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Yield Response to N, P, K of Tomato, Brinjal and Bhendi

by

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Introduction: Vegetables, though generally grown all through the year yield high only in the recognised seasons. The low yields in the off-seasons are made good usually by the high prices prevailing in the market. A comprehensive study of the application of fertilizers for increasing production in vegetable crops is very necessary, in view of insufficiency of vegetables. A scheme on fertilizer trials on some of the major vegetable crops of the State *viz.*, tomato, brinjal, bhendi was initiated with these objectives from 15-12-62 at Dindigul in Madurai district and from 11-9-63 in Manikandam near Trichy in Trichy district. The results of trials on tomato, brinjal and bhendi are reported in this paper.

Review of Literature: No systematic study on the fertilizer requirements of vegetable crops in Tamil Nadu appears to have been undertaken. Reports on fertilizer trials conducted in India are fewer than in the foreign countries. Studies in Texas Agricultural Experiment Station (1931) showed that an application of 1344 kg/ha of a complete fertilizer analysing 4-6-6 was beneficial for high yields in tomato. Experiments on tomato conducted in New York State Agricultural Experiment Station (1933) also showed that P was very effective in influencing both early and total yields while the application of N and K was only next in order. Best results were, however, seen in the application of a complete fertilizer high in P, the proportion of nutrients being 4-16-4 given at the dose of 1344 kg/ha. Watts and Watts (1944) found that tomato responded to liberal fertilisation. They recommended an application of 560 to 1344 kg/ha of a complete fertilizer of 4-16-4 or 4-12-4 for tomato. In brinjal also, the same fertilizer schedule was found to be the best giving high yields. Work and Carew (1955) in their book have also recommended a 1-2-1 or 1-4-1 complete fertilizer for tomato.

Barooah and Ahmed (1964) recorded increased plant growth and crop yield with increase in dosage of N upto 134.4 kg/ha. They have also found the favourable influence of P in inducing faster plant growth in the early stages of the crop. Reddy and Rao (1964) reported high yields with 44.8 kg/ha with tomato. Toderi (1965) found that production in egg plants was highest and earliest with high P and high K and when applied alone K was more effective than P and in combination they showed possitive interaction.

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The dosage of the nutrients used in their trial was 6, 60 and 120 kg/ha. From fertilizer trials on Okra, Winham (1966) recommended a dosage of 26.8, 53.6 and 53.6 kg/ha of N, P and K respectively for soils with ample top soil and organic matter content of 1.2% and which was well drained to obtain high yields. For light soils the increase of rate of N and a reduction in the P and K rate were recommended.

Materials and Methods: The trials on vegetable crops at both the centres, Dindigul (Madurai district) and Manikandam (Trichy district) were conducted on the farmers' holding. The results of the trials on the three vegetable crops tomato, brinjal and bhendi conducted in the two centres are reported here. At the Dindigul centre, *Ananji* local variety of tomato, *Kottapatti* local of brinjal and *Pusa sawani* of bhendi were the varieties used, while at Manikandam, the varieties used were respectively *Marglobe* tomato, long or round purple brinjal and *Pusa sawani* bhendi.

The trial was laid out with 3^5 confounded factorial design with 3 blocks of 9 plots each, comprising the following treatments over a basal dose of 15 tonnes of farm yard manure/ha.

Levels of N – 0, 33.6 kg, 67.2 kg/ha

Levels of P – 0, 33.6 kg, 67.2 kg/ha

Levels of K – 0, 56 kg, 112 kg/ha

The sources for the three nutrients were ammonium sulphate, super phosphate and muriate of potash respectively for N, P and K. N was applied in two split doses *viz.*, one half of the dose before sowing or planting and the other half one month after and P and K were applied basally. The seasons of sowing of the crops were June–July for the monsoon crop and December–January for the summer crop. The gross plot size varied from year to year depending upon the availability of land in the farmers' holding. The plot sizes adopted in the different years ranged from 14′×12′ to 28′×12′. The spacing adopted for brinjal and tomato was 2′×2′ whereas for bhendi it was 2′×1½′. The net plot for purposes of yield data was obtained eliminating one border row on all four sides of the plot. At harvest the yield in kg per net plot was recorded.

