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CONTENTS

STUDIES IN CAPSICUM.*

I. ANTHESIS, POLLINATION AND FERTILISATION

BY P. GOPALARATNAM, L. Ag.

Cotton Assistant, Agricultural Research Station, Guntur.

Introduction. Chillies, though broadly classified under condiments and spices stand next in importance to the staple food crops in India. The crop in spite of its being an introduced one from South America (Watt. 8.) has established very well in the country and created a special taste for the people at large. The necessity for chillies is all the more felt in the Madras Presidency as it forms one of the daily requirements of both the rich and the poor alike. The value of the crop is enhanced further by the discovery of Quinn, Burtis and Milner (5) of the presence of vitamins A, B and C in the green chillies. Considering the deterioration of the crop to an alarming extent in the Guntur district both in the quantity and quality, work on the improvement of this essential crop was taken up at the Agricultural Research Station, Guntur. A definite knowledge as to the anthesis, methods of pollination and the occurrence of cross-fertilisation is necessary for the improvement of any crop. The process of anthesis is a delicate one and it invariably varies with the weather conditions such that the

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observations recorded at one place might not hold good at another. An accurate information on the above phases facilitates the choice of the methods of improvement to be adopted, the testing of the new varieties as well as the combating of the insect pests and plant diseases by evolving disease-resistant types.

Material. The investigations were started in the year 1931-32 and were continued in the next season so as to confirm the findings of the previous year. The first year's observations were restricted to *Nallapadu* type of chillies, (*Capsicum annuum*) and the same were extended to some more species during the year 1932-33 as given below. In all, four species and six types of chillies were examined of which the first three types are cultivated in the Guntur District.

Particulars.	Pedicel.	Colour of fruit		Type of fruit	Habit of the matured fruit
		Green	Ripe		
1. *C. annuum* :-					
(a) Bellary chillies	Solitary	Green	Red	Broad & long	Pendent
(b) Nallapadu ,,	Do.	Dark Green	Red	Narrow & long	Do.
(c) Local ,,	Do.	Do.	Red	Stout & short	Do.
2. *C. annuum-var-acuminata pendula* :-					
(d) Yellow chillies	Do.	Light green	Yellow	Medium broad and long to short	Do.
3. *C. annum-var-nigra* :-					
(e) Black chillies	Do.	Black	Red	Thin & short	Erect
4. *C. frutescens* :-					
(f) Needle chillies	Twos & Threes	Green	Red	Very thin & small.	Do.

Method. In the first year of observations the period of anthesis was determined by labelling a certain number of well developed flower buds that are to open on the next day and the progress of flowering was noted at intervals of one hour from 2-0 a. m. till all the buds opened. The study was made at the end of every month from November to February but in the succeeding year it was felt that if the observations were to be limited to individual plants the results obtained will give a better insight into the subject. With this end in view, five plants from each of the above mentioned six types were selected for the purpose. The observations on anthesis were attended to throughout the night and day at intervals of one hour while the details of anthesis were made once in a week. The identity of the observed flowers was maintained by tagging the flowers with their respective serial numbers and the date of opening.

Biology of the Flower. Before getting into the details of the subject, the general description of the *Capsicum annuum* flower is given

below. The description given by Duthie, (1) and Erwin (2) are consulted though the one given by Shaw (6) is very closely followed.

Flower. The flower is one pedicelled; axillary; solitary and regular.

Calyx. Companulate; minutely 5 or 6 lobed, much shorter than the fruit and completely covers the base of the bud

Corolla Rotate, Five lobed and valvate in bud. Lobed three veined, and curved at the tips.

Stamens. Five or six as the case may be, adnate and are attached near the base of the corolla.

Anthers. Not connivent in cone, not longer than the filaments, dehiscing longitudinally by lateral slits.

Style. Linear.

Stigma. Sub capitate and bi-fid.

Ovary. Two celled with the connate carpels.

Observations made at Guntur indicate that flowers with five lobes are common with a variation of ± 1 in 2 per cent of the flowers produced per plant. In addition to the above, cases of flowers having unequal number of stamens to the number of corolla lobes were also noticed. The difference found was one, being always on the reduction side.

Floral Secretion. During the course of anthesis studies in 1931, the writer observed several insects hovering in the chilli plot as early as 4 a. m. The attraction of insects to the chilli flowers in spite of their being non-odorous, un-attractive, pendent, and partly hidden by foliage created a curiosity for examining the flowers for floral secretions if any. On careful examination small globules of sweet liquid were noticed on the inner side of the petals as well as at the places where the filaments are attached to the corolla. Usually the secretion commences by about 4 a. m. No mention of such secretion in chilli flowers is made by the other workers in India but Erwin (2) states that the phenomenon was noted by him at Iowa about the same time. On analysis he found the Osazone of dextrose in the nectar secreted by the chilli flowers.

Details of Floral Parts :—

(a) *Pedicel.* Usually in the common forms of chilli plant the pedicel is solitary and axillary but in some species they arise in numbers. The matured pedicel is either erect or pendent. The length and size of the pedicel varies with the type of chilli plant. In almost all the cases it is green but in a few cases it is either streaked with purple or remains completely violet.

(b) *Calyx.* In the tender stages of the bud, the calyx completely encloses the flower bud in most of the cases. As the bud developes the calyx widens leaving space for the developing bud to come up. Like the pedicel the calyx is green in colour but in a few cases it is either streaked with purple or remains completely purple. In the majority of cases it is persistent and remains attached with the fruit while in a few cases it is loose and comes off easily either at the time of collection or storing.

(c) *Corolla.* The colour of the petals is white in general but in some types it is either dirty white to yellowish green or violet with varying intensities as in the case of black chillies.

(d) *Filaments.* These are either white or pigmented and are as long as the anthers or even slightly longer.

(e) *Anthers.* The general hue is green but cases of light green and violet coloured anthers are also present in some types of chillies.

(f) *Style.* The style is of different lengths in flowers produced by a single plant on the same day. It is either light yellowish green or purple. Cases of bent styles are also reported by Shaw (6).

(g) *Stigma.* This may be coloured purple or remains light green according to the types of the chilli plant. The number of stigmatic lobes in their turn vary with the species and as many as two to three lobes were observed by the writer in the six types of chillies under consideration.

Appearance of the first Flower. The appearance of the first flower in the chilli crop commences from the sixth week after sowing and is usually found in the nurseries. The production of the first flower varies with the type and vigour of the plant. For a chilli cultivator the appearance of the first flower is a signal to get his nurseries topped.

Development of the Flower-bud. To start with, the bud is minute and appears as a green speck between to linear lanceolate leaves. The bud takes two to three days for the formation of the pedicel. The calyx remains closed till the bud attains the fifth day when a bend forms in the pedicel either at the base or just below the calyx. In another two or three days the corolla pushes out and takes seven to eight days for opening. The relative positions of the stigma and anthers vary in the bud. In the young bud the anthers and the stigma are at the same level but the style grows more rapidly than the stamens and hence in an open flower the style is found to be 1 to 2 mm. longer than the stamens. By the time the flower opens the development of the anthers and stigma will be completed as no further growth in size was noticed under the Guntur conditions. On the same plant we come across flowers having styles longer than the staminal column, styles flush with the staminal column and styles shorter than the staminal column. Counts taken from the flowers produced by the same plant throughout the flowering season gave the following results :—

Type of Chilli plant.	Nature of style.			
	Longer.	Flush.	Shorter.	Total.
Bellary	67	56	19	142
Nallapadu	104	39	7	150
Local	81	59	11	151
Yellow	187	20	10	217
Black	51	12	4	67
Needle	151	8	5	164

Of the six types of chillies only the flowers of Needle chillies have a greater percentage of longer styles.

Order of Flowering. Flowers in the chilli crop arise from the axils and no definite order of opening can be specified as the branching is dichotomous. The earliest flowers appear among the older (i. e.) on the lower branches and the younger flowers occur on the branches nearer the apex of the stem. In a branch the flowering follows the same order, the older ones being nearer the main stem.

Duration of Flowering. The transplanting of the seedlings is usually done in September and the flowering commences from October and extends up to February. Stray flowers do appear till the end of February. In general, the flowering extends over a period of three months with the maximum flush occurring between the end of November and the beginning of December (Fig. 1). The maximum variation in the flowering period of the six types under consideration was eight days and the mean was eighty-six days. Of the six types, Bellary and Black chillies had the minimum period of eighty-one days and the Local had the maximum of eighty-nine days.

Progress of Flowering in a day. Shaw & Khan (6) mention that under Bihar conditions chilli flowers open at about 7-30 a. m. and continue opening till 1 p. m. with the majority of the buds opening between 8 and 10 a. m. They further state that in a few cases the opening extends up to 3 p. m. while some buds remain in an unopened or partially opened condition which in their turn open fully earlier than the buds that are to open the next day.

Shrivatsava (7) working on chillies in Bihar and Central Provinces found that in the month of October on a clear day all the flower buds observed by him opened between 4 and 7 a. m. He added further that on a cloudy morning the flower buds prolong their opening and continue opening till 9 a. m. In a few cases he noticed them to open as early as 1 a. m. and as late as 12 noon.

Erwin (2) working at Iowa states that the period of anthesis in chillies is comparatively short and in most cases less than a full day. His observations were made on 18—8—31 by noting the flower opening at half hour intervals starting just after sun rise (i. e.) 5—15 a. m. and continued till 10 a. m.

Chilli flowers as observed at Guntur commenced opening as early as 2 a. m. and continue up to 4 a. m. as indicated below. Of the total number of flowers that open on any one day, the major part of them blossom by 6 a. m. and only in a very few cases the opening is delayed. Dewy nights and cloudy atmospheric conditions retard the normal progress of anthesis and cause the buds to open late. Cases of buds opening late in the evening and the unopened buds of a particular day opening earlier to the flower buds that are to open on the next day were also noticed. The opening of such buds usually takes place between 0 and 1 a. m. as given below. The following table gives the

total number of flower buds observed under each type of plant and the distribution of the anthesis activity. Though the observations were made in 5 plants under each of the types the results of a single typical plant are given for having a clear and definite idea of the time.

Type of Chilli plant.	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-4 P.M.	Total
	A. M.													
	1931—32.													
Nallapadu	9	28	39	58	43	31	10	8	3	2	...	...	9	240
	1932—33.													
Bellary	6	36	36	34	23	13	14	3	8	2	2	...	5	182
Nallapadu	7	30	32	41	21	22	3	2	...	...	...	...	2	160
Local	9	56	41	32	22	12	2	10	6	4	...	...	6	200
Yellow	10	17	37	65	59	39	7	14	4	...	...	...	11	263
Black	2	7	13	23	24	12	2	14	3	6	4	1	2	113
Needle	15	23	24	40	60	51	12	16	5	8	3	3	20	280

N. B:— The number of buds given under 0-1 a. m. are the immature buds opened on the next day.

Of the six types of chillies examined, the flowers of Black and Needle chillies open comparatively late, but in general the maximum activity of anthesis occurs between 2 and 6 a. m. Table II in the annexed appendix gives the fuller details of the anthesis energy at fortnight intervals. A cursory glance at Tables I and II in the appendix indicate that the vigour of the anthesis is directly controlled by the atmospheric conditions.

Dehiscence of anthers at Guntur was found to follow rather than be simultaneous with the opening of the flowers. The following table gives the rate of anther dehiscence under each type of chilli flowers.

Type of chilli plant.	6—7 A.M.	7—8 A.M.	8—9 A.M.	9—10 A.M.	10—11 A.M.	11—12 Noon.	Immature.	Total.
			1931—32					
Nallapadu	56	87	63	19	6	...	9	240
			1932—33					
Bellary	47	50	37	11	19	6	12	182
Nallapadu	32	35	46	31	4	2	10	160
Local	36	53	56	26	12	3	14	200
Yellow	34	89	64	30	22	2	22	263
Black	...	27	30	26	12	11	6	113
Needle	1	24	65	44	61	53	32	280

Similar to the flower opening the anther dehiscence in Black and Needle chillies commence late. In general, the dehiscence starts only after sun rise and this indicates that the atmospheric temperature is the determining factor for the activity of anther dehiscence. For fuller details (vide) Table III.

General Anthesis. Fully matured chilli bud appears like a knob and just when the bud commences to open, an aperture is formed at the top of the bud (i. e) the junction at which all the corolla lobes meet. The aperture gradually increases in size and extends top

downwards along the margins of the lobes. The slit extends right down to the bottom whereby the corolla lobes get separated, one from the other. After some time, the lobes spread themselves flat and recurve upwards by about 8 a. m. It is by this time that the majority of anthers dehisce. The bursting of anthers invariably begins from top and runs downwards along the edge of the anthers. After the dehiscence, the edges of the pollen sacs gradually get folded outwards exposing the pollen grain fully. Even the slightest touch causes the pollen to fall freely and on a windy day in about half an hour after the opening, all the sacs become empty. To a certain extent bees are also responsible for removing the pollen from the burst anthers.

The flowers commence closing from about 5 p. m. on the day of opening and remain closed during the night. Once again they commence opening from 4 a. m. on the next day and close finally by the evening. The corolla along with the stamens sheds in the course of another twelve hours. The stigma remains attached to the fertilised ovary for some days or even dries up and sheds in a day or two according to the prevailing weather conditions.

Shaw (6) mentions that in Pusa, chilli flowers remain open for two or three days without closing. In Bihar and Central Provinces the chilli flowers were observed by Shrivatsava (7) to remain fully open and turgid till 4 p. m. and get closed on the day of opening. The closed flowers were said to open once again between 4 and 7 a. m. on the next day and remain fresh and turgid as before and finally get closed at 6 p. m.

Details of Anthesis:—Two plants from each of the six types of chillies were selected and the detailed observations of anthesis were attended to on week ending Saturdays. The observations were carried throughout the flowering season and the details of a typical single flower of Bellary chillies are given below:—

Particulars.	Actual timing.	Interval from the opening of flower.	Date.
		Hours.	
1. Commencement of corolla opening	2-00 a. m.	—	5—11—32
2. Separation of corolla lobes	5-00 ,,	3-00	,,
3. Secretion of nectar	5-00 ,,	3-00	,,
4. Recurving of corolla lobes	8-00 ,,	6-00	,,
5. Commencement of anther dehiscence	7-15 ,,	5-15	,,
6. Do in all the anthers	8-50 ,,	6-50	,,
7. Completion of dehiscence	10-00 ,,	8-00	,,
8 Folding of corolla lobes	4-45 p. m.	14-45	,,
9. Opening of corolla	5-00 p m.	27-00	6—11—32
10 Final folding of corolla	4-00 p. m.	38-00	,,
11. Shedding of corolla	Night.		,,
12. Drying of style and stigma	3-00 a. m.	61-00	7—11—32
13. Shedding of style and stigma	10-00 a. m.	80-00	8—11—32

The details of the other types are given in Table IV in the annexed appendix.

With a view to see whether the time of the opening has got anything to do with the other phases of anthesis, flowers opened on the same plant at different hours on the same day were examined and the results are given in Table No. V of the appendix. The effect as can be seen from the table is significant (i. e.) the time interval is inversely proportional to the time of opening of the flower buds. Observations made at different ages of plants also showed marked difference in the time interval of the different phases of anthesis having the time of opening of the flower as the basis. As in the above cases, the time intervals diminish with the age of the plant.

Pollination. The study of pollination enunciated the factors contributing to fertilisation. Observations made at Guntur indicate that the pollination in chilli crop is effected by several natural agencies such as wind, Thrips (*Scirtothrips dorsalis* Hood), Bugs (*Nezara viridula*), Bees (*Apis florea*), Butterflies (*Papilio demoleus, Terias hecabe, Papilio aristolochae*) and small black ants (*Camponotus compressus*). Every one of them in its turn contributes its quota for the general role of pollination and fertilisation. The activity of the agencies commences as early as 4 a. m. and continues itill about 12 noon or even later. The position of the stigma in chilli flowers suggests that the flowers are self pollinated as the flowers are either pendent or half-pendent due to the bending of the pedicel. The style is usually straight and longer than the stamens and hence the chances for the stigma are many for receiving the pollen of the anthers of the same flower.

Shaw (6) points out that in many varieties of chillies a certain percentage of the flowers possess curved styles instead of straight ones and that these shorten the distance between stigma and anthers whereby the stigma will be placed in a more favourable position for receiving the pollen of its own flower. The writer did not come across such bent styles in the several varieties grown at Guntur during the two seasons. Shrivatsav (7) pronounces that the chilli flowers are ordinarily self-pollinated.

Cross Fertilisation. Cross fertilisation in chillies is not uncommon for the fact that anther dehiscence starts much later than the opening of the flowers. Besides this, in some flowers the anthers do not burst due to some unfavourable physiological conditions. In such instances the only resort for the stigma is to depend on the pollen of other flowers.

