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Shaba Arshi Qureshi
Student of M.Sc. (Ag.) Final Year, Department of Agronomy, IGKV, Raipur, Chhattisgarh, India

Dr. YK Dewangan
Senior Scientist, Department of Agronomy, IGKV, Raipur, Chhattisgarh, India

Corresponding Author:
Shaba Arshi Qureshi
Student of M.Sc. (Ag.) Final Year, Department of Agronomy, IGKV, Raipur, Chhattisgarh, India

Impact of different nutrient management practices on growth dynamics, husk and seed yield of isabgol (*Plantago ovata*)

Shaba Arshi Qureshi and Dr. YK Dewangan

Abstract
A field experiment was conducted to access the "Effect of various nutrient management practices on growth dynamics, husk and seed yield of isabgol" during rabi season of 2021-22 under the Department of Agronomy, College of Agriculture, IGKV, Raipur, (C.G.) under the title- "Impact of different nutrient management practices on growth dynamics, husk and seed yield of isabgol". There present total ten treatment combinations, comprises of T_1 (Control), T_2 (FYM @ 10 t ha^{-1}, T_3 [100% RDN through inorganic (50:25:30) NPK kg ha^{-1}], T_4 (75% RDN through inorganic + 2.5t ha^{-1} FYM), T_5 (50% RDN through inorganic + 5 t ha^{-1} FYM), T_6 (100% RDN through inorganic + Azospirillum @ 5 kg ha^{-1} + PSB @ 3 kg ha^{-1}), T_7 (75% RDN through inorganic + Azospirillum @ 5 kg ha^{-1} + PSB @ 3 kg ha^{-1}), T_8 [50% RDN through inorganic + 0.5% foliar spray (19:19:19) at 35 and 65 DAS], T_9 [5 t ha^{-1} FYM + 0.5% foliar spray (19:19:19) at 35 and 65 DAS], T_{10} [100% RDN through organic sources @ (1/3rd FYM + 1/3rd vermicompost + 1/3rd neem cake)]. The data of the experiment were analyzed and it is clearly revealed that application of (100% RDN through inorganic + Azospirillum @ 5 kg ha^{-1} + PSB @ 3 kg ha^{-1}) significantly increases plant height (41.40 cm), number of leaves per plant (37.53), number of spikes per plant (18.01), number of seeds per spike (62.01), and application of (100% RDN through inorganic + Azospirillum @ 5 kg ha^{-1} + PSB @ 3 kg ha^{-1}) significantly produced maximum husk yield (298.36 kg ha^{-1}), and seed yield (566.50 kg ha^{-1}) during investigation in Chhattisgarh plains.

Keywords: Isabgol, Azospirillum, Vermicompost, Biofertilizer (PSB), Husk yield

Introduction
Isabgol (*Plantago ovata*) an imperative medicinal herb plant, that belongs to the family plantaginaceae of genus plantago. It is a highly cross pollinated, annual herb plant, that usually grows up to the height of 30-40 cm and possess adventitious root system. The crop bears alternative leaves which are narrowly linear, acuminate, entire or distantly toothed and attenuated at the base. The flowers are minute, four parted and whitish in colour. The capsule is ovate, the top half lifting up when ripe, releasing smooth, dull, ovate seeds, which are pinkish-grey brown and pinkish-white with a brown streak on the convex surface. The seeds are covered with a translucent membrane, known as husk which is 25% of the total seed fraction. The most important portion in isabgol is its mucilage, which is a polysaccharide coating on the seed. The separated husk is popularly known as "Sat Isabgol" which generally fetch Rs.350 kg^{-1} in the Indian market.

