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Physiological Response of Homobrassinolide on Growth and Yield Component of Black Gram (Vigna Mungo L.)

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Abstract: A field experiment was conducted during the kharif seasons of 2021 at farm of Botany section, College of Agriculture, Nagpur. The experiment was laid out in randomized block design and replicated thrice consisting eleven treatments i. e. Homobrassinolide (0.10 ppm, 0.20 ppm, 0.30 ppm, 0.40 ppm, 0.50 ppm, 0.60 ppm, 0.70 ppm, 0.80 ppm, 0.90 ppm and 1.00 ppm) Results revealed that foliar application of homobrassinolide sprayed at two stages i. e. 20 and 40 DAS significantly improved growth parameters like plant height, number of branches, days to 50 per cent flowering, total dry weight, leaf area and yield parameters like number of pods plant^{-1}, test weight, seed yield ha^{-1} and harvest index. Treatment T_{11} (Homobrassinolide @ 1.00 ppm) gave significantly higher results in all parameters under study.

Keywords: Black Gram, Homobrassinolide, Growth Parameters, Yield Contributing Parameters, Yield.

1. INTRODUCTION

Black gram (Vigna mungo L. Hepper) crops play an important role in Indian agriculture. It is annual herbaceous plant attaining a height of 30 to 100 cm, black gram belong to family Leguminaceae and sub-family Papilionaceae having chromosome number 2n=22. It also known as “Mash bean”. Black gram has originated from Indian sub-continent (Zukovskij, 1962).

The grain of black gram is superior in nutritive value, black gram contain about 24% proteins, 60% carbohydrate, 1.4% fat, 347 Kcal energy, 3.2% minerals, 385 mg 100 g^{-1} phosphoric acid and 16.2% total dietory fibre. Black gram rich in minerals like zinc, cadmium and also rich in vitamins like thiamine, riboflavin and niacin. High values of lysine

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make black gram an excellent complement to rice in terms of balanced human nutrition (Anonymous, 2020).

Brassinosteroids (BS) constitute a well-established and recognized group of phytohormones. Contrary to other groups, this class is steroidal in nature and exhibits great similarity with animal steroids. They are implicated in diverse physiological responses including those associated with seed germination, vascular differentiation, flowering, reproductive development, seed set and maturation, senescence, and overall growth and development of the plant. They also show a promising ameliorative influence on the plants exposed to various stress situations: low and excess water, salt, temperature, heavy metal, pesticides, ultraviolet radiations, and pathogens. They rescue the plants from such adverse conditions or at least mitigate the negative impact of the stress. Various studies suggest a favorable role of BR's in secondary metabolite synthesis of plants. Brassinosteroids also exert a profound influence on the yield (quantity as well as quality) of plants of agricultural importance. Furthermore, brassinosteroids enhance the productivity of various crops of agricultural importance such as cereals, legumes, oil seed crops, fruit crops, and vegetables. One of the most important underlying aspects of BR's-meditated enhancement of crop yield is the regulation of the expression of genes that determines the traits responsible (Ali, 2022).

2. MATERIALS AND METHOD

A field experiment was conducted during the kharif seasons of 2021 at farm of Botany section, College of Agriculture, Nagpur asses the effect of foliar sprays of homobrassinolide on growth and yield of black gram. The experiment was laid out in randomized block design and replicated thrice consisting eleven treatments i. e. T_1 (control), T_2 (Homobrassinolide @ 0.10 ppm), T_3 (Homobrassinolide @ 0.20 ppm), T_4 (Homobrassinolide 0.30 @ ppm), T_5 (Homobrassinolide @ 0.40 ppm), T_6 (Homobrassinolide 0.50 @ ppm), T_7 (Homobrassinolide @ 0.60 ppm), T_8 (Homobrassinolide @ 0.70 ppm), T_9 (Homobrassinolide @ 0.80 ppm), T_{10} (Homobrassinolide @ 0.90 ppm) and T_{11} (Homobrassinolide @ 1.00 ppm). The foliar application of homobrassinolide was given at two stages i. e. at 20 and 40 DAS on black gram. The observation like plant height, number of branches plant^{-1}, total dry weight plant^{-1} and leaf area plant^{-1} were recorded at 30, 50 and 70 DAS. Whereas, days to 50 per cent flowering also recorded. Also, yield and yield contributing attributes viz., number of pod plant^{-1}, seed yield ha^{-1}, test weight and harvest index were recorded at harvest. Data were analysed by statistical method suggested by Panse and Sukhatme (1954).

