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Research Article

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

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ABSTRACT

A field experiment entitled the effect of different levels of nitrogen and phosphorus on growth, yield and quality of isabgol (Plantago ovata Forsk.). The experiment was carried out during rabi season of the year 2017-18 at the Instructional Farm, Department of Agronomy, College of Agriculture, Junagadh Agricultural University, Junagadh. The experiment was laid out in Factorial RBD with 3 replications by combining 2 factors namely four levels of nitrogen (0, 15, 30 and 45 kg/ha) and four levels of phosphorous (0, 15, 30 and 45 kg/ha). Application of 45 kg N/ha was observed superior over rest of the levels of N in increasing plant height, plant spread, number of tillers per plant, number of spikes per plant, spike length,1000 seed weight, seed yield per plant and per hectare, straw yield per plant and per hectare and protein content. Application of 30 kg P_2O_5/ha significantly increased plant height, number of tillers per plant, number of spikes per plant, spike length, seed yield per plant and per hectare, straw yield per plant and per hectare. While, mucillage content in seed and harvest index did not influenced by N application and plant spread, 1000 seed weight, harvest index, protein content and mucilage content did not influenced by P_2O_5 application . Interaction effect of nitrogen and phosphorus was found significant with respect to seed yield per plant and per hectare. Based on finding, it can be concluded that maximum growth, yield and quality parameters was obtained with application of 45 kg N/ha and 30 kg P_2O_5/ha as per requirement under medium black calcareous soil under South Saurashtra agro climatic zone.

Keywords: *Isabgol, Fertilizer, Mucillage, Nitrogen, Phosphorus, Growth, yield, Quality*

INTRODUCTION

India is the bowl of medicinal and aromatic plants in the world due to its diversified ecosystems. Gujarat and Rajasthan together contribute more than 80 per cent of the total seed spices production in the country and thus, both the states together are known as "seed spices bowl" of India. Now a days, it has acquired the name "Dollar earner" in North Gujarat and South Western Rajasthan as described by Modi et al. (1974).

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Isabgol (*Plantago ovata* Forsk.) is one of the most important medicinal plant with the foremost agricultural and commercial values in India. It belongs to the order Plantaginales, which consists of a single family *Plantaginaceae* having the chromosome number 2n=8.

The area under isabgol was 9,700 hectares as on December 13, against the three-year average of 8,900 hectares. Gujarat's dwindling share with about 1.2 lakh tonnes of isabgol production every year, India is the leading producer of the crop (Anon., 2018[1]). Isabgol fetched ₹2,100-2,300 per 20 kg at Unjha, whereas the processed isabgol husk is priced at ₹150-180 per kg, depending on quality. Majority of medicinal crops are grown in marginal land with reduced rate of fertilizer application of nitrogen and phosphorus. To provide economically sustainable yields, nutritional element must be present in sufficient quantities in soil and they must be available for root uptake. Nitrogen and phosphorus are essential element for plant growth and development of isabgol.

Nitrogen is the motor of plant growth and it is a component of protein and nucleic acids. Nitrogen serves as the source for the dark green colour in the leaves of various crops. This is a result of a high concentration of chlorophyll. Nitrogen is a common plant nutrition which promotes vegetative developments in plants. This plant nutrient is also important for producing herbage, folium and seed yields in medicinal and spice plants.

Phosphorus is the most important key element in the nutrition of isabgol second only to nitrogen required by plants (Srinivasan et al., 2015). 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. It is a key nutrient for higher and sustained agriculture productivity (Scervino et al., 2011) which is limiting plant growth in many soils including area of present study. Phosphorus, the master key element is known to be involved in a plethora of functions in the plant growth and metabolism as described by Mahdi et al. (2011).

MATERIALS AND METHODS

The experiment has been conducted during *rabi* season of the year 2017-18 at the Instructional Farm, Department of Agronomy, College of Agriculture, Junagadh Agricultural University, Junagadh. The soil of the experimental plot was clayey in texture and slightly alkaline in reaction with pH 7.67 and EC 0.52 dS/m. The soil was high in available nitrogen (245 kg/ha), medium in available phosphorus (35 kg/ha) and potassium (270 kg/ha). The experiment were laid out in factorial randomized block design with three replications and consisting all possible combinations of four levels of nitrogen *viz.*, 0, 15, 30 and 45 kg/ha and four levels of phosphorus *viz.*, 0, 15, 30 and 45 kg/ha. The sources of nutrients as per treatment like nitrogen and phosphorus were used Urea, SSP respectively. To neutralize the effect of sulphur, cosavetsulphur was applied as per requirement. Full dose of nitrogen and phosphorus was applied as basal dose at the time of sowing of isabgol.

