International Journal of Plant & Soil Science

34(18): 50-55, 2022; Article no.IJPSS.86209
ISSN: 2320-7035

Impact of Plant Growth Regulators and Organic Manures on Performance of Black Gram (*Vigna mungo* L.)

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

Article Information

DOI: 10.9734/IJPSS/2022/v34i1831052

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/86209

Original Research Article

Received 20 February 2022
Accepted 29 April 2022
Published 03 May 2022

ABSTRACT

A field experiment was conducted during Autumn Season 2021 at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj (U.P). The experiment was laid out in Randomized Block Design with nine treatments plant growth regulators and organic manures and replicated thrice. The treatments were T_1: Gibberellic acid(GA) at40 mg L^{-1} + farm yard manure (FYM) at2.5 ton ha^{-1}, T_2: GA at40 mg L^{-1} + Vermicompost (VC) at1.6 ton ha^{-1}, T_3: GA at40 mg L^{-1} + Poultry manure(PM) at0.6 ton ha^{-1}, T_4: Indole acetic acid(IAA) at500 mg L^{-1} + FYM at2.5 ton ha^{-1} , T_5: IAA at500 mg L^{-1} + VC at1.6 ton ha^{-1}, T_6: IAA at500 mg L^{-1} + (PM) at0.6 ton ha^{-1}, T_7: Salicylic Acid(SA) at150 mg L^{-1} + FYM at2.5 ton ha^{-1}, T_8: SA at150 mg L^{-1} + VC at1.6 ton ha^{-1}, T_9: SA at150 mg L^{-1} + (PM) at 0.6 ton ha-1 were used. The results showed that application of T_6 recorded significantly higher plant height, nodules/Plant, No. of Branches/plant, Plant dry weight, Pods/plant, Seeds/pod, Test weight, Seed yield, Haulm yield and Harvest index as compared to other treatments.

Keywords: GA; FYM; IAA; Poultry manure; SA; VC; yield.

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1. INTRODUCTION

Blackgram (*Vigna Mungo*) is considered one of the most important pulse crops in all tropical and subtropical countries, dietary legumes, particularly grain or pulses, are major food sources [1].

It is well-known for its nutritional value, which includes high levels of protein (22-24%), carbohydrates (56.6-59.6%), fat (1.2-1.4%), minerals (3.2%), phosphorus (385 mg/100g), in addition calcium and iron. It differs from other pulses in that it has a relatively mucilaginous pasty texture, which gives the bulk more body due to the lengthy polymer chain of polysaccharide chains of carbohydrates. It is referred to as "poor man's meat" due to the lower cost of the protein source [2].

Plant growth regulators including salicylic acid (SA) and gibberellic acid (GA3) are well-known endogenous regulators of plant metabolism that play a vital role in both biotic and abiotic stress [3]. GA3 are a tetracyclic diterpenoid family of plant growth chemicals. Whereas SA, also known as ortho-hydroxybenzoic acid, is a secondary metabolite that functions similarly to growth regulators. When administered at physiological concentrations, foliar application of SA had a considerable effect on plant growth metabolism, and hence operated as one of the plant growth regulating chemicals [4].

Organic manures viz., FYM, vermicompost, poultry manure and oilcakes help in the improvement of soil structure, aeration and water holding capacity of soil. Further, it stimulates the activity of microorganisms that makes the plant to get the macro and micro-nutrients through enhanced biological processes, increase nutrient solubility, alter soil salinity, sodicity and pH. [5]. Though, they contain relatively low concentrations of nutrients and handling them is labour intensive, there has been large increase in their use over inorganic fertilizers as nutrient source [6]. Therefore, the soil must be 'fed' in a way that the beneficial soil organisms necessary for recycling nutrients and producing humus are not inhibited. The long term manurial studies conducted at many places have revealed the superiority of integrated nutrient supply system in sustaining crop productivity in comparison to chemical fertilizer alone [7].

By keeping these facts in mind the present study was undertaken to find out the effect of plant growth regulators and organic manures on growth and yield of black gram during autumn season. To know effect of plant growth regulators and organic manures on the growth and yield of Black gram,to workout the economics of treatment combinations.

