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Interaction effect of Spacing and Nutrient Levels on N, P and K Content and Uptake of Isabgol Plant (*Planatago ovata forsk*) under Eastern Dry Zone of Karnataka

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The experiment was laid out in a Factorial Randomized Block Design with sixteen treatments and replicated three times. There was no significant difference among the treatments with respect to nitrogen, phosphorus and potassium content of leaves under different levels of planting geometry and interaction effect. But different nutrient levels had significant influence in the N, P and K content in isabgol plant. Higher N (3.76%), P (0.7%) and K (3.59 %) content in the leaves was observed when plants supplied with 75 % RDF (37.5:18.75:22.50 + 7.5 t FYM). The maximum uptake of N (229.11 kg /ha), P (43.98 kg /ha) and K (218.46 kg /ha) was found at row spacing of 22.5 cm, which was significantly superior to other spacing levels.Nutrients had significantly influenced the N, P and K uptake. The 75 % RDF (37.5:18.75:22.50 + 7.5 t FYM) level recorded maximum uptake of N

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(166.36 kg /ha), P (32.13 kg /ha) and K (158.39 kg /ha), which was significantly superior to all other nutrient levels.Among the interactions, 22.5 cm row spacing + 75 % RDF (37.5:18.75:22.50 + 7.5 t FYM) recorded significantly maximum N, P and K uptake (252.05, 49.31 and 238.85 kg/ha respectively).
Where, RDF= recommended dose of fertlizer, FYM = Farm yard manure

Keywords: Isabgol ; Plantago ovata ; spacing; nutrients.

1. INTRODUCTION

India is termed as the Botanical garden of the world with botanical wealth of more than 2000 medicinal plant species. The developing countries are the leading suppliers of medicinal plants to the world and India is one of them. There is an ever-growing demand for medicinal plants in pharmaceutical and phyto-chemical industries. It is estimated that the world trade in these materials is around 12,000 million US $ and it is expected to rise to 33,000 million US $ (Reddy, 2000). India's contribution is around 1,200 million US $ and is expected to rise to 8,500 million US $ at the end of 2000 AD. In addition to this, the demand of these products in the domestic market is also increasing. There exists a considerable gap between demand and supply of the plant products of medicinal nature. Plantago ovata commonly known as Isabgol, Psyllium or Indian Plantago belongs to family Plantginaceae.

Psyllium seed is in use in medicine since long. The seed husk of psyllium has the property of absorbing and retaining water which accounts of its utility in checking diarrrhoea. In patients suffering chronic dysentery, the ulcered surface of intestinal mucosa is soothed by the demulcent action of the mucilage. The mucilage spreads along the inner wall of intestine and protects it against the irritants present in food. Moreover, the mucilage absorbs toxins from the gut and helps in excerting them from the body. Use of 2 or 3 heaped desert spoonfuls of seed, twice a day, for a couple of months resolves all symptoms of chronic dysentery and eliminates Entamiels a histolytica, if present, from the patients body. The mucilage of the seed husk acts as a lubricant in the large intestine. The husk is consumed alone or is mixed with different chemicals, such as powdered anhydrous dextrose, sodium bicarbonate, citric acid etc. Isabgol is diuretic, it alleviates kidney and bladder complaints, gonorrhea, urethritis and hemorrhoids. It removes burning sensation in feet, relieves polyuria difficult micturition and tones up bladder. It is also effective in checking spermatorea. It is recommended for use by pregnant women.Seed husk of Isabgol is also used in ice cream industry as substitute for sodium alginate. The mucilage is used as an ingredient in chocolate making, textile sizing, manufacturing cosmetics and setting and dressing hairs .The seeds and husk are also used in dyeing. Psyllium is also a source of commercial gum. Tribals use Isabgol for several purposes, the snthals use it to relieve pains and treat bronchitis. The tribal inhabitants of North Gujarat consume seed decoction of psyllium as a cooling demulcent to cure diarrhea and dysentery. Isabgol Gola's byproduct of psyllium is used as cattle feed Its consumption has no adverse effect on production and composition of milk and the body weight of milch cows.

2. MATERIALS AND METHODS

2.1 Geographical Location and Climate

The experiment was carried out at Medicinal and Aromatic Crops Block, College of Horticulture, University of Horticultural Sciences Campus, Gandhi Krishi Vignana Kendra (Post), Bengaluru, which is located at an elevation of 930 meter above MSL with a latitude of 12°58' North and longitude of 77°35' East.

