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RESEARCH ARTICLE

Growth and quality of isabgol (*Plantago ovata* Forsk) influenced by phosphorus, PSB and zinc

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SUMMARY

An experiment was conducted during *Rabi* season of 2003-04 to study the effect of phosphorus, PSB and zinc on growth and quality of isabgol. The results showed that application of phosphorus up to 20 kg P_2O_5 ha^{-1} significantly increased the plant height, number of tillers per plant; dry matter accumulation at harvest, protein concentration is seed and husk recovery. The inoculation of seed with PSB significantly enhanced the plant height, number of tiller per plant, dry matter accumulation at harvest, protein concentration in seed and husk recovery over uninoculated control. Also significant improvement in growth parameter *viz.*, the plant height, number of tillers per plant, dry matter accumulation at harvest, protein concentration in seed and husk recovery were also observed with the application of zinc up to 5.0 kg $ha^{-1.}$

Key Words : Growth, Quality, Phosphorus, PSB, Zinc, Isabgol

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At present isabgol crop has required the place "Dollar earner" in north Gujarat and southwestern Rajasthan (Modi *et al.,* 1974). As a whole, India holds near monopoly in production and export of isabgol to the world market and about 80-90 per cent produce is exported through, which about Rs. 100 crores are earned annually (Maiti and Mandal, 2000). During 2003-04 the area and production of isabgol in Rajasthan was 120954 hectare and 74147 tonnes, respectively, with an average productivity of 613 kg ha^{-1} (Anonymous, 2003).

Application of phosphorus not only increases the crop yield but also improves the quality and imparts resistance against diseases. The use of phosphate solubilizing bacteria assumes greater significance because it helps to convert insoluble organic phosphate into simple and soluble forms. Members *Pseudomonas, micrococus, Bacillus* are some of the PSB. Inoculation of seeds with PSB culture also increase nodulation, crop growth, nutrient availability and uptake and crop yield (Shrivastav and Ahlawat, 1993).

The deficiency of zinc is major cause of poor yield or even crop failure (Takkar and Randhawa, 1978). It has also play a significant role in various enzymatic and physiological activity of the plant body. Zinc catalyses the process of oxidation in plant cells and vital for transformation of carbohydrate. Therefore, present investigation was under taken to find out the effect of phosphorus, PSB and zinc on the performance of isabgol.

MATERIALS AND METHODS

The experiment was conducted at SKN College of Agriculture, Jobner (Jaipur) during *Rabi* season, 2003-04 on loamy sand soil. The soil pH was 8.3 and low in organic carbon (0.24%), available nitrogen (127.0 kg ha^{-1}), phosphorus (18.70 kg P_2O_5 kg ha^{-1}), zinc (0.40 ppm) and medium in potash (150.90 kg ha^{-1}). The treatments consisting four levels of phosphorus (0, 10, 20 and 30 kg P_2O_5 ha^{-1}), two levels of PSB (without and

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Table 1: Effect of phosphorus, PSB and zinc on growth and quality of isabgol (*Plantago ovata* Forsk)

Treatments	Plant stand per meter row length	Plant height (cm)	No. of tillers per plant	Dry matter per meter row length (g)	Protein concentration in seed (%)	Swelling capacity (cc g^{-1})	Husk recovery (%)
Phosphorus (kg P_2O_5 ha^{-1})							
0	20.19	26.83	2.88	73.73	11.53	10.89	32.15
10	20.39	33.42	4.25	91.12	11.86	10.85	33.65
20	21.22	38.25	4.82	100.48	12.01	10.76	34.75
30	21.80	40.58	5.08	105.80	12.10	10.72	34.99
S.E.±	0.53	0.78	0.12	1.77	0.13	0.13	0.36
C.D. (P = 0.05)	NS	2.37	0.35	5.34	0.41	NS	1.09
PSB							
Without Inoculation	20.81	33.30	4.10	90.70	11.69	10.69	33.45
With Inoculation	20.98	36.20	4.40	94.90	12.06	10.92	34.33
S.E.±	0.38	0.55	0.08	1.25	0.09	0.09	0.25
C.D. (P = 0.05)	NS	1.68	0.25	3.78	0.29	NS	0.77
Zinc (kg ha^{-1})							
0	20.80	31.40	3.95	87.48	11.76	10.88	33.15
2.5	20.86	35.40	4.30	93.20	11.89	10.83	33.94
5.0	21.04	37.51	4.53	97.67	11.97	10.71	34.56
S.E.±	0.29	0.61	0.06	1.05	0.07	0.08	0.20
C.D. (P = 0.05)	NS	1.74	0.18	3.01	0.21	NS	0.58

NS = Non-significant

with inoculation) in main plot and three levels of zinc (0, 2.5 and 5.0 kg Zn ha^{-1}) in sub-plot were laid out in split plot design with three replications. Isabgol seeds were treated with PSB at the time of sowing. An uniform dose of 40 kg N ha^{-1} through urea and DAP, phosphorus as per treatment through DAP and zinc as per treatment through $ZnSO_4$ were applied at the time of sowing. The isabgol variety GI-2 was sown in rows 20 cm apart with 8.0 kg ha^{-1} seed rate on November 29, 2003.

RESULTS AND DISCUSSION

The experimental findings obtained from the present study have been discussed in following heads:

Effect of phosphorus :

There was no significant difference among phosphorus levels, seed inoculation with PSB and zinc application in terms of plant stand and swelling capacity (Table 1).The successive increase in phosphorus levels up to 20 kg P_2O_5 ha^{-1}, being at par with 30 kg P_2O_5 ha^{-1} recorded significantly improved the plant growth characters *viz.*, plant height at harvest, effective tillers per plant, dry matter accumulation and protein content in grain and husk recovery. Phosphorus plays an important role in root development and proliferation (Chatterjee, 1969). It is the main constituent of co-enzymes, ATP and ADP. Thus, phosphorus influences photosynthesis, biosynthesis of protein and phospholipids, synthesis of nucleic acid membrane transport and cytoplasmic streaming increasing availability of phosphorus resulting in to its application is soil improved the nutrient availability resulting in to their greater up take. The reason for increasing protein concentration and husk recovery is due to higher absorption capacity of nitrogen tended to improve growth. Similar findings were reported by Patel *et al.*(1996).

Effect of PSB :

Significant improvement in growth and quality parameters was also observed due to PSB inoculation (Table 1). Most of the soil phosphorus present in the organic form, which is unavailable to the plant. Thus, the treatment of seed with PSB culture enhanced a availability to the plant by solubilizing it. Solublization of phosphorus by PSB is attributed to extraction of organic acid like oxalic, lactic, succinic and citric acid, which, help in dissolution of rock phosphate and tricalciumphosphate by reducing particle size to amorphous form. Similar results were reported by Sarawgi *et al.* (1999).

Effect of zinc :

Application of zinc up to 5.0kg Zn ha^{-1} significantly increased plant growth characters *viz.*, plant height at harvest, effective tiller per plant, dry matter accumulation and husk recovery (Table 1). Whereas protein content in grain increased only 2.5 kg Zn ha^{-1} . The favourable influenced of applied zinc on growth parameters may be ascribed to catalytic effect of zinc on most of the physiological and metabolic processes of the plant. The improvement in protein and husk recovery of seed was observed with application of zinc which might be due to hindrance caused by increased concentration of zinc through absorption and translocation of phosphorus from the roots to the above ground parts. Similar finding were also reported by Choudhary *et al.*(1997)

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