RESULTS AND DISCUSSION

Effect of nitrogen

Growth, yield and Quality parameters

An assessment of data (Table 1 and 2) indicated that application of nitrogen brought about significant variation plant height, plant spread, number of tillers per plant, number of spikes per plant, length of spikes, 1000 seed weight, seed yield per plant, straw yield per plant, seed yield per kg, straw yield per kg, protein content. Fertilize the crop with 45 kg N/ha produced remarkably higher plant height (30.23 cm), plant spread (18.82 cm), number of tillers per plant (5.42), number of spikes per plant (21.75), length of spikes (4.48 cm), 1000 seed weight (1.57 g), seed yield/plant (4.53 g/plant), straw yield/plant (13.07 g/plant), seed yield (908 kg/ha), straw yield (2741 kg/ha) and

Protein content (10.10 %). However, it was remain statistically at par with 30 kg N/ha with respect to all these parameters. While mucillage content in seed and harvest index did not influenced by N application, this result was confirmed with finding of Omidbaigi and Mohebby (2002), Chouhan et al. (2006) and Patel (2015).

Nitrogen is considered to be a vitally important plant nutrient. In addition to its role in the formation of proteins, nitrogen is an integral part of chlorophyll which is the primary absorber of light energy needed for photosynthesis. Thus, greater availability of photosynthates, metabolites and nutrients to develop reproductive structure seems to have resulted in increased growth, yield attributes, yield and protein content with nitrogen levels of 45 kg N/ha. Nitrogen is the key element in protein and also as nitrogen plays an important role in synthesis of amino acid, which constitutes building blocks of protein and that might have resulted in higher protein content. The present findings are in close agreement with the results obtained by Lekh Chand (2002), Rahimi et al. (2013), Patel (2015), Shivran (2016).

Effect of phosphorus

Growth, yield and quality parameters

Application of phosphorus levels significantly influenced growth parameters, yield attributes and seed and straw yield (Table-1 and 2) except plant spread, 1000 seed weight, harvest index and quality parameters. Significantly the higher plant height (29.16 cm), number of tillers per plant (4.76), number of spikes per plant (20.92), length of spike (4.01), seed yield per plant (4.12 g/plant), straw yield per plant (12.13 g/plant), seed yield (887 kg/ha) and straw yield (2682 kg/ha) were found with application of 30 P_2O_5/ha.

Phosphorus fertilization improves the various metabolic and physiological processes and thus known as “energy currency” which is subsequently used for vegetative and reproductive growth through photophosphorylation. An adequate supply of phosphorus early in the life of a plant is important in laying down the primordial for its reproduction parts. It is an essential for growth, cell division, root growth and elongation, seed and fruit development and early ripening. These all process favourably improved with higher rate of phosphorus and resulted into higher seed and straw yield of isabgol. These results of the investigation are in close conformity with Waghmare et al. (2010), Jajoriya et al. (2013) and Shivran et al. (2015).

Interaction effect of nitrogen and phosphorus

A glimpse of data (Table 3) revealed that among possible interactions in relation to seed yield per plant and per hectare, interaction effect N×P (nitrogen × phosphorus levels) was significant. The treatment combination N_4P_3 (45 kg N/ha and 30 kg P_2O_5/ha) registered significantly the highest seed yield (5.03 g) and (1067 kg/ha), which was remain statistically at par with the treatment combination N_4P_4, N_4P_2, and N_3P_3, Whereas treatment combination N_3P_2 (30 kg N/ha and 15 kg P_2O_5/ha) and N_4P_2 (45 kg N/ha and 15 kg P_2O_5/ha) stayed statistically at par in case of seed yield per hectare. However, higher dose of nitrogen up to 45 kg /ha causes profuse vegetative growth and application of phosphorus results in seed formation and root formation. Both these nutrients play an important role in various physiological functions such as photosynthesis, cholorophyll synthesis and reduced attack of diseases and pests etc. and ultimately leads to the improvement of growth and seed yield. So that interactive effect of both this fertilizer nitrogen and phosphorus produced higher grain yield. This result conformed with the findings of Kharbade and Gaikwad (2008) and Patel (2015).