2.2 Soil Characteristics

The experimental field wasfairly leveled land with red sandy loam soil of uniform fertility status. The soil samples were collected from a depth of 30 cm in randomly selected spotsbefore laying out the experiment. The composite soil samples were analyzed for pH, electric conductivity, organic carbon, available nitrogen, phosphorus and potassium. The Soil samples were also drawn as per treatments after harvest of the crop and analyzedfor pH, electrical conductivity, organic carbon, available nitrogen, phosphorus and potassium.

The study was laid out in FRCBD (Factorial Randomized Block Design) with sixteen treatment combinations having three replications

having T_1- 22.5 cm Row spacing + 75 % RDF (37.5:18.75:22.50 + 7.5 t FYM),T_2- 22.5 cm Row spacing + 100 % RDF (50:25:30 + 10 t FYM),T_3- 22.5 cm Row spacing + 125 % RDF (62.5:31.25:37.50 + 12.5 t FYM),T_4- 22.5 cm Row spacing + 100% RDN through FYM + 10 t FYM, T_5- 30 cm Row spacing + 75 % RDF (37.5:18.75:22.50 + 7.5 t FYM), T_6- 30 cm Row spacing + 100 % RDF (50:25:30 + 10 t FYM), T_7- 30 cm Row spacing + 125 % RDF (62.5:31.25:37.50 + 12.5 t FYM), T_8- 30 cm Row spacing + 100% RDN through FYM + 10 t FYM, T_9- 37.5 cm Row spacing + 75 % RDF (37.5:18.75:22.50 + 7.5 t FYM), T_{10}- 37.5cm Row spacing + 100 % RDF (50:25:30 + 10 t FYM),T_{11}- 37.5cm Row spacing + 125 % RDF (62.5:31.25:37.50 + 12.5 t FYM),T_{12}- 37.5 cm Row spacing + 100% RDN through FYM + 10 t FYM, T_{13}- 45 cm Row spacing + 75 % RDF (37.5:18.75:22.50 + 7.5 t FYM), T_{14}- 45 cm Row spacing + 100 % RDF (50:25:30 + 10 t FYM), T_{15}- 45 cm Row spacing + 125 % RDF (62.5:31.25:37.50 + 12.5 t FYM),T_{16}- 45 cm Row spacing + 100% RDN through FYM + 10 t FYM.

2.2.1 Method of imposing the treatments

Full dose of FYM applied one week before sowing and mixed well with soil. Nitrogen in the form of urea, phosphorous in the form of single super phosphate and potash in the form of muriate of potash were applied. Fifty per cent of nitrogen and full dose of phosphorous and potassium were applied to plot at 7-10 cm depth in the lines just before sowing of seeds and remaining fifty per cent of nitrogen was top dressed at 45 days after sowing.

2.3 Soil Analysis

The representative soil samples from each treatment were collected from a depth of 0-30 cm after harvest of the crop. The soil samples were dried under shade, powdered with wooden pestle and mortar, passed through 2 mm sieve and stored in clean polythene bags for analysis. For determination of organic carbon, 2 mm sieved soil samples were further powdered in a agate pestle and mortar and passed through 0.2 mm sieve. The samples were analyzed for their Physico-chemical properties as per the standard procedure as outlined below.

2.4 Soil pH

The pH of soil was measured in 1:2.5 soil : water suspensions after stirring the contents intermittently for 30 minutes. The pH value was recorded using a pH meter fitted with combined glass and calomel electrodes [1].

2.5 Electrical Conductivity (dS m^{-1})

The electrical conductivity of clear soil water extract was determined in the 1 : 2.5 soil water suspension using a conductivity bridge fitted with conductivity cell and values were expressed in dS m^{-1} [1].

2.6 Organic Carbon (%)

Organic carbon content of the soil was determined by following the wet- oxidation method using standard $K_2Cr_2O_7$ with H_2So_4 and unused dichromate was estimated by back titration with standard ferrous ammonium sulphate as described by Walkley and Black [2] and expressed in percentage.

2.7 Available Nitrogen

The available nitrogen content of soil was determined by following alkaline potassium permanganate method. The liberated ammonia was absorbed in boric acid solution and titrated against standard Sulphuric acid as described by Subbaiah and Asija [3] and expressed in kg ha^{-1}.