Hector (4) found the chilli flowers to favour a certain amount of cross fertilisation. Erwin (2) mentions that chilli plant being a nectar bearing one attracts insects and as a result of that cross pollination is likely to occur. Shrivatsava (7) mentions that the anther sacs burst simultaneously with the opening of the flower but the observations recorded by Shaw (6) and the writer in 1931 & 32 indicate that the

anther dehiscence takes place at least an hour after the opening of the flower which in its turn depends on the diurnal atmospheric conditions. The interval varies from 1 to 10 hours as given below. In very few cases the anthers were found to remain in an unburst state. The delay in the bursting of anthers as expressed by Shaw (6) favours cross fertilistion.

Type of chilli plant.	Interval of anther dehiscence from the time of flower opening.										Total.
	1	2	3	4	5	6	7	8	9	10	
Bellary	16	16	30	32	45	15	11	1	...	2	168
Nallapadu	7	4	13	46	46	18	9	6	2	...	151
Local	5	13	17	36	52	36	20	4	1	1	184
Yellow	8	23	43	56	49	16	5	1	...	...	201
Black	2	5	16	25	28	14	7	1	...	...	98
Needle	7	4	13	46	46	18	9	6	2	...	151

The above figures indicate that the maximum bursting of anthers takes place between 3 to 5 hours since the opening of the flower.

Percentage of Natural Crossing. For determining this, a ready method was devised whereby the flower buds that are to open on the next day were bagged with tissue paper covers at about 6 p. m. The protected buds were emasculated early next morning at 5-30 a. m before the anthers could possibly dehisce. These were allowed to be cross pollinated and the setting of the same was examined on the seventh day. The observations were carried out at the end of every month in the two seasons. The details of the results are given in Table No. VI. On an average it was found to be seven per cent under the Guntur conditions. Shrivatsava (7) noted the percentage of of natural crossing in chillies as two to five per cent. Shaw (6) found that out of the ninety seven naturally fertilised cultures seventy five were found to be splitting for the parental characters. Erwin (2) mentions that he found eighty per cent of open pollination. Out of the thirty cultures raised by the writer in 1932 from the produce of single plants, two were found to be impure for parental characters. Though the figure obtained is low yet it is in conformity with the one mentioned by Shrivatsava (7)

Receptivity of Stigma and longevity of Pollen. A knowledge on this subject of the concerned crop is of vital importance for a plant breeder. Detailed observations were carried out for the last two seasons and as the subject forms a separate paper the matter is not dilated on at the present stage. The experiences gained so far indicate that the stigma in a chilli crop remains receptive for about twenty-four hours from the time of opening and the viability of the pollen lasts for twenty-four hours under the field conditions at Guntur.

Fertilisation. It is evident from the above fact that in chillies both cross and self fertilisation take place. Usually the setting of the early

formed flowers is very low due to the dewy nights and heavy rainfall in the Guntur District (Gopalaratnam 3). Flowering period in chillies extends well nigh over a period of three months. *Mutatis mutandis* the fruitang period also extends from December to March.

Percentage of Shedding and Setting. As the space is limited only a meagre sketch of the work done in this direction is given below. *Capsicum annuum* alone was selected for the purpose and the investigations were made in the first two types of chillies. Five representative plants of the two types were selected in the field and the daily census of flower production was recorded throughout the flowering season but given as weekly totals per plant in Table VII. The flowers were tagged with the dated labels, and counts of the developed chillies were taken from time to time. The percentage of setting in the two types was found to be as low as 6 per cent on the average.

Maturation Period of the Fruit. This, like any other economic character varies with the variety and the age of the plant. Shaw (6) recorded that the ripening of the chilli fruit takes 2 to 2½ months. At Guntur the observations made in all the six types gave the following results.

Type of chilli plant.	Number of days taken for the chilli fruit to mature.		
	Mean.	Minimum.	Maximum.
Bellary	59	49	77
Nallapadu	57	49	62
Local	56	50	62
Yellow	60	52	70
Black	57	51	70
Needle	51	47	55

The above table indicates that the Needle chillies have the minimum maturation period of forty-seven days and the Bellary chillies have the maximum maturation period of seventy-seven days while the mean maturation period among the six types ranges from fifty one to sixty days as given in Table VIII. It was also found that the maturation parid is directly correlated with the age of the plant, the coefficient of correlation (r) being 0·41 and P. E. 0·05 for all the six types of chillies examined.

Summary. 1. Chilli flowers commence opening as early as 2 a.m. and continue till 4 p.m. with the maximum rush of anthesis occurring between 3 and 6 a.m.

2. Anther dehiscence commences at least an hour after the opening of any flower but the mode of dehiscence can be noticed between three and five hours after the flowers open.

3. The activity of anthesis and anther dehiscence are directly influenced by the diurnal atmospheric conditions.

4. The time intervals of the different phases of anthesis diminish with the advancement of the age of the plant and the time of flowering.

5. Chilli flowers commence to secrete nectar by about 4 a.m.

6. Chilli flowers are both self and cross pollinated with the percentage of natural crossing working to seven under the Guntur conditions.

7. The receptivity of the stigma and the viability of the pollen in chilli plants lasts for twenty-four hours under the field conditions of Agricultural Research Station, Guntur.

8. The percentage of setting to the number of flowers produced per plant is found to be six on an average.

9. Maturation period of the chilli fruit varies from forty-seven to seventy-seven days in all the six types of chillies examined and is directly correlated with the age of the plant.

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APPENDIX

Table I.

Details of Atmospheric Temperature and Rainfall.

Particulars.	Temperature in degrees Farenheit. A. M.											Av. Mini.	Av. Maxi.	Rainfall.
	2	3	4	5	6	7	8	9	10	11	12			
						1931—'32.								
Novr 30th.	76	77	78	79	80	86	87	89	90	92	94	82	93	Nil.
Decr. 31st.	75	76	77	77	78	79	81	83	85	86	88	76	88	Nil.
Jan. 31st.	62	63	65	67	68	70	72	75	76	77	78	72	79	Nil.
						1932—'33.								
Novr. 1st.	81	82	83	84	85	87	89	89	90	90	91	80	91	0·08″
Novr. 15th.	77	78	79	80	80	81	82	83	86	87	87	76	88	0·10″
Decr. 1st.	76	77	78	78	79	79	80	81	84	83	85	77	86	0·19″
Decr. 15th.	73	74	75	76	76	78	79	81	82	83	85	70	85	Nil.
Jan. 1st.	71	70	71	73	69	71	77	79	81	84	88	68	87	Nil.
Jan. 15th.	71	70	69	71	68	69	76	80	82	83	85	68	88	Nil.

Table II.

Details of Anthesis energy at fortnightly intervals.

Period.	0—1 a. m.	1—2 a. m.	2—3 a. m.	3—4 a. m.	4—5 a. m.	5—6 a. m.	6—7 a. m.	7—8 a. m.	8—9 a. m.	9—10 a. m.	10—11 a. m.	11—12 Noon.	12—4 p. m.	Total.	Variety of Chilli.
						1931—'32.									
30th Nov.	5	2	2	16	25	16	7	2	2	2			5	84	
31st Dec.	4	18	25	31	15	13	2	5	1	–			3	117	Nallapadu.
31st Jan.	–	8	12	11	3	2	1	1	–	–			1	39	
Total.	9	28	39	58	43	31	10	8	3	2			9	240	
						1932—'33.									
1st Nov.	1	–	6	2	1	–	2						–	12	
15th Nov.	2	5	8	16	9	4	–						1	45	
1st Dec.	1	22	17	10	8	7	–						3	68	
15th Dec.	2	–	3	3	1	–	1	3	3				–	16	Bellary.
1st Jan.	–	6	2	3	4	2	8	–	5	2	2		1	35	
15th Jan.	–	3	–	–	–	–	3	–	–	–	–		–	6	
Total.	6	36	36	34	23	13	14	3	8	2	2		5	182	
1st Nov.	–	–	–	–	2								–	2	
15th Nov.	1	6	10	22	9	0	1						–	55	
1st Dec.	3	22	19	19	8	15	2						1	89	
15th Dec.	1	1	3	–	2	–	–	2					1	10	Nallapadu.
1st Jan.	2	–	–	–	–	–	–	–					–	2	
15th Jan.	–	1	–	–	–	1	–	–					–	2	
Total.	7	30	32	41	21	22	3	2					2	160	
1st Nov.	1	2	2	4	2	1	–	1					1	14	
15th Nov.	2	10	16	10	5	–	–	–					2	45	
1st Dec.	3	26	15	14	7	7	1	–					1	74	
15th Dec.	2	8	7	2	3	1	–	7	2	1			2	35	Local.
1st Jan.	1	3	–	–	3	2	1	2	4	3			–	19	
15th Jan.	–	7	1	2	2	1	–	–	–	–			–	13	
Total.	9	56	41	32	22	12	2	10	6	4			6	200	

Table II. (*Contd.*)

Details of Anthesis energy at fortnightly intervals.

Period.	0—1 a. m.	1—2 a. m.	2—3 a. m.	3—4 a. m.	4—5 a. m.	5—6 a. m.	6—7 a. m.	7—8 a. m.	8—9 a. m.	9—10 a. m.	10—11 a. m.	11—12 Noon.	12—4 p. m.	Total.	Variety of Chilli.
1st Nov.	2	4	9	8	6	1	–	–	–				2	32	
15th Nov.	1	–	5	11	3	8	1	–	–				3	32	
1st Dec.	4	1	13	21	17	5	–	–	–				4	65	
15th Dec.	–	3	3	7	11	14	6	8	3				–	55	Yellow.
1st Jan.	3	3	3	12	12	6	–	5	1				2	47	
15th Jan.	–	6	4	6	10	5	–	1	–				–	32	
Total.	10	17	37	65	59	39	7	14	4				11	283	
1st Nov.	–	–	–	–	–	–	–	–	–				–	–	
15th Nov.	–	–	–	–	–	–	–	–	–	1	1	–	–	2	
1st Dec.	1	4	12	10	5	5	–	–	–	2	1	–	1	41	
15th Dec.	–	1	–	12	13	2	–	7	3	2	2	1	1	44	Black.
1st Jan.	–	–	–	–	2	–	–	3	–	1	–	–	–	6	
15th Jan.	1	2	1	1	4	5	2	4	–	–	–	–	–	20	
Total.	2	7	13	23	24	12	2	14	3	6	4	1	2	113	
1st Nov.	2	1	5	10	5	6	–	4					5	38	
15th Nov.	8	2	2	6	21	7	5	1	–	1	–	–	2	55	
1st Dec.	1	1	–	4	8	14	–	–	–	2	1	2	6	39	
15th Dec.	3	–	2	5	9	2	2	8	3	3	1	1	4	43	Needle.
1st Jan.	1	8	7	9	13	19	5	3	2	1	1	–	3	72	
15th Jan.	–	11	8	6	4	5	–	–	–	1	–	–	–	35	
Total.	15	23	24	40	60	53	12	16	5	8	3	3	20	282	

Table III.

Details of Anther dehiscence.

Particulars,	6—7 a. m.	7—8 a. m.	8—9 a. m.	9—10 a. m.	10—11 a. m.	11—12 Noon	Immature.	Total	Type of Chilli.
				1931–32					
30th Nov.	22	33	22	2	2	...	3	84	Nallapadu
31st Dec.	24	35	34	16	3	...	5	117	
31st Jan.	10	9	7	1	1	...	1	39	
Total.	56	87	63	19	6	...	9	240	
				1932—33					
1st Nov.	...	10	1	...	...	...	2	13	Bellary.
15th Nov.	20	7	12	2	...	...	1	42	
1st Dec.	26	24	12	...	2	...	6	70	
15th Dec.	...	...	6	5	3	...	3	17	
1st Jan.	1	8	2	3	14	6	...	34	
15th Jan.	...	1	4	1	...	...	...	6	
Total.	47	50	37	11	19	6	12	182	
1st Nov.	...	1	...	1	...	...	...	2	Nallapadu.
15th Nov.	6	13	19	16	...	...	3	57	
1st Dec.	26	20	24	9	3	2	4	88	
15th Dec.	...	1	3	2	1	...	2	9	
1st Jan.	...	...	...	...	...	...	...	...	
15th Jan.	...	...	...	3	...	...	1	4	
Total.	32	35	46	31	4	2	10	160	
1st Nov	...	8	3	1	...	...	...	12	Local.
15th Nov.	17	9	11	4	...	...	2	43	
1st Dec.	18	27	14	7	6	...	7	79	
15th Dec.	1	5	16	8	1	—	1	32	
1st Jan.	...	...	5	6	5	2	4	22	
15th Jan.	...	4	7	...	...	1	...	12	
Total.	36	53	56	26	12	3	14	200	
1st Nov.	6	20	2	...	...	...	...	28	Yellow.
15th Nov.	7	14	15	1	1	...	9	47	
1st Dec.	12	26	19	7	10	...	5	79	
15th Dec.	...	13	10	9	11	...	6	49	
1st Jan.	6	8	8	8	...	1	1	32	
15th Jan.	3	8	10	5	...	1	1	28	
Total.	34	89	64	30	22	2	22	263	
1st Nov.	...	...	...	...	...	...	...	...	Black.
15th Nov.	...	...	...	...	...	...	...	...	
1st Dec.	...	28	17	17	...	6	3	71	
15th Dec.	...	...	5	...	7	1	1	14	
1st Jan.	...	...	1	...	2	2	1	6	
15th Jan.	...	...	7	9	3	2	1	22	
Total.	...	28	30	26	12	11	6	113	
1st Nov.	...	4	8	1	11	4	1	32	Needle.
15th Nov.	1	15	29	16	14	9	15	99	
1st Dec.	...	1	25	18	7	6	10	67	
15th Dec.	...	...	...	2	4	8	3	17	
1st Jan.	...	1	...	4	15	14	2	36	
15th Jan.	...	3	3	...	10	12	1	29	
Total.	1	24	65	44	61	53	32	280	

Table IV.

Details of the different phases of anthesis in the six types of Chillies.

Particulars.	Actual time.						Day of opening.
	Bellary.	Nallapadu.	Local.	Yellow.	Black.	Needle.	
1. Commencement of corolla opening.	2-00 a.m.	3-00 a.m.	4-00 a.m.	2-00 a.m	5-00 a.m.	4-00 a.m.	1st day.
2. Separation of corolla lobes.	5-00 a.m.	6-00 a.m.	6-30 a.m.	5-15 a.m.	6-30 a.m.	6-30 a.m.	do.
3. Secretion of Nectar.	5-00 a.m.	5-30 a.m.	5-30 a.m.	4-30 a.m.	6-00 a.m.	6-30 a.m.	do.
4. Recurving of corolla lobes.	8-00 a.m	7-30 a.m.	8-00 a.m	7-30 a.m.	7-00 a.m.	9-30 a.m.	do.
5. Commencement of anther dehiscence.	7-15 a.m.	9-15 a.m.	8-15 a.m.	7-10 a.m.	9-00 a.m.	10-30 a.m.	do.
6. Do. in all the anthers.	8-50 a.m.	9-45 a.m.	8-50 a.m.	8-15 a.m.	9-30 a.m.	11-30 a.m.	do.
7. Completion of dehiscence.	10-00 a.m	11-00 a.m.	10-00 a.m.	11-00 a.m.	11-30 a.m.	12-00 Noon.	do.
8. Folding of corolla lobes,	4-45 p.m.	5-00 p.m.	5-00 p.m.	5-00 p m.	8-00 p.m.	7-30 p.m.	do.
9 Opening of corolla	5-00 a.m.	6-00 a.m	6-00 a.m.	7-00 a.m.	7-00 a.m.	8-00 a.m.	2nd day
10. Final shedding of corolla.	4-00 p.m.	5-00 p.m.	5-30 p.m.	6-00 p.m.	4-00 p.m.	6-30 p m.	do.
11 Shedding of corolla.	Night.	Night.	Night.	Night.	Night.	Night.	
12. Drying of style and stigma.	3-00 p.m.	4-00 p.m.	12-00 Noon.	4-00 p.m.	12-00 Noon.	10-00 a.m.	3rd day.
13. Shedding of style and stigma.	10-00 a.m.	7-00 a.m.	6-00 a.m	5-00 a.m.	4-00 a.m	9-00 a.m.	4th day.

Table V.

Details of the Time Intervals of the Different Phases of Anthesis.

