International Journal of Advanced Biochemistry Research

ISSN Print: 2617-4693
ISSN Online: 2617-4707
IJABR 2024; 8(2): 390-393
www.biochemjournal.com
Received: 19-12-2023
Accepted: 27-01-2024

Kiran Sagar DC
Subject Matter Specialist (Horticulture), ICAR-KVK Vijayapura, Karnataka, India

Shrishail M Vastrad
Senior Scientist & Head, ICAR- KVK, Vijayapura, Karnataka, India

Shikha Saini
Ph.D. Scholar, Department of Fruits Science, ICAR-IARI, New Delhi, India

Ruchitha T
Ph.D. Scholar, Department of Fruits Science., CoH, Bengaluru., UHS, Campus., GKVK Post, Bengaluru, Karnataka, India

Corresponding Author:
Kiran Sagar DC
Subject Matter Specialist (Horticulture), ICAR-KVK Vijayapura, Karnataka, India

Influence of Brassinosteroids foliar spray on growth, reproductive parameters and yield of Drumstick (*Moringa oleifera*) under Northern dry zone of Karnataka

Kiran Sagar DC, Shrishail M Vastrad, Shikha Saini and Ruchitha T

DOI: https://doi.org/10.33545/26174693.2024.v8.i2e.573

Abstract
The present experiment was carried out at Drumstick plantation of ICAR, KVK- Vijayapura-1 during June, 2023 to January, 2024 to find out the effect of Brassinosteroids on Drumstick. Five treatments were employed *viz*., T_0- control, T_1-0.01 BRs, T_2- 0.02 ppm BRs, T_3- 0.04 ppm BRs, T_4- 0.08 ppm BRs and each treatment were replicated for four times. All treatments significantly performed better as compared to control. According to the results obtained, the maximum plant height (3.32 m), Higher number of primary branches (4.82) and stem (13.85 cm) was recorded in the plants treated with 0.04 ppm (T_4 treatment), whereas, minimum plant height was noticed in control treatment of no growth regulator treatment (T_0). In the same way, maximum number of panicles/ plant (46.80), maximum pods set percent plant 3.71) and maximum fruit yield per plant (13.94 kg) was recorded in T_4 treatment of 0.04 ppm and minimum values for all these parameters were recorded in control treatment (T_0). Therefore, foliar feeding of BRs of 0.4 ppm is recommended for better growth, flowering, fruiting and final yield of drumsticks and which is may be used for commercial cultivation drumsticks for good economic returns.

Keywords: Brassinosteroid, yield, drumstick, flowering

1. Introduction

Drumstick botanically known as *Moringa oleifera* L. has seen a rise in popularity recently. This increase in interest is mostly related to the realization of its many advantages for humankind. Drumsticks are growing more and more popular as a result of people realizing how nutritionally good they are. In the market, moringa is favored all year round. A wonderful complement to a nutritious diet, drumstick is renowned for its high vitamin, mineral, and antioxidant content. It is said that moringa oleifera is a "miracle vegetable." Due to its high concentration of essential amino acids, minerals, vitamins A, B, C, and E, as well as a unique combination of rich bioactive secondary metabolites like glucosinolates, flavonoids, and phenolic acids, which may lower the risk of cancer and cardiovascular diseases, its leaves are consumed as a nutritional supplement in many regions. Furthermore, *Moringa oleifera* can be used as an oil plant because of the up to 80% unsaturated fatty acid content of its seeds, which includes 62–75% oleic acid. Strong antioxidants found in its seed oil are gathered for use in cosmetics, lubricants, and food products (Anwar and Bhanger 2003) [3]. Since its introduction to China in 2001, Moringa oleifera has mostly been planted in the Southwestern dry-hot valley regions, which have high temperatures and drought. According to Su and others' (2012) [16] preliminary study results, the fruit setting rate in a mature *Moringa oleifera* was only 2.13%, with an average of 43 pods/plant. This is lower than the corresponding values of 3.04% and 220 pods/plant that were recorded in southern India by Ramachandran and others in 1980. It is crucial to look at ways to raise *Moringa oleifera's* fruit and seed yield because the plant's poor productivity does not provide the area with significant economic benefits. Brassinosteroids (BR) are natural steroid hormones of plants that are necessary for normal plant growth and development (Li and Chory 1999) [10]. They have been recognized as new plant hormones with multiple functions and efficiencies.

