A Note on Pre-Soaking in Phosphate Solutions for Increasing Yield in Rice

By

T. R. NARAYANAN, B. Sc., (Ag.) M. A. (Cantab);

and

S. GOPALAKRISHAN, B. Sc.

(Agricultural Research Institute, Coimbatore).

In recent years research is being directed towards a more efficient utilisation of fertilizers for inrceasing crop production. Various methods of applying fertilizers, differing from straight placement, but with the same object in view, of making available a larger quantity of nutrient elements to the growing plant have been tried. The literature on this aspect of fertilizer research has been very ably summarised in Soils & Fertilizers, Vol. 10, (1947). Among these various methods, coating the seeds with fertilizers before sowing is one and Gusev (1940) has claimed that, by treating cereal and other seeds with phosphates before sowing, either by moistening with a solution of phosphate fertilizer or by coating with a mixture of starch paste and fertilizer, the plants were able to utilise as much 70–80 per cent of the phosphate supplied. The possibilities of this method of pre-soaking seed in nutrient solutions, both as a means of supplying major elements like phosphorus and potassium and as a means of rectifying trace-element deficiencies have been explored in England by Roach and Roberts (1949). The most important result was observed in the case of oats, by soaking it in about one-third of its weight of 21 per cent tri-basic potassium phosphate solution and sowing the seed in phosphate-deficient soil. The yield from untreated seed was 17 bushels per acre, from water-soaked 20, and from phosphate-soaked seed. 25 bushels to the acre, with correspondingly large increases in straw. Similar large increases in yield were recorded in the case of other cereals, like wheat and barley, though the optimum concentration of the phosphate solutions were different. It was observed that the phosphate imbibed by the seed was deposited mainly in the husk, from where it could easily be washed off by running water. A similar promising result was also found in an experiment on oats grown in a manganese-deficient soil suggesting that a large part of the *Mn* requirement in oats could be provided by soaking the seed before sowing, in suitable dilutions of manganese salts.

In view of the obvious convenience, cheapness and adaptability of this technique of pre-soaking and since the method, if substantiated on other crops in large-scale field trials would be of very great practical value for Indian conditions, certain preliminary studies were started at Coimbatore on paddy, groundnut and cowpea, in pot-cultures to see how far the growth and yields of these crops could be improved by using the pre-soaking technique. The results that are available in the case of paddy appear to be of sufficient interest to merit publication for the information of other workers elsewhere who might be contemplating similar trials.

Material and Methods

A short-duration paddy variety Co. 13 was chosen as suitable for sowing in February. A number of treatments, using two concentrations, 10 and 20%, of three kinds of potassium phosphate were tried in addition to soaking in mere distilled water. Incidentally an attempt was also made to see how for pre-soaking in different strengths of a growth-promoting hormone, beta-indolyl-acetic acid, would affect the growth and yields as compared to soaking in phosphate solutions. The seeds were soaked in a third of their weight of solution, care being taken to see that all the liquid was absorbed by the seed within 24 hours. The seed was then air-dried to its original weight, by spreading it thin in a wide stray, with occasional turnings to ensure uniform drying. The seeds were sown in 10″ x 10″ glazed pots holding about 30 pounds of soil, at the rate of two per hole and twentyfive holes per pot. After germination the plants were thinned out in three stages before flowering so as to have a uniform stand of ten plants per pot for flowering and yield records. When ripe the plants in each pot were harvested, separated into grain and straw and weighed, once to get the fresh weight and again after complete drying, to secure dry weight records. The material thus gathered is being utilised for chemical analysis to see if any difference exists in the phosphate or potash content of plants from treated and control seed.

The results so far as they relate to growth and yield in paddy are summarised in the table attached.

