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Effect of Seed Rate and Spacing on Yield and Economics of Isabgol (*Plantago ovata* Forsk.)

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Abstract: A field experiment was conducted to work out optimum seed rate and spacing for isabgol variety 'GI-2' isabgol at SKN College of Agriculture, Jobner, during rabi seasons of 2002-03 and 2003-04. The treatments were 4, 6 and 8 kg ha^{-1} seed rate and sowing at 15, 20, 25 and 30 cm row spacings and broadcasting. Results indicated that 8 kg ha^{-1} seed rate significantly reduced spikes/plant and seeds/spike, whereas, significantly increased seed, straw and biological yields (1321, 3672 and 4993 kg ha^{-1}, respectively) of isabgol over 4 and 6 kg ha^{-1} seed rates. Positive effect of seed rate was not marked on test weight, harvest index and husk recovery. Significantly maximum net returns (Rs. 31,175 ha^{-1}) and benefit:cost ratio (3.69) were also recorded with 8 kg seed ha^{-1}. The sowing of crop at 25 cm row spacing, being at par with 20 and 30 cm, recorded significantly highest spikes/plant, seeds/spike, test weight, seed (1315 kg ha^{-1}), straw (3598 kg ha^{-1}), biological yields (4913 kg ha^{-1}), net returns (Rs. 31,104 ha^{-1}) and B:C ratio (3.73) over 15 cm row spacing and sowing by broadcasting. The spacing could not bring significant change in harvest index and husk recovery.

Key words: Isabgol, seed rate, spacing, yield, net returns, benefit:cost ratio.

Isabgol (*Plantago ovata* Forsk.) also known as "Blond Psyllium" is one of the most important medicinal crops grown for its husk and seeds. At present, isabgol has acquired the name "Dollar earner" in north Gujarat and south western Rajasthan. India commands a near monopoly in production and export of the seed and husk of isabgol in the world market. India produces 9 million tones of isabgol, which is 98% of the world's total production (Rajendaran, 2009). The yield of isabgol is low because it is mostly grown in nutritionally deficient soils without proper production technology. Seed rate and spacing are known to influence the productivity considerably (Maheshwari and Sharma, 2002). Seed rate varies with seed size, sowing time, soil and climate. Seed rate, by maintaining optimum plant population, plays an important role in growth and development. Spacing is a non-monetary input, but it plays a vital role by changing the magnitude of competition. The relative equidistant plant distribution leads to efficient utilization of moisture, nutrients and light interception. Therefore, an attempt has been made to study the effect of different seed rates and spacings on yield attributes, yield and economics of isabgol under location specific semi-arid region of Rajasthan.

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Materials and Methods

A field experiment was conducted at Agronomy Farm, SKN College of Agriculture, Jobner, during rabi seasons of 2002-03 and 2003-04. The soil of experimental field was loamy sand in texture, alkaline in reaction (pH 8.3), low in organic carbon (0.16%), available nitrogen (132.8 kg ha^{-1}), available phosphorus (14.0 kg P_2O_5 ha^{-1}), and medium in available potassium (149.2 kg K_2O ha^{-1}). The experiment was laid out in Randomized Block Design (RBD) with 4, 6 and 8 kg ha^{-1} seed rate and sowing at 15, 20, 25 and 30 cm row spacings and broadcasting with three replications. The crop variety 'GI-2' was sown in 12 m^2 plots at 1 to 2 cm depth on 10th and 14th November during 2002 and 2003, respectively. The crop was harvested on 11th and 12th March of 2003 and 2004, respectively. Five random plants were selected from each plot to record yield attributes. For yield the net plots (9 m^2) were harvested. The husk recovery was estimated according to the method suggested by Kalyansundaram *et al*. (1982). Economics were worked out on the basis of prevailing market prices of inputs and outputs. Data obtained were statistically analyzed (Fisher, 1950).

