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EFFECT OF PLANT GROWTH RETARDANTS ON MORPHO-PHYSIOLOGICAL, SEED YIELD AND QUALITY PARAMETERS OF *KHARIF* BLACKGRAM (*VIGNA MUNGO* L.)

K. Lavanya[1*], K. Jayalalitha[1], M. Ravi Babu[2] and N. Harisatyanarayana[3]
[1]Department of Plant Physiology, Acharya N.G. Ranga Agricultural University, Agricultural College, Bapatla, Bapatla-52210, India.
[2]ANGRAU, RARS, Anakaplle-531001, India.
[3]ANGRAU, RARS, Lam, Guntur-522034, India.
*Corresponding author Email: lavnyareddy9154@gmail.com.
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ABSTRACT

A field experiment was conducted to study the different growth retardants on morpho-physiological, seed quality and yield parameters of blackgram at Agricultural College Farm, Bapatla, during *kharif,* 2024. The basic material for the present investigation consists of blackgram variety LBG-904 and three growth retardants (paclobutrazol, chlormequat chloride and mepiquat chloride). The experiment was laid out in Randomized Block Design and replicated thrice with ten treatments *viz*., paclobutrazol @ 100 ppm, 150 ppm and 200 ppm, chlormequat chloride @ 500 ppm, 1000 ppm and 1500 ppm, mepiquat chloride @ 1000 ppm, 1500 ppm and 2000 ppm and control *i.e*., water sprayed were applied through foliar spray at 35 DAS. Results showed that the morphological parameter *i.e*., plant height was decreased, physiological parameters *viz*., dry matter and total chlorophyll content were increased, test weight, seed yield and quality parameter seed protein content increased significantly with the foliar application of mepiquat chloride @ 2000 ppm.

Keywords **:** Blackgram; Growth retardants; Morpho-Physiological; Quality parameters and Seed Yield.

Introduction

Blackgram (*Vigna mungo* L.) is the fourth most important pulse crop of India after chickpea, pigeonpea and greengram. Blackgram being an important source of human food and animal feed, it also plays an important role in sustaining soil fertility by improving soil physical properties through fixing atmospheric nitrogen. It is suitable to grow both in *kharif* as well as in *rabi* season. However, its cultivation during *kharif* season is quite difficult than that of *rabi*. The primary constraint of this season includes heavy rainfall which leads to excessive vegetative growth, poor fruit formation. Furthermore, indeterminate growth habit leading to continuous and constant competition between vegetative and fruiting sinks (pods) for photo-assimilates throughout the crop growth period led to poor grain yield (Shyam *et al*., 2018). The physiological constraints can be overcome with the use of various plant growth retardants. Growth retardants plays significant role to modifying growth of indeterminate crops where vigorous vegetative growth during flowering stage is major constraint. They restricts the synthesis of gibberellic acid in plants, make plants shorter and boost translocation of photoassimilates towards sink bodies and increased crop yield (Sharma *et al*., 2013). Considering the above facts, the field experiment was conducted to investigate the effect of plant growth retardants on morpho-physiological, seed yield and quality parameters of *kharif* balckgram (*Vigna mungo* L.).

Material and Methods

The present study was carried out during rainy (*kharif*) season of 2024 at Agricultural College Farm, Bapatla. It is geographically located at 150 54'

Northern latitude, and 800 25' Eastern longitude, with an altitude of 5.49 m above the mean sea level and about 8 km away from the Bay of Bengal in the Krishna Agro-Climatic Zone of Andhra Pradesh. The experiment was laid out in randomized block design (RBD) with 10 treatments *viz*., paclobutrazol @ 100 ppm (T_1), paclobutrazol @ 150 ppm (T_2), paclobutrazol @ 200 ppm (T_3), chlormequat chloride @ 500 ppm (T_4), chlormequat chloride @ 1000 ppm (T_5), chlormequat chloride @ 1500 ppm (T_6), mepiquat chloride @ 1000 ppm (T_7), mepiquat chloride @ 1500 ppm (T_8), mepiquat chloride @ 2000 ppm (T_9) and control *i.e*., water sprayed (T_{10}) with three replications of each to study the effect of growth retardants on morpho-physiological, seed yield and quality parameters of *kharif* blackgram (*Vigna mungo* L.). Crop cultivar LBG-904 was sown on 2nd August. The foliar application of treatments was done at 35 DAS (*i.e.,* 10 days before flower initiation) with hand sprayer. Five plants were selected randomly from each plot and were tagged for recording various observations, average values per plant were calculated. Observations on plant height, total dry matter were recorded at 35, 50 DAS and at harvest, total chlorophyll content at 35 and 50DAS. Protein content, test weight and seed yield were calculated at harvest of crop and subjected to statistical analysis as per randomized block design (RBD) as described by Panse and Sukhatme (1978).

