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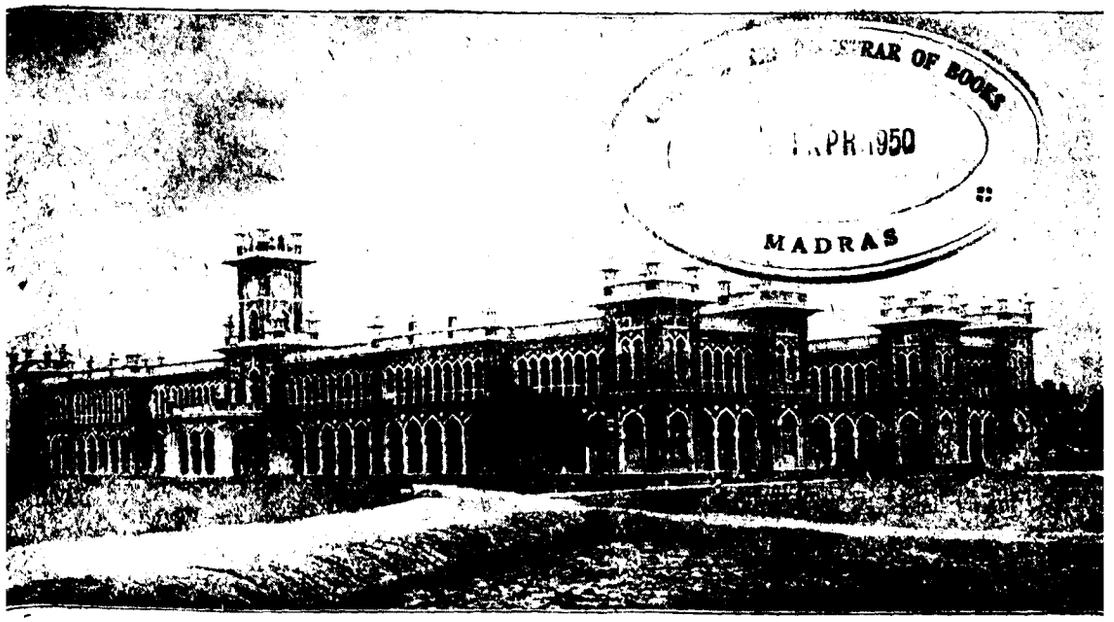

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The Madras Agricultural Journal

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Editorial

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Cancer and malignant tumours are usually associated only with human beings and animals, so that the common man would be surprised to know that cancerous growths occur also in plants. Various types of galls and abnormal growths during callus formation are of common occurrence amongst plants. Recent advances in the technique of tissue culture and studies in plant cancers have helped a great deal in the understanding of the nature of the animal cancers. In malignant cancer, the growth is rapid, unlimited and eventually lethal to the host. It is a diseased state of the cell which spreads from one organ to another by means of whole cells getting detached from the original cancerous tissue. this in other words is known as metastasis. Such migratory cells have lower nutritive needs and higher powers of synthesis. They are not bacterial in origin. Certain carcinogenic viruses, chemicals and radiations can cause such growths. Genetic factors also play an important part, since certain lines are susceptible while other closely related ones are immune. A study of crown gall in plants resulted in the isolation of a bacterium (*Phytomonas tumifaciens*). These bacteria could induce fresh tumourous growths. But when the successful tissue cultures from these induced crown galls were done the bacterium was found to be absent and the metastases from these becterial-free galls induced fresh tumours when transplanted on other plant tissues. Synthesis of indol-acetic acid was found in the cells with bacteria and in cells free from the bacteria this was found to be at a fairly high concentration. Thus the auxin induces tissue proliferation. This chemical explanation was not entirely satisfactory since the rate of the tumifaction was very slow. A theory of the presence of possible carcinogenic virus was put forward. It was also possible that the bacteria, the chemical or the virus may have induced mutation but the presence of too many grades of intensity of tumour formations precluded mutation and therefore a theory of possible enzymatic action has been suggested.

Recent work on *Sorghum* has brought out a phenomenon of continuous division in pollen grains which uses up the entire material ultimately leading to the death of the pollen. The nuclear change here leads to a cancerous condition. This has been adduced to certain polymitotic genes. "In this unlimited growth there is continuous transition from the encapsulated tumour which is limited from further growth by its own effects to the case of malignant tumours in the which the cells are sometimes capable of migration". This excessive growth has been considered, especially, in animals to be due to mutation while in plants certain conditions of nucleus and cytoplasm together could induce such abnormal growths. To cure these self-propagating bodies their character of rapid multiplication the only way suggested is to render the nucleus incapable of supporting cell life. This could be achieved by breaking up the nuclear system in cells of the cancer by exposing them to X-rays or radium emanation.

Parasitism of Striga lutea Lour. on Rice and methods to protect rice plant against Striga.

By

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(Received on 24—6—1949)

Introduction: There is a fair amount of literature on *Striga* as a root parasite on several agricultural crops. Luthra (1921) in the course of his studies of *Striga densiflora* Benth. on sugar-cane makes mention of *Striga lutea* Linn .as a root parasite on Jowar *(Andropogon Sorghum* Brot.) In the case of *Striga densiflora* he thinks that the parasite absorbs the food materials from the soil as a normal course to elaborate its own food while being parasitic on the host's roots. He has threfore classed it as a typical semiparasite. Mechanism of absorbing food material from the host plant and the anatomy of haustoria etc., are described and illustrated by the same author. Thadulingam and Narayana (1932) mention *Striga lutea* as attacking Varagu *(Papsalum Scrobiculatum* Linn.) Ragi *(Eleusine Coracana* Gaertn.) and Sugarcane *(Sacharum officinarum* Linn. The same authors have recorded *Striga euphrasioides*, Benth. another species of *Striga* attacking rice plants in the swamp. In the brochure issued by the Imperial Council of Agricultural Research (16). *Striga lutea* is mentioned as a serious pest on Tenai or Korra *(Setaria Italica* Benth*)*. Pearson (1913) has made an extensive study of *Striga lutea* L. as a parasite on maize. Excepting some casual reference made of its parasitism on rice by a few authors, very little detailed work has been done on it.

Burning, uprooting and growing trap crops have been generally advocated by different authors as cheap and practical methods of control against striga. In his trials with various chemicals to eradicate this weed, Pearson (l. c.) found that sodium chloride and potassium nitrate reduced the infection of striga. Burning of rubbish on the field after harvest wherever this is possible is advocated by this author although he admits that the benifit is very limited. Growing trap crops and ploughing them up successively for two or three years as a measure to reduce the loss on account of this parasite to a minimum, is also suggested by the same author. Sudan grass (Gray, 1932) has been reported to be used as a trap crop. The fact that *Striga lutea* cannot thrive under swampy conditions is made use of in eradicating this parasite on sugarcane. At the Indian Sugar Cane Station, Coimbatore, fields where striga is known to attack canes are now and then puddled to get over the trouble. But in the Malabar Coast of Madras where rice is grown as a dry (rainfed) crop on the slopes of hills (*medan* lands) puddling fields is impracticable.

Realising the importance of ***Striga lutea*** to the dry rice crop of Malabar and the very scanty scientific information available about the parasite, the author undertook the present study of the parasite in several aspects in relation to rice.

Material and methods.

(1) ***Striga in relation to the host:*** To study the habits of ***Striga lutea*** in its relation to the host and incidentally to the neighbouring weeds, the following simple experiments were conducted in an infected field cropped with rice. A striga infested area was divided into a number of compartments and each compartment was subjected to different treatments as below:

Compartment No. 1. All the striga plants were removed along with their roots as well as the hosts (rice plants) and other weeds, chief of them being ***Borreria hispida*** K. Sch. No striga appeared again in this area.

Compartment No. 2. The host plants were retained after rooting out all the striga plants. On the third day fresh batches of striga appeared, evidently they being new and separate ones that were preparing to come out.

Compartment No. 3. The hosts and the parasites were removed leaving only the weeds which included several species of grasses. No striga came out.

Compartment No. 4. The host plants were cut below their root junctions. All the striga plants and also other weeds were removed. On the third day new striga came up as in No. 2, but began to wilt in less than a week.

Compartment 5. In this the above experiment was repeated but the striga plants were retained. Before the lapse of a week the striga plants began to wilt and in another 5 days all of them were dead.

The following conclusions might be drawn from the above observations. (i) each and every plant is not a host for this root parasite, (ii) that weeding affords only a partial relief to the host plant against this parasite and (iii) that even during the later stages of the parasite when it has functioning green leaves etc., it cannot survive without the host.

(2) ***Striga in relation to water:*** Clumps of ***Striga lutea*** "in situ" with their host plants were bodily transplanted into the swamp rice area with water running 5 to 6 inches deep. The parasite did not survive for more than 3 days although the host plants took root and thrived.

(3) ***Striga in relation to the host and the season:*** In a field known to be infected with striga rice was sown periodically at 15 days intervals begining from 13th May 1936 and the time of appearance of the parasite was noted in the respective plots. The statement below gives the data collected about the interval of time between the sowing of rice and the appearance of the parasite above ground level.

Date of sowing rice	The date on which the 1st plant of *Striga* appeared above ground	Period in days between the sowing of rice and the appearance of *Striga*
13—5—36	24—6—36	41
28—5—36	28—6—36	30
12—6—36	18—7—36	35
27—6—36	2—1—36	35

It is seen from the above that for all the sowings of rice on or before the end of May, striga appears only by the end of June while it was observed that this appeared in larger numbers with the begining of July and thereafter. Heavy showers intermittent with bright spells of sunlight which are characteristic of this month appear to be very favourable to an outbreak of striga. Heinricher (1910) has said that most of the root parasites of the same group as striga are sun-loving plants. Again it will be observed that sowing on the 28th of May brought forth striga exactly after a month. This interval of 30 days between the sowing and the first appearance of striga above ground is, more or less, kept up for all the sowing coming after the 28th May.

The limiting factor to the incidence of striga seems to be primarily the season besides proper age and development of the host plant.

Pearson (l. c.) found that an acid medium is favourable for the germination of the striga seed and that the germination is greatly controlled by the physical condition of the soil. In a pot culture experiment, conducted by the writer, it was observed that seeds of striga germinated when kept in contact with the absorptive region of the root and never when kept away from it, thus confirming that the absorptive region of the root alone exuded certain stimulating substance necessary for its germination and necessarily acidic in nature (Dyer, 1894). In the present studies, it looks that only a month or more old rice plant is able to secrete this stimulating substance and this, under certain favourable conditions of the soil attained by the onset of the South West monsoon in June with abundant rains and occasional bright sunshine, perhaps, induces the free germination of the striga seed.

