

## EFFECT OF GA<sub>3</sub> ON QUALITY SEED PRODUCTION OF ONION IN BANGLADESH

MA Ali<sup>1\*</sup>, MM Hossain<sup>2</sup>, M Zakaria<sup>2</sup>, T Hossain<sup>3</sup>, A Naznin<sup>4</sup>, MM Islam<sup>4</sup>

### Address

<sup>1</sup>DAE, Khamarbari, Dhaka

<sup>2</sup>Professor, Dept. of

Horticulture, BSMRAU

Gazipur <sup>3</sup>Professor, Dept.

of Crop Botany, BSMRAU

Gazipur. <sup>4</sup>Scientific officer

BARI, Gazipur

### Correspondence\*

kbd.ahmed@yahoo.com

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### Abstract

A experiment was conducted at Bangabandhu Sheikh Mujibur Rahman Agricultural University (BSMRAU), Gazipur during the year 2011 to 2012. The purpose of the study was to evaluate the performance of different doses of GA<sub>3</sub> on quality seed production of onion (CV. Taherpuri). The field experiment was laid out in Randomized complete Block Design (RCBD) with three replications. Bulbs were planted on November 16, 2011. The depth of planting was 5 cm from the surface of the soil. There were four different treatments viz. G<sub>0</sub> (0 ppm), G<sub>1</sub> (50 ppm), G<sub>2</sub> (100 ppm), G<sub>3</sub> (150 ppm) was sprayed at 45 and 60 days after planting. The seeds were harvested by cutting off the umbels when about 15-30% of the heads had black seeds exposed. After harvesting, the umbels were dried in scorching sun light for 3-4 days and then threshed manually. After threshing, seeds were cleaned and dried properly and kept in polyethylene bags, which were stored properly at room temperature. Data were recorded from randomly selected ten plants from each plot and their averages were taken for treating as per plant. In laboratory Thousand Seed weight, Germination and Electrical conductivity of the seeds were measured. GA<sub>3</sub> influenced the seed yield and quality of onion. Higher doses were more effective and showed a linear relationship in plant growth and seed yield of onion. The highest seed yield (1576.67 kg ha<sup>-1</sup>) was obtained with application of 100 ppm GA<sub>3</sub>. The present study clearly shows that almost all the plants treated with GA<sub>3</sub> performed better than control. GA<sub>3</sub> application significantly varied the scape length, umble diameter, seed yield per plant, thousand seed weight, germination percentage and electrical conductivity. However, application of Gibberelic acid has positive impact on growth and seed yield of onion.

**Keywords:** Onion, Bulb, Scape; Umble, Electrical conductivity

### Introduction

Onion (*Allium cepa* L.) is an important spice crop cultivated all over the world. It grows in almost all the districts of Bangladesh as a winter crop. The main edible portion of the onion plant is the bulb, which is a modified organ constituted by the thickened fleshy leaf sheaths and stem plate. The most important character is its flavor, which increases the taste of food. Besides, it has also preservative and medicinal value. It is used to relieve insect bites and sore throat (Bose and Som, 1990).

In Bangladesh, onion ranks first in terms of production and second with respect to acreage amongst all spices grown and the total requirement is 480 thousand tonnes with a shortage of 208 thousand tonnes per year (BBS, 2004). However, to meet the demand Bangladesh has to import onion from India and Pakistan every year at the higher cost of foreign currency (Hossain and Islam, 1994). The unavailability of good quality onion seeds is partly responsible for such low yield in Bangladesh. To sustain onion production, it is very difficult to increase yield horizontally but there exists a great scope to do the same vertically that could be achieved by using good

quality seed. Therefore, it is essential to generate new knowledge and technologies regarding seed quality attributes for increased production of onion.

