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## Responses of different levels of potassium and zinc on growth and yield of isabgol (*Plantago ovate* Forsk.) under malwa plateau of Madhya Pradesh

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### Abstract

The experiments were carried out under AICRP on Medicinal and Aromatic Plant at College of Horticulture, Mandsaur under Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior (M.P.) during the *rabi* season of 2019-20, 2020-21 and 2021-22. The treatments consisting four levels of potassium (0, 10, 20 and 30 kg K<sub>2</sub>O ha<sup>-1</sup>) in main plot and three levels of zinc (0, 10 and 20 kg Zn ha<sup>-1</sup>) in sub-plot were laid out in split plot design replicated thrice with cv. Jawahar Isabgol 4. Results revealed that, the maximum plant height was recorded in K<sub>4</sub>-30 kg K<sub>2</sub>O ha<sup>-1</sup> (32.30, 33.00, 31.00 & mean 32.10 cm) while, number of tillers (4.10, 4.13, 4.00 & mean 4.08), spike length (3.80, 3.70, 3.50 & mean 3.67 cm) and seed yield (13.67, 13.67, 12.50 & mean yield 13.28 q ha<sup>-1</sup>) were found in K<sub>3</sub>-20 kg K<sub>2</sub>O ha<sup>-1</sup> during 2019-20, 2020-21, 2021-22 and mean, respectively. Similarly, Zn<sub>3</sub>-20 kg Zn ha<sup>-1</sup> had maximum plant height (30.70, 30.75, 29.50 & mean 30.32 cm) but number of tillers (4.00, 3.90, 3.80 & mean 3.90), length of spikes (3.55, 3.45, 3.36 & mean 3.45 cm) and seed yield (12.60, 12.25, 11.15 & mean yield 12.00 q ha<sup>-1</sup>) were found with the application of Zn<sub>2</sub>-10 kg Zn ha<sup>-1</sup> during 2019-20, 2020-21, 2021-22 and mean, respectively. Thus, it is concluded that 20 kg K<sub>2</sub>O ha<sup>-1</sup> and 10 kg Zn ha<sup>-1</sup> performed best under the experiment.

**Keywords:** Potassium, zinc, growth, yield and *Plantago ovate*

### 1. Introduction

Isabgol (*Plantago ovate* Forsk.) word is derived from Isap and ghol, which mean horse ear, due to the shape of the seeds and is a plant of the Plantaginaceae family. It is a sub-caulescent softy hairy or woolly annual herb with short stems and take a height of 28-40 cm (Kumar *et al.*, 2023) <sup>[1]</sup>. It has a diversity of leaves, flowers are small and white, and the seeds are ovate and small with brown grey in color, and protected by a translucent membrane called husk (Tyagi *et al.*, 2016) <sup>[2]</sup>. Constipation and gastrointestinal are treated with the swelling property of the husk (Salimath *et al.*, 2019) <sup>[3]</sup>. India is the world's largest producer and exporter of seeds and husk. It is grown commercially in Madhya Pradesh, Gujarat, and Rajasthan states of county. It is primarily grown in the districts of Neemuch and Mandsaur in State. In Madhya Pradesh 15.209 T. ha, 16.663 TMT and 10.9 q. ha<sup>-1</sup>, besides in India 351.536 T. ha, 333.681 TMT, and 9.50 q. ha<sup>-1</sup> area, production and productivity respectively (Hapis, 2019) <sup>[4]</sup>. Most of the Indian soils are deficient in zinc causing yield losses in crops (Singh *et al.*, 2011) <sup>[5]</sup> and crop like isabgol has been found to respond to zinc application. The lack of zinc is major cause of lower yield or even crop failure (Salimath *et al.*, 2019) <sup>[3]</sup>. It is also playing a significant effect in various physiological and enzymatic activity of the plant growth and also catalysis the process of oxidation in cells of plant and vital for transformation of carbohydrate. Soil application of potassium increases the growth and yield of plants because it play a role in the photosynthesis, mechanism of stomatal movement and helps in osmo-regulatory adaption of plant cause of water stress (Patel *et al.*, 2012) <sup>[6]</sup>. Adequate application of potassium has been exposed to enhance disease resistance in plants. It has triggers numerous enzymes activities and plays an important role in sustains of potential gradients around the cell membranes and maintained of turgor pressure in plants as well as regulate protein & starch synthesis and photosynthesis (Narolia *et al.*, 2013) <sup>[7]</sup>. Therefore, a study on effect of different levels of potassium and zinc on growth and yield of Isabgol (*Plantago ovata* Forsk) was carried out.