Particulars.	Date.	Time of opening of flowers.							
		2—0 A. M.		3—0 A. M.		4—0 A. M.		5—0 A.M.	
		Actual	Interval	Actual	Interval	Actual	Interval	Actual	Interval
1. Commencement of corolla opening	29/10	H. M. 5-00 A.M.	H. M. 3-00	H. M. 5-15 A.M.	H. M. 2-15	H. M. 5-30 A.M.	H. M. 1-30	H. M. 6-15 A.M.	H. M. 1-15
2. Secretion of Nectar	,,	5-00 ,,	3-00	5-30 ,,	2-30	5-30 ,,	1-30	5-30 ,,	0-30
3. Separation of corolla lobes	,,	7-15 ,,	5-15	7-30 ,,	4-30	7-30 ,,	3-30	7-30 ,,	2-30
4. Recurving of corolla lobes	,,	8-00 ,,	6-00	8-00 ,,	5-00	8-15 ,,	4-15	8-20 ,,	3-20
5. Commencement of anther dehiscence	,,	7-15 ,,	5-15	7-15 ,,	4-15	7-15 ,,	3-15	8-00 ,,	3-00
6 do, in all anthers	,,	8-50 ,,	6-50	9-00 ,,	6-00	9-15 ,,	5-15	10-00 ,,	5-00
7. Completion of anther dehiscence	,,	10-00 ,,	8-00	11-30 ,,	8-30	11-00 ,,	7-00	11-30 ,,	7-30
8. Folding of corolla lobes	,,	4-45 P.M.	14-45	4-45 P.M.	14-00	5-00 P.M.	13-00	5-00 P.M.	12-00
9. Opening of corolla lobes	30/10	5-00 A.M.	27-00	6-00 A.M.	27-00	6-00 A.M.	26-00	6-00 A.M.	25-00
10. Final folding of corolla lobes	,,	4-00 P.M	38-00	4-00 P.M.	37-00	4-00 P.M.	36-00	5-00 P.M.	36-00
11. Shedding of corolla	,,	Night	...	Night	...	Night	...	Night	...
12. Drying of style and stigma	31/10	3-00 P.M	61-00	4-00 P.M.	61-00	5-00 P.M.	61-00	5-00 P.M.	60-00
13. Shedding of style and stigma	1/11	10 A.M.	80-00	2-00 A.M.	71-00	2-00 A.M.	70-00	2-00 A.M.	69-00

Table VI.

Details of the percentage of natural crossing.

Month.	1931—'32.			1932—'33.		
	No. of buds emasculated.	No. of buds set.	% of Natural crossing.	No. of buds emasculated.	No. of buds set.	% of Natural crossing.
Oct.	50	3	6	50	4	8
Nov.	50	4	8	50	3	6
Dec.	50	4	8	50	5	10
Jan.	50	4	8	50	3	6
Feb.	50	3	6	50	3	6
Average.			7·2			7·2

Table VII

Details of flower and fruit production.

Weeks.	No. flowers produced per plant.		No of chillies collected per plant,	
	Bellary	Nallapadu	Bellary.	Nallapodu.
16—10—32	1	7		
22—10—32	11	17		
30—10—32	22	50		
6—11—32	23	54		
13—11—32	67	50		
20—11—32	86	54		
27—11—32	72	47		
4—12—32	81	81		
11—12—32	68	30		
18—12—32	25	48		
25—12—32	32	42	...	1
1— 1—33	7	46	2	6
8— 1—33	...	37	2	2
15— 1—33	...	14	...	4
22— 1—33	...	9	3	1
29— 1—33	...	5	3	2
5— 2—33	...	3	10	7
12— 2—33	...	...	12	7
19— 2—33	...	...	...	4
26— 2—33	...	...	2	1
Total,	405	574	34	35
% of setting	6·9	5·9		

Table VIII.

Statistical details of maturation period.

Particulars	No. of Determinations.	Mean	Standard Deviation. σ	Coefficient of variation.
Bellary	64	59	±5·98	9.34
Nallapadu	33	57	±3·70	11·21
Local	35	56	±3·22	8·90
Yellow	25	60	±5·94	23·80
Black	37	57	±4·95	35·36
Needle	60	51	±3·05	15·25

A NOTE ON THE SUGARCANE LEAF HOPPER (*PYRILLA*) IN SOUTH ARCOT DISTRICT

By C. B. FRANCIS,

Cane Farm Superintendent, East India Distilleries & Sugar Factories, Ltd., Nellikuppam, S. India.

Introduction: This pest of sugarcane, though noted in the S. Arcot district for some years past, appeared in some appreciable numbers only last year and has this season for the first time reached the status of a major pest. It was suggested to the writer by Dr. T. V. Ramakrishna Ayyar, the Government Entomologist, Madras, that a connected record on the observations made and some work done during this year might be of some interest and this note is an attempt in that direction. It must however be emphasized that the paper has been prepared by one not specially qualified to observe from an entomological point of view, and that conclusions cannot safely be drawn until more knowledge of the pest and the damage caused by it is obtained.

CONDITIONS UNDER WHICH CANE IS GROWN IN THE S. ARCOT DISTRICT

Soil—Rotations—Manuring, etc. Cane is grown both in wet and garden lands, but this note is concerned solely with cane grown by the Nellikuppam factory in garden land under well irrigation. The soil is a sandy loam of alluvial origin. Sugarcane is grown in the following rotation ; irrigated sugarcane, rainfed cumbu (*Pennisetum typhoideum*), rainfed green manure (Sunnhemp), irrigated sugarcane. Cultivation is intensive, the full rotation taking only two years so that the land is under cane every alternate year. Manuring is heavy as in addition to the green crop which gives about 100 lbs. of nitrogen per acre, heavy applications are given of artificial fertilisers containing 150 to 200 lbs. of N. per acre. Thick varieties of cane are mainly grown, the chief of which is Fiji B (*Badila*). Harvesting extends from about the middle of January to the end of May and planting is done at the same time.

Weather: The shade temperature in the tract ranges from about 70 degrees F. in the months of December and January to about 110 degrees in the months of May and June. The average rainfall is about 43 inches. Normally about 5 inches come down in the first four months of the year, about 8 inches in the next four months which are the hottest months of the year and the rest comes down during the last four months which cover the North-East monsoon period. The rainfall figures for the present season with those of last season which was considered a good one, and also the average for the past ten years are given below :—

	Average for past ten years.	1932—33	1933—34
February	0·44″	...	...
March	0·97″	...	10·63″
April	1·40″	2·18″	0·20″
May	1·57″	2·14″	1·84″
June	1·35″	0·18″	1·31″
July	1·34″	0·35″	2·76″
August	3·93″	1·80″	3·34″
September	4·86″	6·77″	1·25″
October	10·47″	11·43″	4·29″
November	10·93″	13·42″	
December	8·70″	6·74″	
January	2·25″	...	
Total	48·21″	45·61″	

This season the weather was abnormal in that 10·50″ of rain fell during two days in the middle of March, and that September, usually a showery, humid month, was unusually hot and dry. The October rainfall was also much in defect.

Appearance and duration of the pest (*Pyrilla*). The pest appeared in fairly large numbers at the beginning of August, increased until early in September when the crop began to be severely damaged, and the peak was reached early in October. Since then, there has been a gradual decline, but at the time of writing (beginning of November) some blocks are still badly infested. The worst month was September when as stated above the weather was hot and dry.

Control: Control measures were initiated at the beginning of September and the following methods were tried ; spraying, light traps, bagging in handnets and egg destroying. In order to be able to get into the cane fields to carry out the control measures it was found necessary first of all to give a complete trashing.

(a) **Spraying.** The contact poison used was kerosine oil emulsion to the following formula ; one lb. of soap, one gallon water and two gallons kerosine oil, diluted with ten times water This mixture did not cause any damage to the leaves. Only a small area was sprayed but the quantity of solution calculated to be required per acre was 250 gallons. This method was not used on a large scale on the grounds of expense, difficulty of moving the sprayer about inside large blocks of cane, and because the hoppers' habit of sheltering on the undersides of the leaves made it difficult to reach them.

(b) **Light traps.** The traps consisted of small lanterns standing in trays 2 feet by 2 feet by 2 inches in which was a small quantity of oil and water. The cost of the traps was about Re. 1 each. 54 traps were in use every night for some time at a cost for oil and attention of Rs. 2–4–0 per diem, and the average number of flies caught nightly per trap was about 2,000. The traps were discontinued after a time on account of the very large number that would be required to make any appreciable reduction in the millions of flies infesting the fields. In

this connection it has been noticed that, whereas the adults are attracted to bungalows at night they do not fly close to the lights but merely sit on the white walls several feet away from the lamps.

(c) **Bagging in hand-nets.** Nets about 15 inches in diameter on rattan or bamboo frames with bamboo handles were used, the cost per net being about 6 annas. Thin gauze cloth was originally used but this was found to be unserviceable and later mull was substituted which was found satisfactory. This method of control was found to be very successful and large numbers of flies were caught and destroyed by emptying them from the nets into kerosene tins containing water and a little oil. The following figures give the number of coolies employed daily, and the daily collection of flies during the seven weeks ending 4th. November 1933.

Week ending	Coolies employed daily	Flies collected daily measured in Gallons
23— 9—1933	53	28
30— 9—1933	86	42
7—10—1933	83	44
14—10—1933	50	25
21—10—1933	48	28
28—10—1933	39	22
4—11—1933	48	32½
Average	58	31⅛

It is estimated that with an average of 58 coolies working daily for a period of 49 days the total number of flies accounted for was 1543 gallons or about 350 millions. The flies were buried or burned at the end of each day as the smell from them if kept longer was very bad.

In netting the flies it is necessary to beat the cane in order to make the hoppers leave the plant and this caused slight damage to the tuft if done very frequently.

(d) **Destroying egg-masses.** The egg-masses of the insect are easily visible and children have no difficulty in squashing them between the fingers. Women have to be employed if the cane is tall. The children counted the masses upto each 100 as they were destroyed and a cooly in charge of each group of about 10 children marked each 100 against each child's name. In this way an easy check was kept on the number of masses destroyed. Figures for the seven weeks mentioned above were as follows,—

Egg destruction week ending	Women & children employed daily	Egmasses destroyed daily
23— 9—33.	155	603·645
30— 9—33.	123	405·408
7—10—33.	118	381·528
14—10—33.	34	89·001
21—10—33.	14	68·238
28—10—33.	14	22·414
4—11—33.	48	111·521
Average	73	240·251

During the 49 days referred to an average of 73 women and children destroyed a total of nearly 12 million eggmasses and as each mass consists of about 35 eggs, the total number of eggs destroyed is about 412 millions. The reduction in the amount of work done towards the end of the period was due to a lessening in the amount of egglaying, to an increase in parasitisation of the eggs, and the case of two weeks to showery weather and the Dipavali holidays.

Egg parasites. Two parasites have been identified by Dr. T. V. Ramakrishna Ayyar in the area, (a) Dryinid wasp (*Dryinus pyrillae*) which lays an egg in the body of the nymph, and (b) a species of small Chalcididae which parasitises the egg. The Dryinus is not present in large numbers and no detailed observations have so far been made regarding it. The egg parasite was not greatly in evidence at the beginning of the control, but increased later, and masses examined at random throughout the cane area showed the following percentage of parasitisation.

Week ending	Massess Examined	Parasitised	Not parasitised	%age of parasitation.
14—10—33.	712	526	186	73 85
21—10—33.	1486	1126	363	75·77
28—10—33.	1020	667	353	65·39
4—11—33.	3275	1615	1660	49·42

The reduction shown by the figures for the last two weeks was not unexpected as fewer parasites were seen in the fields. At this time large number of dragon flies were seen darting about over the cane, but it is not known if they were feeding on the egg parasites. Parasite breeding cages have not yet been tried but it is proposed to do so.

Effects of a severe infestation. In the case of the variety Fiji B, there is a yellowing of the foliage and a stunting of growth giving the crop a very unhealthy appearance. The upper surface of the leaves becomes covered with the sweet excretion (honey dew) of the hoppers which is later covered by the fungus *Capnodium sp.* so that the older leaves appear completely 'sooty'. In the case of Co. 213 and to a lesser extent Co. 281 there was this season a marked "browning" of the older leaves, commencing at the leaf tips, which may be associated with the infestation. The effect on the quality of the attacked cane has not yet been ascertained.

Comparative effect on different varieties. The thick cane Fiji B (Badila) has suffered the most. Co. 213 appears to be attractive to the pest but is apparently less damaged than Fiji B. Co. 281 is comparatively little attacked and E. K. 28 is even less so. The POJ varieties of which several are under trial appear to be attractive and large numbers of eggmasses can be seen on them, but in most cases the plants do not appear to be affected to any appreciable extent.

Value of the control measures. An improvement in the position, probably more due to the weather conditions than the control

measures has taken place. The control work has however been done in scattered blocks surrounded by ryots' plots in which no control has been attempted, and in spite of the large number of hoppers and eggs destroyed the total population of the pest cannot have been reduced to any extent. It is realised that co-operative effort on a large scale is required to prevent plots on which control measures have been tried from being re-infested, especially as the adults are very active and at night are found flying considerable distances. It is probable therefore that the intrinsic value of the control work done this season is practically nil. The local ryots are inclined to put down an insect attack of this sort to their bad luck and to accept the position with resignation and the main idea in attempting control work was to give them a lead and show them that something can be done to fight the pest. If the work done this season results in a less apathetic attitude being taken in the case of future attacks it will have been worth while.

Acknowledgements. Acknowledgement is made of the valuable information and advice regarding the pest and its control received from Dr. T. V. Ramakrishna Ayyar, the Government Entomologist, Madras, who visited the area and who witnessed the control measures that were being done on the infested areas.

THE PERIOD OF RECEPTIVITY OF RICE STIGMA *

By K. RAMASWAMY, B. Sc. (Ag.),

Assistant to Paddy Specialist.

Introduction. A knowledge of the natural pollination and fertilisation in cultivated crops is of extreme importance to the plant breeder in the matter of evolving successful techniques of artificial hybridisation for crop improvement. In most of the crop plants, which are self fertilised, natural pollination occurs at the time of flower opening, when the anthers dehisce and shed their pollen on the stigma, which is receptive then, enabling the pollen to germinate and fertilise the ovule. In plants where cross fertilisation is the rule, self fertilisation is prevented in nature by the different times of maturity of the anther and the stigma i. e., the pollen is shed either long before (protandry) or long after the stigma is receptive (protogyny). In grasses protandry is more common than protogyny. A study of the period of pollen viability and the receptivity of the stigma forms an important preliminary work in crop improvement. The present paper deals with the studies on the period of receptivity of the rice stigma.

Review of Literature. Biffen (1905) mentions about emasculating wheat flowers and successfully pollinating the stigma a week after,

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proving that the stigma is receptive for a week after anthesis. Solomon (1914), experimenting on wheat to determine the relation between non-fertilisation and occurrence of open glumes, found out that in unpollinated spikelets, " the glumes remained open until the stigmas began to die, which took place in 8 to 10 days ". Anthony and Harlan (1920) have reported of a systematic investigation on the period of receptivity of barley stigma. They found that " the percentage of successful pollination increased for two days. Of these pollinated 2 days after emasculation 100% of the ovaries set seed. From this time there was a gradual decrease until on the sixth day no pollinations were successful ". Dietz (1928), in connection with his studies of the inheritance of rust resistance in *oats* conducted some preliminary trial to determine the best technique to be adopted in hybridisation of *oats*. His results brought out that the optimum time for pollination is after an interval of 24 to 72 hours after emasculation, both with regard to the percentage of fertility and the production of true hybrids. It is presumably based on a knowledge of this phenomenon of the prolonged receptivity of stigma that the practice is in vogue in certain countries of cross pollinating the flowers some time after emasculation. Love and Craig (1918), in Cornell Station generally cross pollinate oat stigmas a day or two after the emasculation of the flowers. Kraus (1907) in his rice investigations at Hawai recorded his observations that " if the stigma fails to receive pollen from the anthers of the same floret, foreign pollen may fertilise it even after a considerable interval. About hybridising rice, Jenkin Jones (1929), from California, Rodrigo (1925), and Torres (1923), from the Phillipines, report that after emasculating the spikelets, the stigmas may be pollinated the same or the next day.

So far as the writer is aware no systematic study has however, been reported about the period of stigma receptivity in rice.

Method of work. The series of artificial hybridisations in connection with this study were conducted during flowering seasons, 1929-30, and 1930-31. The procedure of study adopted was to emasculate a number of spikelets a few hours before their normal opening time, to pollinate them on the same day or at one day intervals on successive days and finally to compare the receptivity of stigma by the percentage of set seeds obtained in each pollination. The technique of hybridisation followed was the one practised all along in the Paddy Breeding Station at Coimbatore with good success (Ramiah 1927). The method adopted in Japan, Java, Phillipines and California viz., of clipping off the upper half of the fertile glumes before emasculation, was not followed as the set seeds obtained in this way are easily liable to be damaged by external agencies and at least some of them rendered nonviable since they are but partially protected by the glumes. Rodrigo in Phillipines appears to employ some nutrient medium to germinate

the hybrid seeds after they are sterilised whereas no such procedure is adopted in Coimbatore. Only five to twenty five per cent success is claimed by the method of clipping the glumes. As the results in the accompanying table will show, the method adopted at Coimbatore has given better results, when the pollinations are done at the optimum condition of the stigma, as for instance till the fourth day after anthesis. The emasculation method advocated by Sharangapani (1924) i. e., to tie up the emasculated flowers with silk thread was also not adopted for this experiment, as the process would naturally restrict the number of spikelets that could be operated on in a short period of interval, whereas, for the present study, the larger the number of cross seeds obtained the greater should be the accuracy of the results.

There was no difficulty in choosing the materials for the crosses from among a collection of over 600 pure lines of rice grown year after year in the station. In selecting the two parents for each set of cross a non-pigmented type was chosen as the female and one with anthocyan pigment on the leaf sheath as the male so that the success of pollination of each grain could be confirmed even in the early stages of the seedlings raised from the crossed seeds, from the presence of pigment on the leaf sheath. Care was also taken to see that the blooming periods of the two parental types synchronised as closely as possible, so that fresh pollen could be procured in abundance from the male parent.