Results and Discussion: A total number of 29 trials in all the three crops in both the centres put together were conducted from the 1963 summer season to 1966 summer season. Of this, the results of only 20 trials are reported in this paper. The yield responses seen to N, P and K for the three crops are presented in Tables 1, 2 and 3 for tomato, brinjal and bhendi respectively.

TABLE 1. *Tomato – Response to Nitrogen, Phosphorus and Potash (kg/ha)*

Centre	Year	Season	Mean yield of control	Mean response to 33.6 kg	Mean response to 67.2 kg	S.E. of response	C.D (P=0.05)	Conclusions	Type of response
Response to Nitrogen									
Dindigul	1966	Summer	8268	3119	5017	1223	2540	$\overline{N_2\ N_1\ N_0}$	Linear
	1964	Monsoon	8291	2782	4032	378	783	$\overline{N_2\ N_1\ N_0}$	Linear & Quadratic
	1966	Monsoon	11908	1493	2555	962	1992	$\overline{N_2}\ \underline{N_1\ N_0}$	Linear
	Monsoon mean		10100	2137	3293	—	—	—	—
Manikandam	1964	Summer	9254	527	2150	230	474	$\overline{N_2\ N_1\ N_0}$	Linear & Quadratic
	1964	Monsoon	8214	1953	4710	584	1428	$\overline{N_2\ N_1\ N_0}$	Linear
	1965	Monsoon	13638	1433	2548	853	1769	$\overline{N_2}\ \underline{N_1\ N_0}$	Linear
	Monsoon mean		10926	2193	3629	—	—	—	—
Response to Phosphorus				Mean response to 33.6 kg	67.2 kg				
Dindigul	1966	Summer	9101	1688	3964	1223	2540	$\overline{P_2}\ \underline{P_1\ P_0}$	Linear
	1964	Monsoon	9939	818	1052	378	783	$\overline{P_2\ P_1\ P_0}$	Linear
	1966	Monsoon	13737	−2086	632	962	1992	$\overline{P_2\ P_0}\ P_1$	Quadratic
	Monsoon mean		11838	− 634	842	—	—	—	—
Manikandam	1964	Summer	8797	2152	1895	230	474	$\overline{P_1\ P_2\ P_0}$	Linear & Quadratic
	1964	Monsoon	8552	2242	4406	584	1428	$P_2\ P_1\ P_0$	Linear
Response to Potash				Mean response to 56 kg	112 kg				
Manikandam	1964	Summer	8755	2348	1826	230	474	$K_1\ K_2\ K_0$	Linear & Quadratic
	1964	Monsoon	8698	2160	4050	584	1428	$K_2\ K_1\ K_0$	Linear

TABLE 2. *Brinjal – Response to Nitrogen, Phosphorus and Potash (kg/ha)*

Centre	Year	Season	Mean yield of control	Mean response to 33.6 kg	Mean response to 67.2 kg	S.E of response	C.D (P=0.05)	Conclusions	Type of response
Response to Nitrogen									
Dindigul	1966	Summer	7702	2506	4392	748	1557	N_2 N_1 N_0	Linear
	1964	Monsoon	9850	846	2253	805	1671	N_2 N_1 N_0	Linear
	1965	Monsoon	9897	131	2135	720	1490	N_2 N_1 N_0	Linear
	Monsoon mean		9874	488	2194	—	—	—	—
Manikandam	1964	Summer	10391	3161	4979	518	1263	N_2 N_1 N_0	Linear
	1965	Summer	4070	1043	2654	287	593	N_2 N_1 N_0	Linear
	Summer mean		7231	2102	3816	—	—	—	—
	1964	Monsoon	3729	924	2125	185	381	N_2 N_1 N_0	Linear
	1965	Monsoon	4846	1806	3635	349	724	N_2 N_1 N_0	Linear
	Monsoon mean		4288	1364	2880	—	—	—	—
Response to Phosphorus				Mean response to 33.6 kg	Mean response to 67.2 kg				
Manikandam	1964	Summer	11587	1725	2827	518	1263	P_2 P_1 P_0	Linear
	1965	Summer	4319	1389	1560	287	593	P_2 P_1 P_0	Linear & Quadratic
	Summer mean		7953	1557	2194	—	—	—	—
	1964	Monsoon	3573	1100	2417	185	381	P_2 P_1 P_0	Linear
	1965	Monsoon	5716	1253	1591	349	724	P_2 P_1 P_0	Linear
	Monsoon mean		4645	1176	2004	—	—	—	—
Response to Potash				Mean response to 56 kg	Mean response to 112 kg				
Manikandam	1964	Summer	11673	2407	1886	518	1263	K_1 K_2 K_0	Linear & Quadratic
	1965	Summer	4772	440	1151	287	593	K_2 K_1 K_0	Linear
	Summer mean		8223	1423	1518	—	—	—	—
	1964	Monsoon	4132	635	1206	185	381	K_2 K_1 K_0	Linear
	1965	Monsoon	5864	1124	1277	349	724	K_2 K_1 K_0	Linear
	Monsoon mean		4998	881	1242	—	—	—	—