In plants, Brassinosteroids regulate several aspects of growth and development, including germination of seeds, roots, blossoming, aging, defoliation, and maturation (Müssig and others 2002; Swamy and Rao 2008) [12, 18]. Brave non-toxic and environmentally acceptable materials. In addition to improving the content of soluble proteins (Khripach *et al.*, 2000) [9], supplementing plants with BR can also improve drought resistance (Fariduddin *et al.*, 2009) [4], the activities of carbonic anhydrase, nitrate reductase, and Rubisco (Hayat *et al.*, 2001) [21], and the distribution of assimilates to various organs of the plants (Fujii and Saka 2001) [5]. So raises several significant economic plants' potential productivity. According to Ali and others during 2008, BR can enhance the number of ears on rice plants as well as the number, weight, and length of grains per ear. Moreover, the application of BR can improve the growth and seed yield of mustard and rapeseed plants (Khripach *et al.*, 2000) [9], increase the number of pods in a single leguminous plant and the overall seed yield and improve the yield of cotton. As a result, BR has promising applications in contemporary agricultural systems to boost crop yields and improve crop quality. The absorption and transport of BR in plants that are exogenously treated with these regulators are now poorly understood. When BR was applied to wheat leaves, it only moved in the direction of the tips of the leaves (Nishikawa and colleagues, 1995) [13]. But when BR was applied to the roots of young wheat seedlings, it was effectively absorbed and dispersed throughout the seedlings (Nishikawa and others, 1995) [13], and it was most likely carried through the xylem. However, Symons and Reid (2004) [18], assert that BR are not transferred over great distances. In the present study, a drumstick plantation at ICAR- KVK, Vijayapura-1 was feeded with various concentrations of BRs as foliar spray under filed growing conditions for the first time. We evaluated the impact of this on the growth, flowering and yield of drumsticks.

2. Materials and Methods

2.1 Experimental Design and Treatments Preparation

This investigation was carried out at ICAR, KVK-Vijayapura-1, which is having a semi-arid tropical type of climate, located 530 km from Northwest of states capital Bengaluru. Bhagya (KDM 01) variety of Drumsticks was developed at KRC College of Horticulture, Arabhavi, University of Horticultural Sciences, Bagalkot was sown in a pit of 45 cm^3 dug on a square system at every 4 meters, Two seeds were planted in each hole, with the soil at a depth of two centimeters. There was only one healthy seedling left after 28 days of growing. During the experiment, no instances of pests or diseases were observed. Two seeds were sown in each hole, at a depth of two centimeters. There was only one healthy seedling retained after 28 days of growing, remaining weaker one is roughed off. During the experiment, no instances of pests or diseases were observed. Two seeds per hole were planted at a soil depth of two centimeters. Only one healthy seedling remained after 28 days of growing. During the experiment, there was no incidence of pests or diseases. The experiment was laid out in randomized block design with four replications and five treatment combinations including control *viz.*, T_0- control, T_1-0.01 BRs, T_2- 0.02 ppm BRs, T_3- 0.04 ppm BRs, T_4- 0.08 ppm BRs. The foliar spray treatments were conducted under climate conditions of no rain and little wind. Irrigation and fertigation were given as per the recommended dose using drip irrigation system.

Plate 1: Transplanting of Bhagya (KDM01) variety of Drumstick seedling at ICAR-KVK, Vijayapura-1 during June month

2.2 Observations Recorded

Observations were recorded from five randomly selected and labelled plants in each treatment in a replication. The data obtained from all plants per replication under each treatment were averaged and analysed. Plant height was measured in meters, starting at the ground and ending at the tip of the main stem. Stem girth was measured at a height of 15 cm from the ground level. Four branches were chosen at random from every direction on a tree in order to record the flowering and fruiting traits. The fruits were harvested at their harvest maturity stage when those were green and medium hard in texture. Every panicle in the plants that were chosen at random was tagged, and the total number of panicles in each tree was tallied and reported as a numerical value. In randomly chosen trees, the total pod yield per plant, pooled over all harvests, was counted. The mean was then represented in kilograms per plant.

