Annals of Plant and Soil Research 19(4): 377-380 (2017)

Effect of mepiquat chloride on growth and yield of onion (*Allium cepa*)

SUNIL KUMAR PAL[1], S.P. SINGH, KULVEER SINGH YADAV, RAVI KUMAR AND ARUN KUMAR

Department of Horticulture, Institute of Agricultural Sciences, Banaras Hindu University,Varanasi-221005, U.P., India

Received: June, 2017; Revised accepted: September, 2017

ABSTRACT

An investigation was carried out at Agricultural Farm, Institute of Agricultural Sciences, Banaras Hindu University Varanasi (U.P.) during rabi season of 2015-16 to evaluate the effect of mepiquat chloride on growth and yield of onion cv. Agrifound Light Red. The investigation comprised eight treatments viz., 50 g a.i.ha^{-1} of mepiquat chloride at 35 DAT, 62.5 g a.i.ha^{-1} of mepiquat chloride at 35 DAT, 125 g a.i.ha^{-1} of mepiquat chloride at 35 DAT, 50 g a.i.ha^{-1} of mepiquat chloride at 50 DAT, 62.5 g a.i.ha^{-1} of mepiquat chloride at 50 DAT, 125 g a.i.ha^{-1} of mepiquat chloride at 50 DAT, 50 g a.i.ha^{-1}of mepiquat chloride at 35 and 50 DAT and control (water spray). The experiment was conducted in randomised block design with three replications. Results revealed that the minimum plant height (64.35 cm) was recorded with 125 g a.i.ha^{-1} of mepiquat chloride at 35 DAT whereas maximum plant height was recorded under control. Treatment 125 g a.i.ha^{-1} of mepiquat chloride at 35 DAT also resulted in maximum number of leaves (9.57), neck diameter (2.15 cm), root length (8.03 cm), total chlorophyll content (2.37 mg/g), bulb diameter (5.80 cm), bulb yield (53.27 kg per plot), yield ha^{-1} (295.93 ton) and B:C ratio (1.80:1). On contrary treatment 125 g a.i.ha^{-1} of mepiquat chloride at 50 DAT showed prominent results in terms of bulb height (5.34 cm).

Key words: Growth, economics, Mepiquat chloride, onion and yield.

INTRODUCTION

Onion is one of the most important bulb crops extensively grown in India. It is widely used both as raw and matured bulb and is also used to add flavour to various delicious curries. As a food item, it is usually served cooked, as a vegetable or part of a prepared savoury dish, but can also be eaten raw or used to make pickles or chutneys. Onion is also used for various medicinal purposes (Pandey, 2017). Indispensable as vegetables, spice, and condiment, onion commands an extensive internal and external markets and consequently the growers receive very good return from this crop. They have a prebiotic effect, improve the intestinal flora, especially the bifidobacteria intestinal conditions against pathogen agents. Mepiquat chloride, 1,1 dimethylpiperidinium chloride, is a water soluble organic molecule, which is absorbed by the green parts and redistributed throughout the plant. Mepiquat chloride inhibits gibberellic acid synthesis by stopping the conversion of geranlgeranyl diphosphate to entkaurene, consequently reducing cell enlargement and cell division rate (Srivastava, 2002). Cotton plants treated with mepiquat chloride are typically more compact, with fewer nodes, shorter internodes and fewer reproductive branches (Bogiani and Rosolem, 2009). As a result, mepiquat chloride controls plant height and earliness, thus facilitating crop management and harvest. Mepiquat chloride also concentrates boll set on lower sympodia, increasing the synchrony of boll maturation and demand for photosynthate (Gwathmey and Clement, 2010). The mepiquat chloride has been found to be great importance in the cotton cultivation (Edmisten, 2012) but there is no information available pertaining to effect of mepiquat chloride on onion. Therefore, the present investigation was undertaken to find out response of mepiquat chloride on growth and yield attributes of onion.

MATERIALS AND METHODS

The experiment was conducted during winter season on onion (*Allium cepa* L.) variety 'Agrifound Light Red' at Agricultural Farm, Institute of Agricultural Science, Banaras Hindu University during 2015–2016. Geographically, the experimental site falls under sub–tropical zone between 25^{0}32' north latitude and 82^{0}98' east longitude. The soil of plot was of normal fertility with good facility for irrigation and

