and dissemination of useful plants all over the world (1). The latter perhaps reached the zenith of their importance in the Tropics during the nineteenth century, with the establishment of tea in India, cinchona in Java, and rubber in Ceylon and Malaya. Some remain, and today discharge wider functions than ever. Others have disappeared or lost their identity in agricultural departments. But the closing years of the nineteenth century and the early years of the twentieth saw the rise of tributary activities which have continuously broadened the course of botanical investigation ever since.

It was during this period that a growing realization of the enormous losses occasioned by insect pests and plant diseases called new specialists to the assistance of agriculture, on the one hand entomologists and on the other botanists who had devoted particular study to the group of plants called fungi. The entomologists and mycologists speedily justified their election and made great advances in the study of their problems. The demand for their services increased, and special courses of training were instituted in certain cases to meet the need. Reciprocally as the number of workers grew. investigations were pushed deeper, and it became increasingly evident that the study of the host plant was not the least important part of the campaign. These successes had both a general and a particular effect on the position of botany in agriculture. They stimulated a general interest in the potentialities of applied research, and they revealed a need for the co-operation of botanists who had specialised along rather different lines.

Particularly, perhaps, was the latter the case when the most promising possibilities of disease or pest control were found to lie in the substitution of resistant varieties of crop plants for susceptible varieties formerly grown, and extensive operations in plant breeding became involved. By a fortunate coincidence the rediscovery of Mendel's laws of heredity occurred during the same period of development, the basis of plant breeding was at last made sound and clear, and fresh emphasis was thrown on the constitution of the individual plant as a factor in agricultural success.

The position which botany has reached in the post-war development of agricultural research services is superficially obscured by a multiplicity of specialist labels. Problems are becoming more and more complex as knowledge advances, and demanding progressively more technical skill in diverse directions, which can only be obtained by increasing specialisation. Hence we find on the staffs of agricultural departments and research Institutions officers described as

plant physiologists, geneticists, plant breeders or cytologists, as well as economic botanists, systematic botanists, ecological botanists, and occasionally just simply botanists. A few of these labels may be useful to distinguish the main branches of a very big subject, but they tend to conceal three important facts, the first that all these specialists have a similar fundamental training, the second that it is rarely either possible or desirable for a botanist to restrict himself to one aspect of his science and the third that in the end it must always be within a framework of general botanical principles that the contributions of specialists are fitted together for translation into improved agricultural practice.

A similar tendency is responsible for the use of labels such as "economic" to distinguish botanists who are working on agricultural, horticultural or technological problems from those who are not. This leads in turn to a distinction being some times drawn between "pure" and "applied" or "economic" botany, whereas in point of fact there is no such division in the science. Considerable difference in outlook is inevitable between the botanist in agriculture, whose work is ultimately tested in terms of momentary profit or loss, and his academic brother whose achievement is assessed solely by his contributions to knowledge, "useful" or otherwise. Even this difference can easily be over-emphasised, since the one adds to knowledge whilst pursuing economic ends just as the other contributes to economic advances whilst pursuing knowledge for its own sake. Still, it undeniably does and must exist and the unity of science can be stressed more convincingly when divergences between its practitioners are frankly recognised. At the same time there appears only occasional need to distinguish by title the botanist in direct contact with crop production or plant industry from him whose contacts are indirect, and the more the two can realise their common interests the better it is for all concerned.

The outlook of the botanist in agriculture is determined by botanical analysis of crop production, and crop production represents the sum of interactions between constitution and environment His problems therefore fall into two series, separable for purposes of discussion though interlocked in practice, those in crop genetics and those in crop physiology.

Provision to the agriculturist of genetically better planting material is perhaps the most important function of the botanist under present conditions. It is not only a matter of plant breeding, though breeding may play a conspicuous part in certain cases. The collection, introduction, comparison and classification of species and varieties of crop plants represent a direct legacy from the days when botanic gardens were the main centres of agriculturul research, and are still as important as ever.

Collection and introduction are returning to favour after an interval under a cloud. It is highly regrettable that the carriage of crop plants from one country to another has so often involved the carriage of pests or diseases as well, with calamitous results to the importing countries concerned. Yet the benefits conferred on agriculture as a whole by plant exchanges were even in the past immeasurably greater than the pathological consequences at their worst, and the important point about this particular risk is that to recognize it is largely to nullify it. With modern methods of plant quarantine available as a safe-guard, there is less reason than ever there was for refraining from plant introductions under proper technical control. Classification, and systematic studies generally are the basis of botany and hence of crop improvement. The imperfection of our knowledge of the systematics of tropical crop plants at the present day is responsible for losses no less serious for being largely unsuspected. One variety of a crop may be known under a whole list of names in different countries, or conversely several disinct types may pass under one and the same name. Such

a state of affairs hinders co-ordination of results between research centres causes unnecessary introductions to be made in some cases and desirable introductions to be omitted in others, and creates a general confusion in which time and effort are wasted that have a real and considerable cash value.

Crop taxonomy has to be much more detailed than the branch of the subject that deals with wild species since the characters that separate agricultural varieties are finer than those used to differentiate species, and moreover are frequently as much physiological as morphological. Hence a herbarium technique is seldom applicable, and comparisons involve growing the varieties side by side and observing them at all stages. For similar reasons, type specimens, against which doubtful varieties can be compared for identification, should be maintained in the living condition as pure lines or colonies if they are to be of real use, and the maintenance of type collections of tropical crops is a requirement as yet almost unfaced.