2.3 Data Analysis

The experimental data were subjected to the statistical analysis by using variance for completely randomized design (CRD). The treatment differences were tested by F-test of significance based on null hypothesis, critical difference (CD) at 5 % level of probability was worked out to compare the treatment means, where the treatment effects were significant.

3. Results and discussion

3.1 Plant height (m)

The growth parameter *i.e.*, plant height was influenced by different Brassinosteroids treatments, maximum increment in plant height was recorded in T_3 treatment (3.32 m) with 0.04 ppm BRs growth regulator application, followed by 0.02 ppm BRs treatment (3.27 m) whereas minimum plant height was recorded in control treatment (3.04 m) with no growth regulator treatment. These results are in line with those reported by Zheng *et al.* (2017) [22] in drumsticks. This enhanced increment in plant height upto 0.04 ppm BRs application is attributed to the impact of BR on plant growth has generally been reported to show positive effects, but some negative effects have also been reported. Amzallag (2002) [2] found that treatment with higher concentration of 0.08 ppm BR significantly reduced the biomass and leaf length of sorghum in the early development stage. The present study showed that treatment with BRs at an appropriate concentration could increase the growth of *Moringa oleifera*, but foliar spray at an excessive concentration exerted a negative effect on the vegetative growth.

Table 1: Effect of Brassinosteroids on growth parameters of Drumstick

Treatments	Plant height (m)	Number of primary branches	Stem girth (cm)
T_0	3.04	4.46	10.00
T_1	3.10	4.70	13.35
T_2	3.27	4.80	13.85
T_3	3.32	4.82	13.85
T_4	3.18	4.57	12.85
SEm	0.050	0.068	0.33
CD (5%)	0.108	0.0148	0.99

T_0- control, T_1-0.01 BRs, T_2- 0.02 ppm BRs, T_3- 0.04 ppm BRs, T_4- 0.08 ppm BRs

3.2 Number of primary branches

The stem girth was varied among all the treatments as shown in the table 1. Maximum increment in number of primary branches was recorded in T_3 treatment (4.82) with 0.04 ppm BRs growth regulator application, followed by 0.02 ppm BRs treatment (4.80) whereas minimum number of primary branches was recorded in control treatment (4.46) with no growth regulator treatment. This enhanced increment in number of primary branches upto 0.04 ppm BRs application is attributed to the impact of BR on vegetative growth has generally been reported to show positive effects, but some negative effects have also been reported at higher concentration. Amzallag (2002) [2] found that treatment with higher concentration of 0.08 ppm BR significantly reduced the biomass and leaf length of sorghum in the early development stage. The present study showed that treatment with BRs at an appropriate concentration could increase the growth of *Moringa oleifera*, but foliar spray at an excessive concentration exerted a negative effect on the vegetative growth. These results are in line with those reported by Zheng *et al.* (2017) [22] in drumsticks.

3.3 Stem girth (cm)

The stem girth was varied among all the treatments as shown in the table 1, the girth of stem was found maximum in the plants treated with 0.4 ppm Brassinosteroids (13.85). whereas, minimum stem girth were recorded in control treatment. The present study showed that treatment with BRs at an appropriate concentration could increase the growth of *Moringa oleifera*, but foliar spray at an excessive concentration exerted a negative effect on the vegetative growth like stem girth and plant height. These results are in line with those reported by Zheng *et al.* (2017) [22] in drumsticks

Table 1: Effect of Brassinosteroids on growth parameters of Drumstick

Treatments	Number of panicles per plant	Pod set percentage (%)	Yield per plant (kg)
T_0	31.00	1.99	8.23
T_1	41.23	2.38	9.58
T_2	41.75	3.37	13.71
T_3	46.80	3.71	13.94
T_4	36.40	2.29	9.00
SEm	1.20	0.13	0.90
CD (5%)	3.63	0.40	2.72

T_0- control, T_1-0.01 BRs, T_2- 0.02 ppm BRs, T_3- 0.04 ppm BRs, T_4- 0.08 ppm BRs