TABLE 3. *Bhendi – Response to Nitrogen, Phosphorus and Potash (kg/ha)*

Centre	Year	Season	Mean yield of control	Mean response to 33.6 kg	Mean response to 67.2 kg	S.E of response	C.D (P=0.05)	Conclusions	Type of response
Response to Nitrogen									
Dindigul	1965	Summer	7791	2691	4396	730	1512	N_2 N_1 N_0	Linear
	1964	Monsoon	5476	1260	1757	380	798	N_2 N_1 N_0	Linear
	1965	Monsoon	14910	1026	3581	570	1186	N_2 N_1 N_0	Linear
	1966	Monsoon	15637	934	2736	611	1270	N_2 N_1 N_0	Linear
	Monsoon mean		12008	1086	2691	—	—	—	—
Manikandam	1964	Summer	8229	788	2362	188	389	N_2 N_1 N_0	Linear & Quadratic
	1964	Monsoon	7532	1265	2406	489	1021	N_2 N_1 N_0	Linear
	1965	Monsoon	2678	935	1802	242	502	N_2 N_1 N_0	Linear
	Monsoon mean		5105	1100	2104	—	—	—	—
Response to Phosphorus				Mean response to 33.6 kg	67.2 kg				
Manikandam	1964	Summer	8048	1562	2135	188	389	P_2 P_1 P_0	Linear & Quadratic
Response to Potash				Mean response to 56 kg	112 kg				
Dindigul	1964	Monsoon	6699	-944	291	380	798	K_2 K_0 K_1	Quadratic
Manikandam	1964	Summer	8851	843	448	188	389	K_1 K_2 K_0	Linear & Quadratic

Tomato: In tomato, results of two monsoon and one summer season's trials in each of the two centres are presented (Table 1). The trend of response to N may be seen generally to be linear in both centres as well as in the both seasons of trial thereby indicating scope for a still further response to higher dose of N beyond 67.2 kg/ha. Between the seasons of the trial there is greater response to N in the monsoon season than to the summer season. This trend is particularly so in the Manikandam (Trichy) centre.

The trend of influence of P for tomato appears to be linear for the summer crop in Dindigul while there is quadratic tendency beyond the 33.6 kg/ha dosage in the summer crop in Manikandam centre. There is a tendency for response to be quadratic in the Dindigul centre for the monsoon crop while at Manikandam it is clearly linear in response. However, in general there appears to be scope for further increasing the dosage of P to specifically determine the level of P needs for tomato.

There has been no response to Potash at the Dindigul centre for tomato while in the Manikandam centre there is linear response clearly seen for the monsoon season whereas it is quadratic in response beyond 56 kg/ha dosage in the summer season trials. The differential response seen between the centres probably is due to soil type differences as also the varieties raised.