For each set of cross, half a dozen plants true to the type were chosen as mother parents and in each of them only the spikelets of the first three tillers were operated upon for the study. Each panicle was considered to be a separate unit for pollination instead of the entire plant and a sort of randomisation was adopted for emasculating and cross pollinating the spikelets of the different panicles on different dates i. e., within the same plant the three different panicles would have been emasculated on different dates and pollinated at different intervals after emasculation. A scheme was drawn up beforehand and the emasculation and cross pollination of spikelets of each tiller were carried out according to the scheme. The panicles were properly labelled after emasculation and cross pollination. For emasculation on a particular day, only the spikelets that would open that day were chosen and those are easily discernible to a trained eye. A panicle takes 5 to 6 days for completing the blooming of all the spikelets in it and for this experiment the panicles were treated on the 2nd or 3rd day after the starting of anthesis, as the maximum number of flowers open on these days. Besides, the later blooming flowers in a spikelet were purposely omitted, as unsetting in rice, even under natural condition is mainly confined to these spikelets (Ramiah 1931). Artificial cross-pollination was always effected at the time of the natural anthesis of the male parent so as to ensure the maximum viability of

the pollen. When the grains were ripe the panicles were separately harvested with the respective labels and the set and unset grains carefully counted under each set of pollination. The set grains of all the groups were then separately preserved after giving them two or three dryings in the sun and they were sown in seed-pans on a subsequent date to ascertain the success of the cross pollination.

Results and Discussion. The results of the different sets of artificial cross pollinations are set forth in a table below.

Table I

Showing the percentages of setting of grains when cross pollinated at different intervals after emasculation.

Time of Cross pollination.	T. 40xT. 130			T.430xT.137			T. 63xT. 344			T. 30xT. 341			Total		
	Set.	Unset.	%set.	Set.	Unset.	%set.	Set.	Unset.	%set	Set.	Unset.	%set.	Set.	Unset.	%set.
Same day of emasculation	10	33	23·3	11	15	42·3	...	...	...	26	4	86·7	47	52	47·5
One day after emasculation	23	70	24·7	0	11	0·0	...	....	...	38	5	88·4	61	86	41·5
Two days after emasculation	19	40	32·2	8	16	33·3	4	13	23·5	16	5	76·2	47	74	38·8
Three days after emasculation	26	38	40·6	19	35	35·2	4	19	17·4	26	8	76·5	75	100	42·9
Four days after emasculation	4	20	16·7	1	35	2·8	4	13	23·5	9	9	50·0	14	77	15·4
Five days after emasculation	...	...	...	0	24	0·0	2	12	14·3	1	5	16·7	3	41	6·8
Six days after emasculation	...	...	...	...	...	...	...	...	...	4	4	50·0	4	4	50·0
Seven days after emasculation.	...	...	...	...	...	...	...	...	...	0	8	0·0	0	8	0·0

Except for the occurrence of a few non-crosses among the first day pollinated spikelets, the set grains obtained from all subsequent pollinations proved to be true hybrids. In cross No. 3 the programme of pollinations on the first two days could not be carried out on account of some unavoidable circumstances. For that particular cross, therefore, only the results of pollinations at subsequent intervals are given here. In cross No. 2, the complete failure to set, when pollinated one day after emasculation is inexplicable. Grouping the results of all the crosses together, the percentages of setting under the different sets of pollinations are represented by a graph below.

Graph. There is no uniformity in the percentage of setting at corresponding intervals of pollination in the different sets of crosses. This is partly due to the varietal differences with regard to their ease of manipulation. In some rices, specially, where the glumes are broad, emasculation is comparatively easier and hence they give a greater percentage of set grains in hybridisation. However, it can be seen from the graph that the rice stimga retains a fairly high degree of receptivity for three days after the natural opening of the flowers

and that later on, the receptivity gradually diminishes until it is completely lost by the seventh day. The high percentage of setting on the sixth day after emasculation in cross number 4 is not quite reliable as the number of spikelets cross pollinated in that particular case was rather small viz., 8.

It is needless to stress on the limitations of this experiment, the results of which are judged purely by artificial hybridisation by mechanical means, as it is well known that atmospheric factors like temperature and humidity play a very important role in the natural opening and pollination of flowers. These are of course, beyond control under ordinary field conditions. Fortunately however, the atmospheric conditions remained favourable during the course of the experiment, as bright weather prevailed throughout this period. The uniformity of skill and care exerted during the crossing operations is another important factor affecting the reliability of the results. This error due to personal factor may however be taken as uniformly distributed over all the sets of emasculations and cross pollinations, as these operations were all done entirely by the writer himself exercising equal amount of care throughout. The limited number of spikelets that could possibly be handled formed another handicap in this investigation. This is due to the short period of 4 or 5 days within which the spikelets of the primary tillers of a pure line of rice complete their flowering phase. A tiny caterpillar which used to damage the emasculated flowers by eating away the stigmatic tissues was another source of trouble which contributed to the reduction in the number of emasculated flowers available for cross pollination.

Summary and Conclusions. The degree of receptivity of rice stigma is reckoned in this study from the percentages of setting exhibited by spikelets which were emasculated one to two hours before the time of their natural opening and cross pollinated on the same day or at one day intervals upto 7 days. Four different sets of crosses were done in connection with this investigation. Although the percentages of setting in the different sets of crosses are not uniform at the corresponding intervals of pollination, it is fairly evident from the data, that for the first three days after the natural opening of the rice flowers, their stigmas maintain nearly as high a degree of receptivity as on the first day, but gradually lose it afterwards until on the seventh day the receptivity is completely lost.

The results obtained from the present study are of importance for the rice breeder in his artificial hybridisation work in the following ways :—

1. In case two parental types differ in their flowering durations by not more than a week, cross pollination may be effected between them by bagging the emasculated spikelets of the earlier variety and cross pollinating them with the later one within six days after

emasculation, although the percentage of set grains thus produced may be somewhat reduced.

2. If, after emasculation of spikelets, unfavourable weather conditions or some other external disturbances do not permit of immediate cross pollination, the latter operation can be safely postponed for two or three days with full confidence of obtaining the same amount of success as can be had by pollination on the same day of emasculation.

3. Cross pollination done one or two days after emasculation is of decided advantage in hybridisation work, as the set grains obtained in this way are sure to be hybrids, as any self fertilized flowers among the emasculated spikelets can easily be detected even the next day after emasculation, from the withering condition of their stigmas and slight enlargement of their ovaries and can thus be rejected then and there.

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MULBERRY CULTIVATION IN KOLLEGAL AND THE SERICULTURAL INDUSTRY

BY P. V. HANUMANTHA RAO,

Assistant Agricultural Demonstrator, Kollegal.

The cultivation of mulberry is simple and may be done in a wide range of climate and soil provided the latter is fairly fertile; the rearing of silkworms is however possible only in temperature ranging between 70° to 90° F. with a humidity of 50 to 70%. During the hot weather the rearing is as a rule stopped and the bushes pruned for a fresh flush of leaves. The above named conditions exist in the Kollegal taluq almost throughout the year and hence the rearing of silkworms is carried on all the year round giving occupation for well over 5000

families in 36 villages, the mulberry crop being raised on 10,000 acres and raw silk to the value of 10 lakhs of rupees being exported from this taluq.

Soils. Red sandy loams, black cotton soil and even sandy and gravelly soils are found suited to the growth of mulberry.

Varieties. Bush mulberry or the white mulberry (*Morus Indica*) is the only species grown in Kollegal. The varieties known locally as the *Ennairangina gaddi* and the *Buddigaddi* are popular on account of the better and more nutritious leaf they give while the variety known as the *Karigaddi* is also to be found here and there.

Propagation, planting etc. The crop is propagated by cuttings. The land is ploughed 6 to 7 times in April and May; 15 to 20 cartloads of cattle manure per acre are applied and spread before the final ploughing. The cut bits are planted with the first showers of the South West Monsoon. Furrows are opened 2½ to 3 ft. apart either way and at the junctions holes 1 foot square and 6″ deep are made and in each hole 2 to 3 cuttings are planted; 4 to 5 headloads of fresh cut bits are required to plant over 1 acre. If the weather is moist and cloudy the cut bits keep for 4 to 5 days. The bits are 8″ to 9″ long with 3 nodes in each and are laid flat like sugarcane setts. When necessary as during dry hot weather, one or two hand waterings are given. Young shoots appear in two months after planting. At this stage, weeding and intercultivation are done by working guntakas. Once a month for the next 7 or 8 months this intercultivation is carried on, every time after the picking of the leaves.

List of implements with a cultivator whose holding is 6 acres in Kamakaral Village:—

1 plough	1—0—0	1 *Ujjari*	0—4—0
1 *Balguntai*	1—2—0	1 Kalkat	0-10—0
1 *Tadiguntai*	1—2—0	Barkani 1 pair	0—2—0
1 *Kiriguntai*	1-12—0	Murrels	0—2—0
1 *Machu*	0-10—0	Yoke and rope	1—8—0
		Total...	7—4—0

Initial cost of planting 1 acre of mulberry.

4 ploughings at 12 annas each	Rs. 3—0—0
15 cartloads cattle manure	7—8—0
Carting	3-12—0
Spreading	0—8—0
Opening furrows for planting	0—8—0
Setts 4 bundles for planting	1—0—0
Cutting setts and carrying	0—8—0
and preparing	0—8—0
Planting setts—10 women	1—4—0
2 Weedings—6 women each time	1—8—0
Hoeings—twice a month for 8 months	4—0—0
Total.	24—0—0

Recurring charges including assessment.		
Assessment varying from 0—12—0 to 1—5—0.	Average	1—0—0
Two ploughings at 0—8—0 each	„	1—0—0
24 hoeings a month at 0—8—0 a pair doing 2 acres a day	„	6—0—0
Pruning—2 men	„	0—8—0
Manure—7 cartloads at 0—8—0	„	3—8—0
Carting	„	1—8—0
Weeding—6 women	„	0—12—0
Applying manure to the pits	„	0—8—0
	Total.	14—12—0

The mulberry leaves are easily browsed by sheep, goats and cattle and the fields should therefore be carefully fenced. Plantations ordinarily keep going for 12 years after which the bushes are pulled out and sown to annual crops like ragi or cholam for 1 year and again planted to mulberry. From 6 to 8 cuttings may be had of an acre of mulberry, 30 headloads or 3000 lbs. of leaves being obtained from each cutting.

Life history of silkworms:—The Kollegal silkworm belongs to the multivoltine or polyvoltine class that pass through a number of generations in a year. Polyvoltine worms feed on all bush mulberry leaves and it is perhaps difficult to rear them on tree mulberry leaves because of over-nutrition. The silkworm lays on an average 250 to 350 eggs which are oval in shape and very minute measuring about 1¼ m. m. by 1 m. m. They are cream-coloured to yellowish white when freshly laid but turn bluish black just before hatching. At Kollegal the eggs hatch out in 10 days; this period may be shorter or longer according to the temperature of the locality. In the hot months (April and May) hatching takes place in 8 days. The new hatched out worms are minute in size 2 m. m. long with a slender more or less elongated cylindrical shape. The worm is at this stage fringed with tufts of fine hairs; its color is dark brown, the head being black. The body is composed of 12 segments or rings. Behind the head there are 3 segments wherein are the front legs and the thorax. The remaining 6 segments constitute the abdomen and here are 5 pairs of legs. The head is composed of 2 scaly parts and is fairly uniform. There are 6 small single eyes. In the middle of the upper lip is a little elongated tubular organ with a microscopic orifice called the 'spinnaret'. The body contains 2 silk glands which open out into this orifice. When the larva approaches maturity these glands are filled with a clear viscous fluid which is thrown out through the orifice. When this fluid comes in contact with air it solidifies and forms the lustrous fibre called 'silk.' The thread thus formed really consists of 2 filaments one from each gland which have become agglutinated. The color of the legs generally indicates the color of the cocoons and the silk thread. The length of fibre that each vomits is from 300 to 1000 yards. The moths that emerge out of the cocoons are creamy white in colour. The male moth

is smaller than the female. Both have the wings developed but they never fly. The male moth is smaller and more lively. Its antennae are long and blackish in color, while those of the female are only slightly developed.

Rearing of silkworms. The main object in rearing silkworms is to get good cocoons yielding good quantity and proper quality of silk. To produce 2½ maunds (1 maund = 25 lbs.) of cocoons or 10 trays, the following appliances were used by Basava Chetty at Kamakarai.

1 Stand	2—0—0	1 lamt	0—0—6
10 Trays	2—8—0	Litter baskets	0—1—6
1 Sickle	0—6—0	4 Ant-wells	2—0—0
2 Baskets	0—2—0	Chopping Board	0—2—0
2 Bags for bringing leaves	1–12—0	10 Chandrikes bamboo trays	5—0—0
			14—0—0

Rearers usually buy seed-cocoons from vendors at Kunigal or Bidadi in Mysore State at Re. 1 per 1000 cocoons when paid in cash or Rs. 2 per 1000 on credit. One maund of cocoons count about 14,000 and cost Rs. 7. These cocoons or seeds are placed in bamboo trays and kept safely on a bamboo stand in a ventilated room. The moths coming out of these cocoons are usually half male and half female in number. As soon as they emerge, each male moth pairs off with a female. After 8 hours of mating the female moth is separated from the male and kept in separate bamboo trays for laying eggs. The newly laid eggs (250 to 350 per moth) are covered with a viscous fluid and so stick on to the surface where they were laid usually a piece of newspaper. Within three days, the eggs are all laid and the female moths are all thrown away—the same fate which the male moths suffered earlier in their career, i. e. after their separation from the females.

The eggs are kept in the same trays over the stands with great care. They hatch out in 10 days. The young larvae are usually brushed on to a fresh tray with a fine feather, and are fed with tender finely chopped mulberry leaves. For each feeding fresh leaves are picked from the plantation.

Feeding and moulting. The life of the worm from hatching time to spinning of the cocoon is 30 days in summer but slightly longer during the cold months. These worms in common with many others moult periodically as they feed and grow. Since they moult four times during this period of 30 days the periods of activity may be said to be five.

The table below shows the interval of each period, number of feeds, quality of leaves etc.

Period.	Number of days.	Number of feeds in 24 hours.	Moulting period.	Quality of leaves supplied for feeding.
1st	7	8	36 hours	Tender leaves finely chopped.
2nd	4	7	24 ,,	Half mature leaves chopped a bit coarser.
3rd	5	6	24 ,,	Half mature leaves chopped much coarser.
4th	6	5	36 ,,	Three quarter mature leaves, each leaf chopped into 3 or 4 parts
5th	8	4	Spinning.	Fully mature leaves fed entire.

Moultings are periods of inactivity when the worms lie inactive and eat nothing. With every moulting the old skin is shed off. The worms should not be disturbed during this period. When the worms get out of their moults their stomachs are delicate and so fairly tender leaves should be given for at least 2 feeds to allow of easy digestion.

Cleaning the litter. The worms do not eat all the leaves that are given to them. They should be removed at least once a day to new trays and the litter collected and thrown away in the manure pit.

Spacing of worms. The worms grow bigger in size day by day and hence greater space is necessary for them. The eggs laid by 500 mother moths when hatched occupy only quarter of a tray but during the spinning stage the adult worms occupy 25 trays i. e. they require 100 fold space. When the worms mature which is recognised by their transparent yellow colour they are collected and sprinkled over in *chandrikas* or spinning trays. Each tray of worms is given space in 1 *chandrika* for spinning. This tray is kept in the open exposed to the morning sun. They are left thus in the trays for 2 days when the cocoons are gathered and sold away in the green state and reeled off into silk.

Rearing room. Generally the courtyard, verandah, sleeping room and even the cattle yard is used as a rearing house, here the bamboo stand is placed and trays arranged on them. The eggs, worms and cocoons are safely guarded against ravages from rats, lizards, birds and ants.

Diseases of silkworms. The chief disease is the "*Pebrine*" an infectious disease. The disease is characterised by the black spots which appear on all parts of the body especially tail, legs and back. The attacked worms remain small, languid, eat little and succumb between second and third moult. There is no cure for the disease; the affected worms must be burnt to prevent infection.

Flacherie. This is a bacterial disease caused by indigestion. The worms become lean and thin and sometimes vomit green fluid matter

from their mouths and void semi-fluid faeces. The disease is contagious and is virulent in summer. The worms spin cocoons if the disease is not acute, but they die and decompose within the cocoons.

Grasserie. This is mostly due to careless feeding first with mature leaves and then with tender or succulent leaves after a rain. This may also be due to exposure of the worms to damp and cold air or sudden change of temperature. The disease is not infectious. Wet leaf and damp air should be avoided. This disease is not of common occurrence in Kollegal.

Muscardine. This is a parasitic disease caused by a fungus. The infected worms are quite stiff after death. The dead worms should be burnt immediately. Good ventilation and light should be maintained in the rearing rooms. This is rarely seen in Kollegal tract.

