Effect of Plant Growth Retardants on Yield And Yield Attributes of Kharif Blackgram (Vigna Mungo L.)

**ABSTARCT**

The field experiment was conducted at Agricultural College Farm, Bapatla, during *kharif,* 2024 to study the effect of plant growth retardants on yield and yield attributes of blackgram. The experiment was laid out in Randomized Block Design and replicated thrice with ten treatments *viz*., paclobutrazol @ 100, 150 and 200 ppm, chlormequat chloride @ 500, 1000 and 1500 ppm, mepiquat chloride @ 1000, 1500 and 2000 ppm and control *i.e*., water sprayed were applied through foliar spray at 35 DAS. The main aim of the study was to increase the yield and yield attributes of *kharif* blackgram by using growth retardants. Results of the experiment revealed that all the growth retardants increased the number of pod clusters plant-1 (25.3), number of pods plant-1 (51.9), pod weight (21.08 g plant-1), test weight (4.95 g) and seed yield (1448.74 kg ha-1) compared to control. The increased seed yield (69.3%) with mepiquat chloride @ 2000 ppm was due to increased sink strength parameters leads to more yield attributes over water sprayed plants.

Keywords: Blackgram; Growth retardants; Yield attributes , Yield

**1. INTRODUCTION**

Pulses occupy a unique position in every system of Indian farming as a main, cover, green manure, catch and an intercrop. These are the protein-rich staple foods for the large section of vegetarian population of the world and are known as “poor man’s meat”. On an average, pulses contain about 20 to 30 per cent protein and is almost three times the value normally found in cereals and adds much needed diversity to the cereal-based diets of the poor.

Blackgram or Urdbean or Urd is one of the important pulse crops in India and it is its primary origin, mainly cultivated in Asian countries. India is the world’s largest producer as well as consumer of blackgram. Blackgram area accounts for about 29% of India’s total pulse acreage and contributes 10.25% total pulse production. In *kharif* 2022-23, blackgram area was 42.33 lakh hectares which was increased by 1.96% when compared to 2021-22 in India, Ministry of Agriculture, 2023. “It contains about 26% protein, which is almost three times that of cereals, and 59% of carbohydrates. In addition, 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. The main constraints during *kharif* season is the growth of vegetative parts becomes rapid which induces the disturbance in reproductive growth, due to excess moisture. 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). Since its vegetative stage continues along with reproductive stage, the partitioning of assimilates is severely affected with excessive dry matter distribution to stems and results in low seed yield. For this reason, the yield during *kharif* season is reported to be lesser than the *rabi* season. Considering the above facts, the field experiment was conducted to investigate the effect of plant growth retardants on yield and yield attributes of *kharif* Blackgram, LBG-904.

**2. MATERIAL AND METHODS**

A field experiment was carried out in *kharif* during 2024 at Agricultural College Farm, Bapatla, Andhra Pradesh. It is geographically located at 15ο 54’ Northern latitude, and 80ο 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 and the soil type is clay loamy. The experiment was conducted in randomized block design and replicated thrice with ten treatments *viz*., paclobutrazol @ 100 ppm (T1), paclobutrazol @ 150 ppm (T2), paclobutrazol @ 200 ppm (T3), chlormequat chloride @ 500 ppm (T4), chlormequat chloride @ 1000 ppm (T5), chlormequat chloride @ 1500 ppm (T6), mepiquat chloride @ 1000 ppm (T7), mepiquat chloride @ 1500 ppm (T8), mepiquat chloride @ 2000 ppm (T9) and control *i.e*., water sprayed (T10). The foliar application of treatments was done at 35 DAS (*i.e.,* 10 days before flower initiation) with hand sprayer. LBG-904 variety was used in experiment. Five plants were selected randomly from each plot and were tagged for recording various observations, average values per plant were calculated. Observations on yield attributes were calculated at harvest of crop and subjected to statistical analysis as per randomized block design (RBD) as described by Panse and Sukhatme (1978).

