JOURNAL OF PURE AND APPLIED MICROBIOLOGY, June 2015. Vol. **9**(2), p. 1665-1669

Response of Different Levels of Nitrogen, Phosphorus and Potassium on Yield and Quality of Isabgol (*Plantago ovata* Forsk.)

D.M. Patel, M.R. Patel, H.K. Patel, R.B. Prajapati and S.A. Chauhan

Department of Agronomy, B.A.College of Agriculture,
Anand Agricultural University, Anand-388 110, India.

(Received: 18 March 2015; accepted: 23 April 2015)

In search for sustainable agricultural methods for medicinal plants. A field experiment was conducted at the College Agronomy Farm, Anand Agricultural University, Anand, Gujarat during *rabi* season of 2013-14. The experiment consisted of eighteen treatment combinations comprised of three nitrogen levels (15, 30 and 45 Kg N ha^{-1}), three phosphorus levels (0, 15 and 30 Kg P ha^{-1}) and two potassium levels (0 and 30 Kg K ha^{-1}). The treatment N_3 (45 kg N ha^{-1}) recorded significantly the maximum seed and straw yields as well as plant height at harvest, no. of effective tiller plant^{-1}, no. of effective spikelet plant^{-1} and test weight of 1000 seeds and significantly higher length of spike as compared to other nitrogen treatments i.e. N_1 (15 kg N ha^{-1}) and N_2 (30 kg N ha^{-1}). Significantly higher seed and straw yields as well as plant height at harvest and no. of effective spikes plant^{-1}, while no. of tiller plant^{-1} showed the significantly higher - response by application of 30 kg P_2O_5 ha^{-1}, other characters like length of spikes and test weight of 1000 seeds and swelling factor found to be non-significant response. The response on growth and yield attributing characters as well as seed and straw yields of isabgol were also found non-significant due to different potassium levels. On economical point of view when isabgol treated with 45 kg N ha^{-1}, 30 kg P_2O_5 ha^{-1} and 30 kg K_2O ha^{-1} noted higher net realization as compared to other treatment.

Key words: Nitrogen, phosphorus, potassium, yield, Isabgol.

At present isabgol crop has required the place “dollar earner” in north Gujarat and south western Rajasthan. India with its varied agro-climatic conditions and topography has a large number of medicinal plant species. Isobgol is an annual her cultivated recevtly as a medicinal plant at Directorate of medicinal and Aromatic plants Research. The herbal wealth constitutes about 5000 species of known medicinal and aromatic plants which are used in the various systems of Indian medicines *viz*., Ayurveda, Siddha and Unani, since time immemorial (Marketa, 2002). Isabgol (*Plantago ovata*, Forsk.) is one of the most important medicinal plant with the foremost agricultural and commercial values in India. Isobgol seed hust has the property of absorbing and retaining water which account for its utility in stopping diarrhea. Some studied have shown that black cumin and isabgol are able to tolerate moderate level of water stress.

Isabgol (*Plantago ovata* Forsk.) is an annual herb of about 30-45 cm height with usually four to five tillers arising from the main stem. It has tap root system as in normal dicots. The most important part of isabgol is the mucilage, which is a polysaccharide coating on the seed. The separated husk is popular as “Sat Isabgol” (fetch price ` 280 kg^{-1}) in the Indian market. The husk from the seed is separated by physical process. It

* To whom all correspondence should be addressed.
E-mail:

works as an anti-diarrhoea drug. It is also used for treating constipation and intestinal disorders. The dehusked seed is around 69 % by weight of total seed and is known to be rich in the starch and fatty acids (Atal *et al.*,1964). Refined husk is used in the food industry for manufacturing sausages, ice creams and sauces. It is also used in dyeing, calico printing, setting lotions and in cosmetics. Nitrogen, phosphorus and potassium shortly are the three primary elements of fertilizer. Deficiency of nitrogen has very marked effect on plant growth. Insufficient nitrogen may reduce the yield drastically and also deteriorates the quality of the produce. Phosphorus play beneficial role in the root development, nodulation and stimulation of the symbiotic nitrogen fixation. Plant require relatively large amount of potassium and often can use more than the soil can supply. Potassium is the third most likely nutrient element to limit plant. Potash plays a critical role in the regulation of plant physiological functions: It strengthens the cell walls, aids in water retention, improves disease resistance and boost nitrogen and phosphate absorption. Enhancing these functions results in improved plant quality and increased yields.

