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Effect of Zinc and Salicylic Acid on Growth and Yield of Green Gram (*Vigna radiata* L.)

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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

A field experiment was carried out through the growth season 2022 at *Zaid* Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj (U.P). To Study the effect of Zinc and Salicylic acid on improve growth green gram (*Vigna radiata* L) in sandy loam. The soil of experimental plot was sandy loam in texture, nearly neutral in soil reaction (pH 7.1), low in organic carbon (0.36 %), available N (171.48 kg/ha), available P (15.2 kg/ha) and available K (232.5 kg/ha). The experiment was laid out on Randomized Block Design with nine treatments each replicated thrice on the basis of one year experimentation. The treatments which are T1: Zn (75PPM) + Salicylic acid (100PPM), T2: Zn (75PPM) + Salicylic acid (150PPM), T3: Zn (75PPM) + Salicylic acid (200PPM), T4: Zn (100PPM) + Salicylic acid (100PPM), T5: Zn (100PPM) + Salicylic acid (150PPM), T6: Zn

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(100PPM) + Salicylic acid (200PPM), T7: Zn (125PPM) + Salicylic acid (100PPM), T8: Zn (125PPM) + Salicylic acid (150PPM), T9: Zn (125PPM) + Salicylic acid (200PPM) are used. The results showed that treatment T9- Zn (125PPM) + Salicylic acid (200PPM). Result was recorded significantly higher growth parameters i.e. Plant height (35.14 cm), Plant dry weight (6.64 g/plant) and Crop growth rate (2.99 g/m^2/day). However, yield attributes and yield parameters like No. of Pods/plant (21.22), No. of seeds/pod (11.35), Test weight (34.04 g), Seed yield (1100.97 kg/ha), straw yield (4471.00 kg/ha) were affected with the treatment T9- Zn (125PPM) + Salicylic acid (200PPM) than other treatments. Higher gross returns (Rs. 82572.75/ha), net return (Rs. 56228.32/ha) and benefit cost ratio (2.13) was obtained in the treatment T9- Zn (125PPM) + Salicylic acid (200PPM) as compared to other treatments.

Keywords: Growth; salicylic acid; yield; zinc.

1. INTRODUCTION

Mung bean (*Vigna radiata* L.) is also known as green gram, it is an important pulse crop of India and grown in Rabi (South India), Kharif and Zaid seasons. It is green with husk and yellow when dehusked. The beans are small, ovoid in shape and green in color. "The mung bean (*Vigna radiata*), alternatively known as the moong bean, monggo, green gram, or mung Sanskrit mugd, is a plant species in the legume family. The mung bean is mainly cultivated in India, Pakistan, Bangladesh, Nepal, China, Korea, South Asia and Southeast Asia. It is used as an ingredient in both savory and sweet dishes. Mungbean is third most important pulse crop of India after chickpea and pigeon pea. The nutritive value of mungbean is a high with easily digestible protein (approximately 25-28%), oil 1.0-1.5%, fiber 3.5-4.5%, ash 4.5-5.5%, carbohydrate 62-65%, water 9.1%, and vitamins on dry weight basis. Mungbean (*Vigna radiate* L. Wilczek) is a summer pulse crop with short duration (70-90 days) and high nutritive value. It has many effective uses, green pod is cooked as peas, sproutrich in vitamins and amino acids" [1].

"Micronutrients are essential for the normal growth of plants, deficiencies of which adversely affect the growth, metabolism and reproductive phase in plants. In many parts of the country, zinc (Zn) as a plant nutrient stands third in importance i.e., next to nitrogen and phosphorus. In the recent years, zinc is considered as one of the constraints in the optimum production of crops. It plays a vital role in synthesis of chlorophyll, protein and nucleic acid and helps in the utilization of nitrogen and phosphorus by plants as it acts as an activator of dehydrogenase and proteinase enzymes, directly or indirectly in synthesis of carbohydrates and protein" [2].

"Plant growth hormones regulate almost every phase of plant growth and development. Plant growth and development are known to be under the control of internal and external factors. The effect of growth regulators is found to be largely dependent upon various factors as concentration and type of growth regulator, method of application, time of application, soil type and other conditions. Salicylic acid (SA) is an endogenous plant hormone that has been found to play a major role in the regulation of plant growth and development, including seed germination, organ differentiation, stomatal movement, photoperiodic responses, and senescence mediation" [3].

