International Journal of Agricultural Sciences
Volume **10** | Issue 2 | June, 2014 | 825-827
e ISSN-0976-5670 | Visit us | *www.researchjournal.co.in*

RESEARCH NOTE

Effect of phosphorus, PSB and zinc on yield attributes and yield of isabgol (*Plantago ovata* Forsk)

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Abstract : A field experiment was conducted to study the effect of four levels of phosphorus (0, 10, 20 and 30 kg P_2O_5 ha^{-1}) two levels of PSB (without and with inoculation) and three levels of zinc (0, 2.5 and 5.0 kg Zn ha^{-1}). The results showed that application of phosphorus significantly increased the yield attributes (number of spikes per plant, spike length and seeds per spike), yields (seed and straw) and net returns of isabgol upto 20 kg P_2O_5 ha^{-1}. The inoculation of seed with PSB significantly enhanced the yield attributes, yields and net returns over un-inoculated control. Application of zinc significantly increased the number of spikes per plant, seeds per spike, spike length, seed and straw yields and net returns upto 5.0 kg ha^{-1}.

Key Words : Phosphorus, Zinc, Yield attribute, Isabgol

View Point Article : Narolia, G.P., Shivran, A.C. and Narolia, R.S. (2014). Effect of phosphorus, PSB and zinc on yield attributes and yield of isabgol (*Plantago ovata* Forsk). *Internat. J. agric. Sci.*, **10** (2): 825-827.

Article History : Received : 28.09.2013**; Accepted :** 26.05.2014

Isabgol is a winter season annual hardy crop and it is an important cash crop, which is cultivated for its export value. It's seeds and husks are used for medicinal purposes. 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).

Phosphorus is the key element in the process involving conversion of solar energy into plant food. It helps in early root development and also enhances maturity. 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 supply of zinc to isabgol crop is more important. 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.

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

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(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 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 replication. 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.

The findings of the present study as well as relevant discussion have been presented under following heads :

Effect of phosphorus :

Application of phosphorus upto 20 kg P_2O_5 ha^{-1}, being at par with 30 kg P_2O_5 ha^{-1} recorded significantly higher the yield attributes such as number of spikes per plant, spike length, seeds per spike over control. The favourable effect of phosphorus treatments leading to significant measure in yield parameters, may be due congenial conditions for root growth and nutrient uptake. The significant increase in seed, straw and biological yields and net returns of isabgol was observed due to increasing levels of phosphorus upto 20 kg P_2O_5 ha^{-1}. 30 kg P_2O_5 ha^{-1} recorded the maximum seed yield (13.68 q ha^{-1}), straw yield (31.22 q ha^{-1}) and biological yield (44.90 q ha^{-1}) and net returns (Rs. 31,555 ha^{-1}). The higher yields and net returns were probably due to vital role of phosphorus in energy formation and metabolic process of plants, photosynthesis and seed formation. Similar findings have been reported by Choudhary (2000) and Arya and Singh (2001).

Effect of PSB :

The significant increase in yield attributes *viz.*, number of spikes per plant, spike length and seeds per spike due to seed inoculation with PSB might be due to mineralization of organic phosphorus into a soluble form there by increased availability of phosphorus in the rhizosphere. The seed, straw and biological yields increased significantly with seed inoculation with PSB. It has also been found to be significantly and positively correlated with yield attributes. Similar results have been reported by Choudhary (2000).

Effect of zinc:

Application of zinc upto 5.0 kg Zn ha^{-1} significantly increased spikes per plant, spike length and seeds per spike was observed whereas, significant improvement in test weight application of zinc @ 2.5 kg Zn ha^{-1} over control. Seed, straw and biological yields and net returns of isabgol significantly increased upto 5.0 kg Zn ha^{-1} with the application of zinc. The absorption of nutrients might have helped the plant in greater photosynthesis, nitrogen metabolism and synthesis of carbohydrates. Thus, there beneficial effects of zinc brought about a substantial improvement in yield attributes of zinc brought about a substantial improvement in yield attributes

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

Treatments	Spikes per plant	Spike length (cm)	Seeds per spike	Test weight (g)	Seed yield (q ha^{-1})	Straw yield (q ha^{-1})	Biological yield (q ha^{-1})	Net returns (Rs ha^{-1})
Phosphorus (kg P_2O_5 ha^{-1})								
0	18.07	2.53	41.68	1.79	8.87	23.27	32.15	17825
10	22.00	3.03	51.51	1.85	11.32	27.51	38.83	24807
20	24.77	3.42	56.34	1.88	13.02	30.18	43.27	29940
30	24.16	3.53	59.78	1.88	13.68	31.22	44.90	31555
SEm±	0.55	0.08	1.15	0.02	0.22	0.85	0.91	671
C.D. (P = 0.05)	1.66	0.25	3.49	0.07	0.68	2.58	2.77	2030
Phosphate solubilizing bacteria (PSB)								
Without inoculation	22.00	3.00	50.30	1.83	11.11	26.62	37.73	24192
With inoculation	23.50	3.20	54.30	1.87	12.36	29.47	41.84	28871
SEm±	0.39	0.06	0.82	0.02	0.16	0.60	0.65	475
CD (P = 0.05)	1.17	0.18	2.47	NS	0.48	1.83	1.96	1435
Zinc (kg Zn ha^{-1})								
0	20.94	2.95	48.39	1.81	10.27	25.39	35.67	22030
2.5	23.13	3.16	53.11	1.86	12.02	28.42	40.44	26832
5.0	24.15	3.28	55.48	1.88	12.92	30.33	43.25	29231
SEm±	0.79	0.04	0.63	0.01	0.16	0.64	0.60	477
C.D. (P = 0.05)	0.83	0.12	1.81	0.03	0.46	1.83	1.73	1368

NS = Non-significant

and ultimately in seed and straw yields of isabgol. The findings are in agreement with these Arya and Singh (2001).

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