The responses evidenced due to the N, P, K fertilisers on the tomato crop show that there is clear response to both N and P with linear trend in both the centres and that there is scope for further increasing the dosage. There was practically no response to Potash in the Dindigul centre while there was almost linear trend seen at the Manikandam centre. There has been no consistent interaction seen between N and P, so also between P and K, where there was interaction seen it was only in the highest level of the nutrients applied.

Brinjal: Two monsoon and one summer season's trial in the Dindigul centre and two trials in each of the season in the Manikandam centre are discussed in the paper (Table 2). It may be seen there is very clear response of brinjal seen to N in both the centres which is linear in trend. The response shown is almost similar in the Dindigul for the two seasons but in the Manikandam centre the response is much more in summer season than in the monsoon season.

For P and K there is absolutely no response shown by brinjal in the Dindigul centre while in the Manikandam centre there is response seen which again is linear in trend. This differential responses seen between the centres probably may also be due to the differences in the variety raised besides soil type differences. At Dindigul, it is the local variety while at Manikandam it is

the improved variety that was used. In the Manikandam centre there is significant interaction for N and P and N and K in the higher level in all the years of trial in both the seasons. In one trial, there is significant interaction for P and K also at the higher level. Brinjal seems to respond well for N at both the centres whereas for the other two elements there is response seen only at Manikandam centre. In the Manikandam centre because of the interaction effect between the three nutrients there seems to be the necessity for complete fertiliser application of N, P and K nutrients.

Bhendi; Bhendi trials of one summer and three monsoon seasons in Dindigul centre and one summer and two monsoon seasons of Manikam centre are reported in Table 3. The response to N was linear in trend in both the seasons as well as in both the centres. Between the seasons the effect in the quantum of response was reverse. Regarding mean yields, the response was more to N in the monsoon season at Dindigul and in the summer season at Manikandam. However, the trend of linear response was clear in both the seasons as well as in both the centres indicating scope for further increasing the nutrient level of N.

Only for the summer season crop at Manikandam there is response for P which is once again linear in trend. But for the other trials there is no response to P.

Response to Potash is seen at both the centres but it is not consistent with the seasons. There is response seen in the monsoon crop at Dindigul while it is seen in the summer crop at Manikandam. This differential response is not quite explainable. Also the trend of response seen at both the centres is not linear which means there is no need to go beyond 112 kg. Potash per hectare.

From the results seen, it is evident that the trend of response to N and P is seen to be linear requiring thereby the need for studying further increase in their dosages. As per the quadratic kind of period seen for response to K it is to be inferred that bhendi will not respond to any further addition beyond 112 kg/ha of application of K.

Summary and Conclusion: Fertilizer trials adopting a 3^3 factorial confounded design in 3 blocks of 9 plots each conducted on the vegetable crops *viz.*, tomato, brinjal and bhendi at Dindigul (Madurai District) and Manikandam (Trichy) from 1963 summer season to 1966 summer season are reported.

A linear response was seen in tomato to the application of N, P and K fertilisers thereby indicating the necessity to study further doses of the fertilzers beyond 67.2 kg/ha in the first two nutrients both in the summer and monsoon

seasons and beyond 112 kg/ha for Potash application in the monsoon season. There was practically no response to Potash ih the Dindigul centre. Generally the trend of response to the various nutrients was more in the monsoon seasor than in the summer season.

In brinjal, there was response only to N with a linear trend and no response was seen to P and K at Dindigul. So it is necessary to study further increases of nitrogen application beyond 67.2 kg/ha. There was not much difference seen in the response between the seasons. Brinjal responded to all the three nutrients in a linear fashion at Manikandam. The response shown was greater in the summer season than in the monsoon season.

There was also interaction effect seen between N and P, N and K universally and to some effect P and K at the higher level of nutrient application. A complete fertiliser application with combination of N, P and K nutrients appears to be essential for brinjal under Manikandam conditions. The responses shown being linear a further increase beyond 67.2 kg/ha in N and P and 112 kg/ha in K requires to be studied.

There was a clear linear response for N application in both the centres of trial for bhendhi. The differences in responses to N between the seasons was contrary to each other between the two seasons. The responses shown to P and K in both the centres were not consistent. As for N there was need for study of further increase of dose beyond 67.2 kg/ha.

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