FURTHER MANURIAL AND CULTURAL EXPERIMENTS ON CHILLIES.

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IN the October, 1938, issue of *The Tropical Agriculturist* (1) an account was given of manurial experiments on chillies conducted at the Vavuniya and Anuradhapura Experiment Stations during the 1937 *maha* season. It was observed that very appreciable yield increases resulted from the use of nitrogenous fertilizers, and that the addition of phosphorus and potassium to the latter was not productive of higher yields. Farmyard manure applied at the rate of 3 tons per acre was effective in increasing the crop significantly at Vavuniya but not at Anuradhapura. This was attributed to the fact that at the latter centre the experimental area had been penned with cattle immediately prior to the trial. In extension of these trials, an experiment was carried out at the Experiment Station, Jaffna, during *yala* 1938, (i.) to compare the effects of a single and double dressing of nitrate of soda on the crop; (ii.) to determine the response to farmyard manure alone and in combination with artificial fertilizers; and (iii.) to ascertain which of two methods of picking the crop was preferable from the standpoint of yield.

DESIGN OF THE EXPERIMENT

The experiment, consisting of twelve treatments, combinations of the three sets of factors enumerated above, was laid down in six randomized blocks of six plots each. The interactions between farmyard manure and method of picking, and between nitrogen, farmyard manure, and method of picking, were partially confounded with block differences. The design was that recommended by Yates (2) in his " Design and Analysis of Factorial Experiments ".

Each plot was 39 ft. by 21 ft. in external dimensions. After leaving a border row, the net area of a harvested plot was

30 ft. by 12 ft., containing five rows of eleven hills each spaced 3 ft. apart between and within rows. Drains separated the plots and blocks from one another.

The factors tested out were the following :—

Nitrogenous fertilizers :
- (i.) No nitrogen
- (ii.) Single nitrogen (N) : nitrate of soda in one dressing of 2½ lb. per plot (20 lb. nitrogen per acre)
- (iii.) Double nitrogen (2N) : nitrate of soda in two dressings of 2½ lb. per plot each (40 lb. nitrogen per acre)

Farmyard manure :
- (i.) No farmyard manure
- (ii.) Farmyard manure (F) at 1½ cwt. per plot or 4 tons per acre

Method of picking :
- (i.) Pods picked red throughout (R)
- (ii.) Normal method pods picked green at first picking ; all subsequent pickings red

EXPERIMENTAL DETAILS

The experimental details were furnished in a paper by Paul and Fernando (3) on the effect of manuring on the incidence of chilli leaf curl and need not be repeated here. It would suffice to state that the farmyard manure was ploughed in just prior to planting and the artificial fertilizer applied in the rows in two dressings, the first about three weeks after harvesting and the second a month after the first. Two seedlings of Tuticorin chillies were planted per hill. Observations were kept on the incidence of diseases and pests, the times of flowering and fruiting, dates of picking, &c. Leaf-curl of the type described in the paper referred to was markedly prevalent in all the plots, no less than 87 per cent. of the plants being affected with the disease at one stage. Neither farmyard manure nor nitrate of soda had any effect on the resistance or susceptibility of chillies to the disease. Many plants were also affected by *Sclerotium rolfsii*, the black stem disease. At each picking, a representative sample of fresh chillies of each of the different treatments was weighed and dried, and the percentage outturn of dry chillies determined. The average weight per pod and the number of chillies per pound were also ascertained at the same time. The rainfall data were presented in the paper already referred to (3). The precipitation having been insufficient during the months of May, June and July, irrigation was necessary on eighteen occasions.

RESULTS

The results are presented in a series of seven tables which give the actual or average yields of crop in lb. per plot, cwt. per acre or percentages. In table I. the actual yields of crop from the different plots are shown; in table II. is set out the analysis of variance of the data after the necessary corrections have been effected; table III. gives the yields in cwt. per acre for the different treatments and table IV. shows the average effects of the different treatments. In table V. the percentages of the total yields obtained at the different pickings and up to each picking are indicated for certain of the treatments. Tables VI. and VII. give the average weights per pod in grains and the mean number of pods per pound for the varying treatments and for the different pickings.

TABLE I.

Yields (lb. per plot)

	Blocks					
	I*a*	I*b*	II*a*	II*b*	III*a*	III*b*
	69·1	54·9	50·2	44·4	25·4	14·1
	G2N	RN	RF	GN	GN	GNF
	33·8	42·3	50·7	29·1	21·8	9·2
	R	G	R2NF	RNF	G2NF	GF
	73·8	79·2	64·7	42·3	16·3	7·8
	GF	R2N	GNF	GF	G	R
	83·9	47·7	78·3	41·4	17·5	21·4
	GN	RF	G2N	R2N	RNF	G2N
	82·9	67·2	52·6	54·4	21·7	32·0
	R2NF	GNF	G	G2NF	RF	R2NF
	64·7	74·5	49·3	23·0	24·6	19·0
	RNF	G2NF	RN	R	R2N	RN
Totals ..	408·2	365·7	345·8	234·6	127·3	103·5

Grand Total = 1,585·1

Mean = 44·03

TABLE II.

