International Journal of Agricultural Sciences
Volume 9 | Issue 1| January, 2013 | 338-340

RESEARCH PAPER

Effect of phosphorus, PSB and zinc on content and uptake of isabgol (*Plantago ovata* Forsk)

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Abstract : 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. Result revealed that application of phosphorus up to 20 kg P_2O_5 ha^{-1}, being at par with 30 kg P_2O_5 ha^{-1}, recorded significantly higher nitrogen uptake by seed and straw and total N uptake, phosphorus concentration in seed and straw, phosphorus uptake by straw, total uptake of phosphorus and zinc uptake by seed and total Zn uptake. The inoculation of seed with PSB significantly enhanced nitrogen concentration in seed, phosphorus concentration in seed and straw, nitrogen, phosphorus and zinc uptake by seed and straw, total uptake of nitrogen phosphorus and zinc concentration in seed uninoculated control. Results revealed that increasing levels of zinc up to 5.0 kg Zn ha^{-1} significantly increased nitrogen uptake by seed and straw and total N uptake, phosphorus uptake by seed and total uptake of phosphorus, zinc concentration in seed and straw, Zn uptake by seed and straw and total uptake.

Key Words : Phosphorus, PSB, Zinc, Uptake, Isabgol

View Point Article : Narolia, G.P. and Shivran, A.C. (2013). Effect of phosphorus, PSB and zinc on content and uptake of isabgol (*Plantago ovata* Forsk). *Internat. J. agric. Sci.,* **9**(1): 338-340.

Article History : Received : 26.11.2012**; Revised :** 16.12.2012**; Accepted :** 30.12.2012

INTRODUCTION

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 of *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 (Shrivastava and Ahlawat, 1993).

The deficiency of zinc is major cause of poor yield or even crop failure (Takkar and Randhawa, 1978). It also plays 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 consisted of four levels of phosphorus (0, 10, 20 and 30 kg P_2O_5 ha^{-1}), two levels of PSB (without and with inoculation) in main plot and three levels of zinc (0, 2.5

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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 ZnSO4 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 :

It was observed that application of phosphorus significantly increased the nitrogen concentration and uptake by seed and straw as well as its total uptake, phosphorus concentration in seed and straw, phosphorus uptake by straw and its total uptake, zinc uptake by seed and its total uptake. The possible explanation would be that application of phosphorus increased availability of nitrogen and phosphorus to the plant consequently leading to higher nitrogen and phosphorus concentration in seed and straw. This increase in nitrogen uptake due to phosphorus application could be attributed to most obvious favorable effect of phosphorus on the root system of plant. It promoted the formation of lateral and fibrous roots, which increased root proliferation and absorbing surface for nutrient. Similar results were also reported by Patel *et al.* (1996). The increasing levels of phosphorus non-significantly decreased zinc concentration in seed and straw due to antagonistic effect (Olsen, 1972). However, the uptake through seed and straw and its total uptake was increased significantly with phosphorus application (Table 1 and 2).

Effect of PSB :

Non-significant increase in nitrogen concentration in straw and zinc concentration in seed and straw was noted but significant increase in nitrogen and protein concentration in seed, N uptake by seed and straw and total uptake, phosphorus concentration uptake by seed and straw and its total uptake, zinc uptake by seed and straw and its total uptake and husk recovery of seed due to seed inoculation with PSB culture was observed (Table 1 and 2). The inoculation of seed with PSB culture enhanced availability of phosphorus by releasing phosphorus from native as well as protecting fixation of added phosphate rendered more available for the plant leading to increased nutrient concentration of the plant. Further increased uptake of nitrogen, phosphorus and zinc by crop seems the to be the result of significant improvement in seed and straw yields. The results are in accordance with the finding of Choudhary (2000).

