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Performance of *isabgol* or blond psyllium (*Plantago ovata*) under different levels of nitrogen, phosphorus and bio-fertilizers in shallow black soil

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ABSTRACT

An experiment was conducted in shallow black soil of Malwa region of Madhy Pradesh during winter season of 1996 and 1997, to find out the effect of fertilizers on the growth, yield and quality of blond psyllium or *isabgol* (*Plantago ovata* Forskaal). Maximum plant height, number of spike-bearing tillers and length of spikes were recorded at 25 kg N/ha without P application. Higher seed yield by 30% was obtained at 25 kg N/ha compared with the control. Phosphorus and cultures did not affect plant attributes and seed yield and different treatments did not show beneficial effect on the swelling factor and mucilage of *isabgol* seed. As such 25 kg N/ha without P was found to be the most optimum and economic dose to realize maximum profit and benefit.

***Key words*:** *Isabgol, Azotobacter*, Phosphate-solublizing bacteria, Nitrogen, Phosphorus, Swelling factor, Mucilage.

Blond psyllium or *isabgol* is predominantly cultivated in Gujarat state and India is the sole exporter to the world market. Being economically important crop it was introduced at Indore centre in 1995 for agronomical studies. Randhawa *et al.* (1978) reported that seed yield of *isabgol* increased up to 60 kg N/ha. In other experiment yield did not increase beyond 20 kg N/ha. This was confirmed by Kalyansundaram *et al.* (1984). Dalal and Sriram (1995) found that crop requires low nitrogen and unless soil is very low in available N (120 kg/ha), no nitrogen should be supplied to the crop. To work out the optimum nutrient requirement, a fertility trial was conducted in Malwa plateau of Madhya Pradesh.

MATERIALS AND METHODS

A field experiment was conducted in randomized block design with 4 replications at the College of Agriculture, Indore, during winter season of 1996 and 1997. The

treatments comprised 3 levels each of N and P_2O_5 @ 0, 25 and 50 kg/ha, with single treatment of *Azotobactor* and phosphate-solubilizing bacteria (PSB) @ 2 kg/ha. Half N was given basal and half was top-dressed 1 month after sowing. The crop was sown with a seed rate of 8 kg/ha with variety 'GI 2' between 22 and 27 November. In 1996, 6 irrigations were given and in 1997 3 irrigations were given due to winter precipitation. The soil was shallow black (depth 40–50 cm), belonging to a benchmark of Kamliakheri series vertic Ustocrepts (Murthy *et al.*, 1982), representing a major area under rainfed crop in the Malwa Plateau. The soil was low in available N (240 kg/ha), P (25 kg/ha) and rich in K (570 kg/ha). The area receives an annual rainfall of 900–950 mm. During the first year rainfall was normal, whereas in the second year late rains were received till January 1998, resulting in damage of the crop. Downy-mildew disease was controlled by drenching the crop twice with Chlorothaloril (0.20%) and Mancozeb (0.25%). The crop was harvested in the fourth week of March.

Swelling factor in *isabgol* was determind by dipping 1 g seed in 40 ml water for overnight and swollen mass was recorded next day (Dalal, 1978). Seed mucilage was estimated in defatted seeds by using hexane. About 2.5 g defatted seeds were heated twice in Erlenmeyer flask with HCl acidulated water of pH 5.5 for 2 hr over waterbath. The supernatant was filtered in a beaker containing 75 ml methanol to obtain the precipitate on whatman No. 1 filter paper and the precipitate was over dried and weighed.

RESULTS AND DISCUSSION

Yield attributes and seed yield

Application of N with or without P increased the plant height, except at 25 kg N + 50 kg P_2O_5/ha it decreased. However, application of P without N and *Azotobactor* + PSB did not enhance the plant height (Table 1). As such maximum plant height was recorded at 25 kg N+0 kg P_2O_5/ha and at 50 kg N + 0 kg P_2O_5/ha. Different treatments had no significant effect on effective tiller number, however maximum was observed at 25 kg N + 0 kg P_2O_5/ha and at 50 kg N + 0 kg K_2O_5/ha. Different treatments had no significant effect no effective tiller number, however maximum was observed at 25 kg N + 0 kg P_2O_5/ha. Short length of spike was noticed at 25 kg N + 50 kg P_2O_5/ha in comparison to other treatments, however longest spike was observed at 25 kg N + 0 kg P_2O_5/ha and 50 kg N + 50 kg P_2O_5/ha. Patel *et al.* (1996) recorded increased tillers and height of *isabgol* at 20 kg N/ha.

