prophylactic and remedial measures. In the early stages, if the adults and the egg galls are hand picked and destroyed, the insect may not assume pest form, but if no attention is paid to it in the early stages, both handpicking and contact washes may be employed with success, even when the bugs are found in numbers. This being the first case of a membracid bug which has shown pest propensities in S. India during his thirty years' experience in S. India, the author has thought it may be interesting to present a short account of such an insect and elicit information and suggestions from economic entomologists in other parts of India.

PRELIMINARY STUDIES IN PLANTAINS GROWN IN MADRAS

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Introduction of new varieties cultivated in the different parts of the province was taken up during 1932 at the Agricultural Research Station, Samalkot. The present collection at the station contains most of the important varieties of the Presidency. It was not till 1935 that it was possible to put them down on a field scale to study some of their economic characters under normal field conditions. The general trend of variation in plant and bunch characters of some of the varieties was studied during the year, and the data obtained are presented in this paper.

The crop was grown on heavy clay soils with good facilities for irrigation and drainage. Good sword suckers of medium size and of about 3 to 4 months old were planted 10 links apart either way. They were manured at 20 cart loads of cattle manure and 1000 lb. of ammonium sulphate per acre. The fields were irrigated and drained as and when required.

Growth. It may be stated that under Godavari conditions, the crop generally makes its maxium growth during the rainy months of July to November. As the plant puts on more and more leaves, the stem (pseudo stem) gets stouter and stouter and elongated, till all growth practically ceases about two to three weeks before the inflorescence, commonly called the " flower ", emerges.

Detailed measurements of the heights and the internodal lengths of four important varieties are recorded in Table I which is self explanatory.

Leaf Production. Varieties vary in the number of leaves they produce in a newly planted field if suckers of almost the same age and size are planted and accorded identical manurial and cultural treatments (Table I). The variation in their different leaf characters is recorded in table II.

Flowering. The rate of opening of the spathes of the "flower" seems to be also a varietal character though largely influenced by weather conditions. Varieties which generally produce smaller number of hands per bunch as the White Chakkerakeli and Bontha, open at the rate of one spathe per day while those which produce a larger number like Karpura Chakkerakeli open at the rate of two or even three. Opening of the spathes covering the staminate flowers also follows the same sequence. Opening is delayed or sometimes does not happen on cloudy and cool days; but if the following day happens to be sunny, the number that open will be more than usual, compensating for the previous day's poor opening.

Spathes commence to separate themselves from the "Flower" proper from about 4 P. M. and completely open out the flowers by about 10 P. M. ordinarily. Varieties vary to some extent in this respect. The pistillate flowers seem to be receptive by this time. Dehiscence of anthers takes place from 6 to 9 P. M, in *Eumusa* and *Musa textalis*, by almost midnight in Peivazhai, and about 2 to 4 A. M. in the West Indian.

If the staminate group of flowers of a plant, is allowed to remain on the plant itself, it continues the process of opening its spathes one after another, till the whole "Flower", exhausts itself. In certain cases the "Flower" continues to open its spathes even after the fruits at the top of the bunch get ripe, while in others the "Flower" exhausts itself before the fruits on the bunch ripen. By allowing the flower to remain on the plant after all the pistillate flowers are released, there seems to be a slight delay in the maturity of the bunch and disparity in the sizes of fruits of the top and bottom hands of the bunch. In varieties like Karpura Chakkerakeli and Bontha Bathusa, if the "Flower" is allowed to remain on the plant after all the fertile hands are released, they at times produce a set of hands with pistillate flowers alternated by few hands with staminate flowers. This seems to be merely an abnormality which only certain varieties exhibit.

Maturation of the bunch. The time taken by a plantain bunch to mature, i. e. the interval between the date of flowering and commencement of ripening of the bunch on the plant, seems to be a varietal character (vide table III). It is however highly elastic, depending on the season following flowering, and the irrigation facilities accorded to it at that stage. The interval gets reduced by more than a month when bunching takes place in February instead of October, in spite of the existence of normal irrigation facilities, probably because of the prevalence of bright warm long days during the maturation period of the bunch thrown out in February. Restricted irrigation at this stage has been found to hasten maturity. It is interesting to note that it is not always the long duration varieties that take a longer time to mature their bunches. Flat sided fruit varieties in general seem to take a much longer time to mature than

the round fruited ones. It therefore seems more useful to note the date of harvest than that of flowering in manurial or cultural experiments on plantain as we are primarily concerned with the time taken for the maturation of the bunch. If this is done, bunches have to be kept on the plant till one or two fruits ripen, to have accurate data.