This one month period might however get extended determined by the state of development in the host. For instance, we note for the sowing on 12th. June in table I that the time taken for the striga to appear has exceeded the minimum period by 6 days. It may be mentioned in passing that this batch was handicapped in the early stage of growth by deficit rains at the time of sowing (Graph I). Subject to a minimum of 30 days in the age of the host, an early and quick growth of the host plant favours an early onset of striga. Evidently, rice which has completed 30 days by July stands to suffer equally badly as rice sown any time after June. Therefore any significant reduction in the yield of rice with later sowings cannot be attributed entirely to the effect of striga. This on the

other hand, may be due to the combined effect of the parasite and the depleted vitality of the host on account of the sowings made in the midst of the increasing rains after June. Graph I gives an idea of the distribution of the rains recorded during this period of the experimentation. It would appear therefore that a crop being over 30 days of age before July is somewhat of an insurance against its succumbing to the parasite. In other words, in cropping the infected fields rice sown earlier than May with the help of the premonsoon showers contrary to the practice of the ryots should yield better than later sowings.

That early sowings contribute to increased yield is evident from the data collected at the station. In the ***modan*** area free from this parasite, the yield of rice when sown in the month of April gives as an average of 4 years an acre yield of 839 lb. of grain against an average yield of 642 lb. when sown late in May. In one year (17) a particular variety of rice when sown early in April gave an acre yield of 858 lb. while the same variety gave only 347 lb. when sown late in May. It must, however, be understood that early or late sowings which bring about differences in yield cover only a short period of time. The middle of May may be taken as the maximum limit for late sowings capable of producing differential effect on yield, while sowings done beyond that do not influence the yield.

The ordinary practice with the ryots is to sow rice, more or less, with the commencement of the regular monsoon. It is clear then, that by sowing so late as with the monsoon, the young rice crop is unable to make full use of all the benefits accruing from the earlier rains. The non-availability of the earlier opportunities therefore constitute a definite loss to the growth and development of rice, when this is sown late. The effect of the season on the yield will therefore be seen when rice is sown sufficiently early with the pre-monsoon showers which though scanty at times are more than sufficient to nurture a young crop of rice through their nursery stage. Graph II gives us a fair idea of the distribution of rains in this tract during the time of *modan* cultivation.

That the crop is benefitted by early sowing not only in fields free from striga but also in the striga infected fields was apparent from the yield data of the station during three seasons 1933—1935 (17).

(4) *The degree of protection against Striga by early sowing:* In order to study this rice was sown in an infected field at four different times starting early in the season at definite intervals of 15 days. Taking advantage of a small shower, before the onset of the monsoon, the sowings were done on the 13th and 28th of May, 12th and 27th of June 1936, respectively. The four sowings were randomised into each of four blocks comprising the experimental area. Thus on the whole there were four repetitions for each sowing. Each replication consisted of a single plot 29′ long and 5′ wide. In order to obtain a more uniform and intensive

infection of the soil, each time just before sowing rice, the seeds of striga collected during the previous year were broadcasted in all the four replications at the rate of 1 oz. per cent. The seed was mixed with sand to ensure uniform distribution. In sowing rice, three to four seeds were dibbled in a hole, 4 inches apart in furrows running with the length of the plot. There were 12 such furrows for every plot.

To assess the seasonal influence apart from that due to the parasite, an exact replica (control) of the above sowings was carried out in a non-infected field. A month after sowing, the plants in both the infected and the control area were thinned leaving only 2 seedlings per hole. Fortnightly measurements for the height of plants from sowing to earing were taken for all the sowings commencing 15 days after sowing Heights were measured for 75 plants taken at random from each of the four replications, totalling on the whole 300 plants for each sowing. The average and mean heights of 75 plants for each replication under each date of measurement are presented in tables I and II. Mean heights of 300 plants for the different dates of measurements under each sowing for both the infected as well as the control areas are plotted in the graph I. The dotted lines represent the control. A comparison between the growths of rice in the infected and the control area clearly indicates that all the four batches of sowings in the latter despite being sown at different periods of the season exhibit identical growth for both rate and total growth. The yields from the infected and the control area were statistically analysed and the details of analysis are given in the statements III to XIV. It will be seen that there is practically no difference in the grain yields for the first three batches of sowings in the non-infected area while there is a sudden drop in the yield for the last batch (Table III). The unnaturally low yield of grain in the fourth sowing for both the infected as well as the non-infected areas (Tables III and IX), explained under 'Parasitism and the time of reproduction of striga' (see below) therefore accounts for the significance satisfying the 'Z' test in Table IV. It will, however, be noted that leaving out the last sowing, the difference between no two sowings in the control exceeds the critical difference (Table V), nor is this significant in their straw yields (Tables VI, VII and VIII). On the other hand, the difference in yield in the infected plot (Tables IX to XIV) is found to be highly significant thus proving that the superior performance of the earliest over the later sowings (Tables XI and XIV) in the infected area is not so much due to any seasonal influence as to a successful escaping of the early sown crop from the striga attack explained under striga in relation to the host and the season ". This freedom for the earliest sown crop from striga would be further clear from the similarity of growth which this sowing alone bears to the normal growth of rice in the control (Graph I). The amount of difference above the critical difference, may be an index to the degree of protection conferred on rice against an attack by this parasite.

TABLE I.

(Showing average figures for four replications)

Date of sowing rice.	Dates of measurement										Mean	S.D.	Coefficient of variation
	28—5—36	12—6—36	27—6—36	12—7—36	27—7—36	11—8—36	26—8—36	10—9—36	25—9—36	10—10—36			
13—5—36	6·55	7·93	13·20	16·90	17·70	19·73	23·13	...	...	...	15·02	5·65	37·61
28—5—36	...	4·93	7·28	11·08	12·78	13·45	15·80	18·95	...	...	12·04	4·44	36·87
12—6—36	...	...	5·95	7·90	9·33	10·58	11·40	14·70	15·95	...	10·83	3·29	30·37
27—6—36	...	...	...	5·68	7·90	8·30	10·95	13·78	14·18	15·60	10·91	3·46	31·71

TABLE II

13—5—36	6·73	8·10	11·50	15·78	16·50	17·03	20·65	...	...	...	13·76	4·84	35·17
28—5—36	...	5·13	6·93	9·50	10·75	15·43	20·60	21·08	...	...	12·77	5·91	46·28
12—6—36	...	...	5·85	7·65	9·33	15·10	19·15	20·03	20·75	...	13·98	5·83	41·70
27—6—36	...	...	...	6·28	7·95	13·65	18·18	20·05	20·58	21·28	15·42	5·76	37·35

TABLE III

Area of a single strip — ¼ cent — Grain yield in ¼ oz — control

Blocks	Treatments (Dates of sowing)				Total	Mean yield
	13–5–36	28–5–36	12–6–36	27–6–36		
1	39	42	39	19	139·0	34·75
2	37	35	38	19	129·0	32·25
3	34	33	30	25	122·0	30·50
4	35	37	34	15	121·0	30·25
Total	145	147	141	78	511·0	
					Grand total	
Mean yield	36·25	36·75	35·25	19·50		31·93
						General mean

TABLE IV

Analysis of Variance

Due to	Degrees of freedom	Sum of squares	Mean square	½ log e (Mean sq.)
Blocks	3	51·69		
Treatments	3	829·69	276·56	2·8112
Error	9	109·56	12·17	1·2495

1% point for 'Z' ... ... 0·9724.
Observed value of 'Z' ... ... 1·5617.
Hence significant.

TABLE V

Particulars	Treatments (Dates of sowing)				General mean	S.E. of mean difference	'Z' test satisfied or not P=0·01	Critical difference P=0·05
	13–5–36	28–5–36	12–6–36	27–6–36				
Mean yield in ¼ oz.	36·25	36·75	35·25	19·5	31·94			
% on general mean	113·49	115·06	110·36	61·05	100·00	7·71	Yes	17·44

TABLE VI

Area of single strip ¼ cent — straw yield in ¼ oz. — control

Blocks	Treatments (Dates of sowing)				Total	Mean yield
	13–5–36	28–5–36	12–6–36	27–6–36		
1	253	269	286	254	1062	265·50
2	247	267	269	258	1041	260·25
3	267	232	245	245	989	247·25
4	261	216	269	224	970	242·50
Total	1028	984	1069	981	4062	1015·50
					Grand Total	
Mean yield	257·00	246·00	267·25	245·25		253·875
						General mean

TABLE VII

Analysis of Variance

Due to	Degrees of freedom	Sum of squares	Mean square	½ log e (Mean sq.)
Blocks	3	1396·25	465·416	
Treatments	3	1300·25	433·416	0·7333
Error	9	2445·25	271·69	0·4997

5% point of 'Z' ... ... 0·6757.
Observed value of 'Z' ... ... 0·2336.
Hence not significant.

TABLE VIII

Particulars	Treatments — Dates of sowing 13—5—36	28—5—36	12—6—36	27—6—36	General mean	S. E. mean difference	'Z' test satisfied or not (P=0·05)	Critical difference (P=0·05)
Mean yield in ¼ oz.	257·00	246·00	267·25	245·25	253·87			
% on general mean	101·23	96·90	105·27	96·60	100·00	4·59	No	10·38

TABLE IX

Single strip area—¼ cent—Grain yield in ¼ oz—Infected field

Blocks	Treatments — Dates of sowing 13—5—36	28—5—36	12—6—36	27—6—36	Total	Mean yield
1	89	43	23	6	161	40·25
2	113	41	17	8	179	44·75
3	89	37	16	6	148	37·00
4	117	41	21	9	188	47·00
Total	408	162	77	29	676	169·00
Mean yield	102	40·5	19·25	7·25		42·25 General mean

TABLE X

Analysis of Variance

Due to	Degrees of freedom	Sum of squares	Mean square	½ Loge (mean square)
Blocks	3	241·5	80·5	
Treatments	3	21308·5	7102·83	4·4341
Error	9	5010·0	55·66	2·010

1 % point for 'Z' ... 0·9724
Observed value of 'Z' ... 2·4241
Hence significant.

TABLE XI

Particulars	Treatments — Dates of sowing 13–5–36	28–5–36	12–6–36	27–6–36	General men	S.E. of mean difference	'Z' test satisfied or not (P=0·01)	Critical difference (P=0·05)
Mean yield in ¼ oz.	102·00	40·50	19·25	7·25	42·25	21·10		
% on general mean	241·42	95·86	45·56	17·16	100·00	12·48	Yes	28·23

TABLE XII

Single strip—¼ cent—Straw yield in ¼ oz.—Infected field

Blocks	Treatments — Dates of sowing 13–5–36	28–5–36	12–6–36	27–6–36	Total	Mean yield
1	173	107	66	48	394	98·50
2	229	101	77	54	461	115·25
3	192	108	80	65	445	111·25
4	228	115	60	56	459	114·75
Total	822	431	283	223	1759	439·75
Mean yield	205·5	107·75	70·75	55·75		109·9375 General mean

TABLE XIII

Analysis of Variance

Due to	Degrees of freedom	Sum of squares	Mean square	½ log e (Mean sq.)
Blocks	3	735·69	245·23	
Treatments	3	54435·69	18145·23	4·9031
Error	9	1871·56	207·95	2·6686
1% point of 'Z'	...	...	0·9724.	
Observed value of 'Z'	...	...	2·2345.	
Hence significant.				

