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A Note on the Effect of Placement of Phosphate on the Yield of Paddy

by

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Introduction : Application of phosphatic manures as superphosphate in combination with nitrogen in the form of ammonium sulphate over a basal dressing of green leaf has been found to be essential to obtain high return in rice cultivation. Though most of the soils in Madras State are deficient in available P_2O_5 it has been found that the response to application of phosphates has been limited and is often erratic. This is mainly due to fixation of phosphates by the soil thereby making it unavailable to crops. With the usual method of surface application, about two thirds of the phosphates is locked up within an inch or two of the place of application depending upon the calcium content of the alkaline soils or iron or aluminium in the soils. Experiments on the placement of phosphates in the vicinity of roots have yielded useful results in certain crops. Apart from this, application of phosphates through green manure crops or through composts is also reported to make the phosphate readily available to the plant.

Superphosphate mixed with turnip seed and sown in drill was found more efficient than when the fertilizer was applied direct on the surface soil as early as in 1847 by Lawes (Cooke, 1949). Experiments on cereals showed that combined drilled dressing of superphosphate gave higher yields than broadcast dressings of the fertilizer (Crowther, 1945 and Frank, 1948, quoted by Cooke and Widdowson, 1955). Stewart (1952) concluded that the benefits from placement of the fertilizer were greatest on poor soils deficient in phosphates. Moreover when the fertilizer is placed in the vicinity of root zone of crop plants it is more efficiently utilized than when broadcast and losses of nutrients due to leaching, gas formation etc., are minimised. Further the immobility of phosphates when applied to the soil necessitates placing of such fertilizers as near the roots of the plants as possible. Cooke and Widdowson (1955), while reviewing the experiments on placement of the fertilizer in many countries have rightly pointed out that on soils which have been adequately manured for many years placement is not likely to provide marked benefits. However, gains in yields are obtained by using some method of localising the fertilizer to the seed or roots of crops especially in soils

which are deficient in available nutrients. Patel (1955) found in sugarcane that by mixing superphosphate with sieved compost or dung in 1 : 3 or 1 : 5 proportion for a week or two and applying this by the row or band method gave promising results. In rice, work done at Central Rice Research Institute, Cuttack during 1949—'50, 1950—'51 and 1951—'52 has shown that no yield response due to phosphate fertilization was obtained even when higher doses of superphosphate upto 120 lb. P_2O_5 per acre were applied either broadcast on the surface or as pellets placed deep in the soil.

Field trials to test the efficacy of placement of superphosphate on the yield of rice were conducted at Agricultural Research Station, Pattambi during 1948 to 1951 and at the Paddy Breeding Station, Coimbatore from 1951—'52 to 1955—'56. The results of these trials are discussed in this paper.

Materials and Methods: At Pattambi the experiments were conducted during the first and second crop seasons with the strains PTB. 2 and PTB. 20 respectively. The treatments consisted of the application of superphosphate at 150 lb. per acre (1) before final ploughing (2) after final ploughing and (3) no superphosphate, the other manure applied to the crop being green leaf at 5000 lb. and ammonium sulphate at 150 lb. per acre. The three treatments were randomised and replicated four times.

At Coimbatore the experiment was conducted in a modified form, the quantity of superphosphate applied being at the rate of 45 lb. P_20_5 over a basal dressing of 5000 lb. of green leaf per acre plus a top dressing of 30 lb. of Nitrogen as ammonium sulphate one month after transplanting. The treatments were as follows :—

(1) Superphosphate spread on surface and puddled in by digging (2) Superphosphate made into a paste with mud and the roots of seedlings dipped in the paste before transplanting and (3) superphosphate applied by broadcasting at the time of planting (control). The lay out was in randomised blocks replicated eight times, the variety being Co. 25.

Results: The results of the trials conducted at Coimbatore and Pattambi are furnished in Tables I and II respectively. Table I gives the data regarding measurement of height, number of ear-bearing tillers, length of panicle and number of grains and chaff in the panicle. The data do not show any significant difference between

the three treatments though Treatment I shows a slightly increased length of panicle and less percentage of chaff. Similarly the yield data presented in Table I show no significant difference in grain yield while the difference in straw yield during one season alone has attained the level of significance, the surface application having recorded the maximum yield.

Table II which gives the results of the trial at Pattambi also does not show any significant difference between treatments though the trend is in favour of treatment I where superphosphate is applied before final ploughing.