3. RESULTS AND DISCUSSION

Plant height

Data regarding plant height was recorded at successive stages of crop growth i.e. 30, 50 DAS and 70 DAS.

At 30 DAS the data regarding plant height was found statistically significant and the range of plant height was recorded 15.26-20.17 cm. The data indicated that significantly highest plant height was recorded from treatment T_{11} (Homobrassinolide @ 1.00 ppm) which was superior in respect of plant height over all remaining treatments. However, it was at par with treatment T_{10} (Homobrassinolide @ 0.90 ppm), T_9 (Homobrassinolide @ 0.80 ppm), T_8

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(Homobrassinolide @ 0.70 ppm), T_7 (Homobrassinolide @ 0.60 ppm) and T_6 (Homobrassinolide @ 0.50 ppm). These treatment of homobrassinolide was found superior to increase plant height when compared with treatment T_1 (control) and remaining treatments.

At 50 DAS and 70 DAS the data regarding plant height was found significant and the range of plant height was recorded 34.10-48.15 cm and 34.63-48.70 cm respectively. Among the various treatments significantly highest plant height was exhibited by treatment T_{11} (Homobrassinolide @ 1.00 ppm). Followed by treatments T_{10} (Homobrassinolide @ 0.90 ppm), T_9 (Homobrassinolide @ 0.80 ppm), T_8 (Homobrassinolide @ 0.70 ppm) and T_7 (Homobrassinolide @ 0.60 ppm). These combination of homobrassinolide was found superior to increase plant height when compared with treatment T_1 (control) and rest of the treatments.

Application homobrassinolide through foliar sprays at 30, 50 and 70 DAS increased plant height. It might be due to homobrassinolide promote the elongation and division of plant cell and it enhances the DNA polymerase and RNA polymerase activity and promote the synthesis of nucleic acids proteins in the legume, The data revealed that plant height was increased with the age till at maturity.

Similar results were also reported by Sengupta et al. (2011) the result revealed that the plant height were significantly higher in the treatments where brassinolide sprayed with 0.25 ppm brassinolide. It is assumed that brassinolide induced synthesis of both IAA and GA in plant body and increase in plants height was probably due to their cumulative action.

The results lend support to the views expressed by earlier researchers Netwal et al. (2022) reported that application of brassinoids 1.0 ppm to the Indian bean significantly increased the plant height.

Number of branches per plant

Data regarding number of branches per plant was recorded at successive stages of crop growth i.e. 30, 50 DAS and 70 DAS.

At 30 DAS the range of number of branches plant^{-1} was observed 4.13-5.80. Significantly highest number of branches plant^{-1} was observed in treatment T_{11} (Homobrassinolide @ 1.00 ppm). However, it was at par with treatments T_{10} (Homobrassinolide @ 0.90 ppm), T_9 (Homobrassinolide @ 0.80 ppm), T_8 (Homobrassinolide @ 0.70 ppm), T_7 (Homobrassinolide @ 0.60 ppm), T_6 (Homobrassinolide @ 0.50 ppm) and T_5 (Homobrassinolide @ 0.40 ppm). These treatments of homobrassinolide was found superior to increase dry matter when compared with treatment T_1 (control) and rest of the treatments.

At 50 DAS and 70 DAS the range of number of branches plant^{-1} was observed 10.22-17.40 and 10.22-17.40 respectively. Significantly highest number of branches plant^{-1} was observed in treatment T_{11} (Homobrassinolide @ 1.00 ppm). However, it was at par with treatments T_{10} (Homobrassinolide @ 0.90 ppm), T_9 (Homobrassinolide @ 0.80 ppm), T_8 (Homobrassinolide @ 0.70 ppm), T_7 (Homobrassinolide @ 0.60 ppm), T_6 (Homobrassinolide @ 0.50 ppm) and T_5 (Homobrassinolide @ 0.40 ppm). These treatments of homobrassinolide was found superior to increase number of branches plant^{-1} when compared with treatment T_1 (control) and rest of the treatments.