2.8 Available Phosphorus

The available phosphorus content of soil was extracted with Bray's No. 1 extractant containing 0.03 N NH_4 in 0.25 N HCl for 5 minutes and filtered. In the filtrate, phosphomolybdate blue colour was developed by using ammonium molybdate, antimony-potassium-tartarate and ascorbic acid in H_2SO_4 system. The intensity of blue colour developed was read at 660 nm wave length on UV- spectrophotometer as described by Jackson [1] and expressed in kg ha^{-1}.

2.9 Available Potassium

Available potassium content of soil was estimated by flame photometrically using neutal normal ammonium acetate extract after proper dilution as suggested by Jackson, [1] and expressed in kg ha^{-1}.

2.10 Procedure for Caluculation of N, P and K Content (%) in Plant and its Uptake (kg/ ha)

2.10.1 Plant analysis

Five plants from each treatment were uprooted along with roots at the time of harvest. The plants

were washed with tap water, air dried and then oven dried at 60° C. The dried samples were ground to a fine powder using willey mill.

One gram of powdered sample was pre-digested with 10 ml of concentrated nitric acid and kept overnight. It was digested on a hot plate with di-acid mixture (HNO_3 : HCl_4 in 10:4 ratio) until a gelatinous white residue was formed. It was cooled and made to a known volume with distilled water. This extract was used for analysis of phosphorous and potassium

2.10.2 Total nitrogen content (%)

Plant sample (0.5 g) was digested with concentrated sulphuric acid in presence of digestion mixture (K_2SO_4: $CuSO_4$: Se in 100: 20: 1 ratio) by boiling till a bluish green residue was formed. The nitrogen of digested sample was determined by Micro – Kjeldahl distillation method [4] and expressed on dry weight basis.

2.10.3 Phosphorous content (%)

The phosphorus content of the di-acid digested extract was determined by using Vanado-molybdate phosphoric acid yellow colour method in nitric acid medium. The intensity of yellow colour was read using UV- Spectrophotometer at 420 nm wave length as described by Piper [4] and after digestion using di-acid and expressed in percentage on dry weight basis.

2.10.4 Potassium content (%)

The potassium content of the di-acid digested extract was determined by flame photometric method as outlined by Piper [4] and expressed in percentage on dry weight basis.

2.11 Uptake of N, P and K (kg/ ha)

Uptake of N, P and K by the plant at the time of harvest was computed by using the formulae.
Nutrient uptake (kg/ha) = ((Nutrient concentration in plants (%) x Weight of dry matter (kg/ha)/100)

3. RESULTS AND DISCUSSION

There was no significant difference among the treatments with respect to nitrogen, phosphorus and potassium content of leaves under different levels of planting geometry. But Uptake of nitrogen, phosphorous and potassium by isabgol plants differed significantly due to different row spacing.The uptake of nutrients was maximum with closer spacing due to thehigher plant density and dry matter production.These observations agree with the findings of Singh et al. [5] in isabgol, Joy et al. [6] in *Curculigo orchioides* and Meena et al. [7] in chandrasur.

The different nutrient levels had significant influence in the N, P and K content in isabgol plant. Higher N (3.76%), P (0.7%) and K (3.59 %) content in the leaves was observed when plants supplied with 75 % RDF (37.5:18.75:22.50 + 7.5 t FYM) which was *on par* with 100 % RDF (50:25:30 + 10 t FYM). The lower N (3.54%), P (0.65%) and K (3.38 %) content in the leaves was observed when plants supplied with 100% RDN through FYM + 10 t FYM. The optimum levels of NPK and FYM significantly increased N, P and K concentration in plant and their total uptake (N :166.36 kg /ha, P: 32.13 kg /ha and K :158.39 kg /ha).This might be due to improved nutritional environment in the rhizosphere as well as in the plant system leading to enhanced translocation of N, P and K in plant parts. Since the nutrient uptake is a function of its concentration in crop plant and seed and straw yield of the crop. The increase in these parameters due to NPK and FYM fertilization led to an increased uptake of nutrient in the present study. These observations agree with the findings of Singh et al. [8], Jain et al. [9]& Dadheech et al. [10] in isabgol and Anwar et al. [11] in french basil and wankhade et al. [12] in musk mallow.