Studies of the origins and of the wild relatives of cultivated plants, in their bearings on the problems of collection, introduction and breeding, are scarcely less important than studies of the crops themselves. The centre of origin, if known, indicates the regions to be searched for types with new characters of agricultural value; the manner of origin, if it can be deduced, guides the breeder to appropriate methods, and the use of Saccharum spontaneum in sugar-cane breeding is only one example among dozens of the direct value of wild plants to the raiser of new crop varieties.

Detailed studies of quantitative variability within a crop are usually indispensable preliminaries to actual breeding operations, and the botanist has to decide from them whether to proceed by hybridisation or by the less spectacular methods of simple selection that in mixed tropical crops are probably more frequently appropriate. The genetic survey of Trinidad cacao carried out between 1930 and 1934 provides many illustrations of the useful information that can be gleaned from such researches, particularly where perennial crops of long life-history are in question.

Selection of types among mixed crops is in itself a problem of no mean order. It involves at the outside a working definition of the word "best" for there is rarely if ever one "best" type for all conditions, and the aims of selection must be dictated by economic requirements. The relative importances of yield and quality have to be assessed in the light of some knowledge of local agricultural conditions and of the preferences of the markets, and before that can be done there must be an analysis of all the factors which go to build up yield, a similar analysis of factors contributing to quality in the crop, and a careful study of the interactions of the two sets of factors, which are some times antagonistic.

When hybridisation is found to be necessary, a new set of problems is opened up. Instances have been multiplied in recent years of advances achieved by intercrossing distinct botanical species, and everything points to a still greater use in the future of this particular method of crop improvement. Species crossing whilst enlarging the potentialities of plant breeding, often presents its own difficulties to be overcome, and the microscopical examination of minute details of cell structure may have to be called to the aid of genetics for the direction of practical breeding. In banana breeding and sugar-cane breeding, for example as in the cases of several temperate fruits, cytology provides the only key to baffling behaviour in inheritance.

On the other hand, in cases especially frequent among perennial crops, such as cacao, the breeding of new types is of less immediate importance than correct propagation of the best among those already existing and the task of elaborating propagation methods through research in plant physiology falls appropriately enough to the "plant breeder" in his wider capacity as a botanist

Thus, if a team of specialists is available, there is work in genetic crop improvement for systematics geneticists, cytologists and physiologists, but the common end is one, and frequently the various aspects are of necessity examined to the best of his ability by one individual. Neither the number of workers nor the funds available for research will at present allow a full team to every crop and in any case each crop has its own peculiarities, and requires for its perfect investigation its own specially balanced team. Consequently the botanist whatever his specialist label, must be able to appraise the situation from several angles and select the most appropriate lines of attack.

The function of botany in exploration of the relation of the plant to its environment is scarcely less important, though in this field it shares responsibility with soil science and with plant pathology. The joint problem is to discover and describe in detail how the crop plant lives and grows and builds up its yield in surroundings partly pre-determined by geographical and topographical factors and partly modifiable by agricultural practice.

The physico-chemical complexity of the soil and the tremendous importance of soil conditions in plant growth render imperative for the investigation of soil problems other specialists whose fundamental training is in chemistry rather than in biology. Similarly the multiplicity of parasitic organisms, including both insects and fungi, as well as other groups, calls for specialists in entomology and mycology to cope with the problems of crop pests and diseases. For the rest, it is the botanist who is concerned with tracing the plant step by step through its life-history, observing the effect upon it of varying conditions at every stage, and especially at those stages which are found to be most critical in relation to final yield.

Critical stages in the life history of the plant occur particularly in the development of crops which are grown for their fruits or seeds, and are often connected with the processes of pollination and fertilisation. Plants of complex ancestry are liable to exhibit partial or complex sexual sterility, and barrenness in certain varieties when grown alone or in certain combinations has been traced to this cause for several kinds of crop plants both temperate and tropical. This is a genetic aspect of a yield problem, but in other cases, unfruitfulness may be traced to other causes such as malnutrition, which are primarily physiological.

The environment also includes for the botanist the complex reactions of one green plant on another, and in the case of budded or grafted plants, which are coming more and more into cultivation as the necessity of uniformity in produce is realised, the reciprocal influences of stock and scion provide him with a wide field for research In the case of some crops, such as fruits which are marketed in a living state, he has even to concern himself with the environment of the produce in storage and transport, in co-operation with the biochemist and mycologist.

Finally it is to be remembered that the botanist in tropical agriculture often has functions outside even the wide range of crop plants and their wild relations. Studies of natural vegetation are being increasingly recognised as economically important. To the agriculturist opening up new areas, the wild plant population is a useful indicator of soil and climatic conditions. To the pathologist it is a reservoir whence come pests and diseases of crops, or more happily, wherein can be found natural enemies of pests to be turned to good account in biological control. Vegetation studies are practically impossible without identification of plants, and in many tropical countries the local floras are very imperfectly known. Consequently the collection and identification of species quite unrelated to his crops may legitimately find a place among the activities of the "economic" botanist. In these and many other ways he makes essential contributions to that solid basis of general knowledge upon which alone the various agricultural sciences can build.

(E. E Cheesman in Tropical Agriculture.)