Analysis of Variance

Treatments

	D. F.	Sum of Squares	Mean Square	F
Nitrogen (N) ..	2	1,834·62	917·31	**10·24**
F. Y. M. (F) ..	1	74·25	74·25	
Picking red *vs.* green (P) ..	1	441·70	441·70	**4·93**
F × N ..	2	356·43	178·21	1·98
P × N ..	2	145·70	72·85	
F × P ..	1	8·13	8·13	
N × F × P ..	2	23·35	11·67	
	11	2,884·18	262·20	

	D. F.	Sum of Squares	Mean Square	F.
Blocks ..	5	13,856·51	2,771·30	
Treatments ..	11	2,884·18	262·20	**2·93**
Error ..	19	1,701·95	89·58	
	35	18,442·64		

F (sig.) for $n_1 = 11, n_2 = 19$, P = ·05 is 2·43 and for P = ·01 is 3·54.

Treatments are significant to P > ·05.

F (sig.) for $n_1 = 1, n_2 = 19$, P = ·05 is 4·38, P = ·01 is 8·18.

F (sig.) for $n_1 = 2, n_2 = 19$, P = ·05 is 3·52, P = ·01 is 5·93.

Treatments showing F values in bold type are significant.

TABLE III.

Yields in Cwt. per Acre

	No Nitrogen	Single Nitrogen	Double Nitrogen	Average	Corrected: No Farmyard Manure	Corrected: Farmyard Manure
Green (G)..	42·57	53·92	57·51	51·33	50·33	52·34
Red (R)..	33·16	42·21	55·94	43·77	41·68	45·86
Average ..	37·86	48·07	56·72	47·55	46·00	49·10

Significant difference for method of picking: P = ·05 is 5·04 cwt.; P = ·01 is 6·89 cwt.

Significant difference for quantity of nitrogen: P = ·05 is 6·17 cwt.; P = ·01 is 8·44 cwt.

TABLE IV.

Summary of Effects

	Lb. per plot	Cwt. per acre
Single Nitrogen	**9·45** ..	**10·21**
Double Nitrogen	**17·47** ..	**18·86**
Double *v.* Single Nitrogen ..	**8·01** ..	**8·65**
Farmyard Manure	2·87 ..	3·10
Picking : Red *v.* Green	**— 7·0** ..	**—7·56**
Standard Error per plot ..	9·47 ..	10·2
Significant differences :		
Nitrogen : P = ·05	5·71 ..	6·17
P = ·01	7·81 ..	8·44
Picking : P = ·05	4·67 ..	5·04
P = ·01	6·38 ..	6·89

Figures in bold type indicate significance.

An examination of the data provided by the above tables will indicate that :

(1) Both single and double dressings of nitrate of soda increased yields very significantly. The single dressing gave an average fresh weight increase of 10·2 cwt. per acre or 27 per cent. over the unmanured plot which yielded 37·8 cwt. per acre, while the double dressing recorded an average increase of 18·8 cwt. per acre or 50 per cent. over the control. Reckoned as dry chillies, these increases worked out at 3 and 5·5 cwt. per acre respectively, on an average dry weight outturn of 30 per cent. as determined by experiment. The effect of the second dressing of nitrate of soda was to increase yields by nearly as much as the first. These results are very definitely significant, the odds being over 100 to 1 that they are not due to chance but to the treatment. It is obvious, therefore, that, under the soil and climatic conditions of Jaffna, applications to chillies of nitrate of soda up to $2\frac{1}{2}$ cwt. per acre will be definitely beneficial in respect of yield. The findings of all previous trials in regard to the efficacy of nitrogenous fertilizers for chillies are thereby confirmed. Appreciably higher yield increases would doubtless have been obtained but for the incidence of the leaf-curl and black stem diseases.

(2) In regard to the economic aspect of manuring chillies at Jaffna, reckoning on a market price of Rs. 15 per cwt. of dry chillies, the gross increased returns would be Rs. 45 and Rs. 82 per acre respectively from the single and double nitrogen-

treated plots, as against a corresponding expenditure of Rs. 10 and Rs. 20 per acre on the fertilizer and the same amounts on the extra cost of picking and curing. The increased nett profits per acre as a result of the manuring would therefore vary from Rs. 25 to Rs. 42 per acre. Under more favourable crop conditions, the returns would have been appreciably higher.

(3) Farmyard manure has not, under the conditions of this trial, produced a significant yield increase, when the average yield of plots treated with farmyard manure is compared with that of corresponding plots which did not receive farmyard manure. The individual yield results do, however, strongly suggest that farmyard manure applied alone is beneficial to the crop. It is therefore advised that, particularly on the calcareous loams of the Jaffna Peninsula which are deficient in organic matter, farmyard manure or compost be used as a basal dressing for chillies at a minimum of 2 tons per acre.