The foliar application of homobrassinolide increased number of branches plant^{-1}. These results were paralleled with those obtained by Bera et.al. (2013) reported that the

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highest branches were recorded in crop receiving twice spraying of homobrassinolide at pre-flowering and pod development stage in lentil.

These results are in accordance with the findings of Netwal et al. (2022) reported that application of brassinoids 1.0 ppm to the Indian bean significantly increased the number of branches per plant. This might be due to the stimulating effect of brassinosteroids in cell division and cell elongation. The reason can also attributed to the synergistic effects of brassinosteroid.

Days to 50 per cent flowering

Days to 50% flowering is the number of days required for initiation of flowering in not less than 50% of plants treatment^{-1}.

Flowering was significantly earlier in treatment T_{11} (Homobrassinolide @ 1.00 ppm). However, it was at par with treatments T_{10} (Homobrassinolide @ 0.90 ppm), T_9 (Homobrassinolide @ 0.80 ppm), T_8 (Homobrassinolide @ 0.70 ppm), T_7 (Homobrassinolide @ 0.60 ppm) and T_6 (Homobrassinolide @ 0.50 ppm). These treatments of homobrassinolide was found superior when compared with treatment T_1 (control) and rest of the treatments.

The results are in conformity with Ananthi and Gomathy (2011) reported that days to 50 per cent flowering favourably enhanced by the foliar application of 0.1% humic acid with 0.1 ppm brassinosteroid treatment in green gram.

However, Sumathi et al. (2018) reported that among different PGR's tested, BR proved its worthiness in terms of days to 50 per cent flowering. Among different PGR's, BR initiated flowering early in pigeon pea. Application of BR induces pollen tubes growth and germination, which induces early flowering and fruit setting.

Total dry weight of plant^{-1} (gm)

Data regarding total dry weight per plant was recorded at successive stages of crop growth i.e. 30, 50 DAS and 70 DAS.

At 30 DAS the range of total dry weight was observed 3.47-5.23 g. Significantly maximum total dry matter was observed in treatment T_{11} (Homobrassinolide @ 1.00 ppm). However, it was at par with treatments T_{10} (Homobrassinolide @ 0.90 ppm), T_9 (Homobrassinolide @ 0.80 ppm), T_8 (Homobrassinolide @ 0.70 ppm) and T_7 (Homobrassinolide @ 0.60 ppm). These treatments of homobrassinolide was found superior to increase dry matter when compared with treatment T_1 (control) and rest of the treatments.

At 50 DAS and 70 DAS the range of total dry weight was observed 12.17-18.40 g and 18.30-27.77 g respectively. The mean values of dry matter showed that treatment T_{11} (Homobrassinolide @ 1.00 ppm) significantly enhanced dry matter accumulation in plant.

These results are in accordance with the findings of Netwal et al. (2022) reported that application of brassinoids 1.0 ppm to the Indian bean significantly increased the dry matter accumulation.

Leaf area plant^{-1}

Data regarding leaf area per plant was recorded at successive stages of crop growth i.e. 30, 50 DAS and 70 DAS.

Significant variation with gradual increase (30, 50 and 70 DAS) was noticed regarding leaf area at all the stages of observations. Leaf area at 30 DAS was found

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significant. The range of leaf area recorded was 2.76-3.99 dm^2 . At these stages Significantly maximum leaf area plant-1 was observed in treatment T_{11} (Homobrassinolide @ 1.00 ppm). However, it was at par with treatments T_{10} (Homobrassinolide @ 0.90 ppm), T_9 (Homobrassinolide @ 0.80 ppm), T_8 (Homobrassinolide @ 0.70 ppm), T_7 (Homobrassinolide @ 0.60 ppm) and T_6 (Homobrassinolide @ 0.50 ppm). These treatments of homobrassinolide was found superior to increase leaf area plant-1 when compared with treatment T_1 (control) and rest of the treatments.

At 50 DAS leaf area plant-1 was significantly influenced by different treatments. The range of leaf area recorded was 9.33-13.17 dm^2 . At this stage significantly maximum leaf area plant-1 was noted in treatment T_{11} (Homobrassinolide @ 1.00 ppm). However, it was at par with treatments T_{10} (Homobrassinolide @ 0.90 ppm), T_9 (Homobrassinolide @ 0.80 ppm), T_8 (Homobrassinolide @ 0.70 ppm), T_7 (Homobrassinolide @ 0.60 ppm) and T_6 (Homobrassinolide @ 0.50 ppm). These treatments of homobrassinolide was found superior to increase leaf area $plant^{-1}$ when compared with treatment T_1 (control) and rest of the treatments.