**3. Results and Discussion**

**3.1 Number of pod clusters plant-1**

The data recorded on number of pod clusters plant-1 of blackgram was presented in table 1. At harvest, significantly higher number of pod clusters plant-1 was recorded with mepiquat chloride @ 2000 ppm (T9 - 25.3). Control plants recorded the lowest number of pod clusters plant-1 (T10 - 12.0) which was at par with paclobutrazol @ 100 ppm (T1 - 13.3). The positive effect on yield attributes with mepiquat chloride spray was due to better crop growth and drymatter production. Our results are in agreement with the findings of Garai and Datta (2003) in greengram. The increase in pod clusters might be due to the application of mepiquat chloride which significantly influenced the growth dynamics and reproductive development of the crop. Foliar application of mepiquat chloride inhibits gibberellin biosynthesis, which inturn restricts excessive vegetative growth by reducing plant height, due to this compact plant architecture effectively reducing the sink strength of vegetative tissues such as stems and expanding leaves. Consequently, the photosynthates produced by source organs are more efficiently redirected towards reproductive sinks, including floral buds and developing pods. The improved source-sink dynamics likely support increased flower retention and pod development, which contributes to a higher number of pod clusters plant-1. Our results are in agreement with the findings of Naik *et al*. (2019) in cluster bean.

**3.2 Number of pods plant-1**

 The data recorded on number of pods plant-1 of blackgram was presented in table 1. The higher number of pods plant-1 was recorded with foliar spray of mepiquat chloride @ 2000 ppm (T9 - 51.9) which was at par with mepiquat chloride @ 1500 ppm (T8 - 48.2). The lower number of pods plant-1 was recorded by paclobutrazol @ 100 ppm (T1 - 27.2) which was at par with control (T10 - 29.7). The number of pods plant-1 observed in the remaining treatments were significantly lesser than mepiquat chloride @ 2000 ppm (T9) and higher than control (T10) except paclobutrazol @ 100 ppm (T1) which recorded lower number of pods plant-1 than the control. Our results were similar to the findings of Neelima *et al*. (2005) in soybean. Prajapati *et al*. (2016) stated that the highest value of pods plant-1 recorded with growth retardants might be due to increase in number of branches plant-1, which probably originated more flower buds that resulted in more pod setting percentage.

**3.3 Pod Weight (g plant-1)**

The data revealed that the treatment mepiquat chloride @ 2000 ppm recorded higher pod weight (T9 - 21.08 g plant-1) which was on a par with mepiquat chloride @ 1500 ppm (T8 - 19.72 g plant-1). Lower value was recorded in control treatment (T10 - 12.43 g plant-1) which was at par with paclobutrazol @ 100 ppm (T1 - 13.55 g plant-1). Similar significant variations were reported in peas by Sharma *et al*. (2024). From the data (Table -1), it is evident that foliar application of mepiquat chloride @ 2000 and 1500 ppm at 35 DAS increased the pod weight by 69.6 and 58.6 per cent, respectively, over control. The increase in weight of pods by the application of mepiquat chloride @ 2000 ppm might be attributed to the greater mobilization of metabolites from source (leaves) to sink (pods), also due to greater accumulation of carbohydrates owing to photosynthesis that resulted in increasing dry weight of pods (Sharma and Lashkari, 2009). Similar results were also reported by Pasala *et al*. (2022) in groundnut.

**Table 1. Influence of plant growth retardants on number of pod clusters plant-1, number of pods plant-1, pod weight (g plant-1), pod length (cm) and number of seeds pod-1**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Treatments** | **No. of pod cluster plant-1** | **No. of pods plant-1** | **Pod weight****(g plant-1)** | **Pod length (cm)** | **No. of seeds pod-1** |
| **T~~1~~ : Paclobutrazol @ 100 ppm** | 13.3 | 27.2 | 13.55 | 5.28 | 5.8 |
| **T2: Paclobutrazol @ 150 ppm** | 15.3 | 34.9 | 14.81 | 5.30 | 5.9 |
| **T3 : Paclobutrazol @ 200 ppm** | 17.7 | 42.5 | 18.74 | 5.43 | 6.0 |
| **T4 : Chlormequat chloride @ 500 ppm** | 16.3 | 36.7 | 16.62 | 5.62 | 6.2 |
| **T5 : Chlormequat chloride @ 1000 ppm** | 18.3 | 43.8 | 18.81 | 5.69 | 6.3 |
| **T6 : Chlormequat chloride @ 1500 ppm** | 19.8 | 45.0 | 18.87 | 5.78 | 6.4 |
| **T7 : Mepiquat chloride @ 1000 ppm** | 20.2 | 46.2 | 19.18 | 5.69 | 6.6 |
| **T8 : Mepiquat chloride @ 1500 ppm** | 22.0 | 48.2 | 19.72 | 6.08 | 6.7 |
| **T9 : Mepiquat chloride @ 2000 ppm** | 25.3 | 51.9 | 21.08 | 6.64 | 6.7 |
| **T10 : Control (water spray)** | 12.0 | 29.7 | 12.43 | 4.54 | 5.6 |
| **SE. m (±)** | 1.0 | 1.86 | 0.64 | 0.25 | 0.4 |
| **CD (5%)** | 3.1 | 5.53 | 1.89 | 0.75 | NS |
| **CV (%)** | 10.0 | 7.94 | 6.34 | 7.85 | 11.4 |