MATERIALS AND METHODS

A field experiment was conducted at College Agronomy Farm, B. A. College of Agriculture, Anand Agricultural University, Anand to find out the "Response of different levels of nitrogen, phosphorus and potassium on yield and quality of isabgol (*Plantago ovata* Forsk.) under middle Gujarat conditions" during *rabi* season of 2013-14. The experiment consist of eighteen treatment combination comprise of three nitrogen levels (15, 30 and 45 kg N ha-$^{-1}$), three phosphorus levels (0, 15 and 30 kg P_2O_5 ha-$^{-1}$) and two potassium levels (0 and 30 kg K_2O ha-$^{-1}$). The field experiment was laid out in a RBD (Factorial) with four replications. The soil of experimental site was loamy sand in texture having good drainage capacity with pH 7.15. It was low in available nitrogen (242.50 kg ha^{-1}), medium in available phosphorus (32.56 kg ha^{-1}) and higher in available potash (284.20 kg ha^{-1}). Nitrogen was given as per treatment in the form of urea. The full dose of phosphorus and potassium were applied in the from SSP and MOP, respectively and half dose of nitrogen applied as a basal dose at the time of sowing. The remaining half dose of nitrogen was applied after 30 DAS. The isabgol crop was sown at a spacing of 30 cm using the seed rate of 4 kg ha^{-1}. The economics was worked out on common current price basis. The values of "F" was worked out and compared with the value of table F at 5 % level of significance. The values of S. Em ±, C. D. and C. V. % were also calculated [Cochram and Cox (1967)].

RESULTS AND DISCUSSION

Effect of nitrogen

The results on seed and straw yields of isabgol (Table 1) indicated that the differences due to different nitrogen levels were found significant. An appraisal of data in Table 1 revealed that the seed and straw yields of isabgol displayed on increasing trend with increase in nitrogen levels from 15 to 45 kg N ha^{-1}. Significantly the maximum seed (1243 Kg ha^{-1}) and straw (6459 Kg ha^{-1}) yields were registered under the treatment N_3 (45 Kg N ha^{-1}). The increase in seed yield of isabgol under the treatments N_3 (45 Kg N ha^{-1}) and N_2 (30 Kg N ha^{-1}) were at the extent of 35.86 % and 21.86 %, respectively as compared to N_1 (15 Kg N ha^{-1}). The increase in straw yield of isabgol under the treatments N_3 (45 Kg N ha^{-1}) and N_2 (30 Kg N ha^{-1}) were at the extent of 28.64 % and 14.72 %, respectively as compared to N_1 (15 Kg N ha^{-1}). Significantly the lowest seed (915 Kg ha^{-1}) and straw (5021 Kg ha^{-1}) yields were found under the treatment N_1 (15 Kg N ha^{-1}). Yield of any crop plant depends on the source sink relationship and is the cumulative function of various growth parameter and yield attributing component of sink. The increase in seed and straw yields of isabgol due to different levels of nitrogen might be nitrogen is an essential constituent of plant tissue and involved in cell devision and cell elongation, its beneficial effect on growth and yield characters of plant. The positive role played by the nutrient on growth and metaboism of plants, which increased the accumulation of matter in plant. Other reason might be due to favourable influence of N on growth and yield attributes *viz.*, number of tillers per plant, effective number of spikes per plant and length of spike which were important growth and yield attributes having significant positive correlation with the seed yield. As the grain yield is a product

Table 1. Effect of different levels of nitrogen, phosphorus and potassium on yield, growth, yield attributes and net realization of isabgol