The crop has various medicinal uses and predominantly grown for its husk and the seeds, as it possess chief importance in medicinal point of view. Remarkably India is the largest producer and sole supplier of isabgol husk and seeds (Lahoor *et al.*) and its produce is exported with an average export worth of about (Rs 30 million annually). Currently Gujarat, Rajasthan, Madhya Pradesh and Haryana are the only states in India involved in isabgol production, around 60,000 ha area under isabgol production brought together by the states Gujarat and Rajasthan Isabgol is raised under irrigated conditions as a rabi season crop and grown in all types of soil but performs best on loamy soil. Though, isabgol does not have heavy soil nutrients demand but application of nutrients regarded as one of the basic factors and judicious use of fertilizers is chief important to get potential production. The research findings also indicated that integration of organic, inorganic and biofertilizers will maintain long term soil fertility and encourage higher level of productivity. However very little information present on the nutrient requirement of this crop and thus therefore the present investigation was undertaken.

Materials and Methods

A field experiment was conducted under the title of research "Impact of different nutrient management practices on growth dynamics, husk and seed yield of isabgol", during rabi season of 2021-22 at university farm, near herbal garden, IGKV, Raipur (C.G.). The soil of the experimental field was clayey and belongs to the order *vertisols*. The meteorological data from sowing to harvesting of crop (29th November, 2021 to 29th March 2022) was observed and recorded at meteorological observatory of the Agrometeorological Department, College of Agriculture, IGKV, Raipur. Maximum temperature was 39 °C and minimum temperature was 8.9 °C. The average rainfall received during entire growth period was 2.08 mm. The randomized block design (RBD) was used to conduct the experiment with three replication and ten treatment comprises *viz*. T_1 (Control), T_2 (FYM @ 10 t ha^{-1}, T_3 [100% RDN through inorganic (50:25:30) NPK kg ha^{-1}], T_4 (75% RDN through inorganic + 2.5 t ha^{-1} FYM), T_5 (50% RDN through inorganic + 5 t ha^{-1} FYM), T_6 (100% RDN through inorganic + Azospirillum @ 5 kg ha^{-1} + PSB @ 3 kg ha^{-1}), T_7 (75% RDN through inorganic+ Azospirillum @ 5 kg ha^{-1} + PSB @ 3 kg ha^{-1}), T_8 [50% RDN through inorganic + 0.5% foliar spray (19:19:19) at 35 and 65 DAS], T_9 [5 t ha^{-1} FYM + 0.5% foliar spray (19:19:19) at 35 and 65 DAS], T_{10} [100% RDN through organic sources @ (1/3rd FYM + 1/3rd vermicompost + 1/3rd neem cake)]. The variety used for sowing was Gujarat Isabgol-1, and spacing of 30 cm in between the rows was maintained. The improved seeds were taken from DMAPR, Anand, Gujarat.

Results and Discussion

Plant height and number of leaves

The data revealed that, there is a significant increase in plant height and number of leaves in all the treatments as compared to control. (Table-1) shows that, maximum plant height (41.40 cm) and number of leaves (37.53) was recorded with the application of 100% RDN through inorganic + Azospirillum @ 5 kg ha^{-1} + PSB @ 3 kg ha^{-1}, whereas minimum plant height (30.70 cm) and number of leaves (23.43) found in control. The rise in the plant height might be due to application of nitrogen as it has significantly beneficial effect on increasing plant height. The other reason for increased plant height, might be the more chlorophyll content, produced by the administration of balanced dose of nutrients.

Table 1: Influence of various nutrient management practices on plant height and number of leaves plant^{-1} of isabgol

Treatment	Plant height (cm)	No. of leaves plant^{-1}
T_1: Control	30.70	23.43
T_2: FYM @ 10 t ha^{-1}	35.70	26.13
T_3: 100% RDN through inorganic (50:25:30) NPK kg ha^{-1}	36.05	28.17
T_4: 75% RDN through inorganic +2.5 t ha^{-1} FYM	38.60	33.70
T_5: 50% RDN through inorganic +5 t ha^{-1} FYM	38.01	32.47
T_6: 100% RDN through inorganic + Azospirillum @ 5 kg ha^{-1}+ PSB @ 3 kg ha^{-1}	41.40	37.53
T_7: 75% RDN through inorganic + Azospirillum @ 5 kg ha^{-1} + PSB @ 3 kg ha^{-1}	40.63	34.53
T_8: 50% RDN through inorganic + 0.5% foliar spray (19:19:19) at 35 and 65 DAS	35.51	31.53
T_9: 5 t ha^{-1} FYM + 0.5% foliar spray (19:19:19) at 35 and 65 DAS	34.00	30.07
T_{10}: 100% RDN through organic sources @ (1/3rd FYM + 1/3rd vermicompost +1/3rdneem cake)	32.30	24.87
S.Em±	1.08	0.48
CD (P= 0.05)	3.19	1.43

