Biological Forum – An International Journal **15(9): 981-983(2023)**

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Quality and Economics of isabgol (*Plantago ovata* Forsk.) as influenced by Levels of Potassium and Zinc

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(Received: 07 July 2023; Revised: 05 August 2023; Accepted: 08 September 2023; Published: 15 September 2023)
(Published by Research Trend)

ABSTRACT: As compared to secondary nutrients, micronutrients are required by plants in small quantity but their role in plant is important as a part of regulatory enzyme and in synthesis of secondary metabolites. By management of these nutrients, one could achieve the desired quantity and quality of crop yield without altering the potential of natural resources and environment. A field study was conducted during rabi 2021-22 at the Instructional Farm of the Rajasthan College of Agriculture, Udaipur to study the effect of different levels of potassium and zinc on growth, productivity and quality of isabgol using randomized block design with 3 replications. The experiment consisted of 12 treatments comprising of fertilizers combinations *viz*., 40 kg ha^{-1} K_2O + 30 kg ha^{-1} Zn, 40 kg ha^{-1} K_2O + 25 kg ha^{-1} Zn, 40 kg ha^{-1} K_2O + 20 kg ha^{-1} Zn, 30 kg ha^{-1} K_2O + 30 kg ha^{-1} Zn, 30 kg ha^{-1} K_2O + 25 kg ha^{-1} Zn, 30 kg ha^{-1} K_2O + 20 kg ha^{-1} Zn, 20 kg ha^{-1} K_2O + 30 kg ha^{-1} Zn, 20 kg ha^{-1} K_2O + 25 kg ha^{-1} Zn, 20 kg ha^{-1} K_2O + 20 kg ha^{-1} Zn, 40 kg ha^{-1} N + 20 kg ha^{-1} P_2O_5 + 20 kg ha^{-1} K_2O, 40 kg ha^{-1} N + 20 kg ha^{-1} P_2O_5 and control. The results revealed that application of 30 kg ha^{-1} K_2O + 20 kg ha^{-1} Zn resulted in significantly higher quality and B-C ratio of isabgol.

Keywords: Micronutrients, Quality, B-C ratio, Economics of isabgol.

INTRODUCTION

Blond psyllium (*Plantago ovate* Forsk.) commonly known as "Isabgol" is one of the important medicinal plants. It is an important winter season crop which belongs the family Plantaginaceae having the chromosome no. 2n=28, native to the Mediterranean region and west Asia. India has the monopoly in production and export of the seed and husk in the world market (Farooqui *et al*., 2001). About 80-90 per cent of the produce is exported to various countries. In India, Isabgol is commercially cultivated in the states of Madhya Pradesh, Gujarat and Rajasthan. The crop covers 336327 hectares with the production of 193702 tonnes and average productivity of 576 kg ha^{-1} (Agriculture Statistics, 2018-19) in Rajasthan.

Isabgol (*Plantago ovata* Forsk.) is an important herb that has been used in health care for many centuries in South Asia, whereas it is now widely used for its medicinal properties all over the world. Isabgol is a major contributor to the export earnings. The seeds of isabgol are composed of many different types of chemicals that are used as medicine. It contains mucilage, fatty oil, proteins, carbohydrates, mineral element, etc. Seed oils are used to make soap, paint, printing inks, and other industrial supplies. Potassium 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. Potassium application increases the plant's growth and yield because it participates in the mechanism of stomatal movement, photosynthesis and helps in osmo-regulatory adaption of plant due to water stress (Patel *et al*., 2012). Zinc is an essential element for plant that act as a metal component of various enzymes, involved in RNA metabolism and ribosomal content in plant cells, stimulation of carbohydrates, proteins synthesis, DNA formation, cell division, maintenance of membrane structure and function and sexual fertilization. It also helps in the utilization of phosphorus and nitrogen in plants. Response to applied zinc for better growth and yield of several important field crops has been reported from almost all corners of the country.