Treatment	Yield (kg ha^{-1}) Seed	Straw	Plant height (cm) at harvest	No. of tillers $plant^{-1}$	No. of effective spikes $plant^{-1}$	Length of spike (cm)	Test weight of 1000 seeds (g)	Swelling factor (cc g^{-1})	Net Realization (‘ ha^{-1})	BCR
Nitrogen levels (kg ha^{-1}) (N)										
N_1- 15	915	5021	37.51	70.98	46.68	5.16	1.66	10.33	59337	3.14
N_2- 30	1115	5760	38.93	94.45	60.97	5.68	1.70	10.39	75875	3.98
N_3- 45	1243	6459	40.85	107.60	72.48	5.89	1.75	10.39	86612	4.49
S. Em. +	31	139	0.41	1.32	1.27	0.08	0.01	0.13	-	-
C.D. (P=0.05)	89	395	1.61	3.76	3.61	0.24	0.04	NS	-	-
Phosphorus levels (kg ha^{-1}) (P_2O_5)										
P_1- 0	998	5427	38.11	85.66	54.35	5.44	1.68	10.31	66876	3.64
P_2- 15	1096	5752	39.23	91.57	61.29	5.57	1.69	10.39	74347	3.90
P_3- 30	1179	6062	39.94	95.85	64.50	5.73	1.73	10.42	80603	4.08
S. Em. +	31	139	0.41	1.32	1.27	0.08	0.01	0.13	-	-
C.D. (P=0.05)	89	395	1.16	2.83	3.61	NS	NS	NS	-	-
Potassium levels (kg ha^{-1}) (K_2O)										
K_1- 0	1054	5669	39.27	89.49	58.36	5.55	1.69	10.5	71347	3.83
K_2- 30	1128	5824	39.91	92.56	61.73	5.61	1.71	10.25	76536	3.92
S. Em. +	26	113	0.33	1.07	1.04	0.07	0.01	0.01	-	-
C.D. (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	-	-
Interactions	NS	NS	NS	NS	NS	NS	NS	NS	-	-
C.V. %	14.1	11.85	5.13	7.09	10.37	7.48	4.79	4.79	-	-

Note:- Selling price of Isabgol seed: 80.00 ‘ kg^{-1}, Selling price of Isabgol straw: 01.00 ‘ kg^{-1}

of yield attributing character, increase in their values resulted in increased seed and straw yields. The results are in conformity with the findings of Kumavat *et al*. (2002), Yadav *et al*. (2003), Wankhede *et al*. (2005) and Mir *et al.* (2007).

Singnificantly the height plant height at harvest (40.85 cm), no. of tiller plant^{-1} (107.50), no. of effective spikes plant^{-1} (72.48) and test weight of 1000 seeds (1.75 g) and significantly higher length of spike (5.89 cm) was recorded in treatment N_3 (45 kg N ha^{-1}).Non significant response was found in case of swelling factor during the ivestigation. The increase in plant height with increase in successive levels of nitrogen might be due to more supply of nitrogen to crop resulting in rapid synthesis of carbohydrates and consequently converted into protoplasm and thereby smaller portion available for cell wall formation. This has served consequences one of them is increase in size of cell which is expressed morphologically through increase in plant height (Utgikar *et al*. 2003).

Effect of phosphorus

Application of phosphours not only increase the crop yield but also improves the quality and imparts resistance against disease (Narolia and Shivram, 2013).

The results on seed and straw yields of isabgol (Table 1) indicated that the differences due to different phosphorus levels were found significant. It was apparently from the results that the seed and straw yields of isabgol displayed on increasing trend with the different phosphorus levels. The significantly maximum seed (1179 Kg ha^{-1}) and straw (6062 Kg ha^{-1}) yields were registered under the treatment P_3 (30 Kg P_2O_5 ha^{-1}), however it was at par with treatment P_2 (15 kg P_2O_5 ha^{-1}). The lower seed (998 kg ha^{-1}) and straw (5427 kg ha^{-1}) yields were observed with treatment P_1 (control) which was at par with treatment P_2 (15 kg P_2O_5 ha^{-1}) for straw yield. The increase in seed yield of isabgol under the treatments P_3 (30 Kg P_2O_5 ha^{-1}) and P_2 (15 kg P_2O_5 ha^{-1}) were at the extent of 18.14 % and 9.82 %, respectively as compared to P_1 (control). The increase in straw yield of isabgol under the treatments P_3 (30 Kg P_2O_5 ha^{-1}) and P_2 (15 kg P_2O_5 ha^{-1}) were at the extent of 11.70 % and 5.99 %, respectively as compared to P_1 (control). The increase in seed and straw yields of isabgol due to levels of phosphorus might be due to favourable influence of P on growth and yield attributes *viz.*, number of tillers per plant, effective number of spikes per plant and length of spike. Which were important growth and yield attributes having significant positive correlation with the seed yield. The higher yields of isabgol seed and straw obtained by application of 30 kg P_2O_5 ha^{-1}. The results are conformity with the findings of Jadav *et al.* (2000) and Utgikar *et al.* (2003).