During 1996 different treatments did not show statistically significant effect on grain yield of *isabgol*, however higher yields were resulted by application of N with or without P. Almost similar treatment effect on seed yield was seen in 1997. Here, application of N from 25 to 50 kg/ha with or without P gave significantly higher grain yield compared with those treatments where N was not used, and only P was applied. In pooled seasons treatments effect similar to 1997 was seen on the seed yield, however significantly higher seed yield by 30.1 and 29.7% was obtained by applying 25 kg N and 50 kg N/ha without P, respectively, compared with the control. In

Table 1. Effect of nitrogen, phosphorus and biofertilizers on grain yield, yield attributes and swelling factor of *isabgol* during 1996 and 1997

Treatment (kg/ha)	Plant height (cm)*	Tillers/ plant*	Spike length (cm)*	Grain yield (q/ha)			Swelling factor (cc/g)			Seed mucilage
				1996	1997	Pooled	1996	1997	Pooled	
N_0 P_0	29.2	18.7	3.1	11.54	5.61	8.57	12.10	11.91	12.00	35.15
N_0 P_{25}	29.2	19.9	2.9	12.98	5.61	9.29	10.40	10.88	10.64	34.77
N_0 P_{50}	29.9	17.0	3.2	12.18	5.21	8.69	10.73	10.94	10.83	35.00
N_{25} P_0	31.0	25.2	3.3	14.50	7.81	11.15	11.39	11.36	11.37	35.73
N_{25} P_{25}	30.6	21.9	2.8	13.54	7.41	10.47	11.55	11.53	11.54	35.05
N_{25} P_{50}	28.9	18.9	2.3	13.22	7.81	10.51	11.42	11.79	11.60	35.32
N_{50} P_0	31.0	24.8	3.2	14.63	7.61	11.12	11.01	11.30	11.15	35.09
N_{50} P_{25}	30.6	19.7	2.9	14.10	7.21	10.65	10.92	11.59	11.25	36.39
N_{50} P_{50}	30.4	19.7	3.3	14.34	7.41	10.87	10.91	11.62	11.26	35.81
Azotobacter + PSB (2 kg/ha)	29.9	18.0	3.1	13.14	6.01	9.57	10.12	11.15	10.63	34.57
CD (P=0.05)	2.1	NS	0.8	NS	0.5	1.2	NS	NS	NS	NS

Table 2. Effect of N, P and biofertilizers on economics and benefit : cost ratio during 1996 and 1997

Treatment (kg/ha)	Gross returns (Rs/ha)			Net returns (Rs/ha)			Benefit : cost ratio		
	1996	1997	Pooled	1996	1997	Pooled	1996	1997	Pooled
N_0 P_0	23,080	11,220	17,150	19,080	7,220	13,150	4.8	1.8	3.3
N_0 P_{25}	25,960	11,220	18,590	21,460	6,720	14,090	4.8	1.5	3.5
N_0 P_{50}	24,360	10,420	17,390	19,360	5,420	12,390	3.9	1.1	2.5
N_{25} P_0	29,000	15,620	22,310	24,800	11,420	18,110	5.9	2.7	4.3
N_{25} P_{25}	27,080	14,820	20,950	22,380	10,120	16,250	4.8	2.2	3.5
N_{25} P_{50}	26,440	15,620	21,030	21,240	10,420	15,830	4.1	2.0	3.1
N_{50} P_0	29,260	15,220	22,240	24,860	10,820	17,840	5.7	2.5	4.1
N_{50} P_{25}	28,200	14,420	21,310	23,300	9,520	16,410	4.8	1.9	3.4
N_{50} P_{50}	28,680	14,820	21,750	23,280	9,420	16,350	4.3	1.7	3.0
Azotobacter + PSB (2 kg/ha)	26,280	12,020	19,150	22,148	7,888	15,018	5.4	1.9	3.7

Cost of cultivation, Rs 4,000/ha; cost of N, Rs 8/kg; cost of P (as P_2O_5), Rs 20/kg; cost of *Azotobactor,* Rs 50/kg and cost of phosphate-solubilizing bacteria (PSB), Rs 16/kg

Selling rate of seed, Rs 20/kg

individual year and pooled years, no positive response to P and cultures application on seed yield was marked. Singh and Chauhan (1994) recorded increase in seed yield of *isabgol* with increasing levels of N and P, whereas Singh *et al.* (1992) obtained maximum seed yield of *isabgol* with 30 kg N/ha when applied 50% basal and 50% top-dressed.

Swelling factor

Positive effect of different doses of N, P_2O_5 and biofertilizers was not marked on swelling of seed in 1996, 1997 and on pooled basis and as such maximum value was recorded at zero levels of N and P_2O_5 (Table 1). Similarly, seed mucilage (%) was not influenced by different treatments in 1997.

Economics

Higher gross and net returns and benefit: cost ratio were observed at 25 N/ha applied without P_2O_5 in individual years and on pooled basis (Table 2). Maximum gross returns, net returns and benefit : cost ratio was noted on pooled basis compared with the control. Singh *et al.* (1996) observed higher net income and benefit : cost at 30 kg N + 15 kg P_2O_5/ha in *isabgol.*

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