It would be clear from the data that pre-soaking the seed in tri-basic potassium phosphate has resulted in a better growth than soaking in solutions of the other two salts, mono-basic and di-basic potassium phosphates. With tribasic phosphate itself, a higher

strength seems to be more helpful than a lower one. The grain yield in treatment 8, (soaking in 20% tribasic phosphate solution) is nearly 40 per cent more than in control, while it is only 21% more in the case of treatment 7, (soaking in 10% solution.) Pre-soaking in beta-indolyl acetic acid has also improved the grain yield significantly, but there is no great difference in effect between ten and twenty parts per million concentrations. Pre-soaking in mere distilled water has had no effect on grain yield if done once (treatment 1), but a repetition of the process (treatment 2) has a definitely adverse effect on both grain and straw. A combination of presoaking in phosphate solution and vernalisation in continuous light for two weeks (treatment 13) did not show any beneficial effect on grain or straw yield, although the tillering appeared to be improved. Further work is needed for determining the factors involved in this mutual annulling effect of two methods, each of which is individually beneficial in improving yields

In regard to plant height, soaking in tri-basic phosphate has produced the tallest plants, with the 20% treatment better than 10%, but this is counter-balanced by a poorer tillering in the former so that the straw yield in treatment 8, is less than in treatment 7. Straw yields in general do not seem to be improved much by any of the phosphate soakings; nor is there any perceptible effect in flowering earliness.

Summary

The results obtained from a preliminary pot-culture study on the effect of pre-soaking paddy seed in phosphate solutions are presented and discussed. Soaking the seed in a 20 percent solution of tri-basic potassium phosphate showed an increase of 38·8% in grain yield over control and a 21·1% increase after soaking in a 10% solution.

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Reference

(1) Soils and Fertilizers (1947)—Vol. X, No. 2, p. 121.

(2) *Roack W. A.* (1949)—Treatment of seed instead of Soil Brit. Information Services, Jan. 1949.

TABLE

Effect of Pre-soaking Paddy Seed in Phosphate solutions

Pot-Culture Experiment in 10" x 10" glazed pots ... Variety—Co. 13
13 Treatments, replicated 4 times, each in 2 soils ... Sown on 28—2—1949.
Complete, (NPK) and phosphate-deficient, (NK) ... Flowered — May, 1949.
From the Permanent Manurial plots ... Harvested — 8—6—1949.

(a) Summary of Results, from both soils types, NPK and NK

No.	Treatments	GRAIN YIELD. Mean per pot (gms.)	% on Control 100	STRAW YIELD. Mean per pot (gms.)	% on Control 100	Plant Height (gms.)	Tillering	Flowering (days)
1	Soaked—and dried in 1/3 weight of seed of distilled water—once	21·35	94·5%	37·39	70·2%	98·1	2·9	76
2	,, —thrice	17·50	77·5%	33·00	63·6%	94·6	2·8	79
3	,, KH_2PO_4 — 10%	21·35	94·5%	45·50	84·7%	99·2	3·4	77
4	,, ,, 20%	20·88	92·4%	58·44	112·7%	101·1	3·5	77
5	,, K_2HPO_4 — 10%	22·10	97·8%	51·25	98·8%	104·5	3·2	80
6	,, ,, — 20%	25·06	110·9%	48·63	93·8%	103·0	2·8	77
7	,, K_3PO_4 — 10%	27·36 *	121·1%	57·26	110·4%	106·0	3·3	77
8	,, ,, — 20%	31·35	138·8%**	52·58	101·4%	109·5**	3·0	76
9	,, beta—indole acetic acid 10 p.p.m.	26·86 *	118·9%	45·78	88·3%	102·1	3·0	74
10	,, 20 p.p.m.	26·50 *	117·3%	51·12	98·6%	104·3	3·4	74
11	**Control** — dry seed	22·59	100·0%	51·86	100·0%	98·8	3·6	77
12	Soaked 24 hours before sowing	21·00	93·0%	52·74	101·7%	101·3	3·0	76
13	Continuous light for 14 days, in conjuction with soaking in 2% K_3PO_4 solution	19·34	85·6%	51·89	100·1%	94·9	4·6	78
	Whether statistically significant or not	Very	highly	significant		Yes	Yes	No
	Critical difference — 1% level	5·27 gms.	23·3%	11·67 gms.	22·5%	81 cm.	0·6	
	,, 5% level	3·20 gms.	14·2%					

(b) Effect of Soil					
Complete (NPK) soil	25·78 gms.	54·02 gms.	100·3 cm.	3·6	76·5 days
P-deficient (NK) soil	20·87 ,,	43·98 ,,	102·3 cm.	2·7	77·4 days
Whether significant or not	Yes	Yes	Yes	Yes	No
Critical difference 1% level	2·07 gms.	4·58 gms.	3·2 cm.	0·2	

Note:—* Superior to control at 5% level.
** ,, at 1% level.