Int.J.Curr.Microbiol.App.Sci (2023) *12*(08): 261-266

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Volume 12 Number 8 (2023)**
Journal homepage: http://www.ijcmas.com

Original Research Article https://doi.org/10.20546/ijcmas.2023.1208.027

Studies on Influence of Growth Retardants in Increasing Yield and Quality in Bellary Onion (*Allium cepa* var. cepa)

M. I. Manivannan[1*] and J. Prem Joshua[2]

[1]*Department of Horticulture, Agricultural College and Research Institute, Killikulam-628 252, Thoothukudi District, India*
[2]*Department of Horticulture, Horticultural Research Station, Pechiparai, Kanyakumari District, Tamil Nadu, India*

**Corresponding author*

Keywords

Allium cepa L, Alliaceae family, Onions, non-vegetarian dishes, spices

Article Info

Received:
08 July 2023
Accepted:
06 August 2023
Available Online:
10 August 2023

A B S T R A C T

A field experiment was conducted during *rabi* (2017) at the Department of Horticulture, Agricultural College and Research Institute, Killikulam to study the effect of growth retardants on yield and quality of bellary onion. The field trial was laid out during December 2018 and the crop was transplanted during February 2019. The plants were sprayed with plant growth retardants in different concentrations *viz.*, Chlormequat 500 ppm, Chlormequat 1000 ppm, Mepiquat chloride 500 ppm, Mepiquat chloride 1000 ppm, Brassinolide 0.250 ppm, Brassinolide 0.500 ppm, Daminozide 500, ppm, Daminozide 1000 ppm and Control. All the treatments showed significant difference for various growth and yield attributing characters. Mepiquat chloride (500 ppm) reduced the number of days taken for maturity (127.30) significantly over control (135.66). Marketable yield of bulb per plot is directly and positively correlated with the bulb weight and the maximum was recorded with Mepiquat chloride @ 500 ppm (17.97 kg**)** and minimum recorded in control (12.45 kg). Hence, it is concluded that that the foliar spray of Mepiquat chloride 500 ppm improved the bulb weight and the resultant bulb yield per hectare.

Introduction

Onion (*Allium cepa* L.) a member of Alliaceae family, is the most important conventional vegetable crop; commercially grown in India. Onion is used in the preparation of salads, pickles, spices, condiments and all types of vegetarian and non-vegetarian dishes. Fresh as well as dehydrated onions are the good source of earning foreign exchange. It is believed to be originated from Central Asia. Onions have received considerable attention for their healthful, functional benefits. Phytochemicals in onions include the organosulfur compounds such ascepaenes and thiosulfinates (Dorsch and Wagner, 1991; Goldman *et al.*, 1996). India is the second largest producer of onion bulbs in the world. The

major onion producing states are Maharashtra, Madhya Pradesh, Karnataka, Gujarat, Bihar, Rajasthan, Andhra Pradesh, Haryana, West Bengal, and Uttar Pradesh in the country. These States account for almost 90% of the total onion production of the country. The area and production of onion in India is about 1.27 million hectares and 21.56 million tons of bulbs respectively, with an average productivity of 16.97 tons ha^{-1}.

In India, Maharashtra state has the prominent position in respect to onion production accounting 37.12 per cent of area and 31.4 per cent of national production. Tamil Nadu ranks 8^{th} in cultivated area (0.34 lakhs hectares), 13^{th}in annual production (3.47 lakhs tons) and 23^{rd} in productivity (10.18 tones ha^{-1}) (Horticultural statistics at a glance, 2017). The area under Bellary onion crop is increasing year after year due to its increasing demand in the local and overseas market. One of the major problems in onion production is lack of high quality bulbs and improper agronomic practices used by farmers.

The field experiment was carried out to study the effect of growth retardants on yield and quality of bellary onion. Plant growth retardants were used at lower concentration in vegetable crops to restrict the vegetative growth there by promoting earliness, higher yield and quality of bulbs. Growth retardants slow cell division and cell elongation of shoot tissue and regulate plant height physiologically without formative effects.