[1]*Corresponding author e-mail: sunil15apr1993@gmail.com*

drainage. The investigation comprised eight treatments *viz.,* T_1 - 50 g a.i.ha^{-1} of mepiquat chloride at 35 DAT (days after transplanting), T_2 - 62.5 g a.i.ha^{-1} of mepiquat chloride at 35 DAT, T_3 - 125 g a.i.ha^{-1} of mepiquat chloride at 35 DAT, T_4 - 50 g a.i.ha^{-1} of mepiquat chloride at 50 DAT, T_5 - 62.5 g a.i.ha^{-1} of mepiquat chloride at 50 DAT, T_6 - 125 g a.i.ha^{-1} of mepiquat chloride at 50 DAT, T_7 - 50 g a.i.ha^{-1} of mepiquat chloride at 35 and 50 DAT and T_8 - control (water spray). The experiment was conducted in randomised block design with three replications. Seed sowing was done in second week of October and one month old seedlings (20 December) were transplanted at 15 cm row to row and 10 cm from plant to plant distance. Plot size was kept 6.0 × 3.0 m to accommodate 1200 plants in each plot. Recommended dose of Urea, DAP and MOP were applied @ 60 kg N + 50 kg P_2O_5 + 50 kg K_2O ha^{-1} were applied as urea, diammonium phosphate and muriate of potash, respectively. Compost (25 t ha^{-1}) was broadcasted and incorporated into the soil just before transplanting. Half dose of required nitrogen was applied at the time of transplanting as basal dose. Remaining half of the nitrogen was applied as top dressing at 35 days after transplanting. Irrigation was done regularly as and when required. Hoeing and weeding were given to all the plots evenly whenever required. The data on plant height, number of leaves, neck diameter and chlorophyll content of leaves were recorded at 90 DAT and rest of the parameters at harvesting of the crop. The crop was harvested at 130 days after transplanting.. The chlorophyll content was measured by adopting standard method. Bulb per plot was harvested separately and yield per plot was recorded. Yield per ha was obtained by multiplication of factor 5.56 in yield per plot.

RESULTS AND DISCUSSION

Growth parameters

The data (Table 1) clearly revealed that there were marked variations in growth attributes of plant due to different treatments. The plant height decreased gradually with increasing the concentration of mepiquat chloride. The maximum plant height (71.71 cm) was recorded under control followed by 50 g a.i.ha^{-1} of mepiquat chloride at 50 DAT (69.64 cm), 50 g a.i.ha^{-1} of mepiquat chloride at 35 DAT (69.0 cm) and 62.5 g a.i.ha^{-1} of mepiquat chloride at 50 DAT (68.87 cm) whereas, it was the minimum (64.35 cm) under 125 g a.i.ha^{-1} of mepiquat chloride at 35 DAT. Never the less, treatment 62.5 g a.i.ha^{-1} of mepiquat chloride at 50 DAT and 50 g a.i.ha^{-1} of mepiquat chloride at 35 DAT did not differ significantly with each other. Garai and Datta (2003) reported that application of cycocel decreased the plant height in green gram as compared to control. The mechanism of reduction in plant height with chlormequat chloride and mepiquat chloride may be ascribed to slowing down of cell division and reduction in cell expansion due to anti-gibberellins quality (LopezValencia, 2002). The maximum number of leaves (9.57) was recorded with 125 g a.i.ha^{-1} of mepiquat chloride at 35 DAT. It was closely followed by 62.5 g a.i.ha^{-1} of mepiquat chloride at 50 DAT (9.33), 50 g a.i.ha^{-1} of mepiquat chloride at 35 and 50 DAT (9.07) whereas, the minimum (7.73) under control. This may be due to the ability of growth retardants to delay senescence of leaf by arresting the chlorophyll degradation and protease activity and promoting. Identical results have also been reported by Memane *et al.* (2008) for the effect of cycocel (1000 ppm) on number of leaves in garlic. Prakash *et al.* (2003) reported an increase in number of leaves by growth regulators in black gram. Similarly, the neck diameter was observed to be maximum (2.15 cm) under 125 g a.i.ha^{-1} of mepiquat chloride at 35 DAT. It was closely followed by 125 g a.i.ha^{-1} of mepiquat chloride at 50 DAT (2.04 cm). It was the minimum (1.71 cm) in control. The thickness of the stem (neck) is the important parameter since it is the neck which is ultimately going to be converted into bulb. Hence, more the thickness of the neck more will be the bulb size and yield. These results corroborate the findings of Singh *et al.* (2003) in onion. Maximum (8.03 cm) root length was recorded with 125 g a.i.ha^{-1} of mepiquat chloride at 35 DAT whereas, the minimum (7.20 cm) under control. These results are in accordance with the findings of Singh and Bhonde (2003) who founded that soaking of seeds in Cycocel (chlormequat) at 250 ppm of onion cultivars Agrifound Light Red increased the root length and 100 seedling weight as compared with control.