The other reason for the enhancement of vegetative growth might be due to the production of plant growth regulators by bacteria in the rhizosphere region, which are sucked up by the roots. This result was in agreement with the results of Yadav *et al*. (2003) [2] in isabgol.

Number of spikes plant^{-1} and Number of seeds spike^{-1}

Data pertaining to number of spikes per plant and number of seeds per spike of isabgol were recorded and presented in (Table-2). The different nutrient management practices, produced significantly, higher numbers of spikes per plant (18.01) and number of seeds per spike (62.01) which was observed highest with the application of 100% RDN through inorganic + Azospirillum @ 5 kg ha^{-1} + PSB @ 3 kg ha^{-1}, while minimum numbers of spikes per plant (10.70) and number of seeds per spike (49.01) observed in control. Increased number of spikes per plant and number of seeds per spike may be due to the application of 50 kg N ha^{-1} and 30 kg P_2O_5 ha^{-1} similar finding was observed by Utgikar *et al.* (2003) [1].

Table 2: Influence of various nutrient management practices on yield attributes and husk and seed yield of isabgol

Treatment	No. of spikes plant^{-1}	No. of seeds spikes^{-1}	Husk yield (kg ha^{-1})	Seed yield (kg ha^{-1})
T_1: Control	10.70	49.01	93.73	249.33
T_2: FYM @ 10 t ha^{-1}	13.10	53.20	144.66	352.93
T_3: 100% RDN through inorganic (50:25:30) NPK kg ha^{-1}	14.02	54.02	159.46	379.27
T_4: 75% RDN through inorganic +2.5 t ha^{-1} FYM	16.50	58.03	229.83	488.23
T_5: 50% RDN through inorganic +5 t ha^{-1} FYM	15.80	56.40	206.56	455.51
T_6: 100% RDN through inorganic + Azospirillum @ 5 kg ha^{-1}+ PSB @ 3 kg ha^{-1}	18.01	62.01	298.36	566.50
T_7: 75% RDN through inorganic + Azospirillum @ 5 kg ha^{-1} + PSB @ 3 kg ha^{-1}	17.04	59.04	246.66	506.83
T_8: 50% RDN through inorganic + 0.5% foliar spray (19:19:19) at 35 and 65 DAS	15.01	55.50	189.53	421.37
T_9: 5 t ha^{-1} FYM + 0.5% foliar spray (19:19:19) at 35 and 65 DAS	14.70	54.81	173.50	405.03
T_{10}: 100% RDN through organic sources @ (1/3rd FYM + 1/3rd vermicompost +1/3rd neem cake)	12.50	52.08	127.33	322.17
S.Em±	0.31	0.97	16.93	19.83
CD (P= 0.05)	0.92	2.87	50.31	58.92

Husk yield and seed yield

The data with respect to husk and seed yield in (Table-2), shows that the application of 100% RDN through inorganic + Azospirillum @ 5 kg ha^{-1} + PSB @ 3 kg ha^{-1} have given remarkable increase in the husk and seed yield during investigation. The maximum husk yield (298.36 kg ha^{-1}) and seed yield (566.50 kg ha^{-1}) were recorded in the treatment receiving 100% RDN through inorganic + Azospirillum @ 5 kg ha^{-1} + PSB @ 3 kg ha^{-1}. The minimum husk (93.73 kg ha^{-1}) and seed yield (249.33 kg ha^{-1}) obtained in control. Increase in husk yield is correlated with the higher seed yield and the reason for increased seed yield might be due to increase in yield attributing characters which is influenced by application of optimum dose of fertilizers. These reasons are similar with the findings of Sharma and Garg (2002) [7].

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