ABSTRACTS

Bio-chemical Investigation on different Varieties of Bengal Rice. By Basu and Sarkar. (*Ind. Jour. Med Res*, 1935, *22*; 745.) The authors who have undertaken a systematic biochemical investigation of the different varieties of Bengal rice critically examine a belief widely held in Bengal that the *Aman* rice is much superior to the *Aus* variety. A number of varieties of both types were analysed as paddy, and as polished, non-polished and parboiled rices. The husks and brans obtained during the husking and polishing respectively of some selected rices were also analysed It was found that as the husks are rich in woody fibre and ash (mostly silica) husking enriches the protein, fat, carbohydrate and phosphate content of the rice—The content of potash, which is apparently uniformly distributed in the grain, is not affected by husking. The brans obtained by polishing the husked rices contain greater amounts of fat phosphate, potash and iron, and polishing therefore results in a corresponding depletion of these constituents as also of some protein, in the rices produced—In addition, the calcium content is lowered. These observations are explained, by the fact that the aleurone or germ layer of the grain which is very rich in protein, fat and minerals, is removed during "polishing". Except for a slightly higher protein content, parboiled rice does not differ in composition from husked rice.

The *Aman* varieties analysed definitely greater percentages of proteins and fat than the *Aus* varieties. Further, although the former type register a lower mineral content than the latter, it contains more calcium and potash; but less phosphate, which is nevertheless, adequate. In a predominantly starchy food like rice, the superiority of a given rice is a direct function of its richness in protein and minerals—specially lime and phosphates. Judged by this standard, the analytical results justify popular opinion.

In the second paper, (Ibid, p .759.) the authors deal with the enzymatic digestibility of the different rices using Taka Diastase. The popular opinion that the *Aman* rices are more easily digested than the *Aus* varieties is not borne out by these experiments which show the reverse to be the case. It must be pointed out, however, that to obtain strictly comparable results, an enzyme secreted by the human body should be used in place of Taka Diastase, which is prepared from a fungus. Polished rices are more easily digested than the unpolished ones. In all cases the digestibility is enhanced by par boiling because the rice gets cooked to a certain extent during the treatment.

Note:— *Aus* and *Aman* rices of Bengal may be taken as roughly corresponding to *Kar* and *Samba* rices of Madras. It may be mentioned here that McCarrison and Norris after examining 29 samples of rice from five South Indian varieties (kuruvai, white samba, kattai sambalai, red samba and konamani) arranged the nutritive and vitamin values in the following order (1) raw, milled, unpolished rice (2) parboiled, milled, unpolished rice (3) parboiled, milled rice, slightly polished (4) parboiled, milled rice, highly polished and (5) raw, milled and polished rice. They also found that washing of rice (raw or parboiled) greatly reduces its nutritive and vitamin value. Y. V. N.

Irrigation Practice in growing grapevines. By H. V. Gole, (*Poona Agri. Coll. Mag. July 1935.*) The main difficulty in the extension of the area under grape cultivation in South India, has been the very heavy amount spent under irrigation charges, and in view of the uniform practice in the south, to irrigate grape vine fields every day during the bearing season, the present article is important in that it throws light on the desirability of curtailing the number of irrigations to grapevine.

Some of the points dealt with by the author are :—

1. When the rain-fall is normal with good rains in September, the soil to four feet depth and more will be wet to its field capacity. Therefore irrigation before or after pruning will not be required and should not be given.

2. However when the rain-fall is deficient and the soil is not sufficiently wet by good rains in September, one thorough irrigation should be given before pruning. At this time the vines are dormant and the roots will not suffer any injury from excess of moisture. A good irrigation at this time will save the necessity of irrigating the vines in November, and thereby the risks of infection by disease will be avoided. A second irrigation after pruning will not be required and should not be given. After pruning the vines will sprout and produce good growth. The amount of moisture will be sufficient to sustain the good growth and the fruit will set evenly. The vineyard will not require irrigation till December.

3. From December till ripening time in March, the vines should receive one good irrigation every month. The volume of water should be sufficient to wet the soil to four feet depth.

4. A light irrigation at ripening will prove beneficial.

5. After the grapes are picked and harvested, the vines are pruned in April. In April and May the vines may be irrigated every twenty days. In the hot season the growth will be very active and with hot sun and strong breezes the evaporation from the leaves will be very brisk, consequently the roots will take up large amount of water. The crop of the next season will very much depend on what growth the vines will make during April and May.

6. The vines will not require any irrigation during the monsoons, unless under exceptional circumstances.

7. For the first two or three years in the beginning of the plantation, young vines will require irrigating at short intervals as their root system is not well developed. Late irrigations will be harmful in the case of young non-bearing vines. They should be irrigated every ten to fifteen days in the growing season.

8. "No part of vineyard should remain muddy more than 48 hours in the growing season" is a good precept for growers.

Investigations into the water requirements of crops. By B. N. Singh, R. B. Singh and K Singh, (*Proceedings of the Indian Academy of Sciences.* Vol. I. No. 9, March 1935, pp. 471). The article covers new ground being the first systematic attempt to obtain information about Indian crops, with regard to two chief problems that confront the agriculturist viz. (1). How far an increase of water supply to the soil will bring about an increase in the dry matter production and final yield? and (2) how, and in what manner, and at what stage in the life cycle, a deficiency in the same would enable the plant to withstand drought and allow it to remain above its wilting level?

The plants experimented were, one variety each of barley, oats, linseed, mustard, potato, pea and tobacco, four varities of wheat, nine of rice, sixteen strains of cotton and twenty one improved types of sugarcane, making in all 57 plants under examination covering a wide range of crops grown in India.