Results and Discussion

The results obtained on morpho-physiological, yield attribute, yield and quality traits of blackgram as influenced by different treatments of findings of research.

Plant height (cm)

Plant height (cm) is one of the indices for the plant growth. The data on plant height of blackgram and data presented in Table 1. At 35 DAS, there was no significant difference in plant height with different concentrations of growth retardants. From 50 DAS and at harvest, significant differences were noticed among the different treatments. At 50 DAS and at harvest, among the treatments, foliar application of mepiquat chloride @ 2000 ppm recorded lesser plant height (T_9 - 48.21 and 50.07 cm, respectively), which was statistically at par with mepiquat chloride @ 1500 ppm (T_8 - 53.53 and 55.73 cm, respectively). Significantly higher plant height was recorded in control *i.e.*, water spray (T_{10} - 63.91 and 66.95 cm, respectively) over other treatments except the treatment paclobutrazol @ 100 ppm (T_1 - 57.63 and 60.77 cm, respectively) which was on par with control. Our results are in line with the results obtained by Gurdeep *et al.* (2020) in greengram, Arora *et al*. (1998) in chickpea who reported that the growth retardants have specific capacity to reduce plant height by reducing internodal length. Among the treatments, foliar spray of mepiquat chloride @ 2000 and 1500 ppm decreased the plant height by 25.2 and 16.8 per cent, respectively, over control. Basically, plant height is a genetically controlled character, but several studies indicated that plant height can be either increased or decreased by the application of synthetic plant growth regulators. Among the treatments, foliar application of mepiquat chloride @ 2000 and 1500 ppm reduced the plant height significantly than the other treatments as it counteracts the gibberellin biosynthesis which in turn reduces internodal length and further decreased the plant height. Similar findings were obtained by Sudharani and Sudhakar (2018) in pigeonpea.

Total dry matter (g plant^{-1})

Dry matter accumulation and distribution is an important factor indicating partitioning efficiency of a plant. In the present study, at 35 DAS there was no significant difference was observed but total dry matter increased from 50 DAS to harvest in all the treatments. The total dry matter of treatments varied significantly at all the stages of observation. At 50 DAS, total dry matter production of ten treatments ranged from 8.09 to 12.66 g plant^{-1}. The maximum was recorded with the treatment mepiquat chloride @ 2000 ppm (T_9 - 12.66 g plant^{-1}) which was at par with the treatment mepiquat chloride @ 1500 ppm (T_8-11.78 g plant^{-1}). The minimum was recorded with the treatment control (water spray - 8.09 g plant^{-1}) which was on par with the treatment paclobutrazol @ 100 ppm (T_1 - 9.05 g plant^{-1}). The remaining treatments recorded significantly lesser total dry matter compared to mepiquat chloride @ 2000 ppm (T_9) and higher dry matter compared to control (T_{10}). At harvest, total dry matter production in ten treatments ranged from 14.68 to 28.35 g plant^{-1}. The highest total dry matter was obtained with mepiquat chloride @ 2000 ppm (T_9 - 28.35 g plant^{-1}) which was on par with mepiquat chloride @ 1500 ppm (T_8-25.03 g plant^{-1}). Control plants (T_{10}) recorded the lowest dry matter *i.e.*, 14.59 g plant^{-1} and it was at par with paclobutrazol @ 100 ppm (T_1 - 18.04 g plant^{-1}). All other treatments were significantly lower than mepiquat chloride @ 2000 ppm (T_9) and higher than control (T_{10}). The increase in total dry matter accumulation with growth retardants treated plots might be due to increased photosynthetic efficiency of leaves and also due to the translocation of stored photoassimilates towards the development of reproductive organs thus, assisting in accumulation of

more photosynthates in sinks and ultimately resulting in higher seed yield. Basically, dry matter is one of the indices for determining the growth and physiological efficiency. The increase in dry matter in the mepiquat chloride @ 2000 ppm treated plants could be due to increased photosynthetic ability of leaves and thus assisting in the accumulation of more photosynthates by plants and ultimately resulting in higher dry weight in plant. Similar observations were earlier made by Saisankar (2001). Other reason might be increased stem thickness in shorter plants (treated plants) than taller plants in control, which had also contributed to increased dry matter production in the growth retardant treatments. Our results are similar with the findings of Chandrashekharayya *et al.* (2023) in pigeonpea.