The data revealed that N, P and K content of isabgol plant did not differ significantly due to interaction. However, the interaction of 22.5 cm row spacing + 75 % RDF (37.5:18.75:22.50 + 7.5 t FYM)combination recorded significantly higher N, P and K uptake (252.05, 49.31 and 238.85 kg/ha respectively) and which was *on par* with the 22.5 cm row spacing + 100 % RDF (50:25:30 + 10 t FYM)(242.40, 46.76 and 231.4 of N, P and K kg/ha respectively), the lower N, P and K uptake (88.56,15.78 and 84.54 kg /ha respectively) was recorded in45 cm row spacing + 100% RDN through FYM +10 t FYM combination. These observations agree with the findings of Yadav et al. [13] in garden cress, Pushpa et al. [14] in roselle.

Table 1. Influence of planting geometry and nutrients on nutrient content in leaves after harvest in Isabgol

Treatment	N(%)	P(%)	K(%)
Spacing (S)			
S_1 (22.5 cm)	3.71	0.71	3.54
S_2 (30 cm)	3.69	0.71	3.53
S_3 (37.5cm)	3.66	0.69	3.52
S_4 (45 cm)	3.63	0.68	3.51
S.Em ±	0.03	0.006	0.03
CD @ 5%	NS	NS	NS
Nutrient levels (N)			
N_1-75 % RDF (37.5:18.75:22.50 + 7.5 t FYM)	3.76	0.72	3.59
N_2- 100 % RDF (50:25:30 + 10 t FYM)	3.72	0.71	3.56
N_3-125 % RDF (62.5:31.25:37.50 + 12.5 t FYM)	3.65	0.69	3.55
N_4-100% RDN through FYM + 10 t FYM)	3.54	0.65	3.38
S.Em ±	0.03	0.006	0.03
CD @ 5%	0.09	0.017	0.08
Interaction (SXN)			
S_1N_1	3.81	0.75	3.61
S_1N_2	3.76	0.73	3.59
S_1N_3	3.69	0.72	3.56
S_1N_4	3.59	0.66	3.41
S_2N_1	3.78	0.74	3.60
S_2N_2	3.74	0.72	3.58
S_2N_3	3.68	0.71	3.55
S_2N_4	3.57	0.67	3.40
S_3N_1	3.76	0.71	3.59
S_3N_2	3.72	0.71	3.56
S_3N_3	3.65	0.69	3.56
S_3N_4	3.53	0.65	3.39
S_4N_1	3.71	0.71	3.58
S_4N_2	3.69	0.71	3.56
S_4N_3	3.63	0.69	3.55
S_4N_4	3.51	0.63	3.35
S.Em ±	0.06	0.012	0.06
CD @ 5%	NS	NS	NS

Note: DAS= Days After Sowing, RDF= Recommended Dose of Fertilizers, RDN= Recommended Dose of Nitrogen , FYM= Farm Yard Manure, CD= Critical difference, NS= Non significant

Table 2. Uptake of Nutrients as influenced by planting geometry and nutrients in Isabgol

Treatment	Uptake of N (Kg/ha)	Uptake of p (Kg/ha)	Uptake of k (Kg/ha)
Spacing (S)			
S_1 (22.5 cm)	229.11	43.98	218.46
S_2 (30 cm)	169.81	32.50	162.20
S_3 (37.5cm)	124.29	23.38	119.46
S_4 (45 cm)	94.58	17.17	91.26
S.Em ±	1.27	0.23	1.08
CD @ 5%	3.68	0.68	3.14
Nutrient levels (N)			
N_1-75 % RDF (37.5:18.75:22.50 + 7.5 t FYM)	166.36	32.13	158.39
N_2- 100 % RDF (50:25:30 + 10 t FYM)	161.66	31.00	154.62
N_3-125 % RDF (62.5:31.25:37.50 + 12.5 t FYM)	150.90	28.93	146.03
N_4-100% RDN through FYM + 10 t FYM)	138.86	25.50	132.32