TABLE XIV

Particulars	Treatments — Dates of sowing 13—5—36	28—5—36	12—6—36	27—6—36	General mean	S. E. of mean difference	(Z' test satisfied or not (P=0·01)	Critical difference (P=0·05)
Mean yield in ½ oz.	205·50	107·75	70·75	55·75	109.84			
% on general mean	186·92	98·01	64·35	50·71	100·00	9·27	Yes	20·97

(5) ***Parasitism and the time of reproduction of striga:*** A scrutiny of graph I will throw some light into the inter-relation that exists between certain phases of growth in the life cycles of the host and the parasite. A close study of the life history of striga occurring in the *modan* lands showed that for an average striga plant from a seed lying in the top layer of the soil, it takes nearly 21 days from emergence on the surface of the soil to the opening of the first pair of the axillary flower buds. Normally the corolla sticks to the ovary for about 2 days and when it drops the next pair of buds immediately above open. From counts made for a number of plants, the total number of pairs of the flower buds per plant averaged 12. Thus it is seen that the flowering period extends to about 24 days. Adding to this a further period of 15 days from setting of the seed to the bursting of the capsule, the average life of a striga plant from appearance to the bursting of the last pair of the capsules runs to sixty days. This is the life span above ground for the majority of the striga plants occurring among the *modan* rice leaving those that live the major portions of their lives under ground. It has already been indicated that the incidence of striga is closely bound with the season and the age of the host plant. Putting the above two facts together the following table has been constructed to indicate the approximate dates on which striga is expected to appear, to put forth flowers and to develop pods for each of the four sowings. Against these are set the approximate dates of decline in the growth of rice under the different sowings as indicated by the growth curves (Graph I) in the infected fields and also the normal growth curves recorded from the control area.

TABLE XV

Dates of sowing rice	Date of 1st appearance of *Striga*	Expected date of appearance of *Striga*	Date of commencement of decline in the growth of host plant as indicated by the graph	Expected date of commencement of flowering in *Striga*	Date of partial recovery from the depression of growth in the host as indicated by the graph	Expected date of termination of the flowering period in *Striga*	No. of days by which the recovery is earlier than the date of termination of the flowering period in *Striga*
13–5–36	24–6–36	Last week of June	12–7–36	15–7–36	27–7–36	8–8–36	11
28–5–36	28–6–36	28–6–36	12–7–36	19–7–36	11–8–36	12–8–36	1
12–6–36	17–7–36	12–7–36	27–7–36	2–8–36	26–8–36	26–8–36	Nil
27–6–36	2–8–36	27–7–36	27–7–36 & 10–9–36	22–8–36	11–8–36 & 25–9–36	15–9–36	...

The expected dates of flowering in striga has been calculated by adding 21 days to the date of its appearance above ground while it will be remembered that the average duration of ***modan*** rice from sowing to flowering is 10 days. On a scrutiny of the figures in the above table it will be seen that there is some agreement between the time of flowering of the parasite and the time of general decline in the growth of the host plant. In other words, the injury done to the host by the root parasite is at its worst when the latter enters its reproductory stage. Further, it is seen from the table that an early sown rice crop recovers from this depression occurring at the time of reproduction in striga very much earlier than a late sown one.

These varied phenomena in the growth of the host in relation to the root parasite under the different sowings have a close parallel to the yields of the different sowings (Tables XI & XIV). The low grain yield of the fourth sowing in the control as well as the infected area (Tables III & IX) in the same experiment could be partly attributed to a heavy infestation of the rice bug *(Leptocoriza aucta)* since these were the only strips of rice left in the whole area of the *modan* field and partly to the heavy showers at this period (Graph I) inducing some un-setting in the grain. The accepted principle among the ryots in these parts that *modan* rice should not be sown late in June as in this case has some significance. It is clear then that for the purpose of elucidating the information for which this experiment was designed, the last sowing is superflous and therefore might be ruled out.

To have an idea of the population of striga plants in the infected plot the number was counted in each of the plots at the time of harvest and tables XVI & XVII serve to show the degree of infection with striga, its distribution per rice plant and the percentage of visible striga plants to the number of seeds sown. Each replication was sown with 0·33 ozs. of striga seeds containing 13,67,815 seeds.

TABLE XVI

Repetitions	Dates of sowing striga seed											
	13—5—36			28—5—36			12—6—36			27—6—36		
	No. of Striga plants	No. of rice plants	Av. distribution of striga per rice plant	No. of striga plants	No. of rice plants	Av. distribution of striga per rice plant	No. of striga plants	No. of rice plants	Av. distribution of striga per rice plant	No. of striga plants	No. of rice plants	Av. distribution of striga per rice plant
1	3165	2112	1·5	3282	2112	1·5	2977	2112	1·4	1031	2112	0·5
2	3321	2112	1·6	3219	2112	1·5	2451	2112	1·0	1651	2112	0·8
3	4122	2112	1·9	3179	2112	1·5	2611	2112	1·2	975	2112	0·4
4	3341	2112	1·5	4021	2112	1·9	3031	2112	1·4	1112	2112	0·5
Total	13949	8448	6·5	13701	8448	6·4	11070	8448	5·0	4769	8448	2·2
Average	3487·2	2112	1·6	3425·2	2112	1·6	2767·5	2112	1·3	1192·2	2112	0·56

TABLE XVII

Repetition	Dates of sowing rice							
	13—5—1936		28—5—1936		12—6—1936		27—6—1936	
	No. of striga plants over ground	% of visible plants to seed	No. of striga plants over ground	% of visible plants over seed	No. of striga plants over ground	% of visible plants to seed	No. of striga plants over ground	% of visible plants to seed
1	3165	0·16	3282	0·18	2977	0·15	1031	0·06
2	3321	0·18	3219	0·17	2451	0·13	1651	0·09
3	4122	0·22	3179	0·17	2611	0·14	975	0·05
4	3341	0·18	4021	0·22	3031	0·16	1112	0·06
Total	13949	0·19	13701	0·18	11070	0·15	4769	0·06

TABLE XVIII

Treatments	1	2	3	4	5	6
Dates on which counts made	Live striga plants before application of lime	Striga that died subsequent to the application	Live striga plants before application of lime	Striga that died subsequent to the application	Live striga plants before application of lime	Striga that died subsequent to the application
I. Pot Sowings						
14—7—33	23	Nil	18	Nil	20	Nil
15—7—33	...	18	...	8	...	Nil
17—7—33	...	3	...	7	*1	Nil
19—7—33	...	1	...	1	*3	Nil
21—7—33	...	1	...	Nil	...	Nil
% death on the total live plants.		100%		89%		Nil%
II. Field Sowings						
17—8—33	20	Nil	40	Nil	12	Nil
19—8—33	...	12	...	26	...	Nil
20—8—33	...	5	...	Nil	*1	Nil
28—8—33	...	Nil	...	6	...	Nil
% death on the total live plants		85%		80%		Nil%
Dates on which counts made	Live striga plants before application of lime	Striga that died subsequent to the application	Live striga plants before application of lime	Striga that died subsequent to the application	Live striga plants before application of lime	Striga that died subsequent to the application
I. Pot Sowings						
14—7—33	13	Nil	20	Nil	16	Nil
15—7—33	...	2	...	4	...	Nil
17—7—33	*1	1	*2	2	*1	Nil
19—7—33	*2	1	*2	1	...	2
21—7—33	...	Nil	...	Nil	...	
% death on the total live plants.		25%		29%		11·7%
II. Field Sowings						
17—8—33	14	Nil	16	Nil	12	Nil
19—8—33	...	4	...	Nil	...	Nil
20—8—33	...	2	*1	Nil	*1	Nil
28—8—33	...	Nil	...	2	...	Nil
% death on the total live plants		43%		11·7%		Nil%

* New arrivals after application of lime.

The low population of striga in the last sowing may be due either to bad germination of striga seed or to the germinated plants dying off due to the too wet conditions. The trials conducted at the station to study the habit of striga under the swampy condition and recorded elsewhere in this paper strengthens this view.

(6) ***Protection of rice plant against*** striga by: (i) ***Weeding***: Systematic weeding before the parasite sets seeds carried on over a series of years might mitigate the trouble. But due to the small size of the seed, the large number produced and the capacity of the seed to remain dormant in the soil for long periods, it cannot be a complete success. Moreover, the soils in which the parasite occurs being poor in fertility, the yield of rice is usually low and it will not be an economic proposition to spend much money on weeding. (ii) ***Employment of chemicals:*** The efficacy of the following chemicals to destroy striga in all its stages of growth both above and under the soil without affecting the host plants, were tried taking into consideration the cost of the chemicals and the general resources of the average ryot.

(a) ***Lime:*** Burnt shell lime was tried both in the pot culture and in the field experiments. Rice plants about 2 months old growing in pots with the root parasites in all stages of growth were first treated with lime. The tabular statement below gives the doses of lime applied and the number of live parasites in the begining, the number of deaths and fresh ones coming through, daily for about a week. Cylindrical pots used in the experiment were filled with equal volumes of *modan* soil. The quantity of lime to be applied for each treatment was calculated for the surface area of the pot which measured 1 sq. ft. for each pot.

The treatments were—lime at lb. per acre: 1. 10,000, 2. 8,000, 3. 4,000, 4. 2,000, 5. 1,000, 6. Control—No lime. The first treatment was found to affect the rice plants causing some of them to wilt and die. That smaller doses of lime are not quite so efficacious in killing the parasite, is evident from the fact that in these treatments new striga plants did appear after the experiment was started. The same experiment was repeated in the infected field adopting identical doses over a 2 feet square area for each treatment. The lime was applied on 17—8—33. The results are tabulated below (table XVIII).

The results in the field experiments do not entirely agree with those of the pots though the trend is very similar. Even the maximum doses of 8 to 10,000 lb. of lime per acre which killed the striga completely in pots did not do so in the field. It was also noted that a crop, however, well treated against infection of striga with lime did not produce anything equal to the average yield from a non-infected crop. The results in the above experiments indicate that lime in doses of 4000—8,000 lb. per acre is almost fatal to the parasite killing over 80% of the population without appreciably affecting the host.

Economics of liming: 4000 lb. of lime would cost the ryot at the cheapest Rs. 20 (pre-war-rate). The net profit from an acre of non-infected *modan* rice will be not more than Rs. 15 for the prevailing price. It will, however, be remembered that an infected crop when treated with lime does not yield anything more than the average yield from a non-infected crop. Liming as a measure to eradicate striga is therefore un-economical.

(b) ***Copper sulphate:*** Copper sulphate solution was sprayed in 3 concentrations 1, 2 & 4 percent at 1000 c.c. of each over the surfaces of the soil in the pots (1 to 3) which were infected with striga. The sprayings were done on 17—8—1933. The observations are given below.