The methods employed were those used by earlier workers and writers growing plants in big sized pots, provided with metal containers, which allowed of all holes and crevices being closed up completely by plasticine, thus ensuring transpiration and loss of moisture only through the aerial parts of the plant. The sealed plants were arranged side by side with field crops and allowed to grow under similar conditions.

At periodical intervals the pots were weighed and the water lost by transpiration made good by fresh addition. The various determinations made were

(1) water requirement (2) dry matter produced (3) evaporating power of the atmosphere. Meteorological data like rain, maximum and minimum temperatures, humidity and hours of sunshine, were also recorded during the course of the experiment. The results obtained are sufficiently important and interesting, to deserve a detailed notice and can be put down as follows.

Crop plants	Varietal water requirement.	Specific water requirement.
Wheat — Pusa 4	420	
Pusa 12	381	
Cawnpore 13	402	408
Pusa 52	430	
Barely — Cawnpore 25	601	601
Oats — Local	676	676
Linseed	942	942
Mustard	523	523
Pea	612	612
Rice — Kuari	395	
Badali	468	
Jhengi	475	
Karahni	514	
Saro	500	519
Karangi	502	
Lehula	554	
Jilhore	630	
Kasturi	635	
Sugarcane. Co. 205	125	
Co .281	140	
Co. 213	147	
Co. 331	157	
Co. 313	160	
Co. 334	172	
Co. 332	159	
Co. 298	133	
Co. 310	136	
Co. 329	214	
Co. 320	188	203
Co. 312	207	
Co. 330	248	
Co. 301	232	
Co. 290	267	
Co. 300	249	
Co. 299	260	
Co. 214	350	
S. 48	215	
Reori.	297	
Paunda (E. K.)	510	

It will be seen that different varieties of the same crop show appreciable differences as regards their water requirements, and the more efficient of these due to their high yielding nature and short life cycle, should be adopted to minimise the cost of cultivation, by curtailing the number of irrigations. Thus most efficient as regards water requirement amongst the varieties will be Pusa 12, among the wheats, Cawnpore 520, and Co. 2 among the cottons, Co. 205 among the sugarcane, Kuari among the rice.

The minimum amounts of water required by the different crops per acre, both for transpiration and for soil evaporation are as follows in order—Sugarcane requiries 45 acre inches, tobacco 30·1, cotton 28·3, rice 27·4, potato 20 4, wheat 8 5, oats 8 1, barley 7 8, linseed 6·4, pea 5·6, and mustard 4·34, for the whole life cycle of the plant.

M. R. B.

Research Notes.

Pennisetum Typhoides (Stapf & Hubbard),

and

Pennisetum Leonis (Stapf & Hubbard).

Pennisetum typhoides (S. & H.) is the bulrush or spiked millet, *Cumbu* (Tamil), and *Sajja* (Telugu). Its earhead has its own characteristic packing of grains. The small glistening grains which are naked (being clipped by the glumes only at the base) are so closely packed on the rachis that they give marked rigidity to the earhead, so that the grains are more in the nature of a stucco to a central rigid column. This compactness is secured by the conjoint effect of the growing grain with its glumes, the unisexual floret in between them and the bristle brush which is the remnant of a suppressed fascicle axis.

In *P. typhoides* the grains are obovoid. The bristles vary from 2 to 3½ in. in length. With their characteristic plumose inner bristles they serve as an efficient regulator of temperature and a padding in between the grain mass. *P. typhoides* is itself compact; more compact to the extent of being absolutely rigid is *Pennisetum leonis* (S. & H.) (a new entrant from Africa) with its small umbonate grains. A number of readings made on the packing of the grain on the spike gave per square centimeter 32 grains in *P. leonis* to the 18 of the obovoid grains of *P. typhoides*. *P. leonis* manages to secure this packing on account of its narrowly elliptic grain. This packing is also made possible by the receding of the bristle brush which being only about 2½ in. long, falls back well below the grain surface. This condition leaves the grains huddled up without the intervening mass of bristle tips, so prominent in *P. typhoides*. The ovate pointed grains of *P. leonis* so packed put the strain of the packing on the glumes. A device by which *P. leonis* secures the physical and physiological advantages so necessary for this packed condition is by the provision of cilia on the glumes so packed. Looked through a lens the cottony mass of this glumal cilia are characteristically evident.

Crosses made between *P. typhoides* and *P. leonis* show that the ciliolate condition of the glume of *P. leonis* is a simple dominant to the glabrous glume of *P. typhoides*. The following table shows the segregates obtained.

P. typhoides × *P. leonis* – F_2.

Family Number.	Ciliolate glumes.	Glabrous glumes.
P. T. 589	31	9
,, 591	48	18
,, 592	30	9
,, 594	22	7
,, 598	73	25
,, 602	38	12
Total.	242	80
Expected 3 : 1	241·5	80·5

The central stalk of *Pennisetum* is very felty. So are the inner bristles of the bristle brush. In *P. leonis* the glumes also turn ciliolate. The *Pennisetum* group is broadly divisible into perennials and annuals. The perennials have not the dense spikes of the annuals. Their glumes are all glabrous. In the annuals there are two groups. *P. typhoides* will fall into the one and *P. leonis* into the other. The main characteristic that separates the two is this extra physiological equipment by way

of ciliolate glumes which is closely associated with a greater packing of the grains and a shortening of the bristle brush. The simple dominance of this ciliolate glume over the glabrous glume of *P. typhoides* is, therefore, very interesting in the light it might throw on its origin. A survey of the wild *Pennisetums* of the African continent may possibly reveal wild forms to which *P. leonis* has affinities.