Treatment	Uptake of N (Kg/ha)	Uptake of p (Kg/ha)	Uptake of k (Kg/ha)
S.Em ±	1.27	0.23	1.08
CD @ 5%	3.68	0.68	3.14
Interaction (SXN)			
S_1N_1	252.05	49.31	238.85
S_1N_2	242.40	46.76	231.14
S_1N_3	221.76	43.25	213.39
S_1N_4	200.24	36.62	190.47
S_2N_1	184.25	35.80	175.03
S_2N_2	180.35	34.51	172.63
S_2N_3	165.42	31.70	159.37
S_2N_4	149.22	28.00	141.76
S_3N_1	130.44	24.66	124.54
S_3N_2	127.08	24.25	121.46
S_3N_3	122.17	22.98	119.31
S_3N_4	117.46	21.63	112.52
S_4N_1	98.72	18.77	95.15
S_4N_2	96.81	18.50	93.28
S_4N_3	94.26	17.80	92.06
S_4N_4	88.56	15.78	84.54
S.Em ±	2.54	0.47	2.17
CD @ 5%	7.36	1.36	6.28

Note: DAS= Days after Sowing, RDF= Recommended Dose of Fertilizers, RDN= Recommended Dose of Nitrogen, FYM= Farm Yard Manure, CD= Critical difference

4. CONCLUSION

22.5 cm row spacing + 75 % RDF (37.5:18.75:22.50 + 7.5 t FYM) recorded significantly maximum N, P and K uptake under eastern dry zone of karnataka

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Jackson MC. Soil chemical analysis. Prentice Hall of Indian Pvt. Ltd., New Delhi; 1973.
2. Walkley A, Black IA. An examination of Degtjareff method for determining soil organic matter and a proposed modification of the chromic acid titration method. Soil Sci. 1934;37(1):29-37.
3. Subbiah BV, Asija GL. A rapid procedure for estimation of available nitrogen in soils. Curr. Sci. 1956;25(8):259-260.
4. Piper CS. Soil and Plant Analysis, Hans Publishers;1966.
5. Singh L, Pal B, Singh L. Influence of saline water at fertility levels on nutrient composition and its uptake by isabgol. Res. Crops. 2010;2(2):174-178.
6. Joy PP, Savithri KE, Mathew S, Skaria BP. Effect of shade and spacing on growth, yield and quality of black musli (*Curculigo orchioides* Gaertn.). 2016;1-15. Available: https://www.researchgate.net/publication:
7. Meena BK, Chouhan GS, Meena VK, Singh S, Meena LK. Response of Chandrasur (*Lepidium Sativum* L.) to Sowing Durations and Stand Geometries. Chem. Sci. Rev. Lett. 2017;6(22):850-856.
8. Singh P, Jain KK, Sharma SK. Effect of sowing dates and nitrogen levels on nutrient uptake and quality of Isabgol (*Plantago ovata* Forsk.). Annals of Agricultural Research. 2001;24(1):197-199.
9. Jain KK, Agarwal B. Sharma SK. Growth, yield and quality of psyllium (*Plantago ovata* Forsk) as affected by nitrogen and phosphorus. National seminar on new perspective in commercial cultivation, processing and marketing of seed spices and medicinal plants. 2004;25(1):54-55.
10. Dadheech LC, Sumeriya HK. Response of isabgol (*Plantago ovata* Forsk) to sowing dates, farmyard manure and various fertility levels. National seminar on new perspective in commercial cultivation, processing and marketing of seed spices and medicinal plants. 2004;26(1):39-40.

11. Anwar M, Patra DD, Chand S, Naqui AA, Khanuja SPS. Effect of organic manures and inorganic fertilizer on growth, herb and oil yield, nutrient accumulation, and oil quality of French Basil. *Comm.* Soil Sci. and Plant Ana. 2005;36:1737–1746.
12. Wankhade SG, Khode PP, Khale MR, Rao SA, Venkat Rao P, Narayana Reddy Y, Ganesh M. Effect of nitrogen and phosphorus on seed yield and uptake of nutrient (NPK) in musk mallow. J. Spices. Aromatic Crops. 2005;14(2):162-164.
13. Yadav LR, Santosh GL, Sharma OP. growth, productivity and nutrient uptake under different sowing dates, row spacing and nitrogen levels in Garden cress (*Lepidiumsativum*). Ind. J. Agron. 2013;58 (1):4-6.
14. Pushpa K, Murthy NK, Murthy RK. Growth and yield parameters of roselle varieties as influenced by spacing and nutrient sources. J. Agric. Sci. 2016;5(3):105-110.

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