Dates of observations	(1) 1% solution	(2) 2% solution	(3) 4% solution
17—8—33	18 living striga plants. Host plants all healthy.	11 living striga plants. Host plants all healthy.	15 living striga plants. Host plants all healthy.
19—8—33	All striga plants scorched and 10 lodged. Host plants not affected.	All striga plants completely scorched and dying. Host plants partly affected.	Striga plants totally charred beyond recognition. Host plants badly scorched.
20 to 23-8-33	Host plants not affected.	Host plants dead.	Host plants dead.
24—8—33	Host plants affected.		

Copper sulphate of even 1% strength proved injurious to the host plants. In a subsequent trial still weaker solutions of copper sulphate were used. The spraying was done on 12—7—37. The results are recorded below.

Dates of observation	½ % solution	¼ % solution	Control
12—7—37	47 striga plants. 21 host plants. All healthy.	41 striga plants. 19 host plants. All healthy.	34 striga plants. 20 host plants. All healthy.
13—7—37	All the striga plants scorched and wilting. Host plants slightly affected.	All the younger ones among the striga scorched and wilting. Older ones badly affected. Hosts are healthy.	Both hosts and parasites healthy.
14—7—37	Striga all completely dead. 4 of the host plants wilting. The rest show signs of wilting.	All the striga plants fast wilting. Hosts healthy.	Both hosts and parasites healthy
15—7—37	No improvement in the hosts.	Striga all dead. Hosts healthy.	do.
17, 18 and 19—7—37	Hosts sickly.	Hosts healthy and normal.	do.

A quarter percent solution of copper sulphate kills the parasite striga without apparently affecting the host plant.

Economics of spraying with copper sulphate: The quantity of copper sulphate required for spraying an acre at the rate of 1000 c. c. of ¼% solution used for a sq. foot area works up to 240 lb. The cost of this will be at its cheapest Rs. 15 (pre-war-rate). The high cost, however, does not warrant its use considering the small income almost equal to it, proceeding normally from an acre of non-infected ***modan*** rice.

(c) ***Common salt:*** This in doses working out to 10 tons (22, 400 lb.), 20 tons and 60 tons per acre were applied to the potted rice plants infected with striga. In all the cases striga died instantaneously and thereafter the host plants too. In the case of 22,400 lb. there was no immediate effect on the host plant which, however, showed signs of wilting sometime later. It is clear therefore that any dose to achieve our objective should be less than ten tons. Even 1 or 2 tons will be too expensive for a ryot to use.

(iii) Dodging the parasite by adjusting the cultural practices : It has already been shown that early sowing does to a great extent provide a way out of the trouble due to this pest. The rule should be to sow rice with the help of pre-monsoon showers taking the earliest opportunity. As a rule, these showers are received in the month of April. Occasionally they might be received even earlier, 2 or 3 inches of rain, at times, are received within a week or two. Seeds when sown germinate in 3 or 4 days. The succeeding rains during this pre-monsoon period, even though they might be small and unsteady, help a good deal to force the young seedling up.

The regular monsoon commences generally by the third week of May. Even if the rice is sown by the first week of April or even earlier, the seedling once established are able to resist drought considerably till the break of the monsoon. At the Pattambi Agricultural Research station, in the year 1936, rice was sown with the help of the pre-monsoon showers on the 2nd of April. Regular monsoon commenced on the 28th of May. 1.34" of rain received since sowing the rice, was able to keep the crop going through an absolutely rainless period of 45 days immediately preceeding the outbreak of the monsoon on the 20th of May. The crop practically remained unaffected.

Early sowing, however, carries with it the risk of a long period of drought following. This necessarily causes some of the rice seedling to wilt and die. A fairly large percentage of the seedlings is destroyed by white ants, (a 30 days old crop showed 45%.) In another crop where plants were only 20 days old and therefore had not to contend so much a droughty weather as the earlier sown one, the plant population showed to be 70 percent of the seed sown. Ordinarily the seed rate adopted by the ryots under very favourable conditions for sowing ranges between 100 and

150 lb. per acre which is about 2 to 3 times that is ordinarily used for a broadcast crop under wet conditions. To provide against loss of plants due to drought when rice is sown early, the seed rate could with advantage be raised to 200 lb. per acre. The extra cost due to the excess seed may not cost the ryot more than a rupee (pre-war valuation) and will be more than justified by an almost normal crop ensured in an infected field by early sowing.

(iv) Cultivation of resistant varieties: Even rice varieties which grow in the swamp can grow under *modan* conditions though not so luxuriantely. Though no swamp varieties were actually tried, several of the dry rices that are grown in the tracts outside were collected and tried in a preliminary study to find out if there was any difference in the degree of pest incidence in them. The six varieties tried were *modan dirty glume*, *modan black glume*, *kattamodan straw glume*, *budama*, *chennellu*, and *chamodan* and their flowering durations varied from 85 to 105 days. Though sown at the same time no differences were noticed in the striga incidence. It may however be noted here that in a preliminary trial conducted to study the infectiousness of *Striga lutea* on crops other than rice, it was observed that *Striga lutea* did not attack P. T. 499, a strain of cumbu (*Pennisetum typhoideum*) evolved by the Madras Department of Agriculture although Sawyer (1922) has said that this millet was a host of the parasite.

(v) Biological control: This as a control measure employed by the entomologists to combat crops pests, has of recent years assumed great importance. If any insect could be found which will eat up striga and spare the rice, it will be a useful method of controlling striga. During 1935, the grubs of a certain species of beetle were found to be highly predatory on striga sparing no parts of its shoot system including the stem leaves and the pods. The adult which was found to be harmless was identified by the Government Entomologist, Coimbatore, to be a ***Calurucine*** beetle. This beetle should, therefore, provide an effective biological control if bred and released in large numbers during the season of rice cultivation in the infected areas. Though no experiments have however been done in this line, it would probably appear worthwhile investigating the problem.

Summary and conclusions.

1. The relevant literature available on *Striga* is briefly reviewed.

2. In the trial conducted to find out if *Striga lutea* attacked any other cereals besides its known hosts, it was found that it did not attack P. T. 499, a strain from Cumbu *(Pennisetum typhoideum)* which is known to be a host for this parasite.

3. Even when above ground, *Striga* is vitally dependent on the host plant.

4. ***Striga lutea*** does not thrive under aquatic conditions.

5. The incidence of ***Striga*** is controlled by season as well as the age and development of the host. The proper age and development of the rice plant appear to be essential to produce certain root exudations essential for stimulating the striga seed to germinate. The seasonal conditions at the on set of the South-West-Monsoon in June, perhaps brings about certain ideal physical conditions in the soil, which appears to be equally essential for the free germination of this seed. A rice crop being over 30 days of age before July is some what of an insurance against its succumbing to the parasite.

6. The superior performance of the earlier sown rice crop over the later sown one in the infected area is not so much due to any seasonal influence as to its dodging the ***Striga*** by passing the optimum conditions favouring an effective attack.

7. The injury done to rice by ***Striga*** is at its worst when the latter enters its reproductory phase and an early sown crop recovers from this injury much earlier than a late sown one.

8. The low incidence of ***Striga*** in the rice fields sown with its seed during the rainiest part of June may be due to the too wet condition of the soil.

9. Burning, uprooting and growing trap crops are some of the practical methods of control against ***Striga***. Flooding is another method employed but this is not practicable in ***modan*** rice fields.

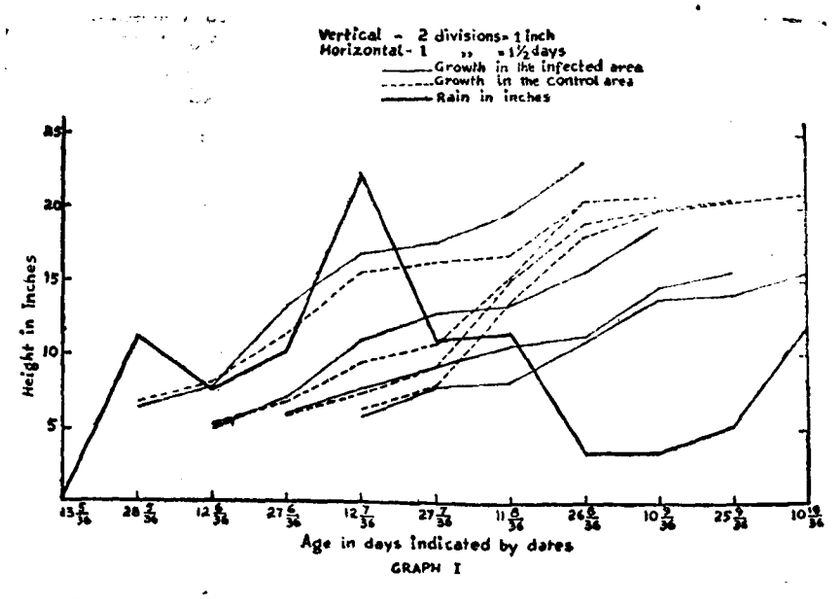
10. Weeding of the parasite affords only a partial relief to the rice crop.

11. Lime in doses of 4000—8000 lb. per acre is found beneficial to the infected crop. A quarter per cent copper sulphate solution kills the parasite without appreciably affecting the host plant. Both these, however, are uneconomical to use on account of their high cost. Sodium chloride applied at 10 tons per acre killed the parasites immediately but not the host which however, succumbed after a week. Even one or two tons will be too expensive for a ryot to adopt.

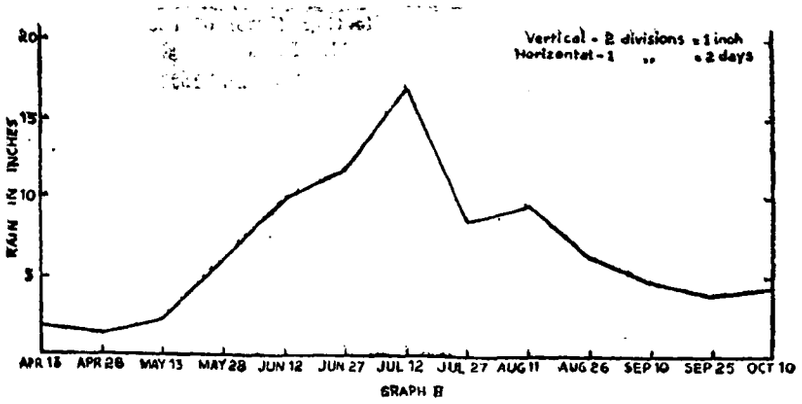
12. Early sowing to a great extent provides a way out of the trouble due to this pest. Rice should be sown with the premonsoon showers taking the earliest opportunity. To provide against any loss of plants due to drought, the usual seed rate could with advantage be doubled.