MATERIALS AND METHODS

The field experiment was conducted during *rabi* season of 2021-22 at the Instructional Farm, Rajasthan College of Agriculture, Udaipur (Rajasthan) on clay loam soil having pH 7.8, EC 0.75 dS m^{-1}, 283.44 kg available nitrogen ha^{-1}, 22.2 kg available phosphorus ha^{-1} and 279.3 kg available potassium ha^{-1}. The average annual rainfall was 637 mm. The experiment was conducted using randomized block design with three replications. There were 12 treatments in the experiment *viz*., 40 kg ha^{-1} K_2O + 30 kg ha^{-1} Zn, 40 kg ha^{-1} K_2O + 25 kg ha^{-1} Zn, 40 kg ha^{-1} K_2O + 20 kg ha^{-1} Zn, 30 kg ha^{-1} K_2O + 30 kg ha^{-1} Zn, 30 kg ha^{-1} K_2O + 25 kg ha^{-1} Zn, 30 kg ha^{-1} K_2O + 20 kg ha^{-1} Zn, 20 kg ha^{-1} K_2O + 30 kg ha^{-1} Zn, 20 kg ha^{-1} K_2O + 25 kg ha^{-1} Zn, 20 kg ha^{-1} K_2O + 20 kg ha^{-1} Zn, 40 kg ha^{-1} N + 20 kg ha^{-1} P_2O_5 + 20 kg ha^{-1} K_2O, 40 kg ha^{-1} N + 20 kg ha^{-1} $P_2O_5$and control. The Isabgol *cv*., UI-124 was sown in each plot. Treatments were applied in the form of urea, SSP, MOP and $ZnSO_4$. Full dose of phosphorus, potash and zinc were applied prior to sowing. Nitrogen was applied in three equal doses *viz*. 1/3rd at sowing, 1/3rd after hoeing and 1/3rd at flower initiation. Data recorded for various growth and yield parameters were statistically analyzed using the analysis of variance as described by Panse and Sukhatme (1985).

RESULTS AND DISCUSSION

A. Quality Parameters

The data related to quality parameters are presented in Table 1.

Protein content (%). It is explicit from the data that application of 30 kg ha^{-1} K_2O + 20 kg ha^{-1} Zn resulted in significantly higher protein content (16.43 %) in seeds of isabgol and this was found at par with treatments T_8 (30 kg ha^{-1} K_2O + 25 kg ha^{-1} Zn), T_9 (30 kg ha^{-1} K_2O + 30 kg ha^{-1} Zn), T_{10} (40 kg ha^{-1} K_2O + 20 kg ha^{-1} Zn), T_{11} (40 kg ha^{-1} K_2O + 25 kg ha^{-1} Zn) and T_{12} (40 kg ha^{-1} K_2O + 30 kg ha^{-1} Zn). The minimum protein content in seed was found with no application of nutrients i.e., control.

Swelling factor (CC g^{-1}). A perusal of data reveals that swelling factor was not significantly affected by application of different doses of potash and zinc.

Husk recovery (%). Application of potash and zinc at varying levels failed to record significant variation in husk recovery in isabgol crop.

Husk yield (kg ha^{-1}). The data show that significantly higher husk yield (210.83 kg ha^{-1}) was recorded under T_7 (30 kg ha^{-1} K_2O + 20 kg ha^{-1} Zn) while minimum was recorded under control. However, this result was at par with application of treatments T_8 (30 kg ha^{-1} K_2O + 25 kg ha^{-1} Zn), T_9 (30 kg ha^{-1} K_2O + 30 kg ha^{-1} Zn), T_{10} (40 kg ha^{-1} K_2O + 20 kg ha^{-1} Zn), T_{11} (40 kg ha^{-1} K_2O + 25 kg ha^{-1} Zn) and T_{12} (40 kg ha^{-1} K_2O + 30 kg ha^{-1} Zn).

A marked improvement in protein content of isabgol was reported with the application of 30 kg ha^{-1} K_2O + 20 kg ha^{-1} Zn. Though swelling factor and husk recovery were not significantly affected by applying various combination of nutrients. However, husk yield shows significant increment with increased application of fertilizer dose. Protein content is essentially the manifestation of N content in seed. Better and bold seed development as indicated by higher test weight in present study might be responsible for high husk recovery. Further, significantly higher protein content (16.43%), husk recovery (27.82%) husk yield (210.83 kg ha^{-1}) were found with application of 30 kg ha^{-1} K_2O + 20 kg ha^{-1} Zn. These quality parameters could be attributed to variable nitrogen availability and test weight. This is consistent with the findings of Verma *et al.* (2012); Sumathi *et al.* (2013); Choudhary *et al.* (2015).

Table 1: Effect of nutrient management on quality of isabgol.