### 2. Material Method

The experiments were carried out under All India Co-ordinated Research Project on Medicinal

and Aromatic Plant at College of Horticulture, Mandasaur under Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior (M.P.) during the *rabi* season of 2019-20, 2020-21 and 2021-22. The treatments consisting four levels of potassium (0, 10, 20 and 30 kg K<sub>2</sub>O ha<sup>-1</sup>) in main plot and three levels of zinc (0, 10 and 20 kg Zn ha<sup>-1</sup>) in sub-plot were laid out in split plot design replicated thrice with cv. Jawahar Isabgol 4. All the morphological and yield parameters were recorded at harvest and later on their mean was calculated. The experimental data were subjected to statistical analysis using analysis of variance technique suggested by Panse and Sukhatme (1985) [8]. Where the “F” test was found significant at 5% level of significance, the critical differences for the treatment’s comparison were worked out.

### 3. Results and Discussion

#### 3.1 Responses of potassium

All the levels of potassium were showed significant variation among the traits of isabgol (Table 1). However, the maximum plant height was recorded in K<sub>4</sub>-30 kg K<sub>2</sub>O ha<sup>-1</sup> (32.30, 33.00, 31.00 & 32.10 cm) which was at par with K<sub>3</sub>-20 kg K<sub>2</sub>O ha<sup>-1</sup> (31.00, 31.00, 30.00 & 30.67) but significantly higher over rest of the levels during 2019-20, 2020-21, 2021-22 and mean, respectively. The higher plant height with the application of higher dose of potassium might accelerate the enzymes activity, cell metabolism, maintained cell osmosis, increased photosynthetic activities and absorption of water which encourage the growth of plants as well as retained the moisture in the plant cell and provide resistance to plant system. Similar statement was said by Jajoria *et al.* (2013) [9] and Patel *et al.* (2015) [10]. While, number of tillers (4.10, 4.13, 4.00 & 4.08), spike length (3.80, 3.70, 3.50 & 3.67 cm) and seed yield (13.67, 13.67, 12.50 & 13.28 q ha<sup>-1</sup>) were found in K<sub>3</sub>-20 kg K<sub>2</sub>O ha<sup>-1</sup> and was at par with K<sub>4</sub>-30 kg K<sub>2</sub>O ha<sup>-1</sup> for number of tillers (3.87, 3.90, 3.70 & 3.82), spike length (3.53, 3.53, 3.25 & 3.44 cm) and seed yield (12.50, 12.50, 11.30 & 12.10 q ha<sup>-1</sup>) but significantly superior with the remaining levels during 2019-20, 2020-21, 2021-22 and mean, respectively. Increase in number of tillers and length of spikes may be due to the fact that adequate soil application of potassium increased number of leaves, which is positively associated with the length of spikes. Parallel results were also reported by Utgikar *et al.* (2003) [11], Waghmare *et al.* (2010) [12]. Moreover, significant increment in yield of seed of isabgol might be due to the higher number of tillers and

length of spikes per plant with the fact that potassium is expected to hasten plant growth, development and extend the period of photosynthates movement from source to sink Narolia *et al.* (2013) [7]. In due course, these yield attributing trait had helpful in higher seed yield of isabgol. Similar outcome was also reported by Ahirwar *et al.* (2014) [13] Kumar *et al.* (2015) [14] Shivran (2016) [15].