13. None of the few ***modan*** rice varieties tried showed any varietal resistance against this parasite.

14. Grubs of a particular ***Calurucine*** beetle found to feed exclusively on ***Striga*** may be of potential value in the biological control of this parasite.



GRAPH I



GRAPH II

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Description of Graphs

Graph 1: Showing the growth of rice measured for the different sowings at different dates commencing from 15 days after sowing and ending some time before harvest and also showing the distribution of rain as recorded during these periods.

Graph 2: Showing 10 years average rain distribution for the period of ***modan*** rice cultivation at the Agricultural Research Station, Pattambi.

Some Experiences with Gammexane (B. H. C.) and D. D. T.

III. *The Paddy Jassid — (Nephotettix bipunctatus,* F.)

A short account of the experiments and the campaign.

By

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(Received on 12—11—1949)

This insect, which was hitherto classified as a minor pest on paddy plants suddenly assumed serious proportions during October, 1948. The phenominal incidence of this hitherto little-known insect was an eye-opener regarding the potentialities of our insect foes and showed that the entomologist has not only to contend with numerous major forms of insects peculiar to cultivated crops, but has also to hold himself in readiness to fight any obscure insect which may suddenly turn a pest.

The first report about a widespread damage was received from Tanjore district by the last week of October 1948, and it was found on investigation that the "Kuruvai" crop which was almost ready for harvest by this time, had harboured considerable numbers of these bugs and that their number had subsequently dwindled to negligible limits with the harvest of the crop. The real trouble, however, started by about the end of this month. An alarming report was received from Chinglepet, and this was followed by similar accounts from Salem, South Arcot, North Arcot Chittor, Coimbatore, Tiruchirappalli. Madura and Tirunelveli. In short practically the entire part of the country at present known as the "Tamil Nad" was seriously infested with the pest during October—November. On the whole, the alarm was so unprecedented that the resources of the Entomology Section were at no time more heavily taxed than during the present occasion. The pest has been recorded in a serious form in the Central Provinces, Bihar and Orissa. Coming nearer home it was prevalent in North Arcot during 1946. One of the probable factors for its sudden multiplication and virulence may be the complete failure of the North-East monsoon during 1948. Another possibility is that the present system of intensive and continuous cultivation of paddy in some of the garden-land areas practically throughout the year might have afforded a fertile breeding ground for the jassids to multiply.

The pest, its life-history and habits: The bugs are small, active, wedge-shaped creatures about 5 m. m. in length, green in colour, the males

having a prominent black spot on each of the fore-wings. The female inserts her eggs into the lower leaf sheaths of paddy plants and the egg-laying capacity of an individual varies from 24 to 34. The nymphs hatch out in 4 or 5 days. They feed on the plant sap as they grow and reach the adult stage in about 20 days, moulting five times during the period. The full grown nymph is pale-green in colour. The females are ready for egg-laying in about 10 days. It is, therefore, likely that there may be at least 4 to 5 broods during a paddy season. The bugs are reported to breed on a few species of wild grasses also during the off-season.

Nature and extent of damage: The pest, was observed to be more severe in tracts where paddy was cultivated under well-irrigation. The maximum area under a well rarely exceeds 3 or 4 acres and even this is planted in successive stages, the area being decided according to the availability of water. As a result of this practice one often finds the crop in all stages of growth at the same time in a garden. The pest has been found to be particularly partial to young crops under two months old. The first visible symptom of infestation is that the plants develop an unhealthy look without the usual bright green colour and the growth is some what stunted. On a closer examination, scores of the bugs can be seen resting on the plants sucking up the plant sap. More definite symptoms are perceptible a few days later. The plants make no progress in growth, the leaves turn yellowish and the crop eventually withers and dries up. The drying up of the crop is probably hastened by the utter neglect of such fields. The owners do not even care to irrigate them out of sheer helplessness, and invariably plough them up. Though the bugs restrict their activities to young crops, an appreciable population may also be found on the older plants, but such older plants appear to be capable of withstanding the drain and hence no serious damage is caused. Most of the reports of jassid damage were from the well irrigated areas, except for two instances from the deltaic tracts of Tanjore and Tiruchirapalli. The present year's experience shows that the pest is virulent during the months of October, November and December,

Preliminary work: The approved methods of control in vogue were systematic hand-netting of the bugs supplemented by light traps, to which these insects are attracted in large numbers. On receipt of the earlier reports, every available hand in the section and districts was deputed to demonstrate and popularise these methods. Hundreds of the handnets and leaflets in Tamil giving a description of pest and the control measures to be adopted were distributed in all districts. In addition, the District Agricultural Officer, Salem arranged a special issue of 800 gallons kerosine to kill the bugs caught by netting, the humorous aspect in the distribution being that the possession of a handnet entitled the owner for his quota of kerosene. At Coimbatore about 100

nets were kept ready and every ryot was given one or two. These mechanical methods of control, however, can at best be claimed merely as palliatives and the pest was kept in check only in places where the measures were adopted systematically and assiduously.

Work done: The Entomology Section at Coimbatore had, in the meanwhile, realised that machanical methods should at once be replaced by efficient insecticides, especially the new compounds B. H. C. and D. D. T. The following experiments were designed and conducted. Severely infested areas round about Coimbatore were surveyed, suitable plots were selected and dusted separately with D. D. T. at 2, 3, 5 and 10% concentrations and B. H. C. (D. O. 25). The result after 24 hours was not very marked. The trials were repeated with the addition of sprays of the two chemicals at O.1 and O.25% strengths and here again the mortality was not convincing for 24 hours. A third repetition was made on the next day with aqueous forms of D.D.T. and B.H.C. at O.1 and O.25% and D.D.T. kerosene emulsion at O.16, O.32, O.64, O.96 and 1.28% (1, 2. 4, 6 and 8 oz. of the emulsion in a gallon of water). In the third set of trials, the areas treated 3 days previously revealed a complete mortality of the entire jassid population in tte plots treated with D.D.T. both as dust and as spray. Encouraged by these results, the trials were repeated once again in another area and the previous observations were confirmed. The course of mortality is by itself quite interesting. The jassids do not at all seem to be affected for the first 24 hours, as they are quite active, when disturbed. On the second day stray specimens may be found dead here and there but the full effect is seen only after three days. The leaf hoppers, once they had come in contact with the chemical do not seem to be capable of hopping to long distances even in the course of the three days, as they are invariably found dead immediately below the plants on which thy had been resting. The hoppers drop down and float in the water and get wafted along the direction of the wind and thousands of them can be found collected along the field bunds, generally on the third or fourth day after the spraying. A gist of the trials made, the result obtained as well as of the costs of the different tratments is furnished iu a separate statement.

From the data, it is evident that D.D.T. both as dust and spray has a speciffic action against this jassid, though it takes three days to effect a complete kill. D.D.T. emulsion in kerosene is effective but the higher concentrations have a scorching effect. B.H.C. was not found to be quite so effective as D.D.T. Meanwhile trials were also taken up with another preparation 'Torch Brand D.D.T. 4% Emulsion' at Madras, Salem etc. This too was quite effective, but had to be given up because of its prohibitive cost.

In view of these results, steps were taken to popularise the method, but the problem was the availability of the chemical, the use of the chemical

not having been attempted so far on a field scale, at any rate in this presidency. Only 17 x 28 lbs. tins were at all available at Madras with Messrs Addison and Co., the stockists. The entire quantity was requisitioned and apportioned to the different districts according to the virulence of the pest. The staff at Coimbatore was trained in the spraying technique and sent to the different districts a second time to demonstrate and popularise the new method, and the spraying compaign was in full swing, within a week of the preliminary findings. The results were everywhere remarkably successfull and the specific action of DDT against the jassid was established beyond doubt.

Summary: *The paddy jassid–Nephotettix bipunctatus*, F. though considered only as a minor pest till recently suddenly became a serious pest in the Tamil districts, during 1948. It was more virulent on well irrigated tracts, having a partiality to young crops under one or two months. DDT either as spray or dust had a spectacular effect against the pest. Between the two forms the spray was found to be cheaper. Two lbs. of "Guesarol 550" in suspension in 100 gallons of water are required to treat an acre and the cost of the chemical works out to Rs. 6. DDT emulsion in kerosene, though effective is not recommended as its inadvertent use is fraught with phytocidal risks with the added disadvantages of a higher cost and the difficulty in procuring the necessary grades of DDT and kerosene. The preference of the pest to small patches of newly transplanted paddy under well irrigation is a vulnerable point in its habits as it is easy to tackle these limited areas promptly and effectively.

References: 1. Misra C. S. 1919. The Rice leaf hoppers — Memoirs of the Department of Agriculture in India Entomological series Vol. V.

2. Rana Abalos 1939. The Rice leaf hoppers — The Philippine Journal of Agriculture Vol. 10.

Statement of the trials conducted against the paddy jassid

S. No.	Insecticide	Concentration	Quantity required to treat one acre	Approximate cost	Time taken for complete mortality	Remarks
1	DDT dust	2% DDT	20 lb.	8 12 0	2 to 3 days	High mortality
2	do.	3% do.	20 do.	10 0 0	do.	do.
3	do.	5% do.	20 do.	12 8 0	do.	do.
4	do.	15% do.	20 do.	20 0 0	do.	do.
5	BHC D. 025 dust	5% BHC	20 do.	10 0 0	...	Mortality not very high
6	DDT 550 spray	0·1% DDT	2 lbs. in 100 gallons of water	6 0 0	do.	High mortality
7	DDT do.	0·25% do.	5 do. do.	10 0 0	do.	do.
8	BHC P 520	0·1% G. I.	15 do. do.	30 0 0	...	Mortality low
9	do.	0·25% do.	37½ do. do.	75 0 0	...	do.
10	DDT emulsion spray	0·16%	6¼ do. do.	7 0 0	...	do.
11	do.	0·32%	12½ do. do.	14 0 0	do.	High mortality *
12	do.	0·64%	25 do. do.	28 0 0	12 hours	do. *
13	do.	0·96%	37½ do. do.	42 0 0	do.	do. †
14	do.	1·28%	50 do. do.	56 0 0	do.	do. †

* Slight Scorching; † Scorching more prominent.

Preparation of DDT emulsion and its probable cost (item 10 to 14):

Aromex	1 Gallon	1 8 0
DDT pure	3 lbs.	12 0 0
Soap	5 ozs.	0 8 0
		14 0 0

Gives 1½ gallons or 200 ozs. of 25% DDT stock solution.

Results of the experiments carried on in the Hospet Sugar Factory area for improvement of yield.

By

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The India Sugars and Refineries Ltd., Hospet.