Fruit. Varieties vary widely in the number of hands per bunch and in weight per fruit, and they respond within limits to varied conditions of plant growth. Data in table IV give an idea of the characters of the bunch for some of the varieties studied.

Number of fruits per hand seems to be a varietal character and the variation in it is practically negligible under average conditions of growth. But under extreme fertility conditions, the number appreciably increases or decreases. In heavier bunches it is only the first three hands that show considerable increase in the number of fruits per hand with a large coefficient of variability while all the other hands excepting the last one or two represent the modal class. It is also the early formed hands in the bunch that record higher weight per fruit (table V).

Ripening of the fruit. The general trend of ripening and rotting and the loss in weight of the bunch during the process, as observed in April, in a group of White Chakkerakeli and Karpura Chakkerakeli bunches are brought out by the data in table VI. Bunches with one or two ripe fruits while on the plant were harvested for purposes of this study.

Under aerated and cool conditions, a fully mature Karpura Chakkerakeli-bunch takes about four days and a White Chakkerakeli bunch takes about five days to completely ripen (i.e. turning yellow). Rotting commences 2, 3 and 4 days respectively in the two varieties after the fruits turn yellow. It therefore shows how White Chakkerakeli is unsuitable for distant transport and marketing.

The relative times taken by a bunch with hands intact and that cut into hands, for ripening and rotting is brought out in the table VI.

It is clear that ripening and rotting are hastened by about 1 to 1½ days in the case of bunches cut into hands.

Seeding in plantain. Plantain fruiting is generally parthenocarpic in nature. Excepting a few wild seeded varieties, none of the cultivated ones produce seed normally, though some of these are however capable of doing so, if a wild seeded variety is in the neighbourhood.

To determine as to which of the commonly cultivated varieties are good female parents for the evolution of new varieties, elaborate crossing work was taken up using primarily White Chakkerakeli, Karpura Chakkerakeli, Mauritius and Bontha as female parents and *Eumusa*, *Musa textalis*, West Indian and *Sapota arati* (Peivazai) as male parents. Mauritius and the White Chakkerakeli refused to set seed

while the other two did so when crossed with *Eumusa* and *Musa textalis*. In addition West Indian induced seeding in Karpura Chakkera-keli and Sapota Bontha. Neivannan was also found to seed freely as it happened to be in the neighbourhood of *Musa textalis* in flower.

The seeds were sown as per 'Dr. Cheesman's method', but all of them failed to sprout. This may either be due to the incompatibility of the parents or the seed under local conditions may require more resting period. The local "Ginjala arati", however, readily sproued when the seed was sown immediately after the fruit became ripe.

Table No. 1.

Composition of the Pseudo-stem of plantain after bunching.

(*Mean of measurements in 10 plants of each variety*).

Serial Number.	Variety.	Length of internodes in inches (numbering from the top).										Average total length of the stem up to the junction of the flag leaf.	Average length of stalk of the Bunch.	Average length of bunch proper.	Average number of green leaf bases around the stem at the time of bunching.	Average total number of leaves per plant.
		1	2	3	4	5	6	7	8	9	10					
1	Karpura chekkerkeli	29·3	32·22	19·88	8·90	4·75	3·60	2·04	1·64	1·25	...	99·65	23·78	23·56	20·00	27
2	White chekkerkeli	19·12	26·00	23·57	14·85	7·73	3·70	1·98	1·19	0·98	0·60	98·91	16·50	11·95	16·8	25
3	Bontha	27·01	37·50	23·42	14·40	6·16	39·2	2·08	1·25	0·85	1·40	109·3	32·00	16·20	19·8	29
4	Mauritius	15·00	15·75	10·50	7·00	3·15	1·75	1·15	0·75	0·65	0·45	56·2	...	20·00	16·0	25

Table II.

Some of the leaf characters in Plantain.

(Average of 10 plants in each variety.)