2. MATERIALS AND METHODS

"The present examination was carried out during 2022 at *Zaid* Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj, UP, which is located at 25.28oN latitude, 81.54oE longitude and 98 m altitude above the mean sea level" [4] . The experiment laid out in Randomized Block Design which consisting of ten treatments with T1: Zn (75PPM) + Salicylic acid (100PPM), T2: Zn (75PPM) + Salicylic acid (150PPM), T3: Zn (75PPM) + Salicylic acid (200PPM), T4: Zn (100PPM) + Salicylic acid (100PPM), T5: Zn (100PPM) + Salicylic acid (150PPM), T6: Zn (100PPM) + Salicylic acid (200PPM), T7: Zn (125PPM) + Salicylic acid (100PPM), T8: Zn (125PPM) + Salicylic acid (150PPM), T9: Zn (125PPM) + Salicylic acid (200PPM), are used. "The experimental site was uniform in topography and sandy loam in texture, nearly neutral in soil reaction (PH 7.1), low in Organic carbon (0.38%), medium available N (225 kg ha-1), higher available P(19.50 kg ha-1) and medium available K (213.7 kg ha-1). In the period from germination to harvest several plant growth parameters were recorded at frequent

intervals along with it after harvest several yield parameters were recorded those parameters are growth parameters, plant height, and plant dry weight are recorded. The yield parameters like Pods/plant, No. of grains/pod, Test weight, seed yield, straw yield and harvest index were recorded" [4].

"Study was statistically analyzed using analysis of variance (ANOVA) as applicable to Randomized Block Design" (Gomez and Gomez 1984).

3. RESULTS AND DISCUSSION

3.1 Growth Attributes

3.1.1 Plant height

Significantly maximum Plant height (35.14 cm) was recorded with the treatment with Zn (125PPM) + Salicylic acid (200PPM) over the other treatments. However, treatments with Zn (125PPM) + Salicylic acid (150PPM) (34.99 cm) which were found to be statistically at par with Zn (125PPM) + Salicylic acid (200PPM) as compared to other treatments.

"Zinc application in different physiological processes like enzyme activation, electron transport, chlorophyll formation, stomatal regulation, etc. With the increase in levels of zinc the plant height gradually increased, which might be attributable to greater photosynthetic activity and chlorophyll synthesis due to zinc fertilization resulting into better vegetative growth" [5].

3.1.2 Plant dry weight (g/plant)

Data in Table 1 show that the effect of Zn (125PPM) + Salicylic acid (200PPM) was significantly maximum dry weight (6.64 g/plant) compared the other treatments. However, treatments with Zn (125PPM) + Salicylic acid (150PPM) (6.56 g/plant), Zn (100PPM) + Salicylic acid (200PPM) (6.40 g/plant), Zn (100PPM) + Salicylic acid (150PPM) (6.39 g/plant), Zn (125PPM) + Salicylic acid (100PPM) (6.26 g/plant) and Zn (75PPM) + Salicylic acid (200PPM) (6.19 g/plant) which was found to be statistically at par with Zn (125PPM) + Salicylic acid (200PPM) as compared to other treatments.

"The reported positive effect of application of Zn on an enhanced branching in green gram and mainly attributed to promotion of shoot development by the auxins whereas Zn application ultimately increased the availability of other nutrients and accelerated the translocation of photo assimilates which ultimately helped in increase of plant dry weight of millet" [6].

The increase in dry weight with increasing levels of salicylic acid might be due to the promoted effect of salicylic acid on morphological characters which enhanced the photosynthetic rate and also maintained the stability of membrane thereby improving the dry matter production. The reports were in accordance to Keykha et al. [7].

3.2 Yield Attributes and Yield

3.2.1 Number of pods/plant

Result in Table 2 found that the application of Zn (125PPM) + Salicylic acid (200PPM) was significantly Maximum Number of Pods/Plant (21.22) than other the treatments. However, the treatments Zn (125PPM) + Salicylic acid (150PPM) (20.79) which were found to be statistically at par with Zn (125PPM) + Salicylic acid (200PPM).

"The increase in number of pods per plant under increasing levels of salicylic acid might be due to reduced drop due to efficient translocation of photosynthesis from source to sink" [8].

3.2.2 Number of Grains/pods

Result in Table 2 show that the significantly maximum Number of Grains/pod (11.35) as affected with the application of Zn (125PPM) + Salicylic acid (200PPM) over all the treatments. However, the treatments Zn (125PPM) + Salicylic acid (150PPM) (11.16) which were found to be statistically at par with Zn (125PPM) + Salicylic acid (200PPM).

Result in Table 2 indicator that the application of Zinc to green gram crop generally improves ear head growth by synthesizing tryptophan and auxin. The enhancement effect on pods/plant, seeds/pod and attributed to the favorable influence of the Zn application to crops on nutrient metabolism, biological activity and growth parameters and hence, applied zinc resulted in taller and higher enzyme activity which in turn encouraged more number of pods/plants, seeds/pod and seeds test weight. Similar findings have been reported earlier by Mahilane and Singh [9].