Economics of mulberry cultivator. About 80% of the cultivators rear their own worms. Others sell the plantation as a standing crop to other rearers. A plantation is usually kept for 12 years with an initial expenditure of Rs. 24 and a recurring charge of Rs. 14—12—0 per acre every year. The average cultivation charges per year come to Rs. 15—8—0. The yield of leaves on an average is 3,000 lbs which at 12 annas per headload of 100 lbs works to Rs. 22—8—0. The net gain per acre is thus Rs. 7—8—0. The interest on the value of the land which varies from Rs. 20 to Rs. 150 per acre has been ignored in the above calculation.

A ryot rearing the worms himself out of the leaves from 1 acre may raise 6 crops.

The table below shows the quantity of leaves from pruning, to pruning, the number of seed cocoons, the number of trays of worms, wages of labour employed etc.

Crop.	Headloads. of 100 lbs.	Seed cocoons.	Trays.	Labour.
1	10	700	8	2—8—0.
2	5	250	4	1—2—0.
3	5	250	4	1—2—0.
4	3	200	2	Nil.
5	2	100	1	,,
6	8	500	6½	2—4—0.
		Oil		2—4—0.
		Seed cocoons		2—8—0.
	33	2000	25½	11—12—0

Twenty five trays of worms will yield 6¼ maunds of cocoons which at the present rate of Rs. 6 to 7 per maund works out to an average of Rs. 40. Since the leaves and the labour are the ryot's own he realises about Rs. 40 when he sells the cocoons. If the leaves are valued and the labour as well, he makes only Rs. 5 or even less; the industry is not therefore in a very good condition. If the price of cocoons would

go up to Rs. 10 per maund the ryot may hope to get about Rs. 65 and there will be a net profit of Rs. 30 per acre. The fall in the price of cocoons is in the opinion of the writer, due to the dumping in of silk from China where the cost of production is far lower on account of the existence of tree mulberry there and other natural facilities. If the Government could give protection to the silk rearers of India by prohibiting the import of foreign silk into India there is some hope for the survival of the old indigenous industry which is the source of livelihood for about 5,000 families in this taluq.

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Notes & Comments.

The New Year 1934. The year 1934 would have come into existence by the time this issue of the Journal reaches our readers. For the Journal another year of service will begin. The present period is one of unusual depression and the stars aspect the agriculturist with a malignity. The produce of his labour sells very low. The unending jugglery in monetary values continues. Meanwhile population increases and the need for food and other commodities behind all industry, continues the more insistent. The agriculturist has to continue in his calling. He needs help and will continue to need it. May this little Journal serve to further the cause of the noble calling of agriculture!—is the prayer with which we appeal to our members to continue and enlarge their support to this Journal.

Agrarian Relief. The United Provinces Agricultural Relief Bill is a sound measure calculated to alleviate some of the many ills which an agriculturist is heir to. The chronic indebtedness of the Indian agriculturist is a well known fact and his social setting and traditions are such that there is no near prospect of his mending his ways. Preventive measures are thus remote and the only sympahy that can be shown to him is to enact measures likely to cure his economic diseases. The present economic depression has all the world over hit the agriculturist most. The wide agrarian unrest, rumblings of which are heard even in Madras needs sound and sympathetic handling and we hope and pray that this passing phase may prove a blessing in disguise.

Development of Silk Industry The world produces about 150 million lbs of silk. Of this Japan monopolizes well over half. China and Italy come next. India produces about 2¼ millions and of this, Mysore produces half. Next to agriculture sericultune is the most important industry and the Mysore Assembly is to have a member representing the silk industry. In Mysore more than 5 lakhs of persons

are supported by silk and the revenue it brings to the State is about a crore of rupees. The economic depression and the dumping of cheap foreign silk, natural and artificial, has created a serious disturbance in the silk industry and measures designed to alleviate this trouble were discussed at the recent conference at Chennapatna in the Mysore State. The delay in giving the much needed protection by the Tariff Board was deplored and quick action urged. Measures calculated to higher efficiency in production and greater co-ordination in the trade and industry were discussed. It was decided to suggest the inclusion of sericulture in the activities of the Imperial Council of Agricultural Research. Nearer home, the possibility of inducing a greater use of silk by the common folk as in China, was to be explored. A factory for waste silk was needed badly. We in Madras have our sericultural interests equally at stake and it is up to us to profit by these activities in Mysore.

The Science Congress and the Imperial Council of Agricultural Research. The Indian Science Congress will hold its twenty-first session at Bombay in January 1934. This Congress has an Agricultural Section in which papers of Agricultural importance are read and discussed. The Imperial Council of Agricultural Research is interested in agricultural improvement and takes opportunities of having joint consultations on aspects of improvements at the various sectional meetings which it holds. The old Board of Agriculture meetings are getting sparse, so much so that the Agricultural section of the Science Congress seems to be the only annual gathering of a comprehensive character bringing together scientists of varied interests to further the cause of agriculture. Owing to financial depression there is a tendency in recent years of Agricultural Officers from the provinces to be deputed to attend the Congress in lesser and lesser numbers. We take this opportunity to suggest to the Imperial Council of Agricultural Research the desirability of their sympathetically considering the question of giving small lump grants to the provinces to enable them to meet either in part or in whole the expenditure involved in the deputation of its Agricultural Officers to participate in the deliberations of the Agricultural Section of the Indian Science Congress.

Cattle breeding. The Improvement of cattle is of vital importance to Indian Agriculture and should go hand in hand with improvement along other lines. Cattle are the back-bone of the cultivator. The two wings of the Imperial Council of Agricultural Research—one for Agriculture and another for Animal Husbandry are a token of this importance and as such sound policies have to be laid down and steadily pursued in this vital work. If errors have been made, lessons have to be learned from such errors with a view not to repeat them. The experiment in the cross-breeding of the local breeds with foreign stock which in Madras reached in 1919 the stage in which half-breds

were mated to half-breds, was closed down during this year. It was noticed that there was a steady decline in all the desirable qualities that in the first generation gave rise to hopes in this line of improvement. Fourteen years have gone by and the present generation is being " served by Scindhi bulls in order to breed back to the country herd ". In this connection we invite the attention of our readers to the illuminating evidence of Mr. Bruen, Livestock Expert to Government of Bombay, before the Royal Commission on Agriculture stressing the desirability of improving local breeds in clear preference to cross-breds (vide Report of the Royal Commission on Agriculture Vol. II, Part I pages 414-5).

The Ongole breed of cattle are of international reputation and have been much sought after in other countries for their superior qualities. This breed is the premier breed of Madras. The Livestock Research Station at Chintaladevi has been closed down as a measure of retrenchment and a select herd has been transferred to Hosur. The Director of Agriculture in his current Annual Report says "There is very little demand for this breed at Hosur and the animals themselves do not thrive well in the tract. It has been decided to discontinue maintaining this breed here". This is a sad end to an important line of work and it is hoped that with the passing away of the financial depression one of the first endeavours of the Department will be to begin again work on this breed at a suitable centre in the Ongole tract. Cattle improvement is a slow work involving generations of sound endeavour and can ill-afford to have breaks of this kind.

The Indian Sugar Committee. Coimbatore had the honour of a visit from the members of the Sugar Committee of the Imperial Council of Agricultural Research, who met in conference this time at the Sugarcane Breeding Station, the centre from which improved Sugarcanes are distributed throughout India. As a result of protection, the number of factories has already increased and a very big increase is naturally expected in the coming years. This will automatically result in an increased growing of sugarcane. Foreseeing the inevitable clash between the interests of the grower and manufacturer, the Committee recommended legislation by which the price paid to the grower would be linked up with the profits made by the sugar factory. This is a difficult task, but other sugar producing countries have achieved this and with the freedom given to the provinces, they can each act to suit local needs. The Committee approved of schemes for research into the chemistry and anatomy of sugarcane and sanctioned the establishment of a central institute for sugar research. There are many aspects to the sugar problem and such an institute will be able to co-ordinate the various lines into a harmonious whole. The problem of molasses disposal is a chronic one and the Committee decided to carry out preliminary experiments on the

problem of the production of power alchohol and blending it as motor fuel with petrol and legislate for this combination and trial in a restricted area. The sugar industry is now growing under the safe wings of protection, but measures to utilize waste and bye products will help to stabilize the industry and enable it to face world competition, if and when protection is withdrawn. We wish the Committee all success, in this comprehensive scheme of help that it is planning on behalf of this great industry.

ABSTRACTS

The effect of Mechanical seed injury on the Development of foot rot in Cereals. By J. E. Machacek and F. J. Greaney. (*Canadian Jour. of Res. Vol. 8, No. 3, p. 276—281*). Greenhouse and field experiments have shown that the use of mechanically injured seed promotes the development of seedling blight and foot rot caused *Fusarium culmorum* in cereals, thereby retarding the growth of the plant and decreasing yield.

Discussion. The mechanical injury of seed appears to be an important factor in the development of pathologic conditions other than the foot rot caused by *F. Culmorum*. The investigations of Hurd and Wallden show that mechanically injured seed is particularly susceptible to invasion by saprophytic fungi. Hurd found that mechanical injury lowers seed vitality, although germination may be unimpaired. If favourable conditions are present, the injured seed, though its initial germination is good, soon becomes invaded by saprophytic fungi, the invasion resulting in distortion and stunting of the seedlings, and often in lessening of the coleoptile and primary roots. Hurd believes that the seed testa protects the seed from fungous invasion, and that, if the test is broken, the nutrients contained in the endosperm become readily available of these fungi, resulting in their luxuriant growth when conditions of temperature and moisture permit. Consequently according to her findings, mechanical seed injury as well as other factors that lower vitality of seed grain predispose the seed to invasion by fungi.

It is probable that the same host-parasite relationship exists in the development of *F. Culmorum* foot-rot in cereals. Through mechanical injury of the seed the endospermic nutrients become readily available to the fungus, thereby promoting its growth, but at the expense of seed and seedling. That this theory is at least partly correct is shown by the examination of the greenhouse experimental data. A considerable number of seedlings failed to reach the soil surface when injured seed was planted in infested soil, whereas injured seed produced seedlings that, under similar conditions, were able to emerge from the soil in large numbers. The possible increased growth of the fungus in the case of the injured seed, is directly reflected in the rapid development of pre-emergence blight. It would therefore seem probable that the use of uninjured seed would be advantageous to the farmer in his attempt to produce a disease-free crop.

Nitrogen Accumulation in soil as Influenced by the Cropping system. T. L. Lyon and J. A. Bizzell, pp. 266—272. (*Jour. of American Society of Agronomy. Vol. 25, No. 4, April 1933*). The kind of crop grown immediately preceding another appeared to be a more important factor in determining the yield of nitrogen in the succeeding crop than was a previous gain or loss of soil nitrogen, at least where such differences were large. The influence of the preceding crop appears to be caused through its effect on the availability of soil nitrogen. In the case of alfalfa this was very great.

Saugkraftmessungen an Baumwollsorten. *(A translation).* By E. Taschdjiam. (Osmotic pressure determinations in Cotton Fortschr. Landw. 1928: 159-69.) On the ground of osmotic pressure determinations on 25 cotton varieties of Egyptian and American origin the following relationships can be deduced:– I. Varieties with high osmotic pressure, have correspondingly long staple, transpiration conditions being the same. II. The yield in dry climates depends upon the osmotic pressure. Higher osmotic pressure are associated with higher yields. III. With increasing osmotic pressure of the variety the number of shedbolls falls. IV. With increasing osmotic pressure the germination is quicker and more uniform. This is of importance in practice in that the stand in the field is more uniform, the harvest is accomplished more rapidly and the plants are less damaged by fungus attack. V. With increasing osmotic pressure the length of life falls, the genus and transpiration being the same. From this it follows that the danger of forest damage is less in early varieties. VI. With increasing osmotic pressure the growth is lower and the resistance to damage by wind etc., is less, within the same genus. VII. With increasing osmotic pressure the resistance to boll weevil rises. VIII Varieties with higher osmotic pressure are more suited to dry soils, transpiration being equal. These relationships will enable important practical results for cotton cultivation to be obtained when the investigations are continued with still more extensive material.

The Root-Knot, Heterodera radecscola (Greeff) Muller of Tomato and other plants in the Philippine Islands. By Fajardo T. G. J. Palo M. A. 1933. *The Philippine Journ. of Science 51—4 (457—481).* In this paper the authors present the results of a comprehensive study of the Root-Knot nematode problem in the Philippine islands. As a result of a general survey of the nature and extent of the malady, the widespread prevalence of this root inhabiting organism attacking as it does such economic crops as Sugarcane, Tobacco, Tomato, Cowpea, Beans Abaca, Pepper etc. is brought into prominence The climatic and other conditions of the country being quite conducive to the unhampered activity of the parasite the authors rightly sound a note of warning regarding the growing menace and potential danger from this pest to Agriculture of the islands. They proceed to give an account of the principal observations on the parasite. As external morphology and the effects on the host including the physiological disturbance of the host plant and the resultant symptoms on the aerial and underground portions of infested plants. The general external morphology of the several stages of the causal organism are briefly outlined. From certain cross-inoculation experiments it has been concluded that there exists no distinct biological strains of the nematode. It has been observed that any moisture conditions capable of sustaining plant growth are equally suitable for the continued activity of the organism. The effect of loading of infected soil is found to yield beneficial results in that the nematode population gets considerably reduced. Air dessication of such soil also produced equally beneficial results. The total elimination of the worms from such soil may be effected provided the period of treatment is sufficiently long, the minimum period recorded being 30 to 35 days under the meteorological conditions of the country. But this is a factor subject to great variability being dependent upon the proportion of initial moisture in the soil experimented with.

Laboratory experiments on the sensitiveness of the larvae to complete dryness revealed that the earlier stages are less able to withstand dry conditions than the older ones. All stages were killed within a period of 10 to 15 minutes of drying in the laboratory while the newly hatched larvae were killed much sooner i.e. within three minutes. On the other hand the larvae were observed to be more tolerant to moist conditions without food than to dessication and a small percentage managed to be alive under these conditions for a maximum

period of 30 days. No seasonal changes in the activity of the organism have been noted by the writers under the climatic conditions obtaining there. Numerous trials regarding the relative susceptibility or resistance of different varieties of Tomato to nematode infection exhibited no appreciable difference. The Host range of the organism is tentatively defined and about 23 economic plants are listed under the category. A few resistant ones such as rice, corn, garlic, onion, peanuts have also been recorded which may be of great use in the rotation of crops. The paper concludes with a discussion of some well-known control measures advocated all the world over.

The paper presents results which throw light on the biological peculiarities of the parasite Despite the large amount of work done in various parts of the world the problem of its control still remains unsolved. Any investigation, therefore, that might tend to elucidate the bionomics of this notorious pest will be of utmost value. The correct name of the nematode (according to the international rules of zoological nomenclature) appears to be Heterodera marioni (cornu) Goadey. (Goadey 1932—Journ. Helumithology 10, 21—28) P. N. K.

Gleanings

"A Banana Recipe Booklet" It is true that the banana, eaten in an unripe state, will, in common with all fruits, cause intestinal disturbance to a greater or less degree. The ripe banana, however, is not only a fruit of remarkably high food value, but is amazingly easy to digest. It can be eaten with safety and relished by every one from infancy onwards. No fruit compares with the ripe banana in food values; no fruit approaches it in regard to digestibility and easy assimilation; no fruit and very few foodstuffs approach it in regard to value for money expended. Writing of the banana, Professor S. C. Prescott (Massachusetts Institute of Technology) says: "The ripe banana contains all the classes of food materials required for the human body. Although the amounts of protein and fat are slightly too low to constitute a perfectly balanced ration, the combination of bananas with milk, or its utilization to supplement a diet containing a small amount of meat will produce a ration which is ample to take care of the body needs." (Agricultural Gazette, New South Wales, Vol. XLIV, Part II, November 1933).

Genetic factors for pigmentation in the onion and their relation to disease resistance. By G. H. Rieman. *Summary.* In an attempt to make a genetic analysis of the relation of the red, yellow and white color classes to disease resistance in the common onion, data involving a classification of not less than 330 progenies and approximately 22,000 individual bulbs are reported. An interpretation of the results obtained in the F-1 to the F-4 generations of the various genetic tests employed, requires five different genes governing bulb pigmentation as follows:—

(1) I gene for incomplete inhibition of color. (2) I gene allowing expression of color. (3) W gene for red pigment. (4) Wy gene for yellow pigment. (5) W gene for white.

The inhibitor of color, gene I, is dominant to its recessive allelomorph 1. The heterozygous factor, pair 11, produces red-neck and cream-colored bulbs in the presence in the color genes W or Wy. Independent inheritance is demonstrated between the allelomorphic pair Ii and the genes for color.

The gene for red, W, is dominant to the gene for yellow, Wy, and the gene for white, W. It is assumed that the gene W is allelomorphic to the genes Wy and W. The relation between genes Wy and W has not been demonstrated.

The gene W and Wy are responsible for the production of a toxic substance, protocatechuic acid, in the other scales of resistant onions.

The color-inhibitor gene, I, interacts with the gene for red,W, producing intermediate resistant bulbs. (J. Agri. Res. Vol. 42, No. 45 pp. 276—278).