Treatment	Protein content (%) in seed	Swelling factor (CC g^{-1})	Husk recovery (%)	Husk yield (kg ha^{-1})
T_1 - Control	14.83	10.85	26.09	164.98
T_2 - N:P (40:20)	15.23	10.88	26.98	166.25
T_3 - N:P:K (40:20:20)	15.36	10.92	27.17	171.80
T_4 - N:P:K:Zn (40:20:20:20)	15.42	11.01	27.20	184.20
T_5 - N:P:K:Zn (40:20:20:25)	15.63	11.07	27.28	186.72
T_6 - N:P:K:Zn (40:20:20:30)	15.87	11.10	27.46	187.64
T_7 - N:P:K:Zn (40:20:30:20)	16.43	11.23	27.82	210.83
T_8 - N:P:K:Zn (40:20:30:25)	16.47	11.25	27.86	214.26
T_9 - N:P:K:Zn (40:20:30:30)	16.50	11.34	27.74	212.53
T_{10} - N:P:K:Zn (40:20:40:20)	16.50	11.28	27.78	213.65
T_{11} - N:P:K:Zn (40:20:40:25)	16.57	11.24	27.72	212.78
T_{12} - N:P:K:Zn (40:20:40:30)	16.62	11.36	27.87	214.52
SEm±	0.25	0.18	0.50	2.32
CD (P=0.05)	0.73	NS	NS	6.81

B. Economic Analysis

The data related to net return and BC ratio is presented in Table 2

Net Return. It is apparent from the data that the net return was significantly high (₹ 91069 ha^{-1}) under the application of T_7 (30 kg ha^{-1} K_2O + 20 kg ha^{-1} Zn) which was found to be at par with higher application of treatments T_8 (30 kg ha^{-1} K_2O + 25 kg ha^{-1} Zn), T_9 (30 kg ha^{-1} K_2O + 30 kg ha^{-1} Zn), T_{10} (40 kg ha^{-1} K_2O + 20 kg ha^{-1} Zn), T_{11} (40 kg ha^{-1} K_2O + 25 kg ha^{-1} Zn) and T_{12} (40 kg ha^{-1} K_2O + 30 kg ha^{-1} Zn).

Benefit Cost Ratio. The data show that significantly high BC ratio (3.15) was observed when the soil was supplied with T_7 (30 kg ha^{-1} K_2O + 20 kg ha^{-1} Zn) which was found at par with other treatments involving higher doses of potassium and zinc.

The results presented in show higher net return (₹ 91069 ha^{-1}) and BC ratio (3.15) with the soil application of 30 kg ha^{-1} K_2O + 20 kg ha^{-1} Zn in isabgol as compared to control and other treatments. The increased net return could be explained because of significantly higher seed yield (1225 kg ha^{-1}) and straw yield (1931 kg ha^{-1}) which were observed with application of 30 kg ha^{-1} K_2O + 20 kg ha^{-1} Zn in the soil over control and at par with the higher application of the fertilizer dose. With the same line of research higher net return and BC ratio were reported by Gupta (2012); Verma *et al.* (2012); Chaudhary *et al.* (2015).

Table 2: Effect of nutrient management on net returns and BC ratio in isabgol.

Treatment	Net return (₹ ha^{-1})	B-C ratio
T_1 - Control	42114	1.66
T_2 - N:P (40:20)	51756	1.93
T_3 - N:P:K (40:20:20)	61168	2.23
T_4 - N:P:K:Zn (40:20:20:20)	67390	2.36
T_5 - N:P:K:Zn (40:20:20:25)	74541	2.58
T_6 - N:P:K:Zn (40:20:20:30)	79297	2.72
T_7 - N:P:K:Zn (40:20:30:20)	91069	3.15
T_8 - N:P:K:Zn (40:20:30:25)	91197	3.13
T_9 - N:P:K:Zn (40:20:30:30)	93455	3.17
T_{10} - N:P:K:Zn (40:20:40:20)	91690	3.14
T_{11} - N:P:K:Zn (40:20:40:25)	92383	3.14
T_{12} - N:P:K:Zn (40:20:40:30)	93519	3.14
SEm±	3998	0.137
CD (P=0.05)	11726	0.402

CONCLUSIONS

It can be concluded from the present study that application of micronutrients improves the quality parameters like protein content and husk yield of isabgol seed. The net return and B:C ratio was also found to improve with micronutrient application.

Acknowledgments. The author is thankful to the Dean, RCA Udaipur for providing necessary facilities during the period this investigation.
Conflict of Interest. None.

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How to cite this article: Chetana Sharma, M.K. Kaushik, Disha Joshi, Manish Tomar, Bhavna Singh Rathore and Pooja Meena (2023). Quality and Economics of isabgol (*Plantago ovata* Forsk.) as influenced by Levels of Potassium and Zinc. *Biological Forum – An International Journal, 15*(9): 981-983.