Physiological attributes

It was observed that growth retardants had profound influence on chlorophyll content in leaf. The maximum total chlorophyll (2.37 mg/g) was recorded with 125 g a.i.ha^{-1} of mepiquat chloride at 35 DAT followed by 125 g a.i.ha^{-1} of

mepiquat chloride at 50 DAT (2.33 mg/g). The minimum total chlorophyll (1.92 mg/g) was recorded under control. Never the less, 62.5 g a.i.ha^{-1} of mepiquat chloride at 50 DAT (2.06 mg/g) was at par with 50 g a.i.ha^{-1} of mepiquat chloride at 35 DAT (2.05 mg/g) and with 50 g a.i.ha^{-1} of mepiquat chloride at 50 DAT (2.09 mg/g). It would be possible that the chlorophyll synthesis is enhanced due to some sort of mild stress created by growth inhibitors and retardants and also the chlorophyllase enzyme, responsible for chlorophyll degradation. The results are in conformity with the findings of Bangarswamay *et al.* (2001) in pigeonpea. Cheema *et al.* (2009) found that application of growth retardants at 35 DAS in cowpea increased the total chlorophyll content.

Table 1: Effect of mepiquat chloride on growth and physiological attributes of onion

Treatments	Plant Height (cm)	Number of Leaves	Neck Diameter (cm)	Root length (cm)	Chl a (mg/g)	Chl b (mg/g)	Total Chl (mg/g)
T_1	69.00	8.20	1.83	7.23	1.64	0.41	2.05
T_2	68.35	8.63	1.94	7.30	1.73	0.42	2.14
T_3	64.35	9.57	2.15	8.03	1.93	0.44	2.37
T_4	69.64	8.07	1.78	7.30	1.71	0.39	2.09
T_5	68.87	9.33	1.92	7.37	1.62	0.44	2.06
T_6	65.97	8.47	2.04	8.00	1.88	0.45	2.33
T_7	67.19	9.07	2.00	7.80	1.87	0.43	2.30
T_8	71.71	7.73	1.71	7.20	1.55	0.37	1.92
CD (P=0.05)	0.53	0.20	0.07	0.20	0.06	0.03	0.06

Yield attributes and yield

Pronounced effects of various treatments were observed on yield parameter (Table 2). Bulb size is an important yield contributing character in onion. The greatest (5.34 cm) height of bulb was observed with 125 g a.i.ha^{-1} of mepiquat chloride at 50 DAT followed by treatment 125 g a.i.ha^{-1} of mepiquat chloride at 35 DAT (5.33 cm). The lowest (4.64 cm) height of bulb was recorded under control. Regarding bulb diameter, the highest diameter of bulb (5.80 cm) was recorded with 125 g a.i.ha^{-1} of mepiquat chloride at 35 DAT. It was closely followed by 125 g a.i.ha^{-1} of mepiquat chloride at 50 DAT (5.23 cm) whereas the lowest (4.24 cm) diameter of bulb was recorded under control which remains at par with 50 g a.i.ha^{-1} of mepiquat chloride at 35 DAT. The reduction in plant height by growth regulators and chemicals was effective in moderating the vegetative growth by mobilizing the photosynthates from other parts to the bulbs and activating synthetic enzymes thereby increasing the bulb size. The results are in conformity with the findings of Singh *et al.* (2003). The bulb yield had significant positive association with number of leaves, bulb length and chlorophyll content indicating the importance of these parameters in improving the yield potential of onion. The maximum yield per plot and yield per ha (53.27 kg and 295.93 tonnes respectively) was observed with 125 g a.i.ha^{-1} of mepiquat chloride at 35 DAT. The minimum yield per plot and yield per ha (45.80 kg and 254.44 tonnes respectively) was recorded in control. The production of large sized bulbs with the growth retardant may be attributed to the fact that growth regulators

Table 2: Effect of mepiquat chloride on yield and economics of onion

Treatments	Bulb Height (cm)	Bulb diameter (cm)	Yield per plot (kg)	Yield (t ha^{-1})	Total Cost (Rs. ha^{-1})	Net Return (Rs. ha^{-1})	B:C Ratio
T_1	5.07	4.50	47.50	263.89	103837.04	160052.96	1.54:1
T_2	5.17	4.85	49.10	272.78	104137.04	168642.96	1.61:1
T_3	5.33	5.80	53.27	295.93	105637.04	190292.96	1.80:1
T_4	4.92	4.47	46.83	260.19	103837.04	156352.96	1.50:1
T_5	5.16	4.63	48.33	268.52	104137.04	164382.96	1.57:1
T_6	5.34	5.23	51.83	287.96	105637.04	182322.96	1.72:1
T_7	5.19	4.90	49.97	277.59	105037.04	172552.96	1.64:1
T_8	4.64	4.24	45.80	254.44	102637.04	151802.96	1.47:1
CD (P=0.05)	0.12	0.27	0.75	4.15	-	-	-

