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RESEARCH ARTICLE

Effect of phosphorus and sulphur fertilization on yield attributes and yields of blond psyllium (*Plantago ovata* Forsk)

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SUMMARY

A field experiment was conducted to study the effect of phosphorus levels (0, 10, 20 30 and 40 kg P_2O_5 ha^{-1}) and sulphur levels (0, 10, 20 and 30 kg S ha^{-1}) on yield and economics of blond psyllium (*Plantago ovata* Forsk). The results showed that application of phosphorus significantly increased the spikes per plant, seed and biological yields of blond psyllium up to 30 kg P_2O_5 ha^{-1}, however, spike length, grains per spike, test weight and straw yield were significantly increased up to 20 kg P_2O_5 ha^{-1}. Application of sulphur significantly increased the grains per spike, seed, straw and biological yields up to 20 kg S ha^{-1}, however, spikes per plant significantly increased up to 30 kg S ha^{-1} and spike length up to 10 kg S ha^{-1}.

Key Words : Blond psyllium, Phosphorus, Sulphur, Yield attributes, Yield

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Blond psyllium is a winter season annual hardy crop and it is an important cash crop, which is cultivated for its export value. Blond psyllium is commonly known as isabgol. It's seeds and husks are used for medicinal purposes. At present blond psyllium 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 blond psyllium 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 blond psyllium 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. It is a constituent of nucleic acid, phytin and phospholipids. An adequate supply of phosphorus is required in entire life. It also increase nodulation and crop yield (Shrivastav and Ahlawat, 1993).

Application of sulphur also plays an important role in crop production as it is an essential constituent of amino acids like cystine, cysteine and methionine and essential oils. It also helps in chlorophyll formation. In India 90 districts have been reported to be deficient in sulphur, of them three in Rajasthan *viz.*, Jaipur, Jodhpur and Udaipur (Tandon, 1991). Hence proper emphasis must be given on phosphorus and sulphur requirement of blond psyllium.

MATERIAL AND METHODS

The experiment was conducted at S.K.N. College of Agriculture, Jobner (Jaipur) during *Rabi* season, 2002-03 on loamy sand soil. The soil pH was 8.2 and low in organic carbon

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(0.25%), available nitrogen (129.14 kg ha^{-1}), phosphorus (15.50 kg P_2O_5 kg ha^{-1}), sulphur (7.3 ppm) and medium in potash (152.7 kg ha^{-1}). The treatments consisted of five levels of phosphorus (0, 10, 20 30 and 40 kg P_2O_5 ha^{-1} and four levels of sulphur (0, 10, 20 and 30 kg S ha^{-1}) were laid out in Randomized Block Design with three replications. An uniform dose of 40 kg N ha^{-1} through urea and DAP, phosphorus as per treatment through DAP and sulphur as per treatment through gypsum were applied at the time of sowing. The blond psyllium variety GI-2 was sown in rows 30 cm apart with 6.0 kg ha^{-1} seed rate on November 7, 2002.

At harvest, total numbers of spikes of five tagged plants from each plot were counted. The average was computed and expressed as spikes per plant. Five spikes were taken from the randomly selected plants from each plot at harvest. The length of these spikes was measured from the base of the lower spikelet to the tip of the upper most spikelet. Their mean was recorded as spike length in cm. Five spikes were randomly collected at harvest from each of five tagged plants, seeds were separated to count total number of seeds. Then average number of seeds per spike was calculated and expressed as number of seeds per spike. One thousand seeds were counted from random samples drawn from the winnowed and cleaned produce of each plot and their weight was recorded with the help of electric balance. The total biomass harvested from each plot was threshed, cleaned and dried. Seeds thus obtained were weighed (g $plot^{-1}$) and then converted into seed yield (q ha^{-1}). Straw yield was calculated by subtracting the seed yield from biological yield and expressed in q ha^{-1}. It was computed as the ratio of seed yield to total biological yield and expressed as percentage (Singh and Stockpot, 1971).