Millets Breeding Station, Coimbatore. } G. N. Rangaswami Ayyangar.
September 1, 1935. } P. V. Hariharan.

Correspondence.

Deterioration in Cotton.

Mr. R. G. Saraiya, writes from Bombay:— I have read with great interest Mr. V. Ramanatha Iyer's article on "Deterioration in the quality of Cambodia Cotton", in your issue of August 1935. It appears that there is some misapprehension in regard to the criticism about the deterioration in quality of Southerns Cotton.

As one of the representatives of the East India Cotton Association Ltd. on the Technological Research Sub-Committee of the Indian Central Cotton Committee, I brought, before the Indian Central Cotton Committee, the question of the deterioration of Southerns Cotton, as understood by the trade. I did not include Cambodia Cotton in the growths which are believed by the trade to have deteriorated. On the other hand, the following growths were definitely mentioned as having deteriorated in quality during recent years, and the attention of the Indian Central Cotton Committee was invited to the subject:

Westerns: Raichur, Adoni, Yadgiri, Bellary, Guntakal, Timmancherla.
Northerns: Nandyal, Kurnool, Tadpatri, Prodatore, Adoni.
Bijapur:
Bagalkote:
Mira: Miraj, Budgaon, Sangli, Shedbal, Mudhol, Bhilavdi, Chikodi. Road, Jamkhandi, Kudchi.

Mr. V. Ramanatha Iyer's article on this subject in regard to Cambodia cotton is very illuminating and I am addressing this letter to you in the hope that it will remove the mis-apprehension with regard to Cambodia cotton and also will elicit further information in regard to the growths of Southerns cotton, which are believed by the trade to have deteriorated in quality in recent years.

Crop and Trade Report.

Cotton—Receipts of loose cotton at presses and Spinning Mills.

Loose Cotton.

	Bales as against an estimate of 445, 600 bales.	Figures for corresponding period in previous year,
1—2—35 to 13—9—35.	387, 447	506, 372
,, 20—9—35.	395, 121	515, 714
,, 27—9—35.	399, 498	521, 228
,, 4—10—35.	402, 542	526, 649.

[Bale = 400 lbs.]

Pressed Cotton.

	Receipts in Mills.	Export by Sea.	Import by Sea.
1—2—35 to 13—9—35.	237, 562	101, 625.	39, 242.
,, to 20—9—35.	242, 938	104, 147.	39, 337.
,, to 27—9—35.	246, 865	104, 404.	39, 337.
,, to 4—10—35	249, 757	107, 367.	39, 610.

Madras—Paddy Crops. 1935—36 First forecast report : The average of the areas under paddy in the Madras Presidency during the five years ending 1933—34 has represented 13·5 per cent of the total area under paddy in India. The area sown with paddy up to the 25th September 1935 is estimated at 6,357,000 acres When compared with the area of 7,244,000 acres estimated for the corresponding period of last year, it reveals a decrease of 5·3 per cent. The decrease in area occurs in ali districts outside East Godavari, Anantapur, Cuddapah, Nellore, South Arcot, Chittur, North Arcot, Salem, South Kanara and the Nilgiris and may be attributed to the late and insufficient rains during the South-West monsoon period in many districts.

The first crop of paddy is being harvested in parts of Trichinopoly, the South and on the West Coast. The yield is expected to be generally normal. The condition of the standing crop is satisfactory.

The wholesale price of paddy per imperial maund of 82 2/7 lb. as reported from important markets towards the close of September 1935 was about Rs. 3—3—0 in Cuddapah, Rs. 3—0—0 in Madura and Nellore. Rs. 2—13—0 in Nandyal, Rs. 2—11—0 in Vellore, Rs. 2—10—0 in Bezwada, Rs. 2—0—0 in Trichinopoly and Cuddalore, Rs. 2—7—0 in Ellore and ranged from Rs. 2—0—0 to 2—6—0 in the other markets. When compared with the prices reported in January 1935, these prices are stationary in Vizagapatam and Vellore and have risen by about 21 per cent in Ellore, 17 per cent in Bezwada, 14 per cent in Masulipatam, 12 per cent in Cuddapah and Madura, 3 per cent in Nellore, one per cent in Trichinopoly, and 5 to 10 per cent in the other markets.

Madras—Groundnut Crop—Third Report 1935. The average of the areas under groundnut in the Madras Presidency during the five years ending 1933—34 has represented 48·2 per cent of the total area under groundnut in India. The area sown with groundnut up to the 25th September 1935 is estimated at 1,990,500 acres. When compared with the area of 1,937,300 acres estimated for the corresponding period of last year, it reveals an increase of 2·7 per cent.

The increase is general outside Ganjam, Vizagapatam, East Godavari, Bellary Anantapur, Nellore, Coimbatore and Malabar. The increase is marked in Kurnool, the Central districts—(Coimbatore excepted) and Tanjore. The area in Bellary and Anantapur has fallen from 364,000 acres to 253,500 acres due mainly to an increase in the area under cotton and other dry crops. The summer crop throughout has been harvested. The yields were generally below normal. The yield of the early crop in Salem and Coimbatore is reported to be slightly below normal due to late sowings and insufficient rains in both the districts besides insect attack in parts of Salem. The condition of the main crop is reported to be generally satisfactory. The crop was affected in parts of the Madura district by drought, insect pest and plant disease to some extent. In the Udayarpalayam taluk of the Trichinopoly district, the crop is reported to have been attacked by hairy caterpillars.