(Received on 6—1—1950)

The recent sugar scarcity and the consequent high price for sugar variously described as the "Sugar Muddle", "Sugar Racket" etc., has brought the sugar industry prominently into public attention and criticism. The main target of criticism has been the high price of Indian sugar compared to sugar produced in other countries. The Industrialists say that it is mainly due to the high price fixed for the cane as the the cane price accounts for nearly 60% of the sugar price and there is no possibility of reducing the sugar price unless the cane price is reduced. The champions of the ryots, however, say that the cane price cannot be reduced without risk of the area under cane being reduced, because of the better return a ryot gets on alternative crops. So the whole question boils down to this, as to, how is it possible to reduce the cane price without reducing the return the ryot gets. There is only one answer to it, to increase the yield per acre and the sugar content of the cane.

Various suggestions have been made to achieve these objects. In this connection it may be of some interest to those who are interested in the sugar industry to know that the yield in our factory area has gone up from 18 to 20 tons in 1945—'46 to 30 to 32 tons this year. Before I state the steps taken to achieve this result I shall state briefly the conditions obtaining in 1945—'46.

Hospet is in the north west corner of the Madras Province on the banks of the Tungabhadra river. The three canals constructed by the rulers of the Vizianagaram Empire taking off from the river, supply water for irrigation. The climate is the same as obtains in the Deccan Sugar Factories in Bombay Province viz., 20 – 25 inches of rain; the major portion being received during the South-West Monsoon and the maximum and minimum temperatures being 104° F. in May—June and 60 to 65° F. in November — December. The factory was erected in 1934 and for the first few years the only variety of cane available a local variety, called "*Pundia*".

"*Pundia*" was a cane well suited for jaggery manufacture as it was soft and easy for clarification. It was not suited for the sugar factory as it deteriorated early and the quantity of begass not sufficient for the

boilers. So it was replaced by CO. 290 and by 1938—'39 the "*Pundia*" variety was no more grown. CO 290 is a hardy early cane, and ratoons well, but is susceptible to red-rot and smut. In 1945 it was found that there was hardly a field which was not affected by red-rot and smut was also on the increase. It was also noted that ratoons were mostly affected. So the factory applied to the Government to ban ratooning. The Government acted with commendable promptness. The then Director of Agriculture, Dr. B. V. Nath, inspected the cane area and was satisfied that something should be done immediately before the situation got out of control. As a result ratooning was banned in 1947, for four years under the Pest Act.

The factory took this opportunity to root out CO. 290 altogether and substitute it with CO. 419. It was not possible to replace it immediatly, as sufficient seed material was not available. Consistent with the total requirments of the factory it refused to accept CO. 290 for crushing and to help the ryots to plant the new variety increased the loans and also helped them to obtain seed material of the new variety CO. 419. By these methods CO. 290 was completely replaced by CO. 419 this year.

The second step taken by the factory was to see that the CO. 419 was planted in the months of January and February, contrary to the usual practice of planting in the months of March—April. Due to the closure of the channel for various periods from January to March for repairs and silt clearance, a continuous supply of water was not available for planting cane earlier than March—April. So the factory had to arrange for silt clearance in the months of December — January. Even though the factory's efforts have not been quite successful in this direction, yet the P. W. D. made arrangements to clean the channels is such a way that water is made available to ryots who plant sugarcane in January — February.

It may be of interest to readers to know that January/February planted cane is not attacked by the top borers while the cane planted in March/April is invariably attacked by borers.

Another step taken was to increase the quantity of manure and apply it in two doses. The usual dose of manure given is one bag (224 lbs) of ammonium sulphate and 4 bags (560 lbs) of ground-nut oil cake per acre, but for the last two years the Government have supplied to the factory sufficient quantities of ammonium sulphate to enable them to apply 2 bags (448 lbs) per acre in addition to the usual quantity of groundnut oil cake. Ammonium sulphate was applied in two doses, one cwt. at the time of planting and the balance with groundnut oil cake at the time of earthing up. The first dose helped towards a vigorous growth of the shoot and early tillering.

So with these four changes viz., banning of ratoons, replacement of the diseased variety, early planting and proper manuring in time, we have been able to push up the yield from 18 tons to 30 tons per acre. The sucrose content of cane has also been increased.

Thus by banning ratooning and taking precautions regarding the purity of the seed material used for planting, the yield can be improved by at least 6 to 8 tons per acre. Any arguments regarding the increase in the cost of cultivation due to banning of ratoons do not stand, as the ryot is more than compensated by the increase in yield. It is expected that next year the yield will be still better, because the area planted in the month of January and February would be about 150 acres against 500 acres this year. There is, of course nothing new in the methods adopted, but they show what can be achieved by persuading the ryots to give up his old accepted practices.

Observation on the "Bud Take and Scion Growth of Peach trees as influenced by rootstocks"

By

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(Received on 6—7—1949)

Among the numerous fruits tried at Coonoor, some varieties of peach were found to be promising, though like all introduced fruits, the peach has yet to be studied in respect of nursery and orchard practices. Till now shield budding has been the rule in peaches under Coonoor conditions, the common peach being the only rootstock employed for the purpose. The optimum age of common peach seedlings for bud insertion and the relative rate of growth made by different peach scion varieties when worked on rootstock of different sizes or ages are not yet known and there has been a great deal of diversity in the prevailing nursery practices. The tendency to prefer large plants for planting is also based on the belief that large plant size at planting time will mean earlier and better yields in the orchard. The initial advantage ascribed to plants of large size is a subject well worth study from the standpoint of the peach grower. To the peach nurseryman, such a study would enable him to restrict his propagational activities to the production of the optimum plant size and also reducing the large variation that is met with in regard to nursery tree size. With these ends in view a small-scale trial was started in 1948 at the Pomological Statoin, Coonoor.

Two well-known varities of peach, Shanghai Seedling and Red Shanghai were selected for the trial, to be budded on common peach seedling. The seeds of the latter were sown on three different dates, to give seedlings of three age-groups at the time of bud-insertion of 8, 20, and 32 months, from the date of transplantation from seed to nursery beds. The bud insertions were all made by one operator during the first week of February 1948, employing the common shield method with no wood attached to the bud shield. All the buds were taken from a single selected parent in either scion variety. About three months after the bud insertion data on 'bud take' were recorded. Four weeks later, in the last week of June 1948, growth measurements of the plants were taken to give an idea of the plant growth measurements in a period of four and half months after bud insertion. The data are given below.

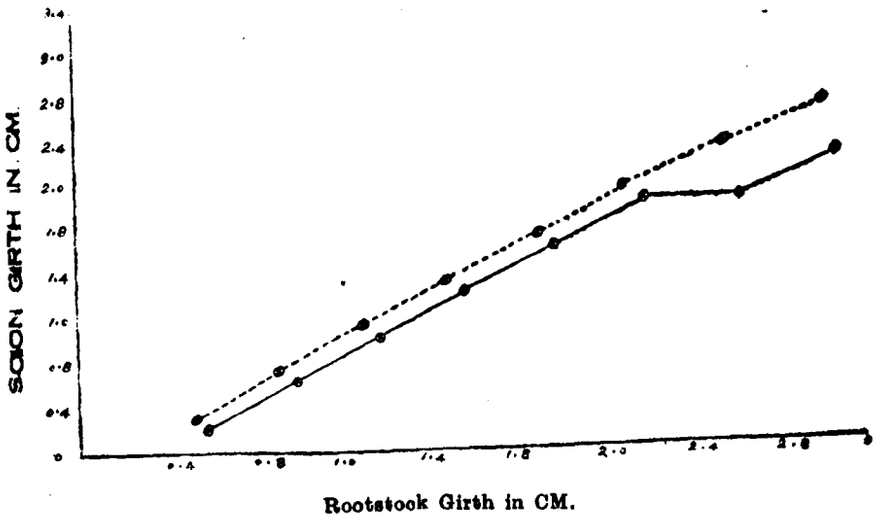
Scion	Age of the common peach seedling at bud-insertion stage	No. of bud insertions made	Number successful	Percentage of "bud-take"
Shanghai seedling	8 months	65	53	80·6
	20 ,,	65	62	95·4
	32 ,,	65	47	72·3
Red Shanghai	8 ,,	65	36	55·4
	20 ,,	65	52	80·5
	32 ,,	65	48	73·8

The data indicate that seedlings of 20 months of age in both varieties provide the most suitable material for budding. Although the actual percentage figures for other age groups are not appreciably different, it would seem that with Red Shanghai, 8 month-old seedlings are unsafe to be used since the 'take' is less by about 25 per cent. At the trial was restricted to a limited number of age groups, it is not possible to generalise from these data or to infer that other age groups may not be found as suitable as 20 month-old seedlings. For the present it may be stated that 20 months old seedlings can safely be employed for bud insertion. Growth measurements made upto 4½ months after bud insertion are represented in the accompanying graph.

A fair indication was observed that the scion stem growth increments keep pace with the rootstock stem growth increments. In other words, the thicker the rootstock stem the faster is the pace of scion growth during the early stages of development. The same inference seems possible from a study of the relationship between the rootstock stem growth and the scion stem extension growth or scion stem height as well as between the former and the number of branches produced by the scion.

FIG. I.

Graph Showing Relation between Rootstock Girth and Scion Girth.



Rootstock Girth in CM.

——— Shanghai Seedling.
..... Red Shanghai.

Summary: (1) From the point of "bud take", common peach seedling of 20 months of age appear to provide the optimum age group for peach bud insertion. (2) Scion growth increments in the first four and half months period after bud insertion seems to keep pace with the root-stock stem size.

Acknowledgement: My thanks are due to Sri U. Narasinga Rao, Assistant Fruit Specialist, for the kind guidance given in conducting this trial and to Sri K. C. Naik, Fruit Specialist, Madras for his valuable assistance in the preparation of this paper.

A Note on the Cultivation of Yams in Krishna and Guntur Districts

By

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(Received on 14—10—1949)

Yam, (*Dioscorea alata.* Linn; Pendalam—Tel.) is a popular vegetable grown for its root tubers. The tubers can be preserved for about 6—8 months without much deterioration and are very popular in Northern Circars, especially East Godavari, West Godavari, Krishna and Guntur districts, where a variety of delicious dishes are prepared out of this vegetable.

The plant is a twiner, with slender, acutely angled stems. The leaves are deeply cordate, orbicular, 5 to 7 nerved, simple, membranous and winged petioled. The tubers vary from 6" to 24" in length and 2" to 6" in diameter, the average size being about 4" in thickness and 12" in length. The tubers are brown and the inner core is white, shining and brittle. Being an exhausting crop its cultivation is restricted to a few favoured places and to small areas in individual holdings. Rich and well drained loamy soils are necessary for this crop to grow well and it requires 8—10 irrigations during its growth period of 8 to 9 months.