2. MATERIALS AND METHODS

The current study was conducted during the Autumn Season of 2021 at the Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj, UP, which is situated at 25.28^{o}N latitude, 81.54^{o}E longitude, and 98 m above mean sea level. The experiment was set up in a Randomized Block Design with nine treatments. T_1: Gibberellic acid(GA) at40 mg L^{-1} + farm yard manure (FYM) at2.5 ton h a^{-1}, T_2: GA at40 mg L^{-1} + Vermicompost (VC)at1.6 ton ha^{-1}, T_3: GA at40 mg L^{-1} + Poultry manure(PM) at0.6 ton ha^{-1}, T_4: Indole acetic acid (IAA) at500 mg L^{-1} + FYM at2.5 ton ha^{-1}, T_5: IAA at500 mg L^{-1} + VC at1.6 ton ha^{-1}, T_6: IAAat500 mg L^{-1}+ (PM) at0.6 ton ha^{-1}, T_7: Salicylic Acid (SA) at150 mg L^{-1} + FYM at2.5 ton ha^{-1}, T_8: SA at150 mg L^{-1} + VC at1.6 ton ha^{-1}, T_9: SA at150 mg L^{-1} + (PM) at 0.6 ton ha^{-1} were replicated thrice.

The experimental location had a consistent topography and sandy loam texture, had a virtually neutral soil response (7.1), was low in organic carbon (0.38%), had medium available N (225 kg ha^{-1}), greater available P (19.50 kg ha^{-1}), and medium available K. (213.7 kg ha^{-1}).The foliar spray of different Plant growth regulators was done according to the treatment details. Organic manures were applied before sowing in respective plot as per the treatment details. Several plant growth metrics were recorded at numerous intervals from germination through harvest, as well as several yield parameters after harvest. These parameters include growth factors such as plant height (cm), Plant dry weight (g), nodules/Plant, and No. of Branches/plant. Pods/plant, Seeds/pod, Test weight (g), Seed yield (kg/ha), Haulm yield (kg/ha), and Harvest index were recorded and statistically evaluated using analysis of variance (ANOVA) as applied to Randomized Block Design (Gomez K.A. and Gomez A.A. 1984).

3. RESULTS AND DISCUSSION

3.1 Growth Attributes

3.1.1 Plant height

Data in table 1 tabulated that significantly highest plant height (45.24 cm) was observed in the treatment with (IAA) at500 mg L^{-1}+ (PM) at 0.6 ton ha^{-1} over all the other treatments. However,

the treatments with application of (GA) at40 mg L^{-1} + (PM) at 0.6 ton ha^{-1} (44.75 cm) and SA at150 mg L^{-1} + (PM) at 0.6 ton ha^{-1} (44.29 cm) which were found to be statistically at par with treatment (IAA) at500 mg L^{-1} + (PM) at 0.6 ton ha^{-1} Indole Acetic acid has a regulatory function in that it produces the shoot apex primary in the leaf primodial and root system, which stimulates stem development as well as cell division, cell elongation, and enzyme release, resulting in an increase in plant height. Quaderi et al.[8]. Poultry manure application improved root proliferation, higher phosphorus solubility, and he nce higher biological nitrogen fixation, nutrient uptake, and availability of all plant nutrients during the crop growth period. As a result, the plant's height increased. These findings are very similar to findings of Patil's [9].

3.1.2 Plant dry weight (g/plant)

Treatment with (IAA) at500 mg L^{-1} + (PM) at 0.6 ton ha^{-1} was recorded with significantly maximum dry weight (6.39 g/plant) over all the treatments. However, the treatments with (GA) at40 mg L^{-1} + (PM) at 0.6 ton ha^{-1} (6.28 g/plant) and (SA) at150 mg L^{1}+ (PM) at 0.6 ton ha^{-1} (6.25 g/plant) which were found to be statistically at par with (IAA) at500 mg L^{-1} + (PM) at0.6 ton ha^{-1}.

Due to their own metabolism regulation, IAA increases cell proliferation in plant developmental phases and promotes cell development by increasing turgor pressure. It also activates different enzymes and has a good influence on plant growth and dry matter accumulation. According to Quaderi et al., [8] the results were discovered. The increase in total dry matter production could be due to improved source and sink capacity developed as a result of improved dry matter production and accumulation in assimilatory surface area, as well as an increase in photosynthetic efficiency, which resulted in increased production of photosynthates, which in turn resulted in better growth and, ultimately, higher dry accumulation. The findings were found to be comparable to those of Nehra et al [10].