Table 1. Effect of zinc and salicylic acid on growth attributes of Green Gram

Treatments	Plant height (cm)	Dry weight (g/plant)
1. Zn (75PPM) + Salicylic acid (100PPM)	32.66	5.79
2. Zn (75PPM) + Salicylic acid (150PPM)	32.93	5.88
3. Zn (75PPM) + Salicylic acid (200PPM)	33.48	6.19
4. Zn (100PPM) + Salicylic acid (100PPM)	33.03	6.07
5. Zn (100PPM) + Salicylic acid (150PPM)	33.98	6.26
6. Zn (100PPM) + Salicylic acid (200PPM)	34.52	6.40
7. Zn (125PPM) + Salicylic acid (100PPM)	34.17	6.39
8. Zn (125PPM) + Salicylic acid (150PPM)	34.99	6.56
9. Zn (125PPM) + Salicylic acid (200PPM)	35.14	6.64
F- test	S	S
S. EM (±)	0.14	0.16
C. D. (P = 0.05)	0.41	0.49

Table 2. Effect of zinc and salicylic acid on yield attributes and yield of Green Gram

Treatments	Pods/plant	Grains/pod	Test Weight (g)	Seed Yield (kg/ha)	Stover Yield (kg/ha)
1. Zn (75PPM) + Salicylic acid (100PPM)	16.67	9.05	31.43	796.30	3560.41
2. Zn (75PPM) + Salicylic acid (150PPM)	17.39	9.35	31.63	825.04	3678.90
3. Zn (75PPM) + Salicylic acid (200PPM)	18.39	9.72	32.42	926.37	3944.34
4. Zn (100PPM) + Salicylic acid (100PPM)	17.94	9.53	32.17	857.21	3772.54
5. Zn (100PPM) + Salicylic acid (150PPM)	19.02	10.05	32.68	973.58	4012.50
6. Zn (100PPM) + Salicylic acid (200PPM)	19.98	10.83	33.32	1031.80	4272.03
7. Zn (125PPM) + Salicylic acid (100PPM)	19.58	10.48	33.13	1000.78	4153.63
8. Zn (125PPM) + Salicylic acid (150PPM)	20.79	11.16	33.73	1081.50	4370.59
9. Zn (125PPM) + Salicylic acid (200PPM)	21.22	11.35	34.04	1100.97	4471.00
F test	S	S	S	S	S
S. EM (±)	0.15	0.06	0.11	19.28	37.69
CD (P = 0.05)	0.44	0.19	0.32	57.81	155.70

3.2.3 Test weight (g)

Significantly Maximum Test Weight (34.04 g) was recorded with the treatment of application of Zn (125PPM) + Salicylic acid (200PPM) over all the treatments. However, the treatments Zn (125PPM) + Salicylic acid (150PPM) (33.73 g) which were found to be statistically at par with Zn (125PPM) + Salicylic acid (200PPM).

3.2.4 Seed yield (kg/ha)

Significantly highest Seed Yield (1100.97 kg/ha) was recorded with the treatment of application of Zn (125PPM) + Salicylic acid (200PPM) over all the treatments. However, the treatments Zn (125PPM) + Salicylic acid (150PPM) (1081.50 kg/ha) which were found to be statistically at par with Zn (125PPM) + Salicylic acid (200PPM).

"Zinc plays a vital role in increasing seed yield because zinc takes place in many physiological process of plant such as chlorophyll formation, stomatal regulation, starch utilization which enhance seed yield. Zinc also converts ammonia to nitrate in crops which contribute to yield" [10].

3.2.5 Straw yield (kg/ha)

Significantly highest Seed Yield (4471.00 kg/ha) was recorded with the treatment of application of Zn (125PPM) + Salicylic acid (200PPM) over all the treatments. However the treatments Zn (125PPM) + Salicylic acid (150PPM) (4370.59 kg/ha) were found to be statistically at par with Zn (125PPM) + Salicylic acid (200PPM).

"Increased in straw yield might be due to the growth promoting effect of salicylic acid which increased the level of cell division within the apical meristem of seedling root and caused higher plant growth and increased the dry matter production" [11].

4. CONCLUSION

It is concluded that application of treatment T9-Zn (125PPM) + Salicylic acid (200PPM) was recorded significantly higher Grain yield (1100.97 kg/ha), higher gross returns (Rs. 82572.75/ha), net return (Rs. 56228.32/ha) and benefit cost ratio (2.13) of Green gram as compared to other treatments. Since, the findings based on the research done inone season, further trails may be required for further confirmation.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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