	Karpura Chekkerkeli.				White Chekkerkeli.				Bontha.				Mauritius.			
	Length in inches of				Length in inches of				Length in inches of				Length in inches of			
Leaf No. from the flag leaf down.	Leaf base.	Leaf Stalk.	Length of Lamina.	Width of Lamina.	Leaf base.	Leaf Stalk.	Length of Lamina.	Width of Lamina.	Leaf base.	Leaf Stalk.	Length of Lamina.	Width of Lamina.	Leaf base.	Leaf Stalk.	Length of Lamina.	Width of Lamina.
1	23·9	...	31·3	17·0	14·6	...	45·0	24·0	18·5	...	9·4	19 0	28·0	...	8 0	5·5
2	51·0	10 8	71·3	26·5	44·8	4·5	39·9	...	46 9	10·1	57·2	23 8	37·7	3·5	44·5	22·0
3	78·4	14·5	80·6	30·1	67·3	6·19	77·3	25 2	74·4	13·8	75·2	25·3	45·3	3·5	57·0	28·0
4	93·9	15·0	82·2	29·4	82·7	8·6	84·2	26 2	86·7	14·4	76·0	25·3	52·4	2·0	61·0	28 5
5	98 2	16·4	82·6	30·4	87·3	10·7	83·0	25·5	97·1	16·1	75·3	25·1	51·7	6·9	63·0	26·5
6	98·5	14·6	79·0	30·5	89 3	9·3	77·7	26·7	97·6	16·5	73·4	25·4	54·0	4·5	47·0	26·5
7	94·9	16·5	76·4	29·5	86·9	9·3	82·1	27·5	95·2	16 6	73 1	25·3	53·3	3·3	56·5	27·0
8	92·6	14·3	...	28 8	83·9	9·1	77·0	29 0	92·1	15 4	70·2	25·5	52·8	3·5	51·0	25·0
9	90·6	16·1	73·3	28·7	80·1	9 0	72·1	27·3	89·3	15·0	71·2	25·5	56·4	2·5	55·5	2·.0
10	85·5	14·2	74·0	28·3	78·6	8·30	69·7	27·3	...	11·8	73 8	23 5	46·0	5·5	51·5	25·0
11	78·6	12·4	67·1	26·3	73·6	...	67·0	27·0	88·0	12·0	...	...	49·7	5·3	51·0	24·0
12	74·6	11 4	60·3	26 9	74·6	8·00	56·0	...	79·0	...	...	...	...	...	...	...
13	68 4	10·2	51·9	24·0	...	...	...	...	...	...	...	...	...	...	...	...

13	68 4	10·2	51·9	24·0	...	...	...	...	...	...	...	...	...	...	...	...	...

Table III.

Time taken by the different varieties to bunch and mature their bunches and the effect of season on the maturation period.

Serial number.	Variety.	No. of plant examined.	Months taken to bunch.		Days taken to mature the bunch.											
					Month of flowering.											
			January planting	June planting	October Fortnight.		November Fortnight.		December Fortnight.		January Fortnight.		February Fortnight.		March Fortnight.	
					I	II	I	II	I	II	I	II	I	II	I	II
1	White Chekkerkeli ...	180	10½	8	...	...	115·0	106·4	103·5	97·9	94·0	88·5	85·0	82·0	78·3	...
2	Karpura Chekkerkeli ...	280	11	8½	129·8	127·6	124·2	123·4	116·9	114·5	113·0	102·3	98·0	96·5	...	...
3	Mauritius	40	9½	6½	124·4	125 9	124·8	126·0	...	109·3	110·3	113·5	...	...	...	...
4	Bontha	40	10	8	...	136·4	137·4	132·6	128·0	118·0	113·1	114·0	...	...	...	...
5	Kadali	12	13	...	...	...	...	...	...	...	...	...	...	89·5	...	...
6	Vadakkan Kadali ...	...	11½	10½	...	...	...	132·5	...	111·5	...	...	...	...	...	...
7	Nendran	...	...	8	...	...	...	...	...	106 0	101·7	99·0	...	...	...	...
8	Kommu Arati ...	...	10½	8	123·0	121·0	112·7	108·0	...	...	...	...	...	...	...	...
9	Namarai	...	9	...	129·0	...	...	...	...	...	...	...	...	...	...	...
10	Sudha	...	10	8	135·0	130 0	128·7	130·8	...	...	...	106·0	...	...	...	...
11	Chingan	...	9	...	143·0	136·0	...	...	...	...	...	...	...	...	...	...
12	Kunnan long	...	11½	...	...	...	...	...	...	...	124·0	...	...	...	...	...
13	Amrutapam	...	12	...	...	...	...	...	...	...	125·0	...	...	...	...	...
14	Nadan	...	9½	...	159·5	155·5	...	...	...	...	...	...	...	...	...	...
15	West Indian	...	10½	7½	...	...	...	144·0	138·0	...	129·5	...	...	...	...	...
16	Kapur bale	...	10	7½	...	154·0	...	150·0	143·0	...	141 0	...	...	...	...	...
17	Vannan ordinary ...	...	10	...	...	...	150·0	...	...	...	...	...	...	...	...	...
18	Eradan	...	9	...	168·7	169·5	...	...	...	...	...	...	...	...	...	...
19	Kundarai Valan ...	...	9	7	...	171·7	...	...	...	...	...	...	...	...	...	...
20	Nei Vannan	...	11	...	...	...	..	141·9	143·0	...	136·5	130·0	...	...	...	...
21	Sirumalai	...	9	7	173·5	174·0	...	...	144 0	138·0	124·0	...	...	...	...	...
22	Yenuga Arati	...	9	7	167·0	168·0	...	...	156·0	143·0	141·0	...	...	...	...	...
23	Vannan Eradan	...	...	8	...	...	...	...	...	142·5	129·0	...	...	...	...	...
24	Boothi bale	...	...	11½	...	...	...	...	...	...	...	...	...	...	...	...