Plant growth regulators are new generation agro chemicals and are expected to play an important role in overcoming the hurdles in manifestation of biological yield. In recent years, plant growth regulators are used to overcome the factors that limiting the growth and yield to obtain maximum benefit from seed production. It is also observed that exogenous application of growth regulators increases the seed yield. These growth hormones regulate the physiological processes and balance the source and sink, thereby increase the productivity and quality of many crop species. Plant growth regulators are considered as key factors in vegetative growth, flowering, fruit setting and seed production in plant. It is revealed from experiments conducted in various part of the world that IAA, NAA, GA<sub>3</sub>, BA, 2, 4-D, IBA and ethrel at various concentrations have remarkable effects on number of flowers per umbel, umbel size and quality seed production of onion (El-Habbasha *et al.*, 1985; Deore and Bharuda, 1991). GA<sub>3</sub> application brings metabolic changes that affect both quality and quantity of the desired product. It stimulates the

synthesis of hydrolytic enzymes which are secreted and act on starchy endosperm in turn affecting physiology of seed germination and establishment of seedlings. So, it has been thought to be important to carry out research on the effect of GA<sub>3</sub> on the seed production of onion. The present investigation was undertaken to determine the optimum concentration of GA<sub>3</sub> on seed yield and quality of onion in Bangladesh.

### Materials and Methods

The experiment was conducted at Bangabandhu Sheikh Mujibur Rahman Agricultural University (BSMRAU), Salna, Gazipur during the year 2011-2012. Field experiments were conducted at the horticultural farm and laboratory experiments were done in the Laboratory of the Department of Seed Science and Technology, BSMRAU, Gazipur. Popular onion variety Taherpuri treated by different concentration of GA<sub>3</sub> viz. G<sub>1</sub> (50 ppm), G<sub>2</sub> (100 ppm), G<sub>3</sub> (150 ppm) and G<sub>0</sub> (only water) followed by Randomized complete Block Design (RCBD) with three replications. The treatments were sprayed at 45 and 60 days after planting. An area of 71.25 m<sup>2</sup> was divided into three equal blocks. Each block consisted of 3 plots where treatments were allotted randomly. There were 9 plots altogether in the experiment. The size of each plot was 2.5 m x 2 m. The distance between two blocks and two plots were 1m and 0.75m respectively. Bulbs were planted on the plots with 15cm x 20 cm spacing. Manure and fertilizers such as Cowdung, Urea, Triple Super Phosphate (TSP), Muriate of Potash (MoP), Zinc and Boron were applied in the experimental field as per fertilizer recommendation guide of BARC( 1995). Bulbs were planted on November 16, 2011. The depth of planting was 5 cm from the surface of the soil. Sprouting was occurred between November 20 and 23, 2011. Un-sprouted bulbs were replaced on November 28, 2011 by healthy bulbs of same size within a week of initial planting. The seeds were harvested by cutting off the umbels when about 15-30% of the heads had black seeds exposed. Harvesting was done early in the morning to prevent shattering of seeds. After harvesting, the umbels were dried in scorching sun light for 3-4 days and then threshed manually. After threshing, seeds were cleaned and dried properly and kept in polyethylene bags, which were stored properly at room temperature. Data on following parameters were recorded from randomly selected ten plants from each plot and their averages were taken for treating as per plant.

- Number of leaves per plant at 30,45 and 60 DAP
- Plant height (cm) at 30, 45 and 60 DAP
- Scape length (cm) at 65 and 85 DAP
- Number of umbels per plant at 65 and 85 DAP

- Umbel diameter (cm)
- Seed yield / plant (g)
- Seed yield per hectare (kg)

In laboratory, the data on thousand seed weight (g), electrical conductivity (mS cm<sup>-1</sup>) and germination percentage were taken.

The collected data from the experiment were analyzed by using statistical package programme MSTAT-C to illustrate the statistical significance of the experimental results developed by Gomez and Gomez (1984). The means differences were compared by using Least Significant Difference (LSD) test at 5% level of significance.

### Results

#### *Scape length*

There was significant variation in scape length due to GA<sub>3</sub> application. The GA<sub>3</sub> rate G<sub>2</sub> (100 ppm) produced the highest scape length (41.37 cm and 70.58 cm) whereas, G<sub>0</sub> (control) produced the lowest (33.45 cm and 64.48 cm) scape length at 65 and 85 DAP, respectively (Table 1).