At 70 DAS the range of leaf area plant-1 was observed 6.80- 10.42 dm^2 . Data revealed that leaf area increased from 30 to 50 DAS. But later at 70 DAS leaf area decreased due to leaf fall at this stage. Under the influence of foliar spray of homobrassinolide treatment T_{11} (Homobrassinolide @ 1.00 ppm). However, it was at par with treatments T_{10} (Homobrassinolide @ 0.90 ppm), T_9 (Homobrassinolide @ 0.80 ppm), T_8 (Homobrassinolide @ 0.70 ppm), T_7. (Homobrassinolide @ 0.60 ppm) and T6 (Homobrassinolide @ 0.50 ppm). These treatments of homobrassinolide was found superior to increase leaf area $plant^{-1}$ when compared with treatment T_1 (control) and rest of the treatments.

Our results are in line with that of Sana et al. (2014) who observed that Leaf area increased significantly by 1 ppm foliar spray of brassinolide over control in (Vigna radiata L.).

These results are in accordance with the findings of Netwal et al. (2022) reported that application of brassinoids 1.0 ppm to the Indian bean significantly increased the leaf area.

Number of pod $plant^{-1}$

At harvest the range of number of pod $plant^{-1}$ was observed in the range of 28.04-39.87. Significantly highest number of pod was found in T_{11} (Homobrassinolide @ 1.00 ppm).

Similar findings were enlightened by Jeyakumar et al. (2008) reported that among the treatments, brassinolide @ 0.1 ppm resulted in more number of pods per plant in black gram. The increased number of pods and seeds could be due to better translocation of nutrients and assimilates to the reproductive regions.

Seed yield $plant^{-1}$ (g), $plot^{-1}$ (kg) and ha^{-1} (q)

Seed yield is the economic yield which is final results of physiological activities of plant. Economic yield is the part of biomass that is converted into economic product (Nichiporovic, 1960).

Significantly maximum seed yield $plant^{-1}$, $plot^{-1}$ and $hectare^{-1}$ were produced in treatment T_{11} (Homobrassinolide @ 1.00 ppm). The range of increase in seed yield $plant^{-1}$,

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plot^{-1} and hectare^{-1} was 4.71 g, 0.51 kg and 11.26 q in treatment T_1 (control) and 10.26 g, 0.80 kg and 17.77 q in treatment T_{11} (Homobrassinolide @ 1.00 ppm) respectively.

According to results of Gograj et al. (2012) the use of brassinolide up to 1.0 ppm was observed to increase significantly grain yield and biological yield of clusterbean.

Similarly, Hamed and Abdullah (2022) reported that plant sprayed with 1.5 mg L^{-1} concentration of brassinolide achieved highest weight of total seed yield of sunflower.

Test weight

The range of test weight recorded after harvest was 4.07-5.02 g. Significantly highest test weight content was found in T_{11} (Homobrassinolide @ 1.00 ppm).

Application of homobrassinolide as foliar spray increased the seed weight due to better mobilization of nutrients to seed.

Gograj et al. (2012) reported that the use of brassinolide up to 1.0 ppm was observed to increase significantly test weight of clusterbean.

Harvest Index

The range of harvest index obtained was 30.44 in control to 38.11 in treatment receiving Homobrassinolide @ 1.00 ppm. Among all treatments under study significantly more harvest index was exhibited in treatment T_{11} (Homobrassinolide @ 1.00 ppm).

The significant effect of homobrassinolide on harvest index was confirmed by Gograj et al. (2012) the use of brassinolide up to 1.0 ppm was observed to increase significantly harvest index of clusterbean.

Our findings about harvest index are in accordance with that of obtained by Matwa et al. (2017) spraying brassinolide 0.25 ppm at 50% flowering and 15 days later showed significant increase on harvest index in green gram.