Table IV.

Characters of the bunches.

Serial No.	Variety.	No. of bunches examined.	No. of hands per bunch.	No. of fruits per hand. Mode.	No. of fruits per hand. Mean.	% of stalk to gross Wt. of bunch at the ripe stage.**	% of pulp to fruit at the ripe stage.	Av. Wt. per fruit (in Ozs.)
1	Karpura Chakkarakeli	12	9–13	16	16·46	8·5	81·10	2·83
2	Sudha	2–5	9–11	16	15·43	9·7	78·00	2·96
3	Vadakkan kadali	...	12–13	16	16·58	...	86·70	2·28
4	Kunnan round	...	8–10	16	16·40	...	...	...
5	Kadali	...	7—8	16	16·52	7·9	87·80	2·40
6	Surya Kadali	...	5—6	16	17·40	10·6	86·00	2·11
7	Namarai	...	5—7	16	15·60	...	70·10	1·10
8	Kunnan long	...	6—8	14	13·87	9·3	...	...
9	Mauritius	...	8—9	14	14·50	6·1	75·40	3·99
10	Yenuga arati	...	8—9	14	13·80	14·7	72·10	3·30
11	Siru malai	...	7—8	14	13·79	16·9	68·00	3·36
12	Eradan	...	7—8	14	13·80	12·30	72·00	3·15
13	Kudarai--Valan	...	7—8	14	14·00	14·1	79·90	3·35
14	Neivannan	...	8—9	14	14·10	10·5	68·60	4·65
15	Nadan	...	7—8	14	13·80	7·9	69·50	4·57
16	West Indian	...	7—8	14	14·00	9·6	73·63	3·33
17	Kapur bale	...	7—8	14	14·00	10·7	69·80	4·67
18	Vannan eradan	...	7—8	14	...	...	77·50	2·44
19	White Chakkarakeli	13	4—5	12	12·71	10·9	67·70	4·43
20	Kommarati	2–5	4—6	12	12·92	10·5	69·65	3·30
21	Chingan	...	6—7	12	12·45	...	77·70	3·78
22	Bontha	14	4—6	12	11·42	8·1	71·40	7·83
23	Bontha Batheesa	...	10–15	12	11·75	...	...	...
24	Nendran	...	4—6	10	9·10	10·7	69·30	7·75
25	Anaikomban	...	6—8	...	...	5·2	75·80	5·64
26	Nalla Chakkerakeli	...	4—5	...	...	5·4	70·30	4·85
27	Bendarati	...	...	...	...	16·1	73·50	1·95
28	Sapota Bontha	...	...	...	...	14·5	...	2·10
29	Amruta Pani	...	6—8	...	...	7·5	...	5·70
30	Airamka Poovan	...	40–45	12	...	8·0	84·90*	2·66*

* Based on the data of fruits in the top 25 hands.

** Stalk cut 18 inches above the top hand.

Table V.

30	Airamka Poovan	...	...	...	...	6—8 40–45	... 12	... ...	14·5 7·5 8·0	... ... 84·90*	2·10 5·70 2·66*

* Based on the data of fruits in the top 25 hands.