These chemicals inhibit growth and promote dormancy and abscission in plants. Mepiquat chloride is an example for plant growth retardant which is used to increase yield by inhibiting gibberellic acid synthesis. Brassino steroids are involved in regulating the metabolism of plant oxidation radicals, ethylene synthesis and root gravitropic response, and have a role in mediating plant responses to stress, such as freezing, drought, salinity, disease, heat and nutrient deficiency. Brassinolide affects activity of enzymes, as well as protein-protein and protein interactions with nucleic or fatty acids. At the plant level, Brassinolide also have been shown to alter growth and development and enhance yield and quality of seed and produce. Daminozide (alar), a plant growth retardant, is used as a foliar spray primarily to inhibit extension growth of horticultural crops. It is also used in different fruit orchard to make fruits attractive and reduce pre-harvest losses. With this background, the present studies on influence of growth retardants in increasing yield and quality in bellary onion (*Allium cepa* var.cepa) was undertaken with the objectives of studying the influence of various growth hormones on bulb size and yield increase and standardizing the appropriate hormone, concentration and stage of application for increasing the yield and quality of bulb.

Materials and Methods

A field experiment was conducted during December 2015 at the Department of Horticulture, Agricultural College and Research Institute, Killikulam to study the effect of growth retardants on yield and quality of bellary onion. The field trial was laid out during December 2015 and the crop was transplanted during February 2016. The plants were sprayed with plant growth retardants in different concentrations as detailed below at 35 days after bulb sowing and 10 days after first spray.

T1**:**Chlormequat 500 ppm
T2**:**Chlormequat 1000 ppm
T3**:**Mepiquat chloride 500 ppm
T4**:**Mepiquat chloride 1000 ppm
T5**:**Brassinolide 0.250 ppm
T6**:**Brassinolide 0.500 ppm
T7**:**Daminozide 500 ppm
T8**:**Daminozide 1000 ppm
T_9- Control

The trial was laid out in randomized block design with three replications. The plot size adopted was 2x $1m^2$. All there commended packages of practices were adopted.

The following observations were taken from the randomly selected ten plants in each plot and mean

values were calculated. Plant height at 45 and 90 days, number of leaves at 45 and 90 days, days taken for maturity, weight of bulb, marketable yield of bulb per plot, unmarketable yield of bulb per plot, marketable yield of bulb per ha, unmarketable yield of bulb per ha and total yield of bulb per ha. The datum on various parameters were statistically analysed as suggested by Panse and Sukhatme (1957). The data was statistically analyzed for critical difference at P=0.05.

Results and Discussion

The greater potentialities of growth retardants for maximizing the yield of vegetable crops had been reported by Mehrotra *et al.,* (1970); Srivastava and Adhikari (1972); Maurya and Lal (1987). Similarly, Nehra *et al.,* (1992) stressed the use of ethrel, $GA_3$and boric acid for initiating early bulbing, bolting and seed set in onion.

In the present study, the growth retardants *viz.* Chlormequat@ 500 ppm and 1000 ppm, Mepiquat chloride @ 500 ppm and 1000 ppm, Brassinolide @ 0.250 ppm and 0.500 ppm and Daminozide @ 500 ppm spray and 1000 ppm were applied to study its effect on bellary onion for yield and quality.

With regard to plant height, all the treatments showed significant difference and T_3 recorded minimum (21.00 cm and 53.25 cm) and control recorded maximum (27.88 cm and 60.28 cm) at 45 and 90 days, respectively. In respect to number of leaves at 45 and 90 days, T_3 recorded maximum (5.80 and 10.10, respectively) and control recorded minimum (4.07 and 8.70). The result of the present experiment revealed that the number of days taken for maturity varied significantly with different growth regulators. Mepiquat chloride (500 ppm) reduced the number of days taken for maturity (127.30) significantly over control (135.66) which was followed by Chlormequat 1000 ppm (129.55) and Chlormequat 500 ppm (129.92). There was reduced percent in number of days taken for maturity (6.16%) by foliar application of Mepiquat chloride (500 ppm) over control. Mepiquat chloride 500 ppm also exerted superiority over other treatments and control significantly for the important yield attributing character bulb weight.

Highest bulb weight was recorded in Mepiquat chloride@ 500 ppm (76g) and minimum in control (52.44g). These results are in agreement with the findings of Bajguz and Hayat (2009) stating that this may be due to increased food reserves in bulbs by effective utilization of photo assimilates. Mepiquat spray increased the RNA and DNA content, polymerase activity, protein synthesis. Similarly, Vidya Vardhini and Rao (2002) in their findings revealed that carbohydrate fraction, reducing sugars, non- reducing sugars and starch have contributed substantially to the increase of bulb weight in onion due to the spray of growth retardant Mepiquat chloride.