2. **Effect of wind on plant growth,** H. H. Finnell. (Jour. Amer. Soc. Agron., 20 (1928), No. 11, pp. 1206—1210, figs. 4). Statistical analysis having indicated a greater damaging effect from high wind than increased transpiration alone would seem to justify, simple pot tests were devised and carried out with mari-golds as the tender foliage plants, using wind at 15 miles per hour as the sole variable factor to be studied. The preliminary results are herein presented.

A portion of the tender foliage was destroyed by the whipping of the wind, deformation of the main stem was marked in early growth stages, and the rate of growth in height was immediately reduced. The time of maturity was lengthened by wind about 10 days for a 60 day period. Yield of dry matter was reduced 48·8 per cent. by wind. Total water requirements per plot did not vary significantly. Water requirements per unit of dry matter produced were approximately doubled by exposure of plant and pot to wind, which also apparently increased the number of secondary branches formed by 42·8 per cent. (Agricultural Botany page 725).

Autumn Leaf Colors. Gorgeous autumnal colors in woods and along roadsides are due to two general classes of chemical compounds in the aging leaves: carotinoids and anthocyanins. The carotinoids are responsible for the yellows and the anthocyanins for the reds of purples.

Dr Charles E. Sando, of the U. S. Department of Agriculture, has summarized the process by which leaves turn from green to grey, when promises of frost begin to cool the air. Carotinoid pigments are present in all leaves, but are masked most of the time by the abundant green coloring matter, chlorophyl. Chlorophyl is always being both formed and destroyed in leaves, but in autumn destruction goes faster than formation, finally reducing it to a low point which permits the yellow carotinoids to be seen. If no other masking pigment is present, such leaves become pure yellow or orange, like tulip-tree, willow and *sassafras.*

The other class of pigments, the anthocyanins, are dissolved in the cell sap. With the exception of a few purple-leaved or bronze-leaved plants, these pigments are also concealed by the more abundant chlorophyl, and show themselves only when it has been sufficiently broken down. At the same time, certain changes in the carbo-hydrate content of the leaves may cause an actual increase in the amount of anthocyanins present. Thus we get the strong reds and purples of sumac, blackberry, sweet-gum, oaks, etc,

Trees like maples, which sometimes show a gorgeous mottling of yellows and reds, may have local patches of anthocyanins masking the carotinoid ground color. (Science, Vol. 76, No. 1971, Oct. 1932, p. 14 (Suppt.)).

The Brahman (Zebu) cross is a Hardy Type. According to an extract, the Proceedings for 1933 of the American Society of Animal Production contains a paper dealing with the growth of different types of cattle in Louisiana, including crosses with the Brahman (Zebu). The writers state that the Brahman is pre-eminently a grazing animal and makes good gains on coarse grasses. The Brahmans do not appear to suffer to the same extent from flies, mosquitoes and external and inter nal parasites. They also stand the heat better. Further, at the Louisiana Station no Brahman grades have died from bloating on clover, while losses among the breeds of British origin are sometimes severe. The authors state that the principal advantage of the Brahman lies in its capacity for making gains on grass alone, a quality that is of great importance on the coastal plains. (Agricultural Gazette, New South Wales, Vol. XLIV, Part II, November 1933).

Tobacco Crop and Potassic Fertilizers. Tobacco compared with other crops is a heavy feeder on potash, and as Anderson, Swanback and Street have shown—(55th Report, Connecticut Agricultural Experiment Station Bulletin 334) the presence of an ample supply of this element in the soil is important if a good quality cigar is to be obtained. Besides inducing characteristic starvation symptoms in the plant itself, the lack of potash renders the crop less resistant to drought and to certain types of disease. From the manufacturer's point of view also, an adequate potash content of the leaves is of great importance, for leaves deficient in this element will not come into "case" in damp weather after curing, that is, they remain brittle and difficult to handle owing to their lack of potash compounds, upon the hygroscopic properties of which the softening process depends. The fire-holding capacity of cured leaves is another property dependent on the potash present, but all the potassium salts tested did not prove equally effective. In general, the Organic Salts were the most suitable for producing the incandescent type of combustion required for a good cigar. A reduction in the dressing of potassic fertilizer given was found to affect the quality of the tobacco produced long before any actual decrease in yield was obtained, an annual dressing of so much as 200 lb. per acre being required to produce the best results at the Connecticut Tobacco Substation at Windsor, U. S. A. (Nature, Vol. 132 No. 3325 July 22nd, 1933).

Pneumatic Tyres for Bullock Carts. A year or two ago no one would have thought it possible that such a refinement as pneumatic tyres could be applied to bullock carts, and yet today it is an accomplished fact. Once more Dunlop is first in the field with perfected equipment which can be purchased at a reasonable cost. The development does not stop at conversion only, for the Allahabad Agricultural Institute has taken the initiative and designed an iron framed cart which, with a load of over three tons is easily pulled by two ordinary bullocks. The usual type of bullock cart with iron shod wheels can carry at the most 46 cwts. for which three and sometimes four good bullocks are required. There is a full range of sizes available and one of the important features of the equipment is the incorporation of roller bearings in the hubs, steel artillery wheels with well base rims being standard. The following are the practical advantages to be gained by the use of pneumatic tyres:—*Carts for Agricultural work.* (1) Ground impassable to iron tyred carts is easily traversed. (2) Loads 50 per cent, greater can be carried. (3) No ruts are made by the passage of the wheels. (4) Carts of lighter construction and larger capacity can be used. (5) A much lower loading line can be obtained, materially reducing the time and effort required to load and unload. (6) The cart itself lasts longer and wheel maintenance is negligible, the greasing of the hubs being necessary only once in six months. (7) More work can be done with fewer bullocks, carting costs and cost of bullock feed are reduced. *Carts Used for transportation purposes.* Similar advantages are obtained with vehicles used for road transport. (1) Much greater loads for the same tractive effort are possible. (2) Vehicles can proceed at a greater pace. (3) Bad roads can be negotiated with ease and the carts move silently and smoothly and can be easily manoeuvred. (4) There is no jolting and carts fitted with pneumatic tyres will last far longer than those fitted with iron tyred wheels. (5) Fragil loads are less liable to breakage, (Indian and Eastern Motors August 1933).

Madras Agricultural Department.

Summary of the Operations in 1932-33.

Retrenchment. The full effect of retrenchment has resulted in the loss of 8 gazetted officers, 24 upper and lower subordinates, 8 clerks, etc. and 17 menials, which is a big toll on an young department like this.

Agricultural Education. Students at the Agricultural College, Coimbatore were levied tuition and lodging fees and the scholarships were reduced from Rs. 25/- to Rs. 20/-. There was a reduction in the number of applicants for admission. 40 students secured the B. Sc. Ag. degree. Facilities for post graduate study for M. Sc. were afforded at the Research Institute and Research Stations.

The middle school at Taliparamba was abolished and the school at Kalahasti could not be opened as the buildings were not ready. The middle school at Usilampatti maintained by the Madura District Board had a marked increase in the number of students.

Farm labourers' schools and classes for practical training in agriculture were maintained at some of the Research Stations.

Season. The general effect of the monsoon on the crops at several Agricultural Stations was adverse though in a few places and in respect of a few crops the yields were above normal.

Research—Chemistry. Research received adequate attention. The chemistry section made a systematic study of soils for their characteristics. The results obtained in the study of soil Nitrogen indicate that an adequate supply of organic matter is a very important factor in maintaining the nitrogen status of the soil and in controlling loss of nitrogen. The litter of *eri* silk worm was found to be as good as castor cake in analysis and in field experiments, its manurial value was even superior to groundnut cake when applied to *ragi* crop. Addition of very small quantities of copper sulphate or common salt rendered a mixture of night soil and village rubbish odourless and thus good manure was obtained. The study of the influence of manuring on the quality of the crop confirmed previous findings, in that grain raised with cattle manure or oil cake, possessed better nutritive value, than grain raised with 'no manner' or chemical manure. *Eri* silk worms fed with castor leaves from plots manured with cattle manure contributed to better growth and greater cocoon weight.

Botany. Besides collecting and preserving specimens at the Herbareum and supplying and exchanging material, the Botany section made economic studies on fodder grasses, the most common weeds and varieties of banana.

Crops. To suit the varying conditions of soil and climate of the different tracts of the presidency sub-stations for the study and improvement of crops are essential; but for the sake of economy, assistants trained at the Research Institute are posted to different existing farms to handle crops locally. Strains of irrigated white and yellow sorghums and dry yellow sorghums have been evolved at Coimbatore by the Millets Specialist and has passed the trial stage. The dull mid-ribbed sweet-stalked variety of sorghum was found to be superior in fodder value. At Nandyal, three strains of sorghum have given as high an yield as N. 23/10, and much higher than T-6, the present standard. Sorghum spacing trials are in progress at Nandyal and Hagari. Ragi (Eleusine) strain E. C. 593 has done well in different parts of the presidency. One strain of Tenai (Setaria) is ready for distribution.

Work on rice is done at Coimbatore as well as in sub-stations where both economic and agronomic research are conducted. A strain of Anai-Komban (Co. 8) has done well at Tinnevelly. Two more promising strains are in the trial stage. Eight strains are ready for release from Maruteru. Similarly new strains have completed their trial stage and are ready for distribution at Aduturai and Pattambi. In manurial trials, best results were obtained by applying Ammonium sulphate one month after planting at Maruteru and Pattambi and two months after planting at Coimbatore. Transplanting has given 25% increase over broadcasting. Dry ploughing of paddy lands had a deleterious effect on the crop at Samalkota.

In cotton three new cambodia strains were superior to Co. 2. One strain of *Karungauni* (546) was again superior to C. 7 and has done well in trial plots at Koilpatti. Experiments at Hagari showed that yellow factor in the flower war related to small bolls and early flowering, and that there was no relation between seed weight and lint weight. In rotation experiments, cotton after green manure, gave the highest yield. A new irrigation experiment to test the influence of irrigation on humidity and insect pests was started at Coimbatore. The various spacing trials confirm the common opinions that a higher seed rate should be used in fertile soils. In the Herbaceum scheme, financed by the Indian Central Cotton Committee, four lines have given hopes of being heavy bearers. In the Pempheres and Physiological scheme, experiments were in progress to tackle the pempheres problem. A study of different varieties revealed that Kidney and Nigerian cotton alone were found to be completely free from attack.

One strain of Bengal gram (Cicer) gave higher yields than local and was also highly wilt-resistant.

In groundnut trials, "Saloum" proved superior to local Maritius for the second time. Spacings of 6"×6" for the bunch variety and 9"×9" for the spreading variety proved most economical. The study of oil formation at different stages in the development of kernels led to interesting results. Studies on the root system and hybridization work with a view to evolve high-yielding short-duration varieties are in progress. Varietal studies and selection work were conducted on gingelly and castor also. In coconuts, manurial experiments, hybridization of different types, and investigations into the methods of selecting promising seedlings from the nursery, were initiated.

In potato, experiments on manures, spacing, planting cut and whole tubers, comparison of new seed with old seed, and spraying against *alternaria* were in progress at Nanjanad.

Investigations on pepper were continued at Taliparamba and on Chillies at Guntur. Cultivation of sugarcane was taken up in almost all the agricultural stations. At Anakapalle, experiments on irrigation, spacing, method of planting and wrapping, and at Samalkota, trench and bed planting, seed (sett) treatment, and spacing were in progress. In manurial trials, Ammonium sulphate was found to be very efficacious, and manure applied in three doses gave better results than if applied in a single dose or in two doses. In a rotation experiment at Palur, cane grown once in four years or five years gave good results, and cane grown in alternate years, was found to be detrimental to the soil.

Among fruit crops, plantain (Banana) received most attention. "Plantain figs" achieved a great success and the demand is growing. Increased attention is being given to fruit cultivation. A scheme of research financed by the Imperial Council of Agricultural Research will shortly be introduced.

Besides maintaining and improving the gardens at Ootacamund and Coonoor, new species of plants and trees were introduced. With a view to create new hybrids and varieties, a number of cross pollinations were effected between different varieties and species of ornamental plants.

Implements. A ball-bearing mhote-wheel manufactured by Messrs. P. S. G. & Sons, Charity Industrial Institute, Coimbatore, has been approved after trial, and is priced at Rs. 10—12—0. Several types of water lifts were under trial. Cooper plough No. 11 was modified with a view to ensure economy in initial cost.

Livestock. The experiment on breeding half-bred to half-bred which has been going on since 1919 has been closed during the year. The results so far obtained go to show that this method would not lead to any success. There was deterioration in all respects in the third and fourth generations, when compared to the second. Work on Ongole herd at Hosur was decided to be discontinued.

Work on Scindi and Kangayam cattle is in progress. Different breeds of poultry are under trial. While white leghorns are the heaviest producers of eggs, the Black Minorcas lay the largest egg.

Entomology. Among the special investigations on which work was continued during the year may be mentioned the rice stem-borer and grass-hopper, cocoanut beetles, thrips on chillies, hairy caterpillar of dry crops, cotton boll worms, and the black-headed catterpillar of cocoanut. An intensive study of some important insect pests of fruit trees and vegetables was started during the year. Information has been gathered on the periods of emergence of such pests as rice stem-borer, cockchafers, groundnut *surul*, ragi white borer, and hairy caterpillar moths. The Apiary started last year has taken a definite shape. Research on the various aspects of bee-keeping was commenced and apprentices were trained. The rearing of *eri* silk worms was started. The bionomics of the worm and the economics of the work as a cottage industry were studied.

Mycology. Studies of the disease known as "foot rot" of rice and treatment for the same were continued. Good results have been obtained by treating seed with different chemicals and hot water. Eight, out of twenty varieties of sugarcane tried, proved highly resistant to mosaic. Studies on wilt on plantain and red gram, betel wine leaf spot and fruit rot diseases are in progress.

Demonstration. The number of trial plots and demonstration plots conducted during the period was 130 and 2733 respectively. The ryots' demand for the services of the demonstrator is on the increase. 168 exhibitions were held and 500 lectures on agricultural subjects were delivered during village fairs, festivals, conferences, etc. The three motor van exhibition units continued their itinerary in the presidency and worked in co-operation with the Veterinary, Fisheries, Industries and Public Health Departments.

Propaganda and demonstrations on the reduction of seed rate in paddy and sugarcane, line planting, trenching, wide spacing and using "short crop" for planting in sugarcane, and drill sowing of dry crops in the south, were in progress. Green manure supplemented by bone meal or superphosphate for paddy, and oil cake in conjunction with ammonium sulphate for sugarcane were recommended as before. Manuring of fruit trees received attention. Distribution of improved strains evolved by crop specialists has all along been one of the main lines of activity of the department. Demonstrations with improved implements and obtaining the same for ryots, forms another main activity of the department 6800 demonstrations were held and about 1700 implements consisting of sugarcane mills, chaff cutters, mhote wheels, iron ploughs, bund-formers and other tillage implements were purchased by the ryots through the department.

The number of breeding bulls maintained under the premium scheme was 72. Besides these there were 127 bulls at stud, including those at research stations, Veterinary hospitals and Jails. Several hundreds of eggs for setting, as well as chicks of good breeds were supplied to the ryots.

Loans amounting to Rs. 1,762—8—0 were granted to ryots for the purchase of implements.

The number of manure pits maintained at the suggestion of the department, amounted to 9 962 besides which there were 2,378 dry earth sheds, 96 byres and 47 loose boxes. 617 compost pits were made during the year.

The demand for *pillipesra (Phaseolus trilobus)* for green manure in the Godavari Delta was great and 1,700 tons were produced for distribution there. In the Trichinopoly and Tanjore Districts 20 tons of wild indigo seed were sold by the Department and 100 tons were purchased by ryots through Co-operative Societies and private agencies. The total quantity of all the green manure seed distributed to ryots amounted to 380 tons.

There was a decline in the use of oil cakes and artificial fertilizers except in the second circle due to general economic depression. In this tract 2260 lb. of bone meal was sold by the Department, besides the large sales made by the fertilizer firms direct.

Use of sulphur dust against sorghum smut was demonstrated with success. The prickly pear is fast disappearing due to the depredations of the cochineal insect recently introduced. In the fourth circle 4000 cocoanut trees were saved from damage by *Nephantis serinopa*, by the introduction of parasites. Timely control measures were taken against slug catterpillar of coconuts in Malabar. Mildew on grapes in the fifth circle was kept in check by the timely spraying of bordeaux mixture.

Large quantities of seeds of paddy, cotton and green manure, were distributed through various co-operative societies. Jaggery, cotton and groundnut were sold through Co-operative concerns. Two societies in the sixth circle purchased bulls for breeding.

Legislation. The Cotton Ginning and Pressing Factories Act, and the Cotton Transport Act, continued to be in force during the year. There were 556 ginning factories and 67 pressing factories of which about 100 of the former and six of the latter did not operate. The absence of restriction on the movement of cotton by road and river continues with the result that the object of the act is not fully attained. The Cotton Control Act passed at the close of last year, was not strictly enforced during the year as seed for sowing had been obtained by ryots before the provisions of the act and rules were widely published and circulated. A bill to provide for the establishment and the better regulation of markets for commercial crops was passed by the Legislative Council.