Table 1 : Effect of plant growth retardants on plant height (cm) and total dry matter (g plant^{-1})

Treatments	Plant height (cm)			Total dry matter (g plant^{-1})		
	35 DAS	50 DAS	At harvest	35 DAS	50 DAS	At harvest
T_1 : Paclobutrazol @ 100 ppm	36.75	57.63	60.77	2.98	9.05	18.04
T_2 : Paclobutrazol @ 150 ppm	36.54	55.97	58.70	2.89	9.70	19.37
T_3 : Paclobutrazol @ 200 ppm	36.39	55.93	58.67	2.87	9.66	19.96
T_4 : Chlormequat chloride @ 500 ppm	36.77	56.13	59.70	3.00	9.98	21.17
T_5 : Chlormequat chloride @ 1000 ppm	36.83	55.64	58.39	2.86	10.62	21.44
T_6 : Chlormequat chloride @ 1500 ppm	36.20	55.60	57.97	2.92	11.17	22.03
T_7 : Mepiquat chloride @ 1000 ppm	36.23	55.25	57.66	2.93	11.07	22.92
T_8 : Mepiquat chloride @ 1500 ppm	36.94	53.53	55.73	2.90	11.78	25.03
T_9 : Mepiquat chloride @ 2000 ppm	36.58	48.21	50.07	2.78	12.66	28.35
T_{10} : Control (water spray)	36.91	63.91	66.95	2.93	8.09	14.59
SE m (±)	1.85	2.28	2.42	0.09	0.42	1.18
CD (5%)	NS	6.76	7.18	NS	1.25	3.51
CV (%)	8.73	7.07	7.16	5.42	7.02	9.62

Total chlorophyll content (mg g^{-1} fr. wt.)

At 50 DAS, foliar spray of mepiquat chloride @ 2000 ppm recorded higher total chlorophyll content (T_9 - 2.59 mg g^{-1}), which was at par with mepiquat chloride @ 1500 ppm (T_8-2.40 mg g^{-1}). The lower chlorophyll content was recorded by control (i.e., water spray - 1.68 mg g^{-1}), which was at par with paclobutrazol @ 100 ppm (T_1 -1.75 mg g^{-1}) and paclobutrazol @ 150 ppm (T_2 -1.89 mg g^{-1}). These results indicate that application of plant growth retardants showed remarkable increase in total chlorophyll. At 50 DAS, the variation in chlorophyll content due to foliar spray of growth retardants might be attributed to decreased chlorophyll degradation and increased chlorophyll synthesis. The high chlorophyll content with the application of mepiquat chloride was attributed to the protection of chlorophyll molecule from photo oxidation and increased chlorophyll synthesis. Further, Jeyakumar and Thangaraj (1998) stated that application of mepiquat chloride to groundnut crop results in high chlorophyll content due to delay in chlorophyll degradation. The increase in dry matter with mepiquat chloride application might be due to the attribution of its ability to enhance chlorophyll synthesis, which in turn inhibits chlorophyllase enzyme, responsible for degradation of chlorophyll, lead to increased chlorophyll content (Rosolem *et al.*, 2013).

Table 2 : Effect of growth retardants on total chlorophyll content (mg g^{-1} fr. wt.), protein content (%), test weight (g) and seed yield (kg ha^{-1})

Treatments	Total chlorophyll content (mg g^{-1} fr. wt.)		Protein content (%)	Test weight (g)	Seed yield (kg ha^{-1})
	35 DAS	50 DAS	At harvest		
T_1 : Paclobutrazol @ 100 ppm	1.60	1.75	23.12	3.85	999.77
T_2 : Paclobutrazol @ 150 ppm	1.54	1.89	24.19	3.96	1085.64
T_3 : Paclobutrazol @ 200 ppm	1.70	2.04	24.76	4.02	1198.22
T_4 : Chlormequat chloride @ 500 ppm	1.75	1.96	24.08	4.13	1150.41
T_5 : Chlormequat chloride @ 1000 ppm	1.80	2.10	25.77	4.09	1209.30
T_6 : Chlormequat chloride @ 1500 ppm	1.79	2.07	26.95	4.14	1290.05
T_7 : Mepiquat chloride @ 1000 ppm	1.80	2.16	26.38	4.18	1252.15