Marketable yield of bulb per plot is directly and positively correlated with the bulb weight and the maximum was recorded with Mepiquat chloride @ 500 ppm (17.97kg**)** and minimum recorded in control (12.45kg). This was followed by Chlormequat @ 1000 ppm (16.65 kg) and chlormequat @ 500 ppm (16.10kg) which are on par with each other. The photosynthetic assimilates accumulated due to the foliar spray of Mepiquat chloride were effectively utilized by the early formed bulbs, resulted in complete development of marketable bulbs where as in control, the photo assimilates synthesized in the early formed bulbs were diverted to late formed bulbs, resulted in under development of bulbs and production of more number of unmarketable bulbs. The mepiquat chloride (500 ppm) increased the number of marketable bulbs by 30.71% over control where in unmarketable bulbs by 73.20% by control over Mepiquat chloride @ 500 ppm (Table 2).

Total yield of bulb per hectare was also recorded with maximum with Mepiquat chloride @ 500 ppm (548.35q) which was followed by Chlormequat 1000 ppm (517.67q) and Chlormequat 500 ppm (504.45q).

Table.1 Effect of growth retardants for vegetative characters in bellary onion

Treatments	Plant height at 45 and 90 days(cm)		No. of leaves at 45 and 90 days	
T_1 - Chlormequat 500 ppm	22.45	54.00	5.02	10.00
T_2 - Chlormequat 1000 ppm	21.22	53.50	5.10	10.06
T_3 – Mepiquat chloride 500 ppm	21.00	53.25	5.80	10.10
T_4 - Mepiquat chloride 1000 ppm	24.15	55.10	4.88	9.45
T_5 - Brassinolide 0.250 ppm	24.50	56.00	4.96	9.63
T_6 - Brassinolide 0.500 ppm	23.74	54.45	4.50	9.56
T_7 - Daminozide 500 ppm	26.96	58.57	4.35	9.18
T_8- Daminozide 1000 ppm	25.34	56.64	4.24	9.86
T_9- Control	27.88	60.28	4.07	8.70
SEd	**0.316**	**0.75**	**0.148**	**0.16**
CD(0.05)	**0.670**	**1.49**	**0.316**	**0.31**

Table.2 Effect of growth retardants on yield and yield attributing characters in bellary onion

Treatments	Days taken for maturity	Weight of bulb (g)	Marketable yield of bulb per plot (kg)	Unmarketable yield of bulb per plot (kg)	Marketable yield of bulb per ha (q)	Unmarketable yield of bulb per ha (q)	Total yield of bulb per ha(q)
T_1 - Chlormequat 500 ppm	129.92	70.34	16.10	1.60	458.85	45.60	504.45
T_2 - Chlormequat 1000 ppm	129.55	72.50	16.65	1.52	474.35	43.32	517.67
T_3 – Mepiquat chloride 500 ppm	**127.30**	**76.00**	**17.97**	**1.27**	**512.15**	**36.195**	**548.35**
T_4 - Mepiquat chloride 1000 ppm	132.66	68.42	15.32	2.15	436.62	61.28	497.90
T_5 - Brassinolide 0.250 ppm	131.33	66.00	15.25	2.30	434.63	65.55	500.18
T_6 - Brassinolide 0.500 ppm	133.00	61.75	14.38	2.76	409.83	78.66	488.49
T_7 - Daminozide 500 ppm	135.00	58.66	13.88	3.00	395.58	85.50	481.08
T_8- Daminozide 1000 ppm	133.33	55.10	13.20	3.42	376.20	97.47	473.67
T_9- Control	135.66	52.44	12.45	4.74	354.82	135.09	489.91
SEd	**0.93**	**2.62**	**0.61**	**0.39**	**17.48**	**10.99**	**8.30**
CD(0.05)	**1.85**	**5.18**	**1.21**	**0.78**	**34.44**	**21.65**	**16.43**

Spraying of Brassinolide (0.250ppm) reduced the vegetative growth and late formed bulbs; therefore, it reduced the duration for crop growth on par with mepiquat chloride application. This also has reflected in total yield of bulb per hectare (500.18q). The minimum total yield of bulb per hectare was recorded in control (489.91q). It might be due to higher leaf area index (LAI) and dry matter

accumulation per unit area (Sairam, 1994 and Sengupta *et al.*, 2011) increasing the bulb size, total number of bulbs per plant and unit area.

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How to cite this article:

Manivannan M. I. and Prem Joshua, J. 2023. Studies on Influence of Growth Retardants in Increasing Yield and Quality in Bellary Onion (*Allium cepa* var. cepa). *Int.J.Curr.Microbiol.App.Sci.* 12(08): 261-266.
doi: https://doi.org/10.20546/ijcmas.2023.1208.027