Date presented in Table-01 indicated that application of phosphorus 30 kg P_2O_5 ha^{-1} noted significantly higher plant height at harvest (39.94 cm), no. of effective spikes plant^{-1} (64.50) and significantly the highest no. of tillers plant^{-1} (95.85). The response of phosphorus treatment found to be non-significant on length of spike, test weight of 1000 seeds and seed swelling factor. The highest growth attributes with the application of 30 kg P_2O_5 ha^{-1} might be due to the better root growth and shoot formation by phosphorus element to isabgol crop. The result is conformity with the findings of Chand and Dadheech (2008).

Effect of potash

The appraisal of mean data pertaining to the influence of different potassium levels on the growth and yield attributes as well as seed and straw yields of isabgol indicated that there existed non-significant difference (Table-1).

Economics

The economic aspect of crop production is the major consideration for farmer while making a decision on the adoption of new technology. Among the different nitrogen levels, application of 45 kg N ha^{-1} (N_3) recorded the highest net realization (86612 ha^{-1}) and B.C.R. (4.79) values, while the lowest net realization (59337 ha^{-1}) and B.C.R. (3.14) were recorded in treatment N_1. Among the different phosphorus levels, application of 30 kg P_2O_5 ha^{-1} (P_3) recorded the highest net realization (80603 ha^{-1}) and B.C.R. (4.08) values. Among the different potassium levels, application of 30 kg K_2O ha^{-1} (K_2) recorded the highest net realization (76536 ha^{-1}) and B.C.R. (3.92) values.

CONCLUSION

In the light of the results obtained from present investigation, it is concluded that for securing higher seed and straw yields of isabgol, crop should be fertilized with application of 45 kg

Nitrogen and 30 kg Phosphorus ha^{-1} in loamy sand soil under middle Gujarat conditions.

ACKNOWLEDGEMENTS

Author profusely thanks, professor and head, Department of Agronomy for giving advice and for providing necessary facilities for this studies.

REFERENCES

1. Atal C K, Kapoor K K and Siddique M M. Studies on Indian Seed Oils : Part-I, *Indian Journal of Pharmacy*. 1964; **26** : 163.
2. Cochran, W. G. and Cox, G. M. Experimental Designs, John Willey and Sons. Inc. New York : 1967: 546-568.
3. Chand, Lekh and Dadheech, R. C. Effect of sowing dates, fertility levels and farmyard manure on growth and yield of isabgol (*Plantago ovata* Forsk.). *Journal of Medicinal and Aromatic Plant Science*, 2008; **30**: 356-358.
4. G. A. Narolia and A.C.Shivram. Effect of phosphorus, PSB and zinc on content and uptake of isabgol. *International J. Agric. Sci.*, 2013; 9**(1):** 338-340.
5. Jadav C N, Sukhadiya N M and Ramani B B. The effect of sowing dates, nitrogen and phosphorus on growth and yield of Isabgol (*Plantago Ovata* Forsk.*). GAU Research Journal*, 2000; **25**(2) : 84-87.
6. Kumawat S K, Gaur B L and Nepali V. Weed dynamics and NPK uptakes by *Blond psyllium* (*Plantago Ovata* Forsk.) as influence by Sowing methods, Nitrogen and Weed management. *Indian Journal of Weed 00Science*, 2002; **34** (3 & 4) : 254-258.
7. Marketa, H. Variability, Correlation and Path Analysis studies in isabgul (*Plantago ovata* Forsk) for yield and downy mildew resistance. M.Sc (Agri). Thesis submitted to Gujarat Agricultural University, S.K. Nagar; 2002.
8. Mir N A, Kar S R, Khan F U and Shah J A. Effect of sowing methods and nitrogen levels on the growth and yield potential of variety Niharika of Isabgol (*Plantago Ovata* Forsk). *Journal of Medicinal and Aromatic Plant Science*, 2006; **29** : 54-56.
9. Utgikar S, Sadawarte K T and Wankhade S G. Growth and yield of isabgol (*Plantago ovate, Forsk*) as influenced by to Nitrogen and Phosphorus levels. *Agricultural Science Digest*, 2003; **23 (**1**) :** 77-78.
10. Wankhede S G, Khode P P, Wanjari S S, Paturde J T and Kale M R. Response of Isabgol (*Plantago ovata Forsk*) to Nitrogen and Phosphorus. *Agricultural Science Digest*, 2005; **25 (**2**):** 121-123.
11. Yadav R D, Keshwa G L and Yadav S S. Effect of integrated use of FYM, urea and sulphur on growth and yield of isabgol (*Plantago ovata*). *Journal of Medicinal and Aromatic Plant Science.*, 2003; **25:** 668-671.