remain physiologically more active to build up sufficient food reserves for developing bulbs which ultimately lead to increased total yields (Memane *et al.,* 2008). Similar findings regarding the yield have also been reported by Reddy (2009). Kumar *et al.* (2010) found that mepiquat chloride @ 100 ppm as foliar spray at 30 and 45 days after planting proved to be most effective to boost growth, yield and quality parameters followed by CCC @ 750 ppm.

Economics

Net income and B:C ratio of a crop are deciding factors for its adoptation for farmers by the commercial production of any crop. It is therefore, important to calculate the increase in income owing to onion cultivation by application of different treatments. In the present study, the highest net return and B:C ratio (Rs 190292.96, 1.80:1 respectively) was observed in treatment 125 g a.i.ha^{-1} of mepiquat chloride at 35 DAT. It was closely followed by 125 g a.i.ha^{-1} of mepiquat chloride at 50 DAT (Rs 182322.96, 1.72:1). This might be due to higher yield obtained in this treatment compared to all other treatments. The lowest net return and B:C ratio (Rs 151802.96, 1.47:1 respectively) was recorded under control due to lower yields of bulb. From the results, it can be concluded that the treatment 125 g a.i.ha^{-1} of mepiquat chloride at 35 DAT was found to be beneficial to modified the plant growth and increasing the yield and economic of the crop.

REFERENCES

Bangarswamay, U., Jeyakumar, P. Magudapathy, K. and Djanaguriraman, M. (2001) Effect of growth regulators on growth and development of pigeon pea. National seminar on Role of plant physiology for sustaining quality and quantity of food production in relation to environment. pp. 5-7.

Bogiani, J.C. and Rosolem, C.A. (2009) Sensibility of cotton cultivars to mepiquat chloride. *Pesquisa Agropecuária Brasileira* **44**: 1246-1253.

Cheema, M.S., Akhtar, M. and Nasarullah, M. (2009) Effect of foliar application of mepiquat chloride under varying nitrogen levels on seed cotton yield and yield components. *Journal of Agricultural Research* **47**(4): 381.

Edmisten, K.L. (2012) Suggestions for growth regulator use. *In* K.L. Edmisten (ed.) North Carolina Cotton Information. pp. 48–54.

Gwathmey, C.O. and Clement, J.D. (2010) Alteration of cotton source sink relations with plant population density and mepiquat chloride. *Field Crops Research* **116**: 101-107.

Kumar, V., Vyakarnahal, B.S., Basavaraj, N. and Birbal (2010) Effect of growth retardants and methods of application on growth and yield of potato. *Indian Journal of Horticulture,* **67**: 308-313.

LopezValencia, M., Sanchezdel Castillo, F. and Contreras Magana, E. (2002) Effect of cycocel and B9 on tomato (*Lycopersicon esculentum* Mill.) plants pruned to two clusters. *Revista Chapingo Serie Horticultura,* **8**(2): 161-170.

Memane, P.G., Tomar, R.S., Kakade, D.K., Kulkarni, G.U. and Chovatia, R.S. (2008) Effect of clove weight and plant growth regulators on growth and yield of garlic (*Allium sativum* L.). *Asian Journal of Horticulture* **3**(1): 82-86.

Pandey, M. (2017) Effect of FYM and manganese on yield and uptake of nutrients by onion (*Allium cepa*) in an alluvial soil. *Annals of Plant and Soil Research* **19** (2): 180-184.

Prakash, M., Kumar, J.S., Kannan, K., Kumar, M.S. and Ganesan, J. (2003) plant growth regulators on growth physiology and yield of black gram. *Legume Research* **26**(3): 183-187.

Reddy, P., Ninganur, B.T., Chetti, M.B. and 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 Sciences,* **22**(2): 289-292.

Singh, D.K. and Bhonde, S.R. (2003) Studies on the efficacy of certain growth regulators on seed viability and vigour in onion. *National Horticultural Research and Development Foundation* **23**(1): 10-16.

Singh, D.K., Singh, N.B. and Bhonde, S.R. (2003) Effect of growth regulators on bulb development in onion during kharif season. *National Horticultural Research and Development Foundation* **23**(2): 14.

Srivastava, L.M. (2002) Gibberellins. In: Srivastava, L.M. Plant growth and development Academic Press, New York, USA. pp. 172-181.