The wholesale price of groundnut shelled per imperial maund of 82-2/7 lb. as reported from important markets towards the close of September 1935 was Rs. 5—13—0 in Cuddalore, Rs. 5—8—0 in Vizagapatam, Rs. 5—2—0 in Vizianagaram, Rs. 5—0—0 in Vellore, Rs. 4—15—0 in Cuddapah, Rs. 4—12—0 in Salem and Rs. 4—10—0 in Adoni. When compared with the prices reported towards the close of July 1935, these prices reveal a fall of 7 per cent in Vizianagaram and Cuddalore, 6 per cent in Salem, 5 per cent in Vellore, 4 per cent in Cuddapah and 2 per cent in Vizagapatam. The price remained stationary in Adoni.

Madras—Sugarcane Crop—Second Report 1935. The average of the areas under sugarcane in the Madras Presidency during the five years ending 1933—34 has represented 3·7 per cent of the total area under sugarcane in India. The area planted

with sugarcane up to the 25th September 1935 is estimated at 125, 390 acres. When compared with the area of 114, 710 acres estimated for the corresponding period of last year, it reveals an increase of 9·3 per cent. The increase in area is general outside Ganjam, Guntur, Anantapur, Salem, Coimbatore, Madura and Ramnad and is mainly due to better prices for jaggery at the time of planting. In Kistna, the area rose from 2,000 acres to 4,000 acres on account of the starting of a sugar factory at Vuyyur. The condition of the crop is generally satisfactory. In Kistna and Salem, the crop has been affected to some extent by insect pests. If the season happens to be normal during the rest of the growing period, the yield is estimated at 359,020 tons of jaggery as against 319,280 tons for the corresponding period of last year. The wholesale price of jaggery per imperial maund of 82-2/7 lb. towards the close of September 1935 was Rs. 7—15—0 in Nandyal, Rs. 5—15—0 in Guntur, Rs. 5—12—0 in Bezwada, Rs. 5—6—0 in Rajahmundry, Bellary and Cuddapah, Rs, 5—2—0 in Ellore and Erode. It ranged from Rs. 4—7—0 to Rs. 4—12—0 in the other centres. When compared with the prices of the previous month, the prices are stationary in Guntur, Nandyal, Erode and Trichinopoly and are lower by 15 per cent in Ellore, 13 per cent in Bellary, 10 per cent in Cuddapah and Vellore, 5 per cent in Vizagapatam and Bezwada and 3 per cent in Rajahmundry

Madras Gingelly crop—1935-36 Second Report. The average of the areas under gingelly in the Madras Presidency during the five years ending 1933—34 has represented 12 per cent of the total area under gingelly in India. The area sown with gingelly up to the 25th September 1935 is estimated at 424, 300 acres. When compared with the area of 405,000 acres estimated for the corresponding period of last year, it reveals an increase of about 4·8 per cent. The increase in area is general outside Vizagapatam, East Godavari, South Arcot, Salem and Ramnad. The increase is marked in Bellary, Coimbatore and Trichinopoly (+22,000 acres) There has however been a marked decrease in Salem (-12500 acres) due to insufficient sowing rains. The early crop of gingelly has been harvested in parts. The yield was generally below normal. The condition of the standing crop is satisfactory.

Bengal, Bihar and Orissa and Assam - Jute crop—1935 Final Forecast. The revised estimated area for the three provinces is 1,947,000 acres, a decrease of 723,100 acres as compared with the revised final forecast for 1934. The total increase as compared with the acreage in the Preliminary Forecast for 1935, is due to revision in the estimates for the three Provinces. It is estimated that the crop will yield 6,396,700 bales of jute, i. e., less than last year.s total (revised) by 2,128,700 bales.

College News & Notes.

Students' Corner. The College re-opened after Michaelmas on 1st October. The third year students immediately left on tour to Mysore, Bellary and Hospet in charge of Messrs R. C. Broadfoot, K. Raghavachari and S. V. Doraiswami. They returned to head quarters on 15th instant.

Athletics. With one class away on tour, athletics were not prominent, but in view of the forthcoming hockey tournament, the Hockey eleven was by far the most active. Besides playing a number of practice matches, it had an occasion to play 3 matches, against the Police Recruit School. the Stanes High School and the N. M. S. Club respectively. The first was won by 3 to 1 and the other two were lost 3 to 6 and 1 to 2. On 12th October a Cricket match was played between 1st and 2nd years in the Victory Cup tournament Entering first the second years were all out for 83 D. V Rajagopal scoring 47. Kodandaraman was responsible

for 4 wickets for 20 runs First year replied with 50, Menon contributing 14. Rajagopal took 6 wickets for 23. In the 2nd innings 2nd years scored 80 and when the other team had just put up 47 for 45 the stumps were drawn for the day. Thus the match ended in a victory for the 2nd years on 1st Innings. Special mention must be made of Ganesh Sunder Rao who brought up two really splendid catches.