#### 3.2 Responses of zinc

The results confirmed from the Table 1 that, different levels of zinc had exhibited significant variations for plant height, number of tillers, length of spikes and seed yield of isabgol. However, the maximum and significant plant height (30.70, 30.75, 29.50 & 30.32 cm) was assessed with the soil application of Zn<sub>-3</sub> 20 kg Zn ha<sup>-1</sup> which was at par with Zn<sub>-2</sub> 10 kg Zn ha<sup>-1</sup> (30.50, 29.75, 28.20 & 29.48) but significantly superior over rest of the levels during 2019-20, 2020-21, 2021-22 & mean, respectively. Zinc is a chlorophyll synthesizing element during photosynthesis in crops (Sravan *et al.*, 2021) [16] and when it is applied in higher dose, it will enhanced plant height. Moreover, Zn<sub>-2</sub> 10 kg Zn ha<sup>-1</sup> had shown superiority in number of tillers (4.00, 3.90, 3.80 & 3.90), length of spikes (3.55, 3.45, 3.36 7 & 3.45 cm) and seed yield (12.60, 12.25, 11.15 & 12.00 q ha<sup>-1</sup>) which was at par with Zn<sub>-3</sub> 20 kg Zn ha<sup>-1</sup> in number of tillers (3.70, 3.75, 3.55 & 3.67), length of spikes (3.40, 3.33, 3.15 & 3.29 cm) and seed yield (11.70, 11.68, 10.45 & 11.28 q ha<sup>-1</sup>) but statistically higher with the remaining levels during 2019-20, 2020-21, 2021-22 & mean, respectively. This may be cause of soil application of zinc which is plays a significant role in physiological reaction and metabolic activity and also act as a catalyzing enzymes for synthesis of chlorophyll, carbohydrates, and protein (Sravan *et al.*, 2021) [16] for the growth and development of crops and zinc regulate the hormones of plant system and provide uniformity in plant growth. The favourable enhancement due to applied zinc on growth and yield parameters of plant may be attributed to catalytic result of zinc on most of the metabolic and physiological activities of the plant. The improvement in yield and yield attributing traits was perceived with the soil application of zinc which might be due to interference caused by applied zinc through translocation and absorption of zinc from the rhizosphere zone to the areal parts of plant (Dhakad *et al.*, 2021) [17]. Similar findings were also confirm with the reported of Patel *et al.* (2015).

**Table 1:** Effect of Potassium and Zinc Levels on the Plant height, Spike length, Number of tillers and Seed yield of Isabgol for the mean year 2019 -20, 2020-21 and 2021-22.

Treatments	Plant height (cm)				Number of tillers				Spike length (cm)				Seed yield (q/ha)			
	2019-20	2020-21	2021-22	Mean	2019-20	2020-21	2021-22	Mean	2019-20	2020-21	2021-22	Mean	2019-20	2020-21	2021-22	Mean
<b>Potassium Levels</b>																
K <sub>1</sub> -0 kg K <sub>2</sub> O ha <sup>-1</sup>	26.20	26.00	25.00	25.73	3.27	3.35	3.25	3.29	2.93	2.90	2.80	2.88	9.50	9.23	7.90	8.88
K <sub>2</sub> -10 kg K <sub>2</sub> O ha <sup>-1</sup>	30.00	29.00	28.00	29.00	3.80	3.70	3.50	3.67	3.20	3.20	3.10	3.17	11.17	11.50	10.50	11.06
K <sub>3</sub> -20 kg K <sub>2</sub> O ha <sup>-1</sup>	31.00	31.00	30.00	30.67	4.10	4.13	4.00	4.08	3.80	3.70	3.50	3.67	13.67	13.67	12.50	13.28
K <sub>4</sub> -30 kg K <sub>2</sub> O / ha	32.30	33.00	31.00	32.10	3.87	3.90	3.70	3.82	3.53	3.53	3.25	3.44	12.50	12.50	11.30	12.10
SEM±	0.45	0.32	0.30	0.36	0.40	0.04	0.03	0.16	0.05	0.03	0.03	0.04	0.31	0.17	0.15	0.21
CD at 5%	1.32	0.94	0.89	1.05	0.11	0.12	0.09	0.11	0.15	0.10	0.08	0.11	0.92	0.48	0.43	0.61
<b>Zinc Levels</b>																
Zn <sub>1</sub> -0 kg Zn ha <sup>-1</sup>	28.40	28.75	27.50	28.22	3.50	3.66	3.45	3.54	3.15	3.23	3.12	3.17	10.70	11.25	10.00	10.65
Zn <sub>2</sub> -10 kg Zn ha <sup>-1</sup>	30.50	29.75	28.20	29.48	4.00	3.90	3.80	3.90	3.55	3.45	3.36	3.45	12.60	12.25	11.15	12.00
Zn <sub>3</sub> -20 kg Zn ha <sup>-1</sup>	30.70	30.75	29.50	30.32	3.70	3.75	3.55	3.67	3.40	3.33	3.15	3.29	11.70	11.68	10.45	11.28
SEM±	0.52	0.37	0.35	0.41	0.40	0.05	0.04	0.16	0.06	0.04	0.04	0.05	0.36	0.19	0.17	0.24
CD at 5%	1.52	1.08	1.03	1.21	0.13	0.14	0.11	0.13	0.18	0.11	0.11	0.13	1.06	0.56	0.50	0.71

#### 4. Conclusion

On the basis of three years research, it could be concluded that the potassium @ 20 kg and zinc @ 10 kg ha<sup>-1</sup> are the best combination for higher yield of Isabgol under Malwa condition of Madhya Pradesh.

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#### 6. Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the research, authorship and/or publication of this article.

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