** Stalk cut 18 inches above the top hand.

Table V.

Variation in the number and weight of fruits. Variety—Karpura Chekkerakeli.

(Mean 16·46; Mode 16.)

Serial number of hand from the base.	Mean number of fruits. No. of hands in the bunch.					C. V. in the number of fruits. No. of hands in the bunch.					Wt. per fruit as a % of mean. Wt. per fruit of the bunch. No. of hands in the bunch.			Remarks.
	9	10	11	12	13	9	10	11	12	13	11	12	13	
1	16·57	19·57	19·94	18·70	17·56	23·78	21·67	20·71	23·84	19·41	109·3	106·6	124·8	
2	17·14	18·75	19·79	20·37	20·11	18·38	17·71	20·00	18·70	21·28	112·3	113·7	116·2	
3	15·52	16·26	16·56	16·85	18·22	4·63	11·93	10·75	11·10	16·74	113·8	117·5	119·4	
4	15·52	15·87	16·34	16·66	16·56	4·63	4·60	5·32	5·22	3·32	111·2	109·6	117·0	
5	15·05	15·95	16·29	16·41	16·00	6·70	4·64	5·03	4·93	2·94	104·5	108·7	109·8	
6	15·00	15·60	15·80	16·43	16·11	6·76	5·51	5·44	5·84	3·41	104·6	112·8	107·7	
7	14·91	15·54	15·72	16·07	16·00	7·71	5·46	5·66	3·73	...	96·7	97·5	96·8	
8	15·10	15·76	16·03	16·25	16·12	11·19	5·52	5·57	5·53	2·33	91·1	95·1	97·5	
9	13·80	15·76	16·15	16·18	16·22	15·50	5·59	6·50	6·18	2·53	90·0	94·4	89·3	
10	...	14·58	15·70	16·20	15·59	...	13·30	7·08	7·22	3·54	79·9	82·9	84·7	
11	...	...	13·75	16·27	15·99	...	...	16·70	6·27	11·19	65·1	72·4	79·4	
12	...	...	...	13·09	15·89	...	...	...	17·79	10·00	...	54·6	61·1	
13	...	...	...	...	12·44	...	...	...	...	23·95	...	...	53·9	
No. of bunches examined.	21	64	95	84	9									
Per bunch.	15·34	16·57	16·63	16·60	16·42	14·73	15·41	16·12	17·11	16·44	100·0	100·0	100·0	

Table VI.

Progress of ripening and rotting in bunches kept in tact and cut into hands.

(The fruits were kept hung up in shade).

No. of days after harvest.	Hands not separated from the bunch.						Hands separated from the bunch.						Remarks.
	% of fruit that have ripened.		% of fruit that have commenced to rot.		Wt. of the bunch as a % of its weight at harvest.		% of fruits that that have ripened.		% of fruits that have commenced to rot.		Wt. of the hands as a % of their weight at harvest.		
	W. Ch.*	K. Ch.*	W. Ch.	K. Ch.	W. Ch.	K. Ch.	W. Ch.	K. Ch.	W. Ch.	K. Ch.	W. Ch.	K. Ch.	
0	0·0	0·0	...	...	100·0	100·0	0·0	0 0	...	...	100 0	100·0	* W. Ch. = White Chekkerakeli.
1	4·4	9·1	...	...	95·5	95·6	1·2	3·9	...	...	94·1	94 9	
2	9·5	37·4	...	...	93·3	93·1	10·0	23 4	0·9	0·5	90·9	93 7	* K. Ch. = Karpura Chekkerakeli.
3	31·7	81·3	...	...	90 2	89 5	43·9	53·7	2·6	0.5	84·8	90·3	
4	68·3	98·4	0·9	0·8	86·2	87·1	100·0	100·0	6·3	4·4	84·1	86·3	
5	94·0	100 0	23·3	2·2	83·3	83·9	...	...	44·1	27·4	81·6	83·3	
6	100·0	...	44 0	11·1	77 1	82·0	...	...	100·0	61·5	78·1	79·3	
7	...	...	68·2	42·1	74·1	...	...	...	...	100·0	74·6	...	
8	...	...	96·6	100	...	...	...	...	...	...	...	...	
9	...	...	100·0	...	...	...	...	...	...	...	...	...	