Original Research Article

Effect of Zinc and Salicylic acid on growth and yield of green gram (*Vigna radiata* L.)

ABSTRACT

A field experiment was conducted during *Zaid* 2022 at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj (U.P). 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 T_1: Zn (75PPM) + Salicylic acid (100PPM), T_2: Zn (75PPM) + Salicylic acid (150PPM), T_3: Zn (75PPM) + Salicylic acid (200PPM), T4: Zn (100PPM) + Salicylic acid (100PPM), T_5: Zn (100PPM) + Salicylic acid (150PPM), T_6: Zn (100PPM) + Salicylic acid (200PPM), T_7: Zn (125PPM) + Salicylic acid (100PPM), T_8: Zn (125PPM) + Salicylic acid (150PPM), T_9: Zn (125PPM) + Salicylic acid (200PPM) are used. The results showed that treatment T_9- Zn (125PPM) + Salicylic acid (200PPM) was recorded significantly higher growth parameters like 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), Stover yield (4471.00 kg/ha) were recorded with the treatment T_9- Zn (125PPM) + Salicylic acid (200PPM). Higher gross returns (Rs. 82572.75/ha), net return (Rs. 56228.32/ha) and benefit cost ratio (2.13) was obtained in the treatment T_9- Zn (125PPM) + Salicylic acid (200PPM) as compared to other treatments.

Key words: *Growth, Salicylic acid, yield, Zinc.*

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 radiata* 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 (**Sharma., 2012**).

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 **(Katyal and Sharma 1991).**

Plant growth hormones regulates 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 **(Hayat *et al.*, 2010)**.

Materials and Methods

The present examination was carried out during *Zaid* 2022 at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj, UP, which is located at 25.28^{o}N latitude, 81.54^{o}E longitude and 98 m altitude above the mean sea level. The experiment laid out in Randomized Block Design which consisting of ten treatments with T_1: Zn (75PPM) + Salicylic acid (100PPM), T_2: Zn (75PPM) + Salicylic acid (150PPM), T_3: Zn (75PPM) + Salicylic acid (200PPM), T4: Zn (100PPM) + Salicylic acid (100PPM), T_5: Zn (100PPM) + Salicylic acid (150PPM), T_6: Zn (100PPM) + Salicylic acid (200PPM), T_7: Zn (125PPM) + Salicylic acid (100PPM), T_8: Zn (125PPM) + Salicylic acid (150PPM), T_9: Zn (125PPM) + Salicylic acid (200PPM), are used.The experimental site was uniform in topography and sandy loam in texture, nearly neutral in soil reaction (P^H 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, stover yield and harvest index were recorded and statistically analyzed using analysis of variance (ANOVA) as applicable to Randomized Block Design (Gomez K.A. and Gomez A.A. 1984).

Results and Discussion

Growth attributes

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. Similar results were reported by **Masih *et al*. (2020).**

Plant dry weight (g/plant)

significantly maximum Dry weight (6.64 g/plant) was recorded with the treatment with Zn (125PPM) + Salicylic acid (200PPM) over the other treatments. However, treatmentswith 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. Similar results were reported by **Kumar *et al*. (2016).**

The increase in dry weight under increasing levels of salicylic acid might be due to the promotive 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.* (2014).**

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

Yield attributes and Yield

Number of Pods/Plant

Significantly Maximum Number of Pods/Plant (21.22) 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) (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 photosynthates from source to sink. These findings were obtained by **Sruthi *et al*. (2020).**

Number of Grains/pods

Significantly Maximum Number of Grains/pod (11.35) 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) (11.16) which were found to be statistically at par with Zn (125PPM) + Salicylic acid (200PPM).

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 (2018).**

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).

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. These results are in confirmatory with the work of **Debnath *et al*. (2016).**

Stover 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) which were found to be statistically at par with Zn (125PPM) + Salicylic acid (200PPM).

Increased in stover 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. Similar findings were also corroborated by **Laishram *et al*. (2020).**

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

CONCLUSION

It is concluded that application of treatment T_9- 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.

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