3.4 Number of panicles per plant

The number of panicles per plant was varied among all the treatments as shown in the table 2. Maximum of panicles was recorded in T_3 treatment (46.80) with 0.04 ppm BRs growth regulator application, followed by 0.02 ppm BRs treatment (41.75). Whereas minimum number of panicles was recorded in control treatment (4.46) with no growth regulator treatment. This increased panicles number upto 0.04 ppm BRs application, and negative impact beyond this concentration is in line with as observed in Pharbitis nil (Kesy and others 2003) [8] and Arabidopsis thaliana (Janeczko and others 2003) [23], numerous investigations have demonstrated that excessive BRs administration might have a deleterious influence on the reproductive development of plants. These results are in line with those reported by Zheng *et al.* (2017) [22] in drumsticks. The reason for this adverse effect could be that BR are linked to the crucial developmental phases in which flower buds in plants differentiate from vegetative growth to reproductive growth. BR primarily react in the meristem tissue region, as Mandava (1998) [11] noted. This can result in elongated growth and cell differentiation, but excessive BR can prevent meristem tissue development and cell differentiation.

Plate 2: Bhagya (KDM-1) Drumstick plantation of ICAR- KVK, Vijayapura-1 at flowering stage

3.5 Pod set percentage (%)

As recorded during the course of experiment, pod setting was found maximum in T_3 treatment (3.71 %) followed by T_2 treatment (3.37), while pod setting percentage was noticed in T_0 treatment (1.99 %). In this study, treatment with Brassinosteroids resulted in increased pod setting and this increased fruit setting is attributed to increased number of panicles per plant.

3.6 Yield/ plant (kg)

The data (Table 2) indicate that yield per plant influenced signicantly by the application of BRs, maximum yield per plant was recorded in T_3 treatment (13.94 kg) with 0.04 ppm BRs growth regulator application, followed by 0.02 ppm BRs treatment (13.71 kg). whereas minimum yield per plant was recorded in control treatment (8.23) with no growth regulator treatment. These results are in line with those reported by Zheng *et al.* (2017) [22] in drumsticks. In this study, one possible reason for such increases in yield upto 0.04 ppm BRs application is likely to increase the number of flowers (Papadopoulou and Grumet, 2005) [14] and fruit setting (Wubs and others 2009) [19] in plants, leading to an increase in the number of Moringa fruits. Moreover, the physiological mechanism by which BRs application improves the yield of M. *oleifera* is reflected by the changes in the photosynthetic parameters.

4. Conclusion
From the present investigation, it is concluded that, treatment T_3 (0.04 ppm Brassinosteroids) is best suited and beneficial for the plant growth, flowering fruit yield of drumsticks vegetable followed by BRs treatment at 0.02 ppm (T_2).

5. Acknowledgements
The authors gratefully acknowledge the ICAR, KVK-Vijayapura-1 for providing financial assistance during the research and for providing paper publication processing charges. Further it will be injustice if we forget mentioning Miss Shikha Saini and Dr. Ruchitha, T., for her technical suggestions and moral support.