Literary : A meeting of the Agricultural College Students' Club was held on 6th October 1935 under the presidency of Mr. H. Shiva Rao when Dr. K. Vekata Rao Badami Ph D., Economic Botanist to the Government of Mysore and Principal, School of Agriculture, Hebbal addressed the students. In the course of his lecture he dwelt on the future of the rural areas in general and of the students of the college in particular and put forth a strong plea for simple living and high thinking. Tracing the source of a good amount of prevailing ignorance regarding the rural areas to the faulty composition of legislatures, he emphatically laid down that so long as the student of agriculture did not go back to the land, so long as he did not act as the "friend, philosopher and guide" of "the poorest, the lowliest and lost" and so long as he did not himself champion the cause of the down trodden within and without the legislature. so long would the present callous state of affairs continue. He also detailed out some of the reforms he had brought about in his School of Agriculture and questioned why it should not be possible to cut our expenses to the barest minimum in this hostel. The greatest tragedy of the modern youth, he observed, is that when he enters life he is not in a position even to maintain the standard he kept up during his college career. The lecture concluded with a few remarks from the chair and the usual vote of thanks by the secretary.

Scientific Meetings at Coimbatore. Under the joint auspices of the Association of Economic Biologists, Coimbatore, the Society of Biological Chemists, Bangalore, and the Indian Academy of Sciences, a Symposium on 'Disease Resistance in plants' was held at the Agricultural College, Coimbatore, on 5th and 6th October. It was a matter of regret that Dr. K. C. Mehta of Agra who was to have presided, suddenly took ill and wired his inability to attend; but the organisers were fortunate in securing the services of Sir C. V. Raman F. R. S., N. L., who at very short notice very magnanimously consented to take the chair.

The proceedings began on 5th morning with a speech by Mr. K. Ramiah. who as President of the local Association, welcomed the visitors. Messages from a number of persons wishing the function all success and regretting their inability to attend were read.

The President in his introductory remarks gave an inspiring speech emphasising the importance of connecting up the physical and biological sciences by the study of biochemistry and biophysics and how the study of the biological

ERRATA

Read ' Cotton Pest Act and the lines following upto 21st instant '

on Page 422 after ' Visitors ' on Page 423.

scientific papers were presented. The President Sir C. V. Raman himself led with a most instructive paper on ' Heavy Hydrogen '.

The cream of the programme was the public lecture on 6th evening by Sir C. V. Raman on ' ultrasonics '. Tackling a technical subject in an extremely popular way, he kept the audience spell bound for over an hour with his eloquent address on the science of ' sounds that cannot be heard '. Illustrated with slides, and interspersed with humour, the lecture dealt with sounds of very high frequency which were beyond human audibility and how the wave lengths could be measured of the ultrasonic waves. experimentally. The lecturer referred to the vast fields of research in the new subject and its applicability in biological work. After a masterly exposition he concluded how sound in its ultrasonic pandemonium would result in heat and traced the relation between heat and sound.

On the 7th the visitors to the scientific meetings, went round the various sections at the Institute and the various Breeding stations, where they were shown round by the respective officers in charge.

Lectures. Mr. K. Banerji, Rice Research Officer, Bengal, delivered a lecture on ' Rice culture in Bengal ' on 9—10—35 with Mr. K. Ramiah in the chair.

Officers' Club Day. The Club Day has been fixed for November 23rd and several tournaments are in progress.

Visitors. Dr. Shirname, Marketing Officer, Imperial Council of Agricultural Research and Mr. S. N. Venkataraman, Assistant Marketing Officer, Madras, visited the College on 25th of September. Among those who attended the joint scientific meetings from outside were Sir C. V. Raman, Dr. R. D. Galloway Dr. M. A. Sampathkumaran, Dr. T. Ekambaram, Dr. M. O. Parthasarathy Iyangar, Prof. Arjerekar, Dr. Likhete, Rao Sahib K. Shawrey, Dr. V. K. Badani, Mr. K. L. Khanna, Dr. V. Subrahmaniam, Mr. M. Sreenivasayya and Mr. B. N. Sastri. Dr. M. A. Sampathkumara had in addition brought a party of students from the Central College, Bangalore on a visit to the College. Mr. Varghese, Mycologist, Travancore and Messrs. K. Banerji, & Chakraburthy, Rice Research Officers, Bengal also visited the Institute during the month.

Weather Review (SEPTEMBER 1935).

The monsoon remained fairly active in the west coast during the first half of the month with nearly general rain over the Peninsula during this period. A deep depression formed in the North East angle of the Bay of Bengal on the 7th and moving inland caused widespread rain in the central parts of the country. The depression filled up over Central Provinces on the 10th. Conditions again became unsettled off the Orissa—Ganjam coast on the 20th where a depression formed. This low pressure area moving inland, filled up on the 23rd after causing widespread rain in North East India and North Madras coast. The monsoon withdrew from the Peninsula on the 23rd. During the rest of the month there were scattered showers in the North Madras coast

Maximum temperatures were below normal for most days in the month.

Rainfall was above normal in the West coast, locally in large excess in the Circars and defective elsewhere.