T_8 : Mepiquat chloride @ 1500 ppm	1.75	2.40	27.37	4.60	1316.85
T_9 : Mepiquat chloride @ 2000 ppm	1.67	2.59	29.87	4.95	1448.74
T_{10}: Control (water spray)	1.31	1.68	21.22	3.13	855.62
SE m (±)	0.12	0.07	0.93	0.25	43.97
CD (5%)	NS	0.21	2.77	0.74	130.64
CV (%)	12.75	5.77	6.37	10.47	6.45

Protein content (%)

The data on the effect of foliar spray of growth retardants on protein content of blackgram seed are presented in Table 2. Seed protein content of different treatments ranged between 21.22 and 29.87 per cent. Foliar application of mepiquat chloride @ 2000 ppm recorded higher protein content (T_9- 29.87 per cent) followed by mepiquat chloride @ 1500 ppm (T_8 - 27.37 per cent). The lowest protein content was obtained with control (T_{10} - 21.22 per cent) followed by paclobutrazol @ 100 ppm (T_1 - 23.12 per cent). Our results are in agreement with the findings of Senthil et al. (2003) and Rajesh et al. (2014) in greengram with foliar application of mepiquat chloride. Gavit (2017) reported that cycocel improves the translocation of photosynthates, and more protein content stored in the seeds might be due to improvement of translocation of photosynthates to the seeds. The application of growth retardants showed significant effect on seed protein which indicated that, the applied growth retardants had marked effect on biosynthetic pathways related to protein synthesis.

Test weight (g)

The data regarding test weight indicated that there was significant increase in seed weight due to foliar spray of plant growth retardants. The maximum test weight was observed with the treatment of mepiquat chloride @ 2000 ppm (T_9 - 4.95 g) which was at par with mepiquat chloride @ 1500 ppm (T_8 - 4.60 g). The minimum value was recorded by control (T_{10} - 3.13 g) which was at par with paclobutrazol @ 100 ppm (T_1 - 3.85 g) at harvest. Our results are in conformity with the findings of Gupta et al. (2021) in pearl millet. The major sink strength parameters i.e., test weight is the important determinants for achieving the higher seed yield (Secondo and Reddy, 2018). In the current study, foliar spray of mepiquat chloride @ 2000 ppm (T_9) increased the test weight by 1.82 g over control (T_{10}). The increase in test weight with growth retardant treatments may be due to better translocation of photosynthates by shortening the plant size. The efficiency of translocation depends on the distance between the source and sink and it is inversely related i.e., shorter the distance, better will be the translocation and vice versa (Kashid et al., 2010) in sunflower. Our results are supported by Jaidka et al. (2020) who stated that foliar application of mepiquat chloride plays an important role in source-sink realization that enhances the seed weight by soybean.

Seed Yield (kg ha^{-1})

The highest seed yield was recorded with foliar application of mepiquat chloride @ 2000 ppm (T_9 - 1448.74 kg ha^{-1}). The lowest seed yield was recorded by control (T_{10} - 855.62 kg ha^{-1}). The remaining treatments were significantly higher than control (T_{10}) and lesser than mepiquat chloride @ 2000 ppm (T_9). Similar treatment variations were observed with foliar application of growth retardants by Kashid (2008) in sunflower and Pourmohammad et al. (2014) in rapeseed. All the growth attributes, dry matter production and yield contributing characters were higher in mepiquat chloride @ 2000 ppm treatment. The increase in seed yield with mepiquat chloride spray might be due to more yield attributes which inturn resulted from enhanced translocation of assimilates from source to sink due to the restriction of length/distance between source and sink (Mukherjee, 2020) in rice. In our study, the increase in seed yield due to growth retardants in blackgram might be due to an increase in number of branches, higher partitioning of dry matter towards reproductive organs, more number of pods plant^{-1} and pod weight. Increased seed yield due to foliar sprays of growth retardants may be because of increased chlorophyll content in leaves and their ability for more photosynthetic activity, which might be helped in increasing the carbohydrate content of pods, that directly responsible for increased production of pods (Jayantibhai, 2022) in clusterbean.

Conclusion

From the results of the present experiment, it can be concluded that foliar application of mepiquat chloride @ 2000 ppm showed profound effect on morphologicsl character like plant height, recorded significantly higher values for total dry matter partitioning and total chlorophyll content. Protein content (%) and yield parameters like test weight and seed yield were recorded with MC @ 2000 ppm. The possible reason for the effect of mepiquat chloride maybe, better partitioning and it significantly improved the source and sink relationship by efficient translocation of photosynthetic assimilates towards

sink (seed) which ultimately helped the crop to maximum potential yield.

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