$$\text{Harvest index (\%)} = \frac{\text{Seed yield (qha}^{-1}\text{)}}{\text{Biological yield (qha}^{-1}\text{)}} \text{x100}$$

RESULTS AND DISCUSSION

The results of the present study as well as relevant discussions have been presented under following sub heads:

Effect of phosphorus:

Table 1 revealed that application of phosphorus up to 30 kg P_2O_5 ha^{-1}, being at par with 40 kg P_2O_5 ha^{-1} recorded significantly higher the spikes per plant, seed and biological yields over control, however, spike length, grains per spike, test weight and straw yield were significantly increased up to 20 kg P_2O_5 ha^{-1}. 40 kg P_2O_5 ha^{-1} recorded the maximum seed yield (12.93 q ha^{-1}), straw yield (28.66 q ha^{-1}) and biological yield (41.59 q ha^{-1}). The increase in yield attributes was probably due to phosphorus in energy transformation and metabolic process of photosynthesis, flowering, fruiting and grain formation in plants. The increase in test weight might be due to the fact that phosphorus helps in grain formation and development, because with the maturity of plant most of the phosphorus within the plant is translocated to grain of blond psyllium. Similar findings were reported by Choudhary (2000) and Arya and Singh (2001).

Effect of sulphur:

There was no significant difference among sulphur levels

Table 1: Effect of phosphorus and sulphur on yield attributes and yields of blond psyllium

Treatments	Spikes per plant	Spike length (cm)	Grains per spike	Test weight (g)	Seed yield (q ha^{-1})	Straw yield (q ha^{-1})	Biological yield (q ha^{-1})	Harvest index (%)
Phosphorus (kg P_2O_5 ha^{-1})								
0	20.03	3.04	39.89	1.90	8.32	20.01	28.33	29.37
10	23.97	3.66	41.19	2.05	10.59	24.40	34.98	30.17
20	26.32	4.02	43.94	2.12	11.81	26.54	38.35	30.71
30	28.15	4.19	45.39	2.14	12.59	28.04	40.63	30.96
40	28.87	4.25	46.36	2.15	12.93	28.66	41.59	31.14
SEm±	0.53	0.08	0.93	0.02	0.24	0.65	0.64	0.86
CD (P = 0.05)	1.52	0.24	2.67	0.06	0.68	1.85	1.85	NS
Sulphur (kg S ha-1)								
0	20.56	3.11	34.84	2.06	9.05	22.15	31.20	28.74
10	24.76	3.59	42.17	2.07	11.10	25.22	36.42	30.43
20	27.57	3.79	46.11	2.08	12.24	26.93	39.16	31.35
30	28.97	3.88	47.89	2.08	12.61	27.73	40.33	31.36
S.E.±	0.47	0.08	0.83	0.02	0.21	0.58	0.58	0.77
C.D. (P = 0.05)	1.35	0.22	2.39	NS	0.61	1.66	1.65	NS

NS = Non-significant

in terms of harvest index (Table 1). The application of sulphur up to 20 kg S ha^{-1} significantly increased grains per spike, seed, straw and biological yields. Whereas, spikes per plant significantly increased up to 30 kg S ha^{-1} and spike length up to 10 kg S ha^{-1}. 30 kg S ha^{-1} recorded the maximum seed yield (12.61 q ha^{-1}), straw yield (27.73 q ha^{-1}) and biological yield (40.33 q ha^{-1}). This might be due to the fact that sulphur addition improves the nutritional environment of rhizosphere as well as in the plant system and ultimately the plant metabolism and photosynthetic activity resulting into better growth and development and it also plays an important role in energy transformation and activation of enzymes in carbohydrate metabolism. Supply of sulphur in adequate amounts, helps in flower primordial initiation for its reproductive parts, which governs the yield parameters have increased the yields of blond psyllium. These findings are in agreement with those reported by Sharma and Singh (1993), Dewal *et al.* (2000).

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