Table 1: Effect of nitrogen and phosphorus on growth and quality of isabgol

Treatments	Plant height (cm)	Plant spread (cm)	Number of tillers/plant	Number of spikes/plant	Length of spike (cm)	Protein content (%)	Mucillage content (%)
Levels of Nitrogen (N kg/ha)							
N_1 : 0	23.91	16.38	3.01	17.08	2.13	7.82	10.32
N_2 : 15	26.75	16.88	4.05	18.50	3.54	8.81	10.37
N_3 : 30	28.54	17.89	5.04	20.58	4.19	9.80	10.39
N_4 : 45	30.23	18.82	5.42	21.75	4.48	10.10	10.40
S.Em.±	0.72	0.42	0.14	0.63	0.10	0.14	0.14
C.D. at 5 %	2.08	1.21	0.39	1.83	0.29	0.41	NS
Levels of Phosphorus (P_2O_5kg/ha)							
P_1 : 0	25.71	16.83	3.93	18.33	2.89	9.01	10.33
P_2 : 15	27.83	17.40	4.51	19.83	3.79	9.14	10.34
P_3 : 30	29.16	18.01	4.76	20.92	4.01	9.18	10.40
P_4 : 45	26.73	17.73	4.33	18.83	3.65	9.20	10.42
S.Em.±	0.72	0.42	0.14	0.63	0.10	0.14	0.14
C.D. at 5 %	2.08	NS	0.39	1.83	0.29	NS	NS
Interaction (N × P)							
S.Em.±	1.44	0.84	0.27	1.27	0.20	0.28	0.28
C.D. at 5 %	NS	NS	NS	NS	NS	NS	NS
C.V.%	9.13	8.31	10.73	11.25	9.83	5.40	4.86

Table 2: Effect of nitrogen and phosphorus on yield attributes and yield of isabgol

Treatments	Seed yield (g/plant)	Straw yield (g/plant)	1000 seed weight (g)	Seed yield (kg/ha)	Straw yield (kg/ha)	Harvest index (%)
Levels of Nitrogen (N kg/ha)						
N_1 : 0	2.66	9.38	1.31	683	2244	23.21
N_2 : 15	3.50	10.44	1.40	762	2438	23.83
N_3 : 30	4.28	12.34	1.52	841	2574	24.67
N_4 : 45	4.53	13.07	1.57	908	2741	24.90
S.Em.±	0.11	0.31	0.02	27	77	0.86
C.D. at 5 %	0.32	0.90	0.06	78	224	NS
Levels of Phosphorus (P_2O_5kg/ha)						
P_1 : 0	3.20	10.79	1.42	658	2283	22.19
P_2 : 15	3.84	11.30	1.46	833	2579	24.55
P_3 : 30	4.12	12.13	1.48	887	2682	24.99
P_4 : 45	3.82	11.02	1.45	816	2452	24.89
S.Em.±	0.11	0.31	0.02	27	77	0.86
C.D. at 5 %	0.32	0.90	NS	78	224	NS
Interaction (N × P)						
S.Em.±	0.22	0.62	0.04	54	155	1.72
C.D. at 5 %	0.65	NS	NS	157	NS	NS
C.V.%	10.34	9.53	4.61	12	11	12.33

Table 3: Interaction effect of nitrogen and phosphorus on seed yield per plant and per hectare

Treatments	Seed yield (g/plant)				Seed yield (kg/ha)			
	P_1	**P_2**	**P_3**	**P_4**	**P_1**	**P_2**	**P_3**	**P_4**
N_1	2.30	2.47	2.87	2.99	450	833	750	700
N_2	3.23	3.74	3.93	3.10	683	667	867	833
N_3	3.89	4.30	4.63	4.31	700	933	867	867
N_4	3.37	4.83	5.03	4.88	800	910	1067	867
S.Em.±	0.22				54			
C.D. at 5%	0.65				157			

CONCLUSION

On the basis of experiment results, it could be concluded that the different levels of nitrogen and phosphorus significantly influenced the growth, yield and quality of isabgol. The application of nitrogen at 45 kg N/ha and phosphorus at 30 kg P_2O_5/ha performed better in terms of growth parameters, yield attributes, yield and quality parameters under medium black calcareous soils.

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