The land is ploughed 6 to 8 times to pulverize the soil well and promote proper development of the tubers. Before the last ploughing about 20 tons of cattle manure is applied. Healthy tubers are cut into pieces each containing one or two buds. The cut pieces are dibbled behind the country plough 1½ ft. apart in rows and 2½ ft. apart between rows. The pieces are covered by the next furrow. July is the proper time of planting. The seed rate is 1500 lbs. of tubers per acre. Before the creepers cover the ground, the interspaces between the lines are ploughed with the country plough twice and one hand weeding is given. The crop is irrigated as and when required. After two months the crop begins to cover the ground. In some places the creepers are allowed to twine round bamboos fixed in the field for the purpose, but this practice is now being given up in view of the high cost of bamboos. The maturity of the crops is gauged by the yellowing and wilting of the leaves, and by the presence of small cracks at the bases of the plants indicating the development of the tubers. Trial digging of the tubers here and there are usually made prior to the main harvest. The creepers are first cut and removed; then the tubers are carefully dug out with crow-bars. Generally the harvest is made piecemeal to cater for the daily or weekly markets. Harvesting commences from the middle of January (Pongal) and continues up to March—April. Normally, each plant will produce 3

to 5 tubers of marketable quality in a bunch. The average yield is about 20,000 lbs. per acre (40 candies). The crop occupies the same field once in 3 to 5 years. It is rotated with maize, tobacco, fodders, sugarcane, and vegetables. It is always raised as pure crop. The profit per acre ranges from Rs. 800/- to 1,000/-.

Nutritive Value (Akroyd)

Moisture	84·40%
Protein	1·20%
Fat	0·20%
Mineral matter	0·30%
Fibre	...
Carbohydrate	14·00%
Calcium	0·01%
Phophorous	0·02%
Iron	0·50%

Akroyd : Health Bulletin No. 23. Nutritive Values of Indian Foods.

A preliminary note on the growth of Jute in Malabar

By

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Agricultural Research Station, Pattambi
Received on 4—12—'49.

This note presents a few important observations on the growth of jute at the Agricultural Research Station, Pattambi in Malabar.

In India, Bengal is a big centre of jute production. It is cultivated over the fertile area composed of the vast flood plains of the rivers Ganges and Brahmaputra. The soils here are alluvial, rich in potash and lime and are well drained friable loams.

Jute requires humid heat for its growth. An average maximum temperature of of over 90° F. and a minimum temperature of over 70° F. with a relative humidity of 80 to 90% during its growing period from February to May. Occasional rains ranging from one to two inches at intervals of about a week are conducive to its best growth. Apart from

temperature and humidity the length of day is considered to be an important factor and it is said that in South India where the climate is moist and warm but the days are never so long as those of the summer in Bengal, it does not grow well. In Bengal the plants reach a height of six to eight feet, an acre of crop yielding 13 to 14 maunds of fibre. One of the most important factors on which the yield depends is the height of the crop.

Corchorus capsularis and *Corchorus olitorius* were the varieties tried on this station in the years 1948 and 1949. These were sown both on double crop wetlands and the drylands called *modan*. Of the two, *C. capsularis* is found to be the best suited under Malabar conditions. Neither of the varieties came up well on *modan* lands. The results given in this note therefore pertain to *C. capsularis* grown in double crop wet lands.

C. capsularis was sown in three batches of monthly sowings from March to May; the sowings were down on 1–3–1949, 1–4–1949 and 2–5–1949. The plots were manured in all cases with cattle manure at 20 tons per acre and were brought to fine tilth before sowing. Crops were irrigated at critical intervals during March, April and May. Altogether 10 irrigations were given in March, three in April and one in may.

The season was normal except for the fact that the south-west monsoon broke by about the middle of May which was, unusually, 18 days ahead of usual time. Height measurements were taken 15 days after sowing and at 15 day's intervals thereafter up to the time of harvest. Fortnightly weather data during the growing periods, the corresponding heights of the crop, differences in growth and the yields of fibre are given in the table. It would appear that both temperature and humidity should remain at a fairly high level for the best growth of jute. The high temperature in March is not accompanied by sufficient atmospheric humidity. Inspite of irrigations therefore the March crop was poor. The humidity rose with the rains received subsequently and the April crop attained the best growth. From the second week of May to the end of June the May crop had a setback as a result of the heavy rains which swamped the fields.

From colums 9, 11 and 13 in the statement below wherein the growth difference in successive measurements up to the time of flowering are given, it is clear that a good outturn of fibre is associated with initial growth on which again depends the maximum growth attained.

It is therefore evident that the best time of sowing in the ordinary double crop wetlands is about the middle of April. It may be sown early in April in the *karinkora* type of lands. The point to be remembered is to avoid any chance of flooding the field during the first month of its growth. If lower grounds are taken there must be facilities for quick drainage. These are certainly limitations to the extensive cultivation of jute in Malabar.

High initial fertility again, is essential as the outturn depends upon the initial growth. In intensively cropped lands application of farm yard manure up to 30 tons per acre will not be too much. In fairly virgin soils the crop comes up well without much of manuring; a crop of jute grown in such lands at Edakkara in Ernad Taluk actually attained a height of seven feet and under these conditions six to eight maunds of fibre can be obtained per acre.

Further trials are necessary for assessing the behaviour of this crop in all aspects under West Coast conditions.

TABLE

		Temperature.			Rainfall			Growth measure in c. m.					
								I batch		II batch		III batch	
		Max. °F.	Min. °F.	Mean humidity %	Quantity in inches	No. of rainy days	100 yrs. average in ins.	Ht. Diff.	in growth	Ht. Diff.	in growth	Ht. Diff.	in growth
1		2	3	4	5	6	7	8	9	10	11	12	13
March	I												
fortnight		99·8	72·9	77·5	...	...	0·06	28·0	...	...	...	...	...
,,	II	99·5	77·0	85·2	...	...	0·86	30·0	2·3	...	...	...	...
April	I	95·1	77·1	83·6	2·58	4	1·46	64·3	34·0	...	...	...	...
,,	II	93·9	78·9	80·4	...	...	2·03	84·2	19·9	84·5	...	...	...
May	I	94·5	78·8	64·1	1·36	2	1·34	93·5	...	129·2	44·7	...	...
,,	II	86·6	75·4	93.1	15·83	14	5·78	98·1	...	164·2	22·7	...	...
June	I	83·7	74·6	94·6	12·32	12	12·14	...	...	170·1	...	59·0	...
,,	II	85·2	74·6	92·1	9·54	9	14·90	...	...	174·3	12·3	91·2	32·2
July	I	83·6	74·5	93·7	15·20	14	14·50	...	...	...		100·8	9.6
,,	II	82·8	74·0	93·3	15·01	9	10·70	...	...	...		115·2	14·4
												143·6	
												150·2	
		Weight of fibre per acre.						86 lb.		280 lb.		270 lb.	

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Page 47, 7th line from bottom for 750 read 150.

Research Note

Experiments on emasculation by hot water in cumbu.

(Pennisetum typhoides Stapf. & Hub. *)*

Cumbu is a protogynous and naturally cross fertilised crop. To fecilitate controlled cross pollination and production of enough quantities of hybrid seed for conducting field trials emasculation by hot water which was successful in crops like sorghum and rice was tried on cumbu. Cumbu ear heads which were two-thirds emerged from the boot leaf and which would normally take about a day or two for flowering were selected for the treatment. The hot water was placed in a tin-can and the panicles were bent and kept immersed in water for the required time. The temperature was maintained constant by the addition of water at higher temperature when it was found necessary. After the treatment half the number of earheads was enclosed in butter paper bags to avoid cross pollination and the other was left for out crossing, to study the effect of the treatments on the viability of the pollen and the receptivity of stigmas as indicated by the seed setting. At the time of harvest a comparative study about the seed setting was made.

The treatments ranged from 59° to 35° c. for periods of one to ten minutes. It was found that temperatures beyond 50°c. for such short period as one minute killed not only the pollen but the entire panicle. At 50°c. treatment beyond ten minutes slowly killed the panicle and for 8—10 minutes the normal anthesis was prevented due to the effective killing of the pollen but the stigmas also were killed as indicated by the lack of seed setting both in the selfed and open pollinated panicles. If the treatment at 50°c. lasted for seven minutes or less it had no effect on the anthesis. Temperature below 50°c. had no effect on flowering. Thus the different treatments given at 48°, 45°, 40° and 35°c. for periods ranging from 4 to 8 minutes did not interfere with the normal anthesis and thus made the treatments ineffective. It was also found that up to 45°c. for 5 minutes the stigmas remained uneffected but at the same time the pollen was not killed and the anthesis was impaired in no way. Thus the treatment which prevented dehiscence of anthers killed the stigmas readily and the treatment which was not injurious to stigmas did not interfere with the anthesis. This may be due to the protogynous nature of the plant where the stigmas are at an advanced stage of development than the anthesis, a day before flowering when the treatment is given and the treatment affects more readily the developed and tender stigmas than the under developed anthers. Hence it may be concluded that the artificial emasculation brought about by subjecting the panicles to heat in the self-pollinated crops like sorghum and rice was ineffective in the case of cumbu which is protogynous and naturally cross pollinated.

Regional Millets Station
NARASAPATNAM,
Dated 4—2—'50.

I. V. G. KRISHNAMURTHY
Millet Assistant.

Weather Review — For February 1950

RAINFALL DATA

Division	Station	Total for the month in inches	Departure from normal in inches	Total since January 1st in inches	Division	Station	Total for the month in inches	Departure from normal in inches	Total since January 1st in inches
Orissa & Circars.	Gopalpore	2·3	+1·4	2·3	Central—*Contd.*	Coimbatore	1·9	+1·5	1·9
	Calingapatnam	1·9	+1·3	1·9		Tiruchirapalli	3·2	+2·9	3·2
	Visagapatnam	0·3	—0·6	0·3	South.	Negapatnam	1·9	+1·1	3·0
	Anakapalle*	0·3	—0·2	0·3		Aduturai*	1·9	+1.5	2·6
	Samalkot*	2·4	+1·9	2·4		Pattukottai*	3·7	+3·3	4·9
	Kakinada	1·2	+0·9	1·2		Mathurai	3·9	+3·4	3·9
	Maruteru*	0·4	+0·3	0·4		Pamban	1·7	+0·8	3·8
	Masulipatnam	1·3	+0·8	1·3		Koilpatti*	6·7	+6·2	6·7
	Guntur*	0·1	+0·1	0·1		Palayamcottai	4·3	+3·1	4·3
	Agrl. College, Bapatla*	1·4	+1·0	1·4		Ambasamudram*	6·5	+5·3	6·6
	Veeravanam* (College Farm)	1·6	(x)	1·6	West Coast.	Trivandrum	1·4	+0·6	1·4
Ceded Dists.	Rentichintala	0·0	—0·5	0·0		Fort Cochin	5·1	+4·3	5·2
	Kurnool	0·1	—0·2	0·1		Calicut	1·1	+0·4	1·1
	Nandyal*	0·3	+0·2	0·3		Pattambi*	4·9	+4·8	4·9
	Hagari*	tr.	—0·1	tr.		Taliparamba*	0·1	J N (e)	0·1
	Siruguppa*	0·2	—0·1(a)	0·2		Nileshwar*	0·0	—0·1	0·0
	Bellary	tr.	—0·2	tr.		Pilicode*	0·0	—0·2 @	0·0
	Cuddapah	0·1	J N(b)	0·1		Mangalore	0·0	—0·2	0·0
	Anantharajpet*	0·3	+0·2	0·3		Kankanady*	0·0	—0·1	0·0
Carnatic.	Nellore	0·1	—0·1	0·1	Mysore & Coorg.	Chitaldrug	0·1	J N (e)	0·1
	Buchireddipalem*	0·1	—0·1	0·1		Bangalore	0·1	—0·2	0·1
	Madras (Meenambakkam)	0·5	+0·1	0·9		Mysore	0·8	+0·6	0·8
	Tirurkuppam*	0·1	—0·6 @	0·1		Mercara	2·3	+2·1	2·5
	Palur*	0·5	+0·1	0·5	Hills.	Kodaikanal	3·4	+1·9	3·7
	Tindivanam*	0·1	J N (c)	0·8		Coonoor*	5·6	+3·6	5·6
	Cuddalore	0·6	—0·3	0·7		Ootacamund*	1·8	+1·3	1·8
Central.	Vellore	0·8	+0·5	0·8		Nanjanad*	2·4	+2·0	2·4
	Gudiyatham*	0·2	J N(d)	0·2					
	Salem	1·9	+1·6	1·9					
	Coimbatore (A. C. R. I.)*	1·4	+1·0	1·4					
	Coimbatore (C. B. S.)*	1.7	+1·4	1·7					