Effect of zinc :

Non-significant reduction in the phosphorus concentration of seed and straw and non-significant increase

Table 1 : Effect of phosphorus, PSB and zinc on content of isabgol

Treatments	Nitrogen content (%)		P_2O_5 content (%)		Zn content (ppm)	
	Seed	Straw	Seed	Straw	Seed	Straw
Phosphorus (kg P_2O_5 ha^{-1})						
0	1.85	0.77	0.546	0.349	43.10	49.90
10	1.90	0.79	0.603	0.382	42.70	49.20
20	1.92	0.80	0.631	0.405	42.20	48.70
30	1.94	0.81	0.645	0.417	41.10	48.50
S.E.±	0.020	0.010	0.007	0.004	0.480	0.510
C.D. (P = 0.05)	0.060	0.030	0.020	0.013	NS	NS
PSB						
Without Inoculation	1.87	0.79	0.596	0.382	41.87	48.60
With Inoculation	1.93	0.80	0.616	0.395	42.68	49.55
S.E.±	0.020	0.010	0.005	0.003	0.340	0.360
C.D. (P = 0.05)	0.050	NS	0.014	0.009	NS	NS
Zinc (kg ha^{-1})						
0	1.88	0.78	0.613	0.393	40.72	47.64
2.5	1.90	0.79	0.606	0.388	42.41	49.21
5.0	1.92	0.80	0.599	0.383	43.70	50.38
S.E.±	0.010	0.010	0.004	0.003	0.260	0.300
C.D. (P = 0.05)	NS	NS	NS	NS	0.740	0.850

NS = Non-significant

Table 2: Effect of phosphorus, PSB and zinc on uptake of isabgol

Treatments	Nitrogen uptake (kg ha^{-1})			Phosphorus uptake (kg ha^{-1})			Zinc uptake (g ha^{-1})		
	Seed	Straw	Total	Seed	Straw	Total	Seed	Straw	Total
Phosphorus (kg P_2O_5 ha^{-1})									
0	16.43	17.83	34.26	4.84	8.10	12.94	38.50	116.5	155.0
10	21.51	21.85	43.36	6.83	10.5	17.35	48.60	135.9	184.4
20	25.16	24.31	49.47	8.25	12.2	20.49	55.30	147.3	202.5
30	26.51	25.33	51.84	8.83	13.0	21.86	56.30	151.5	207.9
S.E.±	0.49	0.79	1.06	0.15	0.39	0.47	1.10	4.70	5.20
C.D. (P = 0.05)	1.49	2.39	3.22	0.47	1.18	1.42	3.30	14.2	15.7
PSB									
Without Inoculation	20.85	20.98	41.83	6.67	10.2	16.90	46.50	129.4	175.9
With Inoculation	23.95	23.68	47.63	7.71	11.7	19.43	52.80	146.2	199.0
S.E.±	0.35	0.56	0.75	0.11	0.28	0.33	0.80	3.30	3.70
C.D. (P = 0.05)	1.05	1.69	2.28	0.33	0.84	1.01	2.30	10.0	15.7
Zinc (kg ha^{-1})									
0	19.47	20.08	39.55	6.38	10.1	16.48	41.90	121.0	162.9
2.5	22.95	22.62	45.57	7.36	11.1	18.49	50.90	139.7	190.6
5.0	24.80	24.28	49.08	7.82	11.7	19.52	56.30	152.6	208.9
S.E.±	0.34	0.54	0.57	0.11	0.27	0.28	0.80	3.10	3.00
C.D. (P = 0.05)	0.98	1.54	1.64	0.31	0.77	0.79	2.20	8.90	8.70

in the nitrogen and protein concentration of seed and straw was observed with application of zinc (Table 1 and 2) 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. The nitrogen and phosphorus uptake was increased significantly (Table 1 and 2) with the application of zinc. The beneficial role of Zn in increasing CEC of roots helped in increasing absorption of nutrient from the soil might have increased zinc uptake of nutrients. Similar findings were also reported by Choudhary *et al.* (1997).

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