Results and Discussion

Seed rate

The pooled data of two crop seasons revealed that the seed rate significantly affected yield attributes, yields, net returns and B:C ratio of isabgol (Table 1). Increasing seed rate upto 8 kg ha^{-1} significantly reduced the spikes/plant (16.41) and seeds/spike (40.17). The test weight remained unchanged. Variation in seed rates significantly influenced the seed, straw and biological yields of isabgol and recorded the highest value (1321, 3672 and 4993 kg ha^{-1}, respectively) at 8 kg which was significantly superior to lower seed rates. The seed yield obtained with 8 kg seed ha^{-1} was 24.50 and 8.81% higher over 4 and 6 kg ha^{-1}, respectively. More spikes/plant and seeds/spike at lower seed rates was due to less competition among the plants for light, moisture and nutrients compared with those at higher seed rates. Although the yield attributes/plant decreased at high seed rate, but more number of plants/unit area perhaps increased seed, straw and biological yields. Pour and Moghaddam (2005) also reported significant increase in yields with increasing seed rate. Positive effect of seed rate was not apparent on harvest index and husk recovery. Significantly maximum net returns (Rs. 31,175 ha^{-1}) and B:C ratio (3.69) were also recorded with 8 kg seed ha^{-1}. The cost of seed was low in comparison to the added output, thus, the increased seed and straw yields led to increased net returns and B:C ratio.

Spacing

The results of two-year study revealed that sowing of isabgol in rows significantly increased yield attributes, yields and economics over sowing by broadcasting (Table 1). The sowing of crop at 25 cm row spacing, being at par with 20 cm row spacing, recorded significantly higher spikes/plant (22.5), seeds/spike (50.1), test weight (1.88 g), seed yield (1315 kg ha^{-1}), straw yield (3598 kg ha^{-1}) and biological yield (4913 kg ha^{-1}) over 15 cm row spacing. Crop planting at 25 cm row spacing recorded higher seed yield by 27.54, 15.04 and 4.44% over sowing by broadcasting and 15 cm and 20 cm row spacing, respectively. The increase in yield attributes and yield under 25 cm row over close spacing may be due to availability of more land area/plant resulting into availability of higher growth inputs to individual plant helping the plant to grow profusely that in turn resulted into higher photosynthetic rate and translocation of photosynthates towards sinks (Singh *et al.,* 2010). Further wider spacing of 30 cm could not bring significant change in yield attributes and yield as compared to 25 cm row spacing. The spacing did not significantly influence harvest index and husk recovery. Significantly highest net returns (Rs. 31,104 ha^{-1}) and B:C ratio (3.73) were also obtained with crop planting at 25 cm row spacing. Theses

Table 1. Effect of seed rate and spacing on yield attributes, yield and economics of isabgol (Pooled data)

Treatments	Spikes/ plant	Seeds/ spike	Test weight (g)	Seed yield (kg ha^{-1})	Straw yield (kg ha^{-1})	Biological yield (kg ha^{-1})	Harvest index (%)	Husk recovery (%)	Net returns (Rs ha^{-1})	B:C ratio
Seed rate (kg ha^{-1})										
4	25.11	53.05	1.86	1061	2890	3951	26.84	32.32	23516	2.83
6	19.92	46.24	1.85	1214	3386	4600	26.46	32.15	28044	3.35
8	16.41	40.17	1.84	1321	3672	4993	26.46	31.84	31175	3.69
SEm±	0.35	0.64	0.01	17	54	59	0.37	0.54	506	0.06
CD (P=0.05)	1.00	1.81	NS	48	154	169	NS	NS	1437	0.17
Spacing										
Broadcasting	17.28	41.31	1.80	1031	2928	3959	26.08	32.47	22819	2.81
15 cm row	19.20	44.52	1.83	1143	3187	4330	26.50	32.44	25595	2.94
20 cm row	21.76	48.36	1.87	1259	3455	4713	26.76	32.12	29228	3.43
25 cm row	22.53	50.09	1.88	1315	3598	4913	26.84	31.53	31104	3.73
30 cm row	21.63	48.14	1.87	1246	3412	4658	26.76	31.95	29143	3.54
SEm±	0.44	0.82	0.01	22	70	76	0.48	0.70	653	0.08
CD (P=0.05)	1.25	2.35	0.04	62	198	218	NS	NS	1834	0.22

findings were in conformity with Dwivedi *et al*. (2008).

Conclusion

The findings of the present investigation indicated that isabgol crop should be sown using 8 kg seed ha^{-1} at a row spacing of 25 cm to obtain higher yield and benefits per unit area.

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