(4) The practice of harvesting chillies "green" *i.e.*, at the stage when the pods though mature are of a green colour, at the first picking and "red" at subsequent pickings, is definitely more advantageous than the method of picking chillies "red" throughout. In addition to the fact that the total yield of crop is appreciably increased by the method of "green" picking, the actual increase in this instance being 7·5 cwt. of fresh chillies, there is the advantage that the green chillies can almost invariably be sold at remunerative prices. The outturn by weight of dry chillies has been found by experiment to be 30 per cent. in the case of pods picked "red" and 27·5 per cent. in the case of pods picked "green". On these figures, the minimum increased profit that would result from the adoption of this system of picking would be approximately the price of 2 cwt. of dry chillies or Rs. 30 per acre. The practice is, therefore, strongly to be recommended, particularly where there is a ready market for green chillies.

(5) None of the interactions between the different factors under experiment has proved significant.

(*For Table V. see page 345*).

It will be noted from table V that:

(i.) Though there appears to be a tendency for nitrogen to delay slightly the ripening of the pods, there is no certainty that such is actually the case, especially in view of the reverse result noted previously (1).

(ii.) There is a steady fall in yield of crop from the third pick onwards. About 95 per cent. of the total crop is obtained in six pickings, and 50 per cent. from the first three picks.

TABLE V.

	Per cent. of total at different pickings							Total per cent. up to particular picking						
	1st	2nd	3rd	4th	5th	6th	7th	1st	2nd	3rd	4th	5th	6th	7th
1. 1st picking green	23·6	6·3	19·6	18·7	18·0	9·3	4·5	23·6	29·9	49·5	68·2	86·2	95·5	100
2. 1st picking green, double nitrogen	17·1	8·1	22·0	14·7	19·9	12·0	6·2	17·1	25·2	47·2	61·9	81·8	93·8	100
3. All pickings red	5·9	20·1	24·3	19·5	16·0	7·9	6·3	5·9	26·0	50·3	69·8	85·8	93·7	100
4. All pickings red, double nitrogen	3·8	16·0	24·4	22·2	17·9	11·2	4·5	3·8	19·8	44·2	66·4	84·3	95·5	100

TABLE VI.

Manurial treatment	Mean weights of pods in grains			Mean numbers of pods per pound		
	Green	Red	Average	Green	Red	Average
1. Control	6·8	7·0	6·9	1,206	1,199	1,202
2. Single nitrogen	6·5	7·9	7·2	1,249	1,130	1,190
3. ,, †F.Y.M.	7·0	7·3	7·15	1,170	1,110	1,140
4. Double nitrogen	6·9	7·2	7·05	1,197	1,133	1,165
5. ,, †F.Y.M.	7·2	7·2	7·2	1,222	1,127	1,174
6. F. Y. M.	6·4	7·0	6·7	1,173	1,157	1,165
Average	6·80	7·27	7·03	1,203	1,143	1,173

TABLE VII.

	Picking						
	1st	2nd	3rd	4th	5th	6th	7th
Mean weights of pods in grains—							
Red	8·4	8·6	7·9	7·7	7·3	6·4	4·6
Green	—	7·3	7·8	8·0	7·6	5·9	4·2
Mean numbers of pods per pound—							
Red	888	864	952	1,025	1,102	1,323	1,844
Green	—	1,025	960	1,012	1,090	1,309	1,821

Tables VI. and VII. summarize the results of determinations of the average weights of pods and numbers of pods per lb. made on representative samples of dry chillies at each picking. It will be observed that :

(1) The average weight per pod of chillies picked "red" from the start is very slightly higher than that of chillies picked "green" at first, but the difference may not be significant. As would be expected, the reverse holds in respect of the number of dry pods per lb. The latter varies from 1,110 to 1,250.

(2) There are no appreciable variations in average weights of pods from differently manured plots.

(3) There is, in general, a decrease in the average weight of pod and consequently an increase in the average number of pods per lb. with advancing picking after the first two picks. The number of pods per lb. rises from 888 in the first picking to 1,844 in the last picking in the case of chillies picked "red" throughout.

SUMMARY

A combined manurial and cultural trial conducted at the Jaffna Experiment Station in the *yala* 1938 season led to the following important conclusions :—

(1) Both single and double dressings of nitrate of soda result in very significant yield increases over the control; the double dressing is definitely superior to the single dressing.

(2) The enhanced profits from manuring chillies, on the data obtained in this experiment, vary from Rs. 25 to Rs. 42 per acre, assuming the price of dry chillies to be Rs. 15 per cwt.

(3) Harvesting chillies "green" at the first picking, and ripe or "red" at subsequent pickings, is very definitely superior in respect of crop yield to picking chillies "red" throughout. An increased fresh weight of 7·5 cwt. per acre of chillies has thus been obtained.

(4) Farmyard manure has not, under the conditions of this trial, produced a significant average yield increase. There is, however, a strong suggestion that used alone farmyard manure is beneficial, and its application, even in relatively small quantities as a basal dressing for chillies under Jaffna conditions, is advocated.

(5) The average outturn by weight of dry chillies on fresh chillies is 30 per cent. when picked "red", and 27·5 per cent. when picked "green".

(6) There is a marked decline in average weight of pod as picking advances, and a steady fall in yield of crop from the third picking onwards.

(7) There is no appreciable variation in the average weights of pods from differently manured plots.

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