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Effect of presoaking seeds in phytohormonal solution on the growth and yield of crops

by

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Introduction: The effects of presoaking the seeds of cereals like paddy *(Oryza sativa)* and cholam (*Sorghum* spp.), in nutrient salt solutions have already been reported (1958). Subsequently further experiments were carried out to study the effect of presoaking seeds of paddy *(Oryza sativa)* and ragi *(Eleusine coracana)* in growth-regulating substances like L-naphthaleneacetic acid (L-NAA) and B-indolylacetic acid (B-IAA) on the growth and yields, and the results are summarised in the following paragraphs.

Review of literature: Mcrosite *et al* (1938), by dusting different concentrations of IAA and NAA, observed some difference in the early growth of wheat varieties and density of stand between the treated and untreated plants and also obtained significant yield differences in grain and straw yields. Hopkins (1940) working on barley concluded that a beneficial effect could be obtained from seed treatment only under certain conditions and increased yield or growth could not be expected in all cases. Youden's (1940) greenhouse experiments on wheat and soya beans gave only negative results. Stewart and his co-workers (1942) found no significant increase in growth from seeds of radish treated with growth-regulating substances like *L*-NAA, *B*-IAA and Indolyl-butyric acid, over a wide range of concentrations, from 2 ppm. to 33,000 ppm., but Bharadwaj and Rao (1955) observed that soaking seeds in solution of L-NAA, B-IAA and 2, 4-dichlorophenoxy acetic acid in concentrations of 0, 10, 100 ppm. resulted in taller plants and at certain concentrations (viz. 100 ppm.) these hormones improved the yields by 42 - 54 percent respectively.

Rao *et al* (1957) by presoaking in different concentrations of IAA and NAA found that the germination percentage of groundnut kernels, variety TMV. could be increased by 86·0 to 94·4%. The yield of pods could also be improved, by the use of these growth-regulating chemicals, though the flowering earliness, the maturity period and the oil content remained unaffected. More recently, gibberellic acid is also reported as useful in increasing the yield of fodder grasses and for inducing earlier flowering in certain plants (1957).

Materials and methods: A known weight of these seeds were soaked in phytohormonal solutions so that the proportion of seeds to solution was kept at 3 : 1 (1958). In the case of ragi, after soaking, the seeds were kept in a refrigerator where the temperature was maintained at 5–6°c. After a lapse 16 hours the seeds were air-dried and then sown in the usual way.

Besides these presoaking treatments, a foliar spray treatment at the preflowering stage was also included.

The hormones used were *L*-NAA and *B*-IAA at two levels of 0 and 50 ppm. concentrations, singly as well as in combination with tribasic potassium phosphate at half-molar concentrations. The soaked seeds were sown in separate nursery beds. The ragi seedlings were transplanted in experimental plots after 20 days, while in the case of paddy the planting was done after 20 days, while in the case of paddy the planting was done after 30 to 40 days, depending on the duration of the variety used. The traials with paddy were carried out at two different locations viz., on the wetlands of Central Farm, Coimbatore and at the Agricultural Research Station, Aduthurai. The experiments were laid out in randomised plots, replicated six times, to facilitate statistical assessment of the results.

Plant heights were recorded, from a fortnight after planting and continued at fortnightly or monthly intervals, depending on the crop and its duration, until the adult stage. Ten representative plants from each plot in the field in the case of ragi, and 25 plant in the case of paddy were selected at random and measured. Tillers were recorded at the audlt stage. In the case of ragi, the effect of treatments on flowering earliness was determined by recording the date of emergence of earhead of ten representative plants for each plot in the field. After harvest, the fresh weight of earheads and of straw were recorded and later the earheads were dried, thrashed and the final grain yield per plot was recorded. In the case of paddy both the fresh and dry weight of grain and straw were recorded.

Results - Paddy: (1) *Height:* At Aduthurai, the growth-measurement data showed no significant difference in the heights of plants from seeds soaked in growth hormone solutions, when compared to the controls. The plants obtained from seeds soaked in growth hormone in combination with $K_3 PO_4$ were shorter than the control at the initial stages of growth, but at the reproductive stage, these differences got levelled off. Nor was there any difference in plant height, when *L*-NAA was given as a foliar application at the preflowering stage. At Coimbatore, however, plants from hormone-treated seeds were taller than untreated controls, from the boot-leaf stage onwards. At the reproductive stage, the plants from these treatments were taller than the control plants by 3·5 to 7·4%.