**3.4 Pod Length (cm)**

The data on pod length (cm) of blackgram was presented in table 1. Significantly the higher pod length (6.64 cm) was recorded in the treatment mepiquat chloride @ 2000 ppm (T9) which was at par with mepiquat chloride @ 1500 ppm (T8 - 6.08 cm). The treatment control recorded the lower pod length (T10 - 4.54 cm) which was at par with paclobutrazol @ 100 ppm (T1 - 5.28 cm). The remaining treatments showed parity with each other. Similar results were also obtained by Rathod *et al*. (2015) and Rajani *et al*. (2016) in French bean and Sahu and Verma (2020) in yardlong bean. Solanki (2021) stated that the increase in pod length might be due to the diversion of photosynthates to reproductive organs in blackgram.

**3.5 Number of Seeds Pod-1**

The data on number of seeds pod-1 of blackgram was presented in table 1. At harvest, there is no significant difference between the treatments. A slightly higher value was found with the mepiquat chloride @ 2000 and 1500 ppm (T9 and T8 - 6.7) and lower value was found in control (T10 - 5.5). This suggests that foliar application of growth retardants had no remarkable effect on number of seeds pod-1.

**3.6 Test Weight (g)**

The data regarding test weight was showed in table-2 that there was significant increase in seed weight due to foliar spray of plant growth retardants. Foliar spray of mepiquat chloride @ 2000 and 1500 ppm increased the test weight by 1.82 and 1.47 g over control (T10). 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). “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). 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 number of seeds plant-1 and seed weight by soybean.

**3.7 Seed Yield Plant-1 (g)**

The data on yield of blackgram was presented in table 2. The highest seed yield plant-1 was recorded with foliar spray of mepiquat chloride @ 2000 ppm (T9 - 11.93 g). The lowest seed yield plant-1 was recorded by control (T10 - 6.26 g) which was at par with paclobutrazol @ 100 ppm (T1 - 6.78 g). The remaining treatments were significantly higher than control and lesser than mepiquat chloride. The increased seed yield plant-1 may be attributed to corresponding increase in seed weight, increase in seed filling per cent and test weight (Kashid, 2008) in sunflower. The increase in seed yield depends on either biomass production and/or partitioning of biomass to the seed. “The photosynthetic productivity and partitioning of photosynthates finally lead to the economic yield of blackgram. The yield in blackgram depends upon the accumulation of photoassimilates during the growing period and the way in which they are partitioned between desired storage organs of the plant. Seed yield and its related parameters in blackgram were influenced by the application of growth retardants which indicated that these growth retardants have differential influence on the distribution of assimilates between vegetative and reproductive organs. The increase in seed yield due to growth retardants might be due to an increase in per cent distribution of pod dry weight and higher partitioning of drymatter towards reproductive organs” (Solanki, 2021) in blackgram.

**3.8 Seed Yield (kg ha-1)**

The growth retardants are capable of redistribution of drymatter in the plant and there by bringing about an improvement in yield potential. Among the treatments significantly higher seed yield was recorded with foliar application of mepiquat chloride @ 2000 ppm (T9 - 1448.74 kg ha-1) presented in table 2, which was 69.3% more than control and significantly lowest seed yield was recorded by control (T10 - 855.62 kg ha-1) compared to all other treatments. Similar treatment variations were observed with foliar application of growth retardants by Kashid (2008) in sunflower and Pourmohammad *et al*. (2014) in rapeseed. “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. The increase in seed yield due to growth retardants in blackgram might be due to, higher partitioning of drymatter towards reproductive organs, more number of pods plant-1 and pod weight (Jayantibhai, 2022).