Chief falls reported were :—

Munnar (Travancore)	...	...	...	7·0″	on the 10th.
Gopalpur ...	...	...	...	3·2″	„ „ 21st.
Bellary ...	...	...	...	4·1″	„ „ 30th.
Guntur ...	...	...	...	3·0″	
Samalkot ...	...	...	...	4·6″	

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	10·7	+4·2	37·3	South	Negapatam	1·8	-5·0	18·8
	Berhampore *	7·26	-1·63	32·29		Aduthurai *			
	Calingapatam	4·3	-3·5	22·0		Madura	2·8	-2·3	15·4
	Vizagapatam	2·8	-3·7	10·5		Pamban	0·3	-0·9	10·9
	Anakapalli *	4·58	-2·91	15 76		Koilpatti *	0·09	-1·93	6·89
	Samalkota*	10·64	+4·34	28·38		Palamkottah	...	-1·2	10·5
	Maruteru *	13·59	+8·01	24·77					
	Cocanada	4·5	-1·2	17·0	West				
	Masulipatam	8·6	+2·4	22·4	Coast	Trivandrum	2·0	-2·2	33·3
	Guntur *	9·77	+2·92	27·57		Cochin	8 2	-0·8	61·3
						Calicut	8·8	+1·1	88 9
Ceded	Kurnool	7 9	+1·6	24·1		Pattambi *	10·93	+2·73	61·92
Dists.	Nandyal *					Taliparamba *	11·89	+1·64	113 69
	Hagari *	3·06	-2·55	17·67		Kasargode *	11·08	+2·21	128·90
	Bellary	4·9	-0·2	15 0		Nileshwar *	11 52	+2·1	110·79
	Anantapur	1·7	...	18·0		Mangalore	11·8	+1·3	105·9
	Cuddapah	2·6	-3·7	27·3					
					Mysore				
Carnatic	Nellore	1·6	-3·2	12·8	and	Chitaldrug	1 6	-2·9	18·4
	Madras	3 0	-2·0	16·1	Coorg	Bangalore	5·1	-1·8	32·2
	Palur *	4·62	+1·78	18·37		Mysore	5·8	+0·9	27·7
	Palakuppam *	4·33	+0·56	9 91		Mercara	16·3	+5·7	112·1
	Cuddalore	4·0	-2·0	14·6					
					Hills.				
Central	Vellore	3·9	-3·4	22·3		Kodaikanal	3·1	-4·1	42·0
	Hosur cattle farm					Coonoor	0·7	...	29·0
						Ootacamund *	4·53	+0·28	25·93
	Salem	4·8	-1·7	25·5		Nanjanad *			
	Coimbatore	0·3	-1·3	6·0					
	Coimbatore Res. Inst. *								
	Trichinopoly	1·0	-3 9	21·9					

* Meteorological Stations of the Madras Agricultural Department.

Weather Report for the Research Institute Observatory.

Report No. 9/35.

Absolute Maximum in shade	...	95 2°F.
Absolute Minimum in shade	...	62·2°F.
Mean Maximum in shade	...	89·3°F.
Departure from normal	...	+0·3°F.
Mean Minimum in shade	...	70·0°F.
Departure from Normal	...	-0·6°F.
Total Rainfall	...	0·70"
Departure from normal	...	-1·74"
Heaviest fall in 24 hours	...	0·47"
Total number of Rainy days	...	2
Mean daily wind velocity	...	5·6 M-P.H
Mean Humidity at 8 hours	...	69·1%
Departure from normal	...	-5·9%
Total hours of Bright sunshine	...	235·9 hours.
Mean daily hours of Bright sunshine	...	7·9"

Summary. Rainfall was in large defect Strong south west winds were blowing over the first half of the month while dry weather prevailed for the rest of the month.

A. S R. & D. V. K.

Departmental Notifications.

Gazette Notifications. Mr. T. S. Ramasubramania Iyer confirmed as Asst. Agl. Chemist, Mr. J. A. Muliyil on joining after leave to be Lecturer in Entomology.

New appointments. Mr. A Azimuddin, B. Sc. Ag. to officiate as Upper Subordinate, Agricultural Section, iii grade and is posted to A. R. S. Aduturai, to join on 1--10--35 Mr. A. Mariakulandai, B. Sc, Ag, to officiate as Assistant in the Millets Section from 14—10—35. Mr. S. Kanakaraj David, B. Sc. Ag, to officiate as Assistant in Paddy Section from 14—10—35. Mr. S. Ganesamurti, B. Sc. Ag, to officiate as Assistant in Oil Seeds Section from 17—10—35. Mr. S. Venkataramappa in the Agricultural Section from 17—10—35.

Confirmation. Mr S. V. Kuppuswami Iyangar confirmed as Assistant in Chemistry.

Promotions Dr. S. Kasinatha Iyer from ii grade to i grade (Rs. 250) without prejudice to his temporary Gazetted appointment. D. Marudaraja Pillai, Assistant in Mycology from iii to ii grade (Rs. 225) Mr. K. Krishna Menon, Assistant in Mycology iv to iii grade (Rs. 200) Mr. M. Sanyasi Raju, v to iv grade (Rs. 120—10—170)

Transfers. Mr. T. S. Lakshmanan A. D. Avanasi to revert as Assistant in Chemistry. Mr. K. Narayana Nair, officiating assistant in Millets Section to revert to Agricultural Section and is posted to VII circle. Mr. M. Sitharamaraju to continue to officiate in the Chemistry section. Mr. M. Gopala Chetty VIII to IV circle. Mr. S. Ramachandran IV to VIII circle.

Leave. Mr. C. Jaganatha Rao extension of leave for one year on half average pay and is permitted to receive Rs. 95 training grant from the Cotton Committee. Mr. G. Sitarama Sastri A. D. Vinukonda leave on M. C. for 2 months. Mr. Bhairy Shivarao, l. a. p. for 2 months. Mr. V. S. Narayanaswami Iyer, A. D l. a. p. on M. C. for 4 months from 24th August 35. Mr. A. G. Ramaswami Ayya Sub Assistant Entomology, l. a. p. for 2 months.

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WILL BE HELD IN JULY 1936

Your co-operation is solicited.