(2) *Tillering:* The tiller counts recorded from Coimbatore showed that tillering in plants from the IAA treatment was greater both at the vegetative and re-productive stage, while it was less than control at the vegetative phase, in the other treatments.

(3) *Grain yield:* The yield of grain at Aduthurai tended to decrease when the seeds were presoaked in NAA 50 ppm. while IAA treatment did not show any difference relative to the control. On the other

hand, the trend was reversed when presoaking was done in solutions of these hormones in conjunction with a nutrient solution like K_3PO_4. There was no difference in the yield when IAA was applied as a foliar spray at the pre-flowering stage.

In the experiment carried out at Coimbatore, there was practically no difference in the yield of grain, due to presoaking treatments. Further, when IAA was given as a foliar spray a significantly lower yield was obtained. (Table I in the appendix).

(4) *Straw:* The data from Aduthurai show that IAA treatment decreased the production of straw (Slightly, by 1·5 per cent), while NAA increased the straw weight by 4·5%. Similarly NAA as foliar spray has proved to be helpful in stepping up the straw yield by 3·7 per cent, but differences were not large enough to be significant statistically. At Coimbatore, while IAA treatment has increased straw yield by 16·9% the NAA treatment reduced it by 5·6 per cent. Here again it is observed that presoaking in a mixture of the growth-hormone and K_3PO_4 adversely affected the yield. Foliar application of IAA at 100 ppm. at preflowering stage was heldful in improving the yield by 13%, while presoaking in K_3PO_4 cum foliar application of IAA has improved the yield to the tune of 17·2% (Table I in the appendix).

Ragi: *Effect on plant growth:* The data obtined on progressive plant heights show that plants obtained from seeds soaked in IAA 50 ppm. were taller than controls in the early stages, but the difference decreased with advancing growth until at the adult stage the plants were somewhat shorter than the untreated control. Similarly, the plants from seeds soaked in *L*-NAA (50 ppm.) showed practically no difference in plant height at any stage of crop growth.

Tillering: In regard to tillering, presoking treatments do not seem to be helpful in ragi. In flowering too, there was no difference as a result of hormonal treatments.

Grain and straw yield: The data on grain yield (vide Table I in the appendix) serve to show that presoaking in growth hormones solution is helpful in enhancing the grain yield in ragi. Presoaking in IAA as well as NAA, produced higher yields of 2·5 to 5·0% over the untreated control. When the seeds were presoaked in a mixture of potassium phosphate and IAA, there was a further significant increase in the grain yield over the untreated control, by about 8·7%. However, when NAA was presoaked in combination with potassium phosphate a reverse trend was noticed, the yield being 5·9% below the untreated control. Similarly, NAA as a foliar spray at 20 ppm. at preflowering stage seem to have an adverse effect on the grain yield.

In regard to straw yield (vide Table II in the appendix) higher yields over control have been recorded wherever growth hormones were used for presoaking or as foliar spray, the order of increase ranging between 2·8 to 21·7%, although the differences were still not large enough to attain statistical significance.

Discussion: Presoaking treatments in hormones do not seem to have much influence on the growth of rice plants at Aduthurai while at Coimbatore the treatments appear to have influenced the growth of plants favourably. In the case of ragi, IAA treated plants were taller in the early stages but the difference got reduced by advancing growth, while in the case of NAA no difference in plant height is observed at any stage. Thus the results obtained vary from hormone to hormone and from crop to crop. In the case of paddy, the results obtained, are in line with the observation made by Bhardwaj and Rao (1955) on wheat.

In tillering too there has been no uniform response. In the experiment at Coimbatore on paddy, both IAA treated and *L*-NAA treated plants showed an increase of tillers at the productive stage but at Aduthurai, IAA showed no effect on tillering, while NAA decreased the number of tillers by 8·8 per cent. In the experiment on ragi, the treatments do not seem to have influenced tillering either way. Misra and Sahu (1957) observed that in the case of an early variety of rice, presoaking for 72 in NAA @ 100, 250 and 500 ppm. had the effect of delaying the earhead emergence by 4-7 days while IAA did not produce any effect on the earhead emergence. With regard to tillering also, there was a differential response while IAA increased the number of tillers and leaves, NAA did not produce any effect.