The Agricultural Pests and Diseases Act was in force during the year in respect of insects and pests affecting cotton (stem weevil and pink boll worm), groundnut (red hairy caterpillar—*Amsacta albistriga*) and palmyra (bud rot), and the eradication of water hyacinth.

Publications. Seventeen leaflets, two notes and two bulletins were published by the department. A book on South Indian Weeds was also published. 59 860 copies of the Villagers' Calendar were printed in the different languages.

The expenditure of the department for the year was Rs. 16,90,668 as against Rs. 17,73,165 of the previous year. This is due to reduction of staff, emergency cut in salaries and allowances and economy in contingent expenditure.

The report concludes with a projected programme of the main lines of work for the succeeding year.

M. A. S.

Crop and Trade Reports.

Cotton Crop—Madras 1933-34. Third Report. The average of the areas under cotton in the Madras Presidency during the five years ending 1931-32 has represented 9 per cent. of the total area under cotton in India. The area under cotton up to the 25th November 1933 is estimated at 1,762,300 acres. When compared with the area of 1,727,600 acres estimated for the corresponding period of last year, it reveals an increase of two per cent. The increase in area occurs in all the important districts outside the Circars, Salem and Ramnad. The area in the Deccan has risen from 778,000 acres to 832,000 acres and the increase is marked in Kurnool and Bellary. The area under irrigated cotton, mainly cambodia is estimated at 165,400 acres as against 156,300 acres in the corresponding period of last year, an increase of about six per cent.

2. Pickings of the early sown crop in the Deccan are in progress and fairly normal yields are expected. The condition of the main crop throughout the Presidency is satisfactory. But in the eastern borders of the Koilpatti taluk of the Tinnevelly District, the newly sown crop has been damaged by heavy rains and floods. Normal yields are expected in all the districts except in Ganjam and Vizagapatam where the yields are expected to be slightly below normal. The seasonal factor for the Presidency works out to 100% of the average as against 99% in the previous year. On this basis, the total yield is estimated at 374,500 bales of 400 lbs. lint as against 361,300 bales of last year, an increase of 3·7%. The crop is young and it is too early to estimate the yield with any degree of accuracy.

3. The estimated area and yield under the several varieties are given below :-

Area in hundreds of acres i.e. 00 being omitted, yield in hundreds of bales of 100 lb. lint, i.e. 00 being omitted.

Variety.	Area 1st April to 25th November.		Corresponding yield.	
	1933.	1932.	1933.	1932.
(1)	(2)	(3)	(4)	(5)
	Acs.	Acs.	Bales.	Bales.
Irrigated Cambodia	1,577	1,456	986	911
Dry Cambodia	1,173	1,170	250	247
Total, Cambodia	2,750	2,626	1,236	1,158
Karunganni in Coimbatore	1,027	930	231	215
Uppam in the Central Districts	247	300	41	48
Nadam and Bourbon	308	397	16	20
Total, Salems	1,582	1,627	288	283
Tinnevellies (a)	3,680	3,662	948	944
Northerns and Westerns	8,320	7,780	1,040	942
Cocanadas	1,141	1,393	215	262
Others	150	188	18	24

(a) Includes Uppam, Karunganni and mixed country cotton in the South.

4. The local cotton trade is not generally active at this time of the year. The wholesale price of cotton lint per imperial maund of $82\frac{2}{7}$ lb. as reported from important markets towards the close of November 1933, was about Rs. 15-3-0 for Cocanadas, Rs. 15—10—0 for red northerns, Rs. 16—8—0 for white northerns. Rs. 14—1—0 for westerns, Rs. 22—4—0 for cambodia, Rs. 20—14—0 for Coimbatore Karunganni, Rs. 19—3—0 for Tinnevelly Karunganni, Rs. 17—0—0 for Nadam and Rs. 17—14—0 for Tinnevelly cotton When compared with the prices in the previous month, these prices reveal a fall of 3 to 8 per cent. for all varieties of cotton except Northerns, Westerns and Cocanadas. The prices of Northerns are stationary and the other two varieties show a rise of about 2 and 3 per cent. respectively.

Sugarcane crop—Madras—1933-34. The sugarcane crop was affected to some extent by heavy rains and floods in parts of Ganjam, by drought in Chittoor and North Arcot and by the attack of insects in South Arcot. The condition of the crop is satisfactory in the other districts and the yield is expected to be normal if the season continues to be favourable.

2. The wholesale price of jaggery per Imperial maund of 82 2/7 lb. as reported from important markets towards the close of November 1933 was Rs. 5—5—0 in Nandyal, Rs. 5—2—0 in Erode, Rs. 4—13—0 in Bellary. Rs. 4—8—0 in Bezwada and Rs. 4—5—0 in Guntur. It ranged from Rs. 3—6—0 to Rs 4—2—0 in the other important stations. When compared with the prices of the previous month, these prices reveal a rise of 24 per cent. in Bellary and 3 to 8 per cent.

in Ellore, Bezwada, Cuddapah and Trichinopoly and a fall of 2 per cent. in Guntur; the prices are stationary in the other stations.

Paddy crop—Madras 1933–34—Second Report The average of the areas under paddy in the Madras Presidency during the five years ending 1931-32, has represented 15·3 per cent. of the total area under paddy in India.

2. The area sown with paddy up to the 25th November 1933 is estimated at 10,491,000 acres. When compared with the area of 10,312,000 acres estimated for the corresponding period of the previous year, it reveals an increase of 1·7 per cent

3. The increase in area occurs in Vizagapatam, Anantapur, Cuddapah, Salem, Coimbatore, Trichinopoly, the South (Ramnad excepted), Malabar and the Nilgiris. This increase has been partly set off by a reduction in area in most of the other districts.

4. The first crop has been harvested throughout the Presidency. Normal yields have been reported from all districts except Godavari (East and West), Chingleput, South Arcot, Chittoor, North Arcot, Trichinopoly, Tanjore, Tinnevelly and Malabar. The crop was adversely affected to some extent by the heavy rains of October in parts of East Godavari and West Godavari and by the attack of insects in parts of Trichinopoly, Tanjore and Malabar. It was effected by drought in parts of the districts of Chingleput, South Arcot, Chittoor and North Arcot.

The seasonal factor for the Presidency works out at 97% of the average as against 99% in the corresponding period of the previous year.

5. The wholesale price of paddy per imperial maund of $82\frac{2}{7}$ lb. as reported from important markets towards the close of November was Rs. 2—14—0 in Nandyal, Rs. 2—2—0 in Cuddapah and Nellore, Rs. 2—0—0 in Vellore and Tinnevelly and ranged from Rs. 1—7—0 to Rs. 1—14—0 in the other markets. When compared with the prices reported for October 1933, these prices are stationary in Berhampur, Vizianagaram, Rajahmundry, Masulipatam, Nellore, Cuddalore, Vellore, Kumbakonam and Madura. They have risen from 3 to 11 per cent. in Cocanada, Rajahmundry, Nandyal, Negapatam, Tinnevelly and Cochin and are lower by 2 to 10 per cent. in the other markets.

THE INDIAN SCIENCE CONGRESS

The twenty first annual meeting of the Indian Science Congress will be held this year from the 2nd to the 8th of January 1934, at the Royal Institute of Science and University Buildings, Bombay, His Excellency Lord Brabourne G. C. I. E. Governor of Bombay will open the session, after which Dr. Meghnad Saha D. Sc., F. R. S, F. A. S. B., University Professor of Physics, the President of this year's Congress, will deliver his address.

The following are the sectional presidents:—

1.	*Agriculture.*	Dr. S. S. Nehru, M. A., Ph. D., I. C. S., Allahabad.
2.	*Mathematics and Physics.*	Dr. S. K. Mitra, D. Sc. (Cal. and Paris) Khaira Professor of Physics, Calcutta University.
3.	*Chemistry.*	Dr. H. B. Dunnicliff, M. A., Sc. D., F. I. C., I. E. S., Professor of Chemistry, Government College, Lahore.
4.	*Zoology.*	Prof. P. R. Awati, B. A. (Cantab) D. I. C., I. E. S,. Professor of Zoology, Royal Institute of Science, Bombay.
5.	*Botany*	Prof. R, H. Dastur, M. Sc., Professor of Botany. Royal Institute of Science, Bombay.
6	*Geology.*	Prof. K. K. Mathur, B. Sc. (Hons.) (Lond) A. R. S. M., Professor of Geology, Hindu University, Benares

7. *Medical and Veterinary.*	Lt Colonel S. S. Sokhey, M. A., D. Sc., D. T. M. & H.; I. M. S. Director, Haffkine Institute, Bombay.
8. *Anthropology.*	Rai Bahadur Ramprasad Chanda, B. A., F. A. S. B., Late Superintendent, Archaelogical Survey of India, Calcutta.
9. *Psychology.*	Manmathanath Banerji Esq. M. Sc., B. L., Lecturer in Physiological and Experimental Psychology, University College of Science, Calcutta.

In addition to the sectional meetings as usual, a number of symposia on different subjects, in which scientists from all over the country will take part, will be a feature of this year's Congress. The following symposia have been tabled in the programme (1) Neutrons, Position and Cosmic Rays. (2) Chemical Researches in India and their bearing on Technical Problems. (3) Recent work in Plant Genetics in India. (4) Recent advances in colloid chemistry. The following popular lectures will also be delivered (1) "The expanding Universe" by Prof. A. C. Bannerjee, I. E. S. (2) "Recent Agricultural Developments in Europe and Canada" by Dr. S. S. Nehru (3) "Is Darwinism dead"? by Prof. R. H. Dastur, (4) "Electrical Transmission of Pictures' by Mr. S. R. Kantebut and (5) "Physiology and Human Welfare" by Major S. L Bhatia.

College News & Notes.

Games. *The Victory Cup Tournament.* In the first round class ii met class i, at cricket, and declared their first innings for 6 wickets, Narasinga Rao making 60 and B. S. Murthy 23, Ramanatha Rao of class i taking three wickets for 28. Class i were all out for 54, Ramanatha Rao making 16, Narasinga Rao and B. S. Murthy taking 3 and 4 wickets respectively for 18 runs each. The winners met class iii who were disposed of for 73 runs, Ananda knocking up 29 and the bowling honours going to Narasinga Rao with 7 wickets for 25. Class ii replied with 114 runs, Narasinga Rao contribuling 30 (retired) and B. S. Murthy 27, the bowling honours being shared by Ananda with 4 wickets for 45 and Sahadevan with 3 for 38.

In football class iii lost to class i by one goal to two, but in their turn, class i in their next encounter met their reverse at the hands of class ii, who won by a comfortable margin of 5 goals to one.

Hockey was not played to a finish, Class iii beating class ii by 2 goals to 1 but the next engagement between class iii and class i not coming off. The Victory Cup has thus been won by class ii this year.

Tennis Handicap Doubles Tournament The finals of the above tournament came off between Narasinga Rao and Venkata Sastry and Mopcy Joseph and Manavalan. The match was very keenly contested, and after two draws, the former pair won finally winning 3 out of 4 sets, the scores being -6, 6-3, 6-3, 7-5.

Though these tournaments served to keep up some lively interest in games during the month, there has been a considerable lull in athletic activities. due to the terminal examinations, for which students were busy preparing.

A trip to Maruthamalai Estate residents with families, organised a trip to Maruthamalai on Sunday the 10th when *Abishegam* was performed for *God Subrahmanya.* The usual *Dhanurmasa puja* and *Bajana* done by the Hindu residents of the estate have begun in full swing.

Visitors. Dr. P S. Hudson B. Sc., Ph. D., Assistant Director of the Imperial Bureau of Plant Genetics, Cambridge, Mr P H. Rama Reddy, Secretary, Indian Central Cotton Committee and Mr. R. C. Broadfoot, Headquarters Deputy Director of Agriculture. Madras, visited the station during the month.

Association of Economic Biologists. Under the auspices of the above association, Dr. P. S. Hudson gave a lecture on the 13th, on "The Origin of cultivated Plants".

Weather Review (NOVEMBER—1933)

RAINFALL DATA

Division	Station	Actual for month	Departure from normal	Total since January 1st	Division	Station	Actual for month	Departure from normal	Total since January 1st
Circars	Gopalpore	2·8	−1·2	54·6	South	Negapatam	12·7	−5·0	36·0
	Berhampore *	0·9	−5·9	59·0		Aduthurai *	5·4	−5·1	25·5
	Calingapatam	0·8	−3·1	43·5		Madura	6·9	+2·0	35·7
	Vizagapatam	2·4	−1·3	29·3		Pamban	7·0	−5·0	20·2
	Anakapalli *	1·5	−3·1	46·4		Koilpatti *	7·4	+0·2	27·0
	Samalkota *	1·1	−3·1	32·8		Palamkottah	11·4	+4·0	33·9
	Cocanada	1·4	−4·0	32·5					
	Maruteru *	3·4	−1 8	42·5					
	Masulipatam	4·8	−0·9	41·8	West	Trivandrum	5·8	−0·8	118·7
	Guntur *	8·5	+4·9	33·4	Coast	Cochin	6·7	+0·2	154·9
						Pattambi *	1·7	−2·4	137·9
Ceded Dists.	Kurnool	3·0	+1·8	27·0		Calicut	2·3	−3·1	167·4
	Nandyal *	2·3	+1·0	32·3		Taliparamba *	1·9	−2·5	189·0
	Hagari *	1·1	−1·2	25·5		Kasargode *	0·4	−4·0	159·9
	Bellary	1·4	−0·8	36·5		Nileshwar *	0·4	−2·6	167·4
	Cuddapah	2·3	−1·3	22·6		Mangalore	2·0	−1·1	160·9
	Anantapur	0·9	...	27·0					
Carnatic	Nellore	7·5	−3·7	45·6	Mysore	Chitaldrug	0·3	−2 0	36·3
	Madras	5 8	−8·5	24·7	and	Bangalore	0·2	−2·7	39·1
	Palakuppam *	4 1	−7·7	29·5	Coorg	Mysore	0·0	−2·5	37·7
	Palur *	5·0	−8·2	36·2		Mercara	1·2	−2·0	159·7
	Cuddalore	6·0	−9·1	32·0					
					Hills.	Kodaikanal	7·4	—0 8	69·9
Central	Vellore	1·6	−5·3	20·7		Coonoor *			
	Salem	2·1	−1·6	45·2		Kallar *	16·3	+4·7	82·6
	Coimbatore	2·5	−1·3	26·5		Ootacamund *	3·1	—1·5	61·7
	Coimbatore Res. Inst. *	3·3	−1·0	29·6		Nanjanad *	2·5	—1·6	54·8
	Trichinopoly	4·1	−1·5	34·7	Central	Hosur cattle farm *	0·1	0 0	26·7

* Meteorological stations of the Agricultural Department.

Summary of weather conditions. In connection with the passage of a low pressure wave into the Andaman Sea from the East across Tenasserim, a shallow depression was formed near Latitude 14° N and Longitude 97° E by the third morning without appreciable movement or intensification. Depression persisted there till the 5th when it weakened into a low pressure area. This low pressure area moved slowly westwards and was concentrating into a depression in the South-West Bay of Bengal with the consequent strengthening of the North-East monsoon in the South of the Bay of Bengal.

The low pressure area moved North-Westwards and passed out South-East of the Arabian Sea by the 10th morning It caused unsettled weather in the South-East of the Arabian Sea between the 10th and 13th and became unimportant thereafter. Widespread locally heavy rain occurred in South-East Madras on the 8th, 9th and 10th, the rainfall being specially heavy in the Tinnevelly District. The rainfall also extended into Malabar, Mysore, South Konkan and West Deccan.

The North-East monsoon strengthened in the South-East Bay of Bengal after the 10th and a depression formed in the neighbourhood of Nicobar by the 14th morning moving slowly west, northwestwards. This depression intensified into

a cyclone which centered near latitude 10° N and longitude 90° E on the 15th and was sevre on the 17th. It crossed the coast between Nellore and Masulipatam early morning on the 18th and weakening, thereafter, lay as a depression over Madras Deccan at 8 hours. The depression continued to move North-Westwards but weakened gradually and a low pressure passed out into the East Arabian Sea across Konkan coast by the 18th morning. The weather was slightly disturbed off Konkan on the 19th. Fairly widespread rain occured during the movement being locally heavy on North Madras Coast and in Madras Deccan on 17th.

The Western disturbance was of more frequent occurrence throughout the month, as many as four, having occurred during this period within short intervals. But these disturbances were of short duration and of low intensity. These passed over Kashmir, Baluchistan, Northwest Frontier and recurved eastwards through extreme north. A few falls of rain in Baluchistan, nearly general rain in east and north Punjab, local falls in the North-west Frontier Province, and showers of rain or snow in Kashmir were the marked results of these disturbances.

A few scattered showers were experienced in South-east Madras during the close of the month with indications for the weather tending to become dry elsewhere.

The minimum temperature remained below normal in the Deccan and central parts of the country during a third of the month followed by a spell of continued showers with rise in humidity and subsequently tending to return to normal temperature with dry weather conditions.