**Table 2. Influence of plant growth retardants on test weight (g), seed yield plant-1 (g), seed yield (kg ha-1) and harvest index (%)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Treatments** | **Test weight (g)** | **Seed yield plant-1 (g)** | **Seed yield (kg ha-1)** | **Harvest index (%)** |
| **T~~1~~ : Paclobutrazol @ 100 ppm** | 3.85 | 6.78 |  999.77 | 37.7 |
| **T2: Paclobutrazol @ 150 ppm** | 3.96 | 7.38 | 1085.64 | 38.1 |
| **T3 : Paclobutrazol @ 200 ppm** | 4.02 | 7.90 | 1198.22 | 39.9 |
| **T4 : Chlormequat chloride @ 500 ppm** | 4.13 | 8.35 | 1150.41 | 39.5 |
| **T5 : Chlormequat chloride @ 1000 ppm** | 4.09 | 9.00 | 1209.30 | 42.0 |
| **T6 : Chlormequat chloride @ 1500 ppm** | 4.14 | 8.66 | 1290.05 | 39.3 |
| **T7 : Mepiquat chloride @ 1000 ppm** | 4.18 | 9.26 | 1252.15 | 40.4 |
| **T8 : Mepiquat chloride @ 1500 ppm** | 4.60 | 10.69 | 1316.85 | 42.9 |
| **T9 : Mepiquat chloride @ 2000 ppm** | 4.95 | 11.93 |  1448.74 | 43.6 |
| **T10 : Control (water spray)** | 3.13 | 6.26 |  855.62 | 35.7 |
| **SE. m (±)** | 0.25 | 0.35 | 43.97 | 1.2 |
| **CD (5%)** | 0.74 | 1.05 | 130.64 | 3.5 |
| **CV (%)** | 10.47 | 7.09 | 6.45 | 5.2 |

**3.9 Harvest Index (%)**

The data on HI of blackgram was represented in the table 2. HI indicates the translocation efficiency of plants and is measured in terms of per cent of drymatter being utilized for the production of economic yield (Koler, 2008). HI among the treatments varied significantly and it ranged between 35.7 and 43.6 per cent. HI was found maximum in the foliar spray of mepiquat chloride @ 2000 ppm (T9 - 43.6 per cent) and it was statistically at par with mepiquat chloride 1500 and 1000 ppm (T8 - 42.9 and T7 - 40.4 per cent, respectively) and chlormequat chloride @ 1000 ppm (T5 - 42.0 per cent). The minimum HI was observed with control (T10 - 35.7 per cent), which was at par with paclobutrazol @ 100 and 150 ppm (T1 - 37.7 and T2 - 38.1 per cent, respectively). Similar results were obtained with the application of mepiquat chloride which

increased the HI with subsequent increase in seed yield in cluster bean (secondo, 2018). Reddy *et al*. (2009) found that mepiquat chloride increased the chlorophyll content, nitrate reductase activity and seed yield significantly by regulating plant growth which is clearly manufactured by increased harvest index.

**Conclusion:** From the results of the present experiment, it can be concluded that foliar application of mepiquat chloride @ 2000 ppm has helped the crop to record significantly higher yield attributes and highest potential yield of the crop. 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.

 **Disclaimer (Artificial intelligence)**

**Option 1:**

**Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.**

**Option 2:**

**Author(s) hereby declare that generative AI technologies such as Large Language Models, etc. have been used during the writing or editing of manuscripts. This explanation will include the name, version, model, and source of the generative AI technology and as well as all input prompts provided to the generative AI technology**

**Details of the AI usage are given below:**

**1.**

**2.**

**3.**

**REFERENCES**

Garai, A.K., & Datta, J.K. (2003). Effect of phosphorus sources and cycocel spray on green gram (*Vigna radiata* L.). *Legume Research*. 26(1), 15-19.

Gupta, S., Sharma, M.K., Jain, N.K., Meena, R.C., Agarwal, V.P., & Gupta, N.K. (2021). Efficacy of growth retardants on physiology and yield of pearl millet under rainfed condition. *Indian Journal of Agricultural Sciences*. 91(3), 398-401.

Jaidka, M., Deol, J.S., Kaur, R., & Sikka, R. (2020). Source-sink optimization and morpho-physiological response of soybean (*Glycine max*) to detopping and mepiquat chloride application. *Legume Research-An International Journal*. 43(3), 401-407.

Jayantibhai, P.M. (2022). Effect of plant growth regulators on growth and yield of cluster bean(*Cyamopsis tetragonoloba* L. Taub). *M.Sc. Thesis*. Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar, India.

Kashid, D.A. (2008). Effect of growth retardants on growth, physiology and yield in sunflower, *Ph.D Thesis*. University of Agricultural Sciences, Dharwad, India.

Kashid, D.A., Doddamani, M.B., Chetti, M.B., Hiremath, S.M., & Arvindkumar, B.N. (2010). Effect of growth retardants on morpho-physiological traits and yield in sunflower. *Karnataka Journal of Agricultural Sciences*. 23(2), 347-349.