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Treatments	Plant height (cm)			Number of branches plant^{-1}			Days to 50% Flowering	Total dry weight plant^{-1}(g)			Leaf area plant^{-1} (dm^2)		
	30 DAS	50 DAS	70 DAS	30 DAS	50 DAS	70 DAS		30 DAS	50 DAS	70 DAS	30 DAS	50 DAS	70 DAS
T_1 (Control)	15.26	34.10	34.63	4.13	10.22	10.22	40.67	3.47	12.17	18.30	2.76	9.33	6.80
T_2 (Homobrassinolide @ 0.10 ppm)	17.06	38.53	38.87	4.33	13.15	13.15	40.00	4.07	14.58	23.69	3.03	10.53	8.47
T_3 (Homobrassinolide @ 0.20 ppm)	17.30	39.68	40.32	4.40	13.70	13.70	39.33	4.10	14.81	24.00	3.04	10.68	8.78
T_4 (Homobrassinolide @ 0.30 ppm)	17.57	41.74	42.15	4.80	14.09	14.09	38.00	4.19	15.08	24.40	3.10	10.79	8.99
T_5 (Homobrassinolide @ 0.40 ppm)	17.81	42.85	43.40	4.87	15.05	15.05	37.67	4.34	15.46	24.76	3.19	11.04	9.01
T_6 (Homobrassinolide @ 0.50 ppm)	18.03	43.08	43.59	5.13	15.61	15.61	37.00	4.41	15.48	25.49	3.30	11.52	9.19
T_7 (Homobrassinolide @ 0.60 ppm)	18.57	45.01	45.65	5.27	16.00	16.00	36.67	4.48	17.30	25.66	3.45	11.81	9.85
T_8 (Homobrassinolide @ 0.70 ppm)	18.96	45.78	46.16	5.33	16.41	16.41	36.33	5.06	17.91	26.63	3.57	12.22	9.94

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T_9 (Homobrassinolide @ 0.80 ppm)	19.35	46.19	46.76	5.40	16.89	16.89	36.00	5.09	18.05	26.78	3.72	12.50	10.15
T_{10} (Homobrassinolide @ 0.90 ppm)	19.87	47.62	48.07	5.67	17.07	17.07	35.67	5.10	18.25	26.92	3.82	13.11	10.36
T_{11} (Homobrassinolide @ 1.00 ppm)	20.17	48.15	48.70	5.80	17.40	17.40	35.33	5.23	18.40	27.77	3.99	13.17	10.42
SE (m) ±	0.75	1.73	1.65	0.30	0.78	0.78	0.63	0.25	0.71	0.98	0.17	0.64	0.45
CD at 5 %	2.24	5.13	4.87	0.88	2.32	2.32	1.86	0.75	2.09	2.89	0.52	1.90	1.34

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Treatments	Seed protein content (%)	Number of pod plant^{-1}	Test Weight (g)	Seed yield plant^{-1} (g)	Seed yield plot^{-1} (kg)	Seed yield ha^{-1} (q)	Harvest index (%)
T_1 (Control)	24.25	28.60	4.07	4.71	0.51	11.26	30.44
T_2 (Homobrassinolide @ 0.10 ppm)	24.64	33.71	4.22	8.01	0.60	13.40	32.06
T_3 (Homobrassinolide @ 0.20 ppm)	24.79	33.77	4.35	8.18	0.61	13.55	32.62
T_4 (Homobrassinolide @ 0.30 ppm)	25.66	34.17	4.52	8.37	0.63	13.99	32.96
T_5 (Homobrassinolide @ 0.40 ppm)	25.84	34.58	4.58	8.41	0.65	14.44	33.21
T_6 (Homobrassinolide @ 0.50 ppm)	26.00	34.79	4.64	8.73	0.69	15.33	33.37
T_7 (Homobrassinolide @ 0.60 ppm)	26.47	38.30	4.74	9.69	0.72	16.07	35.44
T_8 (Homobrassinolide @ 0.70 ppm)	26.63	38.45	4.86	9.75	0.75	16.59	37.22
T_9 (Homobrassinolide @ 0.80 ppm)	26.98	39.15	4.91	9.98	0.77	17.03	37.63
T_{10} (Homobrassinolide @ 0.90 ppm	27.08	39.24	4.96	10.07	0.78	17.33	38.04
T_{11} (Homobrassinolide @ 1.00 ppm	27.18	39.87	5.02	10.26	0.80	17.77	38.11
SE (m) ±	0.33	1.67	0.11	0.58	0.04	1.07	1.26
CD at 5 %	0.98	4.95	0.33	1.71	0.14	3.17	3.74

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