Discussion: The results obtained from four seasons trials conducted at Coimbatore and Pattambi have not given any conclusive results. The differences in plant height, number of productive tillers and length of panicles do not give any clue except that the percentage of chaff in plots where the phosphate is dug in is less than that in the case of other treatments. The yield differences between the placement method and surface application are also not striking. The placement methods adopted in this experiment are either digging or ploughing in the superphosphate before transplanting or dipping the roots of seedlings with super and mud . paste. Inspite of placing the fertilizer so close to the root zone no appreciable differences in yield have been obtained. This leads to the conclusion that lack of response of the crop to phosphates may be due to the high fertility level of soils of the research station where systematically manuring is in vogue. According to Stewart (1952) and Cooke and Widdowson (1955) the benefits from placement are likely to be the greatest on soils which are deficient in available nutrients. On soils which have been adequately manured for many years placement is not likely to provide any such marked benefits. Hence it is suggested that trials conducted in ryots' holdings might give some indication of the effect of placement of this fertilizer.

Summary: Field trials conducted at Pattambi and Coimbatore to test the efficacy of the placement of superphosphate on the yield of rice during four seasons did not show any significant difference either with regard to yield attributes or to yield itself. It is concluded that the possible cause for the lack of response of the crop to phosphate might be due to the high fertility level of the soils of the research stations.

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TABLE I.

Treatments:

1. Basal dressing of 5,000 lb. of leaf plus 30 lb. Nitrogen as ammonium sulphate plus 45 lb. P_2O_5 as Super spread on surface and puddled in.
2. 5,000 lb. leaf as basal dressing plus 30 lb. Nitrogen as ammonium sulphate plus 45 lb. P_2O_5 as Super. The super is made into a paste with mud and the roots of seedlings are dipped in the paste before planting and the balance is applied to the plot.
3. 5,000 lb. leaf as basal dressing plus 30 lb. Nitrogen as ammonium sulphate plus 45 lb. P_2O_5 as super applied as top dressing at the time of planting.

Quantitative charactors (Mean of 600 plants).

Particulars	Treatment I	Treatment II	Treatment III
Height of plant	2′ 3″	2′ 4″	2′ 4″
Number of tillers per plant (Mean of 200 plants)	8	7	8
Length of Panicle in cm.	19·6	19·4	19·5
Number of grains per panicle	128	129	133
Percentage of chaff	3·3	3·7	3·8

Summary of Results for Yield - Grain.

Year	Particulars	Tr. 1	Tr. 2	Tr. 3	General mean.	S. E. (P=0·05)	F. Test
1951—52	Acre yield in lb.	2992	3104	3008	3035	87·9	Not satisfied
	Percentage on control	94·3	103·2	100·0	99·2	2·9	
1952—53	Experiment was not conducted due to the failure of the season.						
1953—54	Acre yield in lb.	3870	3801	3891	3854	69·2	Not satisfied
	Percentage on control	99·5	97·7	100·0	99·0	1·8	
1954—55	Acre yield in lb.	3489	3730	3723	3646	123·9	do
	Percentage on control	93·7	100·2	100·0	97·9	3·9	
1955—56	Acre yield in lb.	3575	3216	3423	3404	163·4	do
	Percentage on control	104·4	93·9	100·0	99·4	4·8	

TABLE I (Continued)

Year	Particulars	Tr. 1	STRAW Tr. 2	STRAW Tr. 3	G. M.	S. E.	F. Test	Critical difference (P=0·05)
1951—52	Acre yield in lb.	6325	6407	6210	6314	157·8		Not satisfied
	% on control	102·0	103·4	100·0	101·8	2·52		
1952—53	Experiment not conducted due to failure of season.							
1953—54	Acre yield in lb.	8103	7964	8205	8091	161·8		Not satisfied
	% on control	98·8	97·1	100·0	98·6	1·97		
1954—55	Acre yield in lb.	5726	5559	6424	5903	159·4	Satis-	558
	% on control	89·1	86·5	100·0	91·9	2·48	fied	7·5
1955—56	Acre yield in lb.	6841	6841	7025	6903	131·2		Not satisfied
	% on control	97·3	97·3	100 0	98·2	1·9		

TABLE II.

Agricultural Research Station. Pattambi.

Treatments:

1. Super phosphate at 150 lb. per acre before final ploughing.
2. Super phosphate at 150 lb. per acre after final ploughing.
3. No super phosphate.

Summary of Results.

Grain

Year	Particulars	Tr. 1	Tr. 2	Tr. 3	G. M.	S. E. P=0·05	F. Test
1948—49 II crop	Acre yield in lb.	2300	2360	2280	2313	68·7	Not satisfied
	% on control	100·9	103·5	100·0	101·4	3·4	
1949—50 I crop	Acre yield in lb.	2210	2053	2123	2128	114·3	do
	% on control	104·1	96·7	100·0	100 2	5·4	
II crop	Acre yield in lb.	2269	2350	2323	2314	120·3	do
	% on control	97·7	101·2	100·0	99·6	5·1	
1950—51 Ic rop	Acre yield in lb.	2329	2258	2258	2282	167·7	do
	% on control	103·1	100·0	100·0	101·9	7·4	