Koler, P. (2008). Effect of plant growth regulators on morpho-physiological, biophysical and anatomical characters in cotton. *M.Sc. Thesis*. University of Agricultural Sciences, Dharwad, India.

Mukherjee, D. (2020). New approach to increasing rice (*Oryza sativa* L.) lodging resistance and biomass yield through the use of growth retardants. *Journal of Cereal Research*. 12(3), 247-256.

Naik, M.T., Srihari, D., Dorajeerao, A.V.D., Sasikala, K., Umakrishna, K., Suneetha, D.R.S., & Pradeepkumar, C.M. (2019). Influence of plant growth regulators on growth and development of cluster bean varieties. *Plant Archives*. 19(2), 2551-2555.

Neelima, A., Archana, B., & Jagmeet, K. (2005). Effect of mepiquat chloride and gibberellic acid on yield attributes of soybean (*Glycine max* L.). *Journal of Punjab Agricultural University*. 42(1), 56-61.

Panse, V.G., & Sukhatme, P.V. (1978). *Statistical Methods for Agricultural Workers*. ICAR, New Delhi. 103-108.

Pasala, S., Shashibhushan, D., Pallavi, M., & Sujatha, P. (2022). Influence of plant growth regulators on flowering and seed yield in groundnut (*Arachis hypogaea* L.). *Biological Forum-An International Journal*. 14(3), 204-207.

Pourmohammad, F., Shekari, & Soltanib, V. (2014). Cycocel priming and foliar application affect yield components of rapeseed (*Brassica napus* L.). *Cercetari Agronomice in Moldova*. 47(1), 157.

Prajapati, K.R., Bhadane, R.S., Ombase, K.C., & Patel, D.B. (2016). Effect of seed priming and foliar spraying of PGRs on morpho-physiology, growth and yield in green gram (*Vigna radiata* L.). *International Journal of Legume Research*. 45(4), 435-444.

Rajani, D., Rao, A.M., Hari, D., & Karnam, S.K. (2016). Effect of plant growth regulators on growth, yield and yield attributes of french bean (*Phaseolus vulgaris* L.) *cv*. Arka komal. *Andhra Pradesh Journal of Agricultural Science.* 2(4), 256-259.

Rathod, R.R., Gore, R.V., & Bothikar, P.A. (2015). Effect of growth regulators on growth and yield of french bean (*Phaseolus vulgaris* L.) *var*. Arka Komal. *Journal of Agriculture and Veterinary Science.* 8(5), 2319-2380.

Reddy, P.B.T., Ninganur, M.B., Chetti, B., & Hiremath, S.M. (2009). Effect of growth retardants and nipping on chlorophyll content, nitrate reductase activity, seed protein content and yield in cowpea (*Vigna unguiculata* L.). *Karnataka Journal of Agricultural Science*. 22(2), 289-292

Sahu, D.K., & Verma, A. (2020). Effect of plant growth regulators on growth and yield of yard long bean (*Vigna unguiculata* L.) *var*. Shefali. *International Journal of Chemical Studies*. 8(6), 1736-1738.

Secondo, P.A.S. (2018). Physiological approaches to improve seed yield of sunflower(*Helianthus annuus* L.)hybrid(KBSH-44). *M.Sc. Thesis*. University of Agricultural Sciences, Bengaluru, India.

Secondo, A.P., & Reddy, Y.N. (2018). Plant growth retardants improve sink strength and yield of sunflower. *International Journal of Current Microbiology and Applied Sciences*. 7(10), 111-119.

Sharma, D., Kumar, R., Renuka, U.R., Khatoon, A., Kumari, S., & Tutlani, A. (2024). Effect of plant growth regulators on qualitative, growth, yield and its attributing traits in pea (*Pisum sativum* L.). *Plant Archives*. 24(1), 131-138.

Sharma, S.J., & Lashkari, C.O. (2009). Effect of plant growth regulators on yield and quality of Clusterbean (*Cyamopsis tetragonaloba* L.) *cv*. Pusa Navbahar. *Asian journal of Horticulture*. 4(1), 145-146.

Shyam, C., Deol, J.S., & Kaur, R. (2018). Effect of crop growth regulation and defoliation on productivity and economics of summer greengram. *Annals of Agricultural Research*. 39(1), 48-56.

Solanki, K.D. (2021). Effect of foliar application of plant growth regulators on morpho physiological, yield attributes and yield of summer blackgram(*Vigna mungo* L.). *M.Sc. Thesis*.Junagadh Agricultural University, Junagadh, India.