3.2 Nodules/Plant

Significantly highest nodules per plant (15.00) was observed in the treatment with application of (IAA) at500 mg L^{-1} + (PM) at0.6 ton ha^{-1}, which was significantly higher over rest of the treatments. However, the treatments with (GA) at40 mg L^{-1} + (PM) at 0.6 ton ha^{-1} (14.58) and (SA) at150 mg L^{-1} + (PM) at 0.6 ton ha^{-1} (14.23) which were found to be statistically at par with (IAA) at500 mg L^{-1} + (PM) at0.6 ton ha^{-1}. The increase in number of nodules per plant might be due to direct addition and slow release of nutrients from poultry manure. The more content of phosphorous and its solubility in soil helped in better root proliferation and formation of nodules. The results were found to be in resonance with Pandey et al. [11].

3.3 Branches/Plant

Significantly highest number of Branches per plant (6.39) was observed in the treatment with application of (IAA) at500 mg L^{-1} + (PM) at0.6 ton ha^{-1}, which was significantly higher over rest of the treatments. However, the treatments with (GA) at40 mg L^{-1}+ (PM) at 0.6 ton ha^{-1} (6.30) and (SA) at150 mg L^{-1} + (PM) at 0.6 ton ha^{-1} (6.28) which were found to be statistically at par with (IAA) at500 mg L^{-1} + (PM) at0.6 ton ha^{-1}. The increased number of branches due to the application of poultry manure could be related to the availability of desired and required quantities of nutrients in the root zone of growing plants for a longer length of time, allowing plant cells to divide. The outcomes were found to be in line with Patil's [9].

3.4 Yield Attributes

Significantly Maximum Pods/plant (65.37) was recorded with the treatment of application of (IAA) at 500 mg L^{-1} + (PM) at 0.6 ton ha^{-1} over all the treatments. However, the treatments (GA) at40 mg L^{-1} + (PM) at 0.6 ton ha^{-1} (64.57) which were found to be statistically at par with (IAA) at500 mg L^{-1} + (PM) at0.6 ton ha^{-1}. Significantly highest Seeds/Pod (7.73) was recorded with the treatment of application of (IAA) at500 mg L^{-1} + (PM) at 0.6 ton ha^{1}over all the treatments. However, the treatments (GA) at40 mg L^{-1} + (PM) at 0.6 ton ha^{-1}(7.59) and (SA) at 150 mg L^{-1} + (PM) at 0.6 ton ha^{-1} (7.49) which were found to be statistically at par with (IAA) at500 mg L^{-1} + (PM) at0.6 ton ha^{-1}. The beneficial response of poultry manure to yield attributes could be attributed to the availability of sufficient amounts of easily utilisable plant nutrients throughout the growth period, particularly during critical growth periods of the crop, resulting in improved uptake, plant vigour, and superior yield attributes. The results are in conformity with Singh et al. [12]. Highest Test weight (36.56 g) was recorded with the treatment application (IAA) at500 mg L^{-1} + (PM) at 0.6 ton ha^{-1} over all the treatments. However, the treatments with (35.64 g) in (GA) at40 mg L^{-1} + (PM) at 0.6 ton ha^{-1} which were found to be statistically at par with (IAA) at500 mg L^{-1} + (PM) at0.6 ton ha^{-1}.

Table 1. Impact of Plant growth regulators and Organic Manures on Growth Parameters of Black gram

Treatments	Plant height (cm)	Dry weight (g)	Nodules/plant	Branches/plant
1. Gibberellic acid at40 ppm + FYM at2.5 t/ha	40.61	5.56	11.77	5.76
2. Gibberellic acid at40 ppm + Vermicompost at1.6 t/ha	43.22	5.95	13.27	5.96
3. Gibberellic acid at40 ppm + Poultry manure(PM) at0.6 t/ha	44.75	6.28	14.58	6.30
4. Indole acetic acid at500 ppm + FYM at2.5 t/ha	41.72	5.68	12.42	5.83
5. Indole acetic acid at500 ppm + Vermicompost at1.6 t/ha	43.88	6.07	13.81	6.12
6. Indole acetic acid at500 ppm + Poultry manure(PM) at0.6 t/ha	45.24	6.39	15.00	6.39
7. Salicylic Acid at150 ppm + FYM at2.5 t/ha	39.95	5.34	11.11	5.70
8. Salicylic Acid at150 ppm + Vermicompost at1.6 t/ha	42.31	5.95	12.91	5.88
9. Salicylic Acid at150 ppm + Poultry manure(PM) at0.6 t/ha	44.29	6.25	14.23	6.28
S. Em(±)	0.35	0.06	0.25	0.05
CD (P = 0.05)	1.04	0.20	0.77	0.14