When IAA was used in conjunction with a nutrient soultion like $\frac{M}{2}$ potassium phosphate, on ragi, the yield was improved significantly by 8· 7% over control but *L*-NAA plus K_3PO_4 had an adverse effect on the grains output.

In the experiment with ragi, the straw yields were improved by 7% and 13·4%, in the case of IAA and NAA respectively. Addition of half molar concentration of K_3PO_4 to NAA has helped in further enhancing the yield of straw. In the case of IAA, no additional advantage was secured by combination treatments with K_3PO_4. This is in contrast to the effect produced on grain yield by this hormone singly and in combination with K_3PO_4 solution.

The response to growth-hormones is also found to vary with location, thus at Coimbatore IAA improved the straw yield by 16·9%, while at Aduthurai the same treatment have straw yields less than in control.

Summary: Results from field experiments on the effect of presoaking paddy and ragi seeds, on growth, tillering and yield are presented and discussed.

The data indicate that presoaking ragi seeds in hormones like IAA and NAA can be helpful in increasing the grain yield, though its effect on plant height and tillering are not clear cut. In the case of paddy, the responses to hormones were different in different localities and hence further work is cleary needed to form any definite conclusions regarding the scope of these growth hormone chemicals. Foliar application of growth hormone chemicals at preflowering stage seems to be helpful in increasing the vegetative growth, as reflected in the increased straw yields.

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TABLE I.

Effect of presoaking treatments on paddy yields

Design: Simple randomized plots — Variety: Co. 25.

Replications: 4 (four)

	Grain				Straw			
	Aduthurai		Coimbatore		Aduthurai		Coimbatore	
	Mean yield in lb/acre	Percentage control	Mean yield in lb/acre	Percentage control	Mean yield in lb/acre	Percentage control	Mean yield in lb/acre	Percentage control
1. Control ...	3209.5	100·0	4,422·0	100·0	5403·6	100·0	11,137	100·0
2. Water soaked ...	3072·7	95·7	4,650·0	105·2	4081·0	94·0	11,590	104·1
3. Soaked in K_2P0_4 Molar/2 ...	2940·5	91·6	4,575·0	103·4	4879·3	90·3	13,015	116·6
4. B–Indolyl acetic acid 50 ppm. Presoaked ...	3226·0	100·6	4,475·0	101·1	5322·9	98·5	13,030	116·9
5. L–naphthyl acetic acid 50 ppm. Presoaked ...	3109·0	96·9	4,400·0	99·5	5645·5	104·5	10,517	94·4
6. (3) + (4) ...	2967·9	92·5	4,325·0	102·3	4879·3	90·3	10,062	90·3
7. (3) + (5) ...	3230·8	100·7	4,325·0	95·7	5040·6	93·3	10,527	94·5
8. Spray with IAA 100 ppm. ...	3230·8	100·7	3,600·0	81·4	5605·2	103·7	12,587	113 0
9. (3) + (8) ...	3214·7	100·2	3,375·0	80·8	5363·2	99·3	13,057	117·2
Significant or not	No.		Yes at 5% level		No.		No.	
Critical difference at 5%	No.		592 lb.		—		—	
Standard error	285·5		203 .b.		309·6		1934 lb.	

TABLE II.

Effect of presoaking ragi-seeds treatment or ragi yields. Showing the yield of grain and Straw lb/plot,

Lay out: Simple randomised. Treatments: 10 (ten).

Plot size: 0·5 cent net. Replications: 6 (six).

	Grain in lb/plot 0.5 cent		Straw in lb Plot.	
	Mean weight	Percentage control	Mean weight	Percentage control
1. Control	13·33	100·0	36·0	100·0
2. Watersoaked Room Temp.	13·67	102·5	44·5	123·6
3. do. Cold.	14·00	105·0	37·5	104·2
4. K_3PO_4 Molar/2 room Temp.	13·33	100·0	39·2	108·9
5. do. Cold.	13·17	98·7	37·8	105·0
6. IAA 50 ppm. cold.	13·67	102·5	38·7	107·5
7. (5) + (6)	14·50	108·7	37·0	102·8
8. NAA 50 ppm. cold.	14·00	105·0	40·8	113·3
9. (5) + (8)	12·67	94·1	43·8	121·7
10. Spray at preflowering stage NAA. 20 ppm.	12·33	92·5	38·3	106·4
Significant or not	Yes at 1%.		No.	
Critical difference. at 5%	0·56 lb.	level	4·29%	