Note:—
(1) * Meteorological Stations of the Madras Agricultural Department.
(2) Average of ten years data is taken as the normal.
(3) (x) Readings are recorded only from February, 1948.
(4) @ Average of seven years data for Tirurkuppam and eight years data for Pilicode is given as normal.
(5) (a) Taluk office normal (average of 39 years) is 0·29″ and Rainfall is 0·01″.
(6) tr. Rainfall from 0·01″ to 0·04″.
(7) (e) Actual deviation is + 0·31″ in the case of Taliparamba and—0·1″ in the case of Chitaldrug.
(8) (b) Actual deviation is —0·02″.
(9) (c) Actual deviation is —0·03″.
(10) (d) Actual deviation is + 0·04″.
(11) JN Just Normal.

Weather Review for February, 1950.

The month began with a shallow low pressure area over East Rajasthan. Next day it moved over to Vindhya Pradesh and the Northern divisions of Madhya Bharat and became feeble on the third day. A western disturbance over North Baluchistan, North-East Punjab and regions near about resulted in local showers in the hills of the East Punjab and of the West United Provinces.

On 10—2—1950 a cold wave gripped North-West India and the Central parts of the country. For two subsequent days its effect was felt in North-West India, the United Provinces, the Central parts of the country, the Deccan, the Konkan, West Bengal and Assam. In some of these places abnormally low temperatures were recorded. Later a number of mild disturbances formed and disappeared.

The low pressure area in the South-East Arabian sea off the South Malabar Coast passed westwards on 20—2—50 through the Maldives and Laccadives. A western disturbance was found moving Eastwards through the North-West Punjab. Rainfall was widespread in South-East Madras and Malabar. From this date onwards a number of mild disturbances and low pressure areas formed over different parts of the country, causing light to moderate showers in different regions. In Madras Presidency the showers received in February were far above the normals for the different tracts. Particulars regarding chief falls are given hereunder:—

Serial No.	Date	Place	Rainfall in inches.
1	20—2—50	Paramakudi (Ramnad district)	5·6
2	,,	Aruppukottai (Ramnad district)	5·1
3	,,	Koilpatti (Tirunelveli district)	4·1
4	,,	Mathurai	3·0
5	,,	Nagarcoil	2·0
6	,,	Alleppey	2·0
7	,,	Palayamcottai	2·0

The weather, in short, has been pleasant throughout the Presidency. The February showers will benefit the ryots almost throughout the Presidency though the ripe fields of paddy have suffered due to water logging in a few places.

Agricultural Meteorology Section,
Lawley Road P. O., Coimbatore
Dated 14—3—1950.

C. B.

Departmental Notifications

POSTINGS AND TRANSFERS.

Name of officers	From	To
	Gazetted Service.	
Sri Bujanga Rao, C.	Asst. Fruit Specialist, Banana Research, Station, Aduthurai,	Superintendent F. R. S., Kodur.
,, Anantharaman, S. E.	Training in Central Tractor organisation, New Delhi,	Asst. Agricultural Engineer, Madras.
,, Gopalan Nair, T.	On deputation to Trinidad	Assistant Fruit Specialist Bananna Research Station, Aduthurai.
,, Muthaiah Nattar, A. M.	On leave,	Sugarcane Inspector, Mathurai.
,, Palanivelu, T. S.	Asst. Agricultural Engineer, Madras,	Asst. Agricultural Engineer for Tractor etc., Bellary.
,, Thirumalachari, N. C.	Sugarcane Inspector, Mathurai,	Seed Development Officer (Paddy) Vellore.
	Subordinate Service.	
Sri Ayyaswami, T. V.	A. D., Srivaikuntam,	A. D., Kumbakonam.
,, Adivi Reddi, A.	Asst. in Fruits, Kodur,	Asst. in Fruits, Kodur.
,, Dharmaraju, E.	Entomology Assistant, Narasapur,	Asst. in Entomology, Razone.
,, Dhanvartani, M.	A. D., Kovur,	P. A. to D. A. O., Nellore.
,, George Vasantha Rao,	A. D., Eluru,	Sugarcane Asst. A. R. S., Siruguppa.
,, Krishnamurthi, G.	F. M., A. R. S., Nandyal,	Marketing Asst. Tadepalligudam.
,, Krishnamurthi, C. S.	On leave,	P. P. A., (Mycology) Mathurai.
,, Morachan, T. B.	P. P. A., (Mycology) Ootacamund,	A. D., Erode.
,, Muthaiah, V.	Assistant in Chemistry, Coimbatore,	F. M., Central Farm, Coimbatore.
,, Ponnaiah, J. H. S.	A. D., Tirunelvely,	A. D., Srivaikundam.
,, Perraju, A.	Entomology Assistant, Razone,	Entomology Assistant Narasapur.
,, Padmanabha Rao, K.	A. D., Giddalore,	A. D., Kurnool.
,, Ramachandran, C. K.	Asst. Cotton Specialist, Koilpatti,	Assistant in Cotton, Coimbatore.
,, Rangaswami G.	On leave,	P. P. A., (Mycology) Ootacamund.
,, Ramakantha Reddy, C.	...	A. D., Eluru.
,, Subba Naidu,	Cotton Asst. Koilpatti,	S. A. D., Elayirampanni.
,, Swaminatha Iyer, M. K.	Agricultural Instructor Central Jail, Tiruchirapalli,	A. D., Virdachalam.
Sri Subbiah, V.	Marketing Assistant Trichirapalli,	F. M., A. R. S., Tindivanam.
,, Satyanarayana Rao, G.	Seed Development Asst. Chittoor.	A. D., Chittoor.
,, Sankaranarayana Iyer, C. S.	Seed Development Scheme, (paddy) Palghat,	S. A. D., Crop cutting Experiments, Calicut
,, Subramaniam, J.	A. D., Kandukur,	Asst. in Fruits, Kodur.
,, Thiruvenkadachari, T. K.	On leave,	A. D., Atmakur.
,, Vasudeva Rao, B.	A. D., Chittoor.	Seed Development Asst. Chittoor.
,, Venkataraman, T. M.	On leave,	A. D., Tirunelvelli.

The following candidates are appointed as upper subordinates and are posted to the vacancies shown against each.

Sri Appalaswami, D.	A. A. D., Parvatipur.
,, Neelakantaiah, O.	A. D., Kandukur.
,, Suryanarayana, J.	Cotton Asst. A. R. S., Nandyal.
,, Sarvanga Rao, M.	F. M., A. R. S., Nandyal.
Miss. C. K. Shanta Raghavan	Asst. Pomological Station, Coonoor.
Sri Subramaniam, T. R.	Asst. in Chemistry, Coimbatore.
,, Vysamurthi, A.	A. A. D., Kurnool.

Agricultural College and Research Institute, Coimbatore,

LIST OF ADDITIONS TO LIBRARY FOR FEBRUARY, 1950.

1. BAWDEN (F. C.): Plant diseases. 1948. Thomas Nelson and Sons Ltd., London.
2. BLOUNT (W. P.): Diseases of Poultry. 1949. Bailliere Tindall and Cox. London.
3. BUTLER (E. J.) and JONES (S. G.): Plant Pathology. 1949. Macmillan & Co., Ltd., London.
4. CULPIN (C.): Farm Machinery. Edition 3. 1949. Crosby Lockwood and Sons, Ltd., London.
5. BOWSON (W. J.): Mannual of Bacterial plant diseases. 1949. Blackie & Co., Ltd., London.
6. ELLIS (J. C. B.) Feeding of Farm Livestock. Edn. 2. 1948 Crosby Lockwood & Sons, Ltd., London.
7. FOSTER (J. W.): Chemical activities of fungi. 1949. Academic Press Publishers. Inc. New York.
8. GALE (E. F.): Chemical activities of bacteria. Edition 2. 1948. University Tutorial Press, London.

9. HUTCHINSON (J.): British flowering plants. 1948. P. R. Gawthorn Ltd., London.
10. HUTCHINSON (J) and DALZIEL (J. M.): Flora of West Tropical Africa. 2. V. Crown Agent for Colonies, 4. Milbank. Westminster, London.
11. HUTCHINSON (T): Machinery on the Farm. 1949. Blackie and Sons Ltd., London.
12. INDIA LABOUR (Ministry of): Library Catalogue. 1949. Manager of Publications, Civil Lines. New Delhi.
13. KRAUS (E. H.) Etc: Minerology 1936. Mc Graw Hill Book Co., London.
14. LONDON. INSTITUTE OP FUEL. Publication Committee: Waste; heat recovery from Industrial Furnaces. 1948. Chapman and Hall Ltd., London.
15. MUNDKUR (B. B.): Fungi and Plant diseases. 1949. McMillan & Co., London.
16. OSBORN (F): Our Plundered Planet, 1948. Faber and Faber Ltd., London.
17. OXLEY (T. A.): Scientific Principles of grain storage. 1948. Northern Publishing Co., Liverpool.
18. PRAIN (David): Memoirs and memoranda—chiefly Botanical. Reprints from Periodicals 1887—1893. Baptist Mission Press, Calcutta.
19. RIDLEY (H. N.): Flora of the Malay Peninsula. 5. V. 1922—1925. L. Reeve & Co., London.
20. TRIST (P. J. O.): Land reclamation. 1948. Faber and Faber Ltd., London.
21. WIDE (S. A.): Forest soils and Forest growth. 1946. Chronica Botanica. Co., Mass. U. S. A.

D. B. K.