Table 2. Impact of Plant growth regulators and Organic Manures on Yield attributes of Black gram

Treatments	Pods/Plant	Seeds/pod	Test weight (g)	Seed Yield (kg/ha)	Haulm Yield (kg/ha)	Harvest Index (%)
1. Gibberellic acid at40 ppm + FYM at 2.5 t/ha	56.56	6.75	31.91	693.29	1740.23	24.47
2. Gibberellic acid at40 ppm + Vermicompost at1.6 t/ha	61.48	7.19	33.16	921.01	2011.39	31.40
3. Gibberellic acid at40 ppm + Poultry manure(PM) at0.6 t/ha	64.57	7.59	35.64	1168.37	2322.20	33.55
4. Indole acetic acid at500 ppm + FYM at2.5 t/ha	57.72	6.94	32.31	799.71	1811.73	30.63
5. Indole acetic acid at500 ppm + Vermicompost at1.6 t/ha	62.23	7.33	33.73	1009.29	2121.92	32.23
6. Indole acetic acid at500 ppm + Poultry manure(PM) at0.6 t/ha	65.37	7.73	36.56	1227.63	2421.79	33.62
7. Salicylic Acid at150 ppm + FYM at2.5 t/ha	54.86	6.57	31.67	615.03	1682.02	26.75
8. Salicylic Acid at150 ppm + Vermicompost at1.6 t/ha	59.66	7.13	32.78	861.38	1873.39	31.49
9. Salicylic Acid at150 ppm + Poultry manure(PM) at0.6 t/ha	63.42	7.49	34.32	1064.49	2253.65	32.09
S. Em±)	0.47	0.09	0.34	30.41	38.02	0.70
CD (P = 0.05)	1.42	0.26	1.03	91.16	114.00	2.09

Significantly highest Seed yield (1227.63 kg/ha) was recorded with application of (IAA) at500 mg L^{-1} + (PM) at 0.6 ton ha^{-1} over all the treatments. However, the treatments with (1168.37 kg/ha) in (GA) at40 mg L^{-1} + (PM) at 0.6 ton ha^{-1} which were found to be statistically at par with (IAA) at500 mg L^{-1} +(PM) at0.6 ton ha^{-1}. IAA is important for improving seed yield because it is involved in a variety of physiological processes in plants, including chlorophyll synthesis, stomatal control, and starch consumption, all of which improve seed yield. The results were in accordance to Hanaa and Safa [13]. Significantly highest Haulm yield (2421.79 kg/ha) was recorded with the treatment application of (IAA) at500 mg L^{-1} + (PM) at 0.6 ton ha^{-1} over all the treatments. However, the treatments with (2322.20 kg/ha) in (GA) at40 mg L^{-1} + (PM) at 0.6 ton ha^{-1} which were found to be statistically at par with (IAA) at500 mg L^{-1} + (PM) at0.6 ton ha^{-1}. The release of macro and micro nutrients during microbial decomposition has been linked to a larger rise in yield. Organic matter also serves as a source of energy for soil microflora, which helps to change other nutrients contained in the soil or applied in other ways into a form that is easily consumed by growing plants, resulting in an increase in seed output. The results were in accordance with Kannan et al. [14]. Significantly highest harvest index (33.62 %) was recorded with the treatment application of (IAA) at500 mg L^{-1} + (PM) at 0.6 ton ha^{-1} over all the treatments. However, the treatments with (33.55 %) (GA) at40 mg L^{-1} + (PM) at0.6 ton ha^{-1}, (32.23 %) (IAA) at500 mg L^{-1} + (VC) at1.6 ton ha^{-1} and (320.9 %) which were found to be statistically at par with (IAA) at500 mg L^{-1} + (PM) at0.6 ton ha^{-1} [15-18].

4. CONCLUSION

It is concluded that application of (IAA) at500 mg L^{-1} + (PM) at 0.6 ton ha^{-1} performed exceptionally in obtaining maximum seed yield of blackgram. Hence [19-20], (IAA) at500 mg L^{-1} + (PM) at 0.6 ton ha^{-1} is advised major yield and benefit cost ratio.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/86209