6. References
1. Ali B, Hayat S, Fariduddin Q, Ahmad A. 24-Epibrassinolide protects against the stress generated by salinity and nickel in *Brassica juncea*. Chemosphere. 2008;72:1387-1392. doi:10.1016/j. chemosphere.2008.04.012.
2. Amzallag GN. Brassinosteroids as metahormones: evidence for their specific influence during the critical period in sorghum development. Plant Biol. 2002;4:656-663. doi:10.1055/s-2002-37397.
3. Anwar F, Bhanger MI. Analytical characterization of Moringa oleifera seed oil grown in temperate regions of Pakistan. J Agric. Food Chem. 2003;51:6558-6563. doi:10.1021/jf0209894.
4. Fariduddin Q, Khannam S, Hasan SA, Ali B, Hayat S, Ahmad A. Effect of 28-homobrassinolide on drought stress induced changes in photosynthesis and antioxidant system of *Brassica juncea* L. Acta Physiol. Plant. 2009;31:889-897.
5. Fujii S, Saka H. Distribution of assimilates to each organ in rice plants exposed to a low temperature at the ripening stage, and the effect of Brassinolide on the distribution. Plant Product Sci. 2001;4:136-144. doi:10.1626/pps.4.136.
6. Hayat S, Yadav S, Wani AS, Irfan M, Ahmad A. Comparatative effect of 28-homobrassinolide and 24-epibrassinolide on the growth, carbonic anhydrase activity and photosynthetic efficiency of *Lycopersicon esculentum*. Photosynthetica. 2011;49:397-404. doi:10.1007/s11099-011-0051-x.
7. Kang YY, Guo SR. Role of brassinosteroids on horticultural crops. In: Hayat S, Ahmad A (eds) Brassinosteroids, a class of plant hormone. Springer. Berlin; c2022. p. 269-288.
8. Kesy J, Trzaskalska A, Galoch E, Kopcewicz J. Inhibitory effect of brassinosteroids on the flowering of the short-day plant Pharbitis nil. Biol Plant. 2003;47:597-600. doi:10.1023/B:B IOP.0000041069.27805.89.
9. Khripach V, Zhabinskii V, Groot AD. Twenty years of brassinosteroids: steroidal plant hormones warrant better crops for the XXI century. Ann Bot. 2000;86:441-447. doi:10.1006/ anbo.2000.1227.
10. Li J, Chory J. Brassinosteroid actions in plants. J Exp Bot. 1999;50:275-282. doi:10.1093/jxb/50.332.275.
11. Mandava NB. Plant growth-promoting brassinosteroids. Annu Rev Plant Physiol Plant Mol Biol. 1998;39:23-52. doi:10.1146/ annurev.pp.39.060188.000323
12. Müssig C, Fischer S, Altmann T. Brassinosteroid-regulated gene expression. Plant Physiol. 2002;129:1241-1251. doi:10.1104/ pp.011003.
13. Nishikawa N, Shida A, Toyama S. Metabolism of C-labeled epibrassinolide in intact seedlings of cucumber and wheat. J Plant Res. 1995;108:65-69.
14. Papadopoulou E, Grumet R. Brassinosteroid-induced femaleness in cucumber and relationship to ethylene yield. Hortic Sci. 2005;40:1763-1767
15. Ramachandran C, Peter KV, Gopalakrishnan PK. Drumstick (*Moringa oleifera)*: A multipurpose Indian vegetable. Econ Bot. 1980;34:276-283. doi:10.1007/BF02858648.
16. Su AZ, Zheng YX, Wu JC, Zhang YP. Effects of planting density on the branching pattern and biomass of Moringa oleifera plantation. Chin. J Ecol. 2012;31:1057-1063 (in Chinese).
17. Swamy KN, Rao SRS. Influence of homobrassinolide on growth, photosynthesis metabolite and essential oil content of geranium [*Pelargonium graveolens* (L.) Herit]. Am J Plant Physiol. 2008;3:173-179. doi:10.3923/ajpp.2008.173.179.
18. Symons GM, Reid JB. Brassinosteroids do not undergo long distance transport in pea. Implications for the regulation of endogenous brassinosteroid levels. Plant Physiol. 2004;135:2196-2206.
19. Wubs AM, Heuvelink E, Marcelis LFM. Abortion of reproductive organs in sweet pepper (*Capsicum annuum* L.): A review. J Hortic Sci Biotech. 2009;84:467-475. doi:10.1080/14620316.2009.11 512550.
20. Zheng YX, Wu JC, CAO FL, Zhang YP. Effects of water stress on photosynthetic activity, dry mass partitioning and some associated metabolic changes in four provenances of Neem (*Azadirachta indica* A. Juss). Photosynthetica. 2010;3:361-369. doi:10.1007/s11099-010-0047
21. Hayat T, Siddiqui AM, Asghar S. Some simple flows of an Oldroyd-B fluid. International Journal of Engineering Science. 2001 Jan 1;39(2):135-147.
22. Zheng Z, Xie S, Dai H, Chen X, Wang H. An overview of blockchain technology: Architecture, consensus, and future trends. In 2017 IEEE international congress on big data (BigData congress); c2017. p. 557-564. Ieee.
23. Oderfeld-Nowak B, OrzyŁowska-ŚLiwińska O, SoŁtys Z, Zaremba M, Januszewski S, Janeczko K, *et al*. Concomitant up-regulation of astroglial high and low affinity nerve growth factor receptors in the CA1 hippocampal area following global transient cerebral ischemia in rat☆. Neuroscience. 2003 Aug 4;120(1):31-40.