The rainfall was below normal throughout the presidency except in places where notable excesses were recorded. The chief falls were Melur (Madura) 7·6″ (4th), Negapatam 4·5″ (9th), Palamkottah 8·0″ (10th), Kurinjipadi (S. Arcot) 7·0″ (9th), Chidambaram (S. Arcot) 6·7″ (9th), Tinnevelly Town 9 9″ (10th), Tenkasi (Tinnevelly) 8·3″ (10th), Kayatar (Tinnevelly) 7·1″ (10th), Sivakasi (Ramnad) 5·7″ (10th), Srivilliputtur (Ramnad) 5·4″ (10th), Srivaikuntam (Tinnevelly) 5·3″ (10th), Nellore 3·7″ (18th).

Weather Report of the Research Institute Observatory: Report No. 11/33.

Absolute maximum in shade	88·5° F
Absolute minimum in shade	62·2° F
Mean maximum in shade	84·4° F
Departure from normal	—0·4° F
Mean minimum in shade	68·2° F
Departure from normal	0·0
Rainfall during the month	3.33″
Departure from normal	—0·96″
Heaviest fall in 24 hours	1·41″
Number of rainy days	4
Mean daily wind velocity	2·3 M. P. H.
Mean 8 hours wind velocity	3·2 M. P. H
Mean humidity	83·3%
Total hours of bright sunshine	225·6
Mean daily hours of bright sunshine	7 5

General weather conditions. The pressure was steady throughout the month with a slight rise towards the second fortnight. The monsoon was not active during the month and practically disappeared after the second week. The rainfall was below normal and a fall of 1·41 inches was recorded on the 6th. The humidity was in excess. The maximum and minimum temperatures were below normal, the latter half of the month being chill during the nights.

C. V. R. & T. S. L.

Departmental Notifications.

First Circle. S. Ramaswamy Iyer, Botany Assistant, l. a. p. for 15 days from 6—11—33 with permission to perfix Sunday 5—11—33 D. Hanumantha Rao, A. D. Razole l a. p. for 15 days on m. c. from 1—11—33. V. Butchiraju, A. D. Ramachandrapur will be in additional charge of the Razole taluk during the period or until further orders. V. Krishnaswamy Rao, A. D. Sompet leave for 3 months on m. c. on full average pay from 15—10—33; the a. d. Narasaraopet will again be in charge of the Sompet subcircle in addition to that of his own. R. Vasudeva Rao, E. M. l. a. p. for 1 month and 9 days from 13—11—33 to 21—12—33 with permission to perfix Sunday 12th November and suffix X'mas and New Year holidays. D. Hanumantha Rao, A. D. Razole, l. a. p. on m. c. for 15 days from 16—11—33 in continuation of 15 days leave already granted from 1—11—33. The existing arrangement will continue during this period. S. Ramaswamy Iyer, Botany Assistant, extension of leave on m. c. for 3 weeks from 21—11—33 in continuation of leave already granted. T. Seshachalam Naidu, A D. Tuni, l. a. p. for 3 weeks from 3—12—33 with permission to suffix X'mas and New Year holidays; A. Rammohan Rao, A. D. Peddapur will be in additional charge of Tuni subcircle during the period or until further orders. M. L. Narayana Reddi, A. F. M. A. R. S. Samalkota, l. a. p. for 1 day on 4—12—33 with permission to avail Sunday the 3rd. N. Ramadoss, A. D. Cocanada on leave extension of l. a. p. for 15 days with permission to affix X'mas and New Year Holidays in continuation of leave already granted; the existing arrangements will continue during the period or until further orders. **Second Circle.** J. Suryanarayana, A. D. Vinukonda, extension of l. a. p. for 3 days from 15—11—33 with permission to avail of the holiday on 18-11-33 and 19-11-33 in continuation of the leave already granted. D. Bapayya, A. D. Guntur will continue to be in charge during the above period in addition to his own. T. Narayana Rao, Millet Assistant, extension of l. a. p for 3 weeks on m. c. from 1st to 21—11—33 in continuation of leave already granted. P. Satyanarayana, A. A. D. Kaikalur, l. a. p. on m c. for 2 months from 1—12—33. **Third Circle.** A. Krishnaswamy Ayyar, A. D. Koilkuntla l a. p. for 1 month sanctioned already is cancelled. P. Subramaniam, A. D. Gooty, extension of l. a. p. on m. c. for 6 weeks in continuation of leave already granted; A. D. Guntakal will be in additional charge of the Gooty sub-circle during this period or until further orders. L. Nilakantan, Cotton Assistant, Nandyal l. a. p. for 18 days from 18—11—33 with permission to avail the holidays on 18—11—33 and 19—11—33. N. Kesava Ayyangar, Cotton Assistant, Hagari, l. a. p. for 18 days from 4—12—33, with permission to avail the holidays on 3—12—33, and the X mas and New Year holidays M. Somayya, F. M. A. R. S. Nandyal l. a. p. for 20 days from 2—12—33 with permission to avail the X'mas and New Year holidays. **Fourth Circle.** K. S. Krishnamurthi Ayyar, A. D. Cuddalore l. a. p. for 3 days 27, 28 and 29—11—33 with permission to avail Sunday 26th. C. S. Krishnaswamy Ayyar, F. M. A. R. S. Palur l. a. p. for 20 days from 20—11—33 to 9—12—33 with permission to perfix and suffix holidays on 19th November and 10—12—33. K. P. Sankunny Menon will be in charge of the Farm during this period. E. N. Rangaswami Ayyangar, A. F. M. Kalahasti l. a. p. for 1 month from 15—12—33. **Fifth Circle.** A. Yesudasan, A. D. Tanjore, l. a. p. for 2 months in continuation of the leave already granted. **Sixth Circle.** M. C. Menon, A. D. Ambasamudram l. a. p. for 2 months from 6th December 33 or date of relief. S. Butchi Raju, A. A. D. on leave is posted to Ambasamudram in relief of M. C. Menon. **Seventh Circle.** K. Govindan Nambiar, A. D. Badagara. l. a. p. for 13 days from 13—11—33 to 25—11—33 with permission to prefix and suffix Sundays on 12th and 26th. K. Vasudeva Shenai, A. D. Puttur, l. a. p. for 3 weeks from 3—1—34 with permission to perfix X'mas and New Year holidays. K. M. Jacob, F. M. A. R. S. Taliparamba, l. a. p. for 14 days from 1 to

14—12—33. **Eighth Circle.** K. H. Subramania Ayyar, A. D. Palladam on leave l. a. p. for 20 days from 12—11—33 to 1—12—33 in continuation of leave already granted. C. S. Namasivayam Pillai, A. A. D. on leave l. a. p for 2 months and 15 days on m. c. in continuation of leave already granted. K. Sivasankara Menon, A. D. Dharmapuri, l. a. p. on m. c. for 1 month in continuation of leave already granted. K. H. Subramania Ayyar, A D. Palladam on leave l. a. p. for 8 days from 2—12—33 to 9—12—33 with permission to suffix Sunday 10—12—33. N. S. Rajagapala Aiyer, on relief at the Millet Breeding station to be A. D. Salem. K. Kuppamuthu A. D. Dharmapuri, on relief by K. Sivasankara Menon to be A. D. Omalur. K. H. Subramania Aiyer A. D. transferred to Annur subcircle. To join duty at Annur on the 15th December. S. S. Katchapeswara Iyer, A. D. Annur transferred to Tiruppur subcircle on relief by K. H. Subramania Iyer. To take over charge of Tiruppur on 22—12—33. N. Srinivasa Rao, A. D. Tiruppur transferred to Pollachi on relief by S. S. Katchapeswara Iyer and to take over charge on 3rd Jan, 34. U. L. Srinivasa Rao A. A D. Pollachi, transferred to Kollegal subcircle. To join duty at Kollegal on the expiry of 1 month's leave granted from 3—1—34. P. V. Hanumantha Rao, A. A. D. Kollegal transferred to Palladam on relief by U. L. Srinivisa Rao. A D. Tiruppur will be in additional charge of Palladam subcircle until P. V. Hanumantha Rao takes over charge at Palladam. U. L. Srinivasa Rao A. A. D. Pollachi l. a. p. for 1 month from 3—1—34 to 2—2—34. On the expiry of his leave to join duty at Kollegal and relieve P. V. Hanumantha Rao. **Cotton Section.** K. L. Ramakrishna Rao, temporary assistant Nadam Cotton Breeding Scheme, Perundurai, l. a. p. for 7 days from 15—12—33 to 21—12—33 with permission to affix X'mas and New Year holidays. S. M. Kalvanaraman assistant 1 a. p. for 7 days from 15—12—33 to 21—12—33 with permission to affix X'mas and New Year holidays. R. Balasubramania Ayyar, assistant and temporary senior assistant, Madras Herbaceum Scheme, l. a. p. for 7 days from 15—12—33 to 21—12—33 with permission to affix X'mas and New Year holidays. **Principal's Section.** S R. Srinivasa Ayyangar, Librarian, l. a. p for 18 days from 4—12—33 to 21—12—33 with permission to avail X'mas and New Year holidays. **G. E. Section.** K. R. Ramamurty, artist, l. a. p, for 10 days from 1—12—33 in continution of leave already granted. P. S. Narayanaswamy, assistant, l. a p. for 9 days from 13—12—33 with permission to affix X'mas and New Year holidays. **D. A's Office Orders.** D. V. Krishna Rao whose officiating appointment as assistant in Chemistry section will terminate on 18—11—33 will continue to officiate from 19-11-33 till further orders vice T. S. Ramasubramania Ayyer on other duty in the Madras Agricultural Service. Muhammad Moinuddin, officiating assistant, Entomology section l. a. p. for 12 days from 12-10-33 for which he is eligible; the probation of Moinuddian will be considered to have ceased from the date of the expiry of the leave granted to him. Though C. K. Ramachandran, Cotton assistant and M. L Balasundaram, Paddy assistant, joined their respective appointments on 20—10—33 they will be considered to have commenced their probation from 22—10—33 only and they will take rank below N. G. Narayanan who joined duty only on the afternoon of 21—10—33 as he was allotted the first vacancy according to communal rotation and he could join duty only on 21—10—33. M. Suryanarayana, Assistant Chemist, Madras Pempheres and Physiological Scheme l. a. p. for 4 months from 17—11—33 or date of relief. The following officiating appointments in the Madras Agricultural Subordinate service—class I Upper Subordinates III grade in the scale of Rs. 75—7½/2—105 are ordered with effect from 9—12—33 :— A. Abdul Samad, B. Sc. Ag., to officiate as A. D. till further orders vice P. S. Narayanaswamy Ayyar on other duty in Entomology section to report himself to D. D. IV Circle, St. Thomas Mount. B Suryanarayana Rao, B. A. (Hons.) to officiate as Assistant in the Entomology section till further orders vice J. A. Muliyil on leave—to report himself for duty to the G. E Coimbatore. K. C. Thomas, B. Ag. (Bombay) to officiate as A. D. till further orders in an existing vacancy—to report himself to the D. D. VIII Circle,

Coimbatore. All the above will be considered to be on probation. They should all join duty on 9—12—33. **Transfers and Postings:** P. S. Narayanaswami Ayyar A.D. VII Circle to Officiate as Assistant in Entomology vice M. Subbayya Pillai on other duty in the Paddy Section—to move immediately. K. Krishnan, F.M.A.R.S, Koilpatti to VII Circle, on relief by C. S. Namasivayam Pillai, S. V. Doraiswamy Ayyar on the expiry of his leave on 8—12—33 will rejoin duty as Assistant Lecturer in Agriculture, A. College. P. A. Venkateswara Ayyar, Assistant Lecturer, A. College on relief by S. V. Doraiswamy Ayyar to Millet Station Coimbatore as F. M. N. S. Rajagopala Ayyar, F. M. Millet Station, Coimbatore, on relief by P. A. Venkateswara Ayyar to report himself to the Assistant Director of Agriculture, Salem. C. S. Namasivayam Pillai, A. A. D. VIII Circle on the expiry of his leave to work under the A. D. A. Madura. **Posting:** B. L. Narasimhamurthy, B. Sc. Ag. is appointed to Officiate as Upper Subordinate—Science Section—III grade in the scale of Rs. 75—7½/2—105 with effect from 11—12—33 till furthor orders vice P. Krishna Rao on leave and is posted to the Millet Section—to report himself for duty to the Assistant in charge A. R. S. Hagari. C. Vijiaraghaya Acharya, Assistant, Millet Section on the expiry of his leave on 8-12-33, will rejoin duty at the A. R. S. Hagari. V. Panduranga Rao, Millet Assistant. Hagari, on relief by C. Vijiaraghava Acharya to Millet Section, Coimbatore. S. Madhava Rao, Permanent Upper Subordinate Agricultural Section and Officiating Assistant Millet Section to III Circle as additional A. D. in Rajampet taluk, Cuddapah district. He should inspect fruit gardens and give advice as to necessary improvements. To be relieved at once: **Transfer and Posting:** M. R. Balakrishna Ayyar Assistant, Chemistry Section is appointed as additional Assistant under the Cotton Specialist for work in the Madras Fodder Cholam Scheme, sanctioned G. O. No. 1420 Ms., Dev., dated 21st November 33. He will work under the guidance of Dr. Kasinatha Ayyar. The G. A. C. is requested to relieve M. R. Balakrishna Ayyar immediately. The following officiating appointments in the Madras Agricultural Subordinate Service—Class I Upper Subordinates, III grade in the scale of Rs. 75—2½/2—105 are ordered with effect from 15-12-33. K. Saptharishi, B. Sc. Ag. to Officiate as Assistant in the Cotton Section till further orders vice T. V. Rangaswami on other duty as temporary Assistant in the Madras Fodder Cholam Scheme—to report himself to the Suporintendent A. R. S. Koilpatti. P. Somayajulu B. Sc. Ag. to Officiate as Assistant till furrher orders in the additional temporary post sanctioned in G. O. No. 1525 Mis. Dev. dated 28-11-33. To report himself for duty to the Superintendent, Rice Research Station Berhampur, Ganjam district. Both the above candidates should join duty on 15—12—33. The following postings of Upper Subordinates in the Science Section are ordered: S. Sundaram, Permanent Assistant Cotton Section and Temporary Assistant in the Madras Fodder Cholam Scheme, Koilpatti. to be Temporary Assistant in Chemistry, in the Madras Pempheres and Physiological scheme vice M. Suryanarayana on leave. To report himself for duty to the Cotton Specialist, Coimbatore. While holding this temporary post S. Sundaram will draw his pay in the regular line plus an allowance of 25% of his pay. T. V. Rangaswami, Assistant, A. R. S. Koilpatti, to be Temporary Assistant in the Madras Fodder Cholam Scheme vice S. Sundaram. Separate orders will issue regarding the appointment of a substitute for T. V. Rangaswami. **Promotions:** The following promotions are ordered in the Upper Subordinate Service, Agricultural Section, with effect from 13-4-33. From IV grade to III grade. M. P. Kunhikutti; K. Govindan Nambiar. From V grade to IV grade, T. S. Venkatarama Ayyar; T. Rangabrahma Rao Naidu; C. S. Krishnaswami Ayyar; R. Govindaramayya; P. Narayana Nayar; V. Satagopa Ayyangar. C. V. Sesha Acharya, Upper Subordinate, Agricultural section I grade having been appointed as Assistant Director of Agriculture, provisionally substantive his lien on his appointment is suspended under Fundamental Rule 13 and the following provisionally substantive promotions are ordered to take effect

from 27-5-33. K. W. Chakrapani Marar from II grade to I grade; K. Ramanuja Acharya from III grade to II grade. The lien of Mr. V. K. Subramania Mudaliar, Temporary Superintendent, A. R. S. Nanjanad on his permanent appointment in the Science Section, IV Grade is suspended under Fundamental Rule 13 and the following provisionally substantive appointments are ordered--to take effect from 1-6-33. S. M. Kalyanarama Ayyar, Assistant in Cotton from V grade to IV grade. M. Venkoba Rao, probationer in the Cotton Section to be Assistant in the same Section. The following promotions are ordered in the Lower subordinate service with effect from 13-4-33. G. R. Venkatachalapathi Raju and K. Balaji Rao from IV to III grade. A Venkoba Achar and S. P. Fernando from V to IV grade. C. Vijiaraghava Acharya, Assistant, Millets Section l. a. p. for 13 days from 9-12-33 with permission to suffix X'mas and New Year holidays. On the expiry of his leave he should rejoin duty at the A. R. S. Hagari. M. J. David whose officiating appointment as Upper Subordinate, Agricultural Section, terminated on 5-12-33 will continue to officiate from 6-12-33 till further orders in one of the temporary posts sanctioned in G. O. No. 329 Mis. Dev. dated 15-3-33. M. J. David will continue to work in the V circle. T. K. Mukundan, whose officiating appointment as Upper Subordinate, Agricultural Section terminated on 19-12-33 will continue to officiate from 20-12-33 till 5-2-34 vice M. C. Menon, A. D. on leave. T. K. Mukundan will continue to work in the IV circle.