#### *Number of umbels per plant*

There was significant variation on number of umbels per plant observed due to GA<sub>3</sub> concentration (Table 1). The rate G<sub>2</sub> (100 ppm) produced the maximum number of umbels per plant (2.57 and 2.69 at 65 and 85 DAP, respectively) and was significantly different from other doses. Whereas, G<sub>0</sub> (control) produced the minimum (2.03 and 2.17 at 65 and 85 DAP, respectively) number of umbels per plant.

Table 1. Effect of GA<sub>3</sub> on scape length, umbels/plant and umbel diameter of onion

| Treat.         | Scape length (cm) |         | Umbels/plant (no.) |        | Umbel diameter (cm) |
|----------------|-------------------|---------|--------------------|--------|---------------------|
|                | 65 DAP            | 85 DAP  | 65 DAP             | 85 DAP |                     |
| G <sub>0</sub> | 33.45b            | 64.48b  | 2.03c              | 2.17c  | 8.41b               |
| G <sub>1</sub> | 37.11ab           | 67.31ab | 2.30b              | 2.41b  | 8.89b               |
| G <sub>2</sub> | 41.37a            | 70.58a  | 2.57a              | 2.69a  | 9.65a               |
| G <sub>3</sub> | 38.99a            | 67.10ab | 2.24b              | 2.44b  | 8.86b               |
| CV (%)         | 12.75             | 6.01    | 8.80               | 8.25   | 5.84                |

G<sub>0</sub> = 0 ppm, G<sub>1</sub> = 50 ppm, G<sub>2</sub> = 100 ppm and G<sub>3</sub> = 150 ppm

#### *Umbel diameter*

There was significant variation in umbel diameter due to GA<sub>3</sub> application. The rate G<sub>2</sub> (100 ppm) produced the maximum umbel diameter (9.65 cm) whereas, G<sub>0</sub> (control), G<sub>1</sub> and G<sub>3</sub> showed statistically similar effect (Table 1).

#### *Seed yield per plant*

GA<sub>3</sub> application had significant influence on seed yield per plant. The highest seed yield per plant (4.73 g) was found from treatment G<sub>2</sub> (100 ppm) which was

significantly different from treatment G<sub>3</sub> (150 ppm) and G<sub>1</sub> (50 ppm) (Table 2).

#### Seed yield per hectare

GA<sub>3</sub> application had significant influence on seed yield/ha. The highest seed yield/ha (1576.67 kg) was found from treatment G<sub>2</sub> (100 ppm) which was significantly different from treatment G<sub>3</sub> (150 ppm) and G<sub>1</sub> (50 ppm). (Table 2)

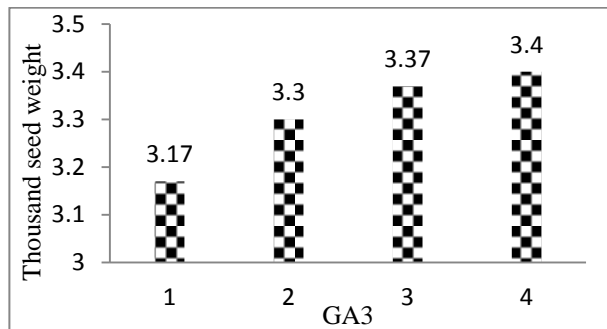
Table 2. Effect of GA<sub>3</sub> on seed yield/plant, seed yield/ha, germination and Electrical conductivity of onion

| Treat.         | Seed yield/<br>plant<br>(g) | Seed<br>yield/ ha<br>(kg) | Germination<br>(%) | Electrical<br>conductivity<br>( mS cm <sup>-1</sup> ) |
|----------------|-----------------------------|---------------------------|--------------------|---|
| G <sub>0</sub> | 3.54c                       | 1180.00c                  | 93.22b             | 0.52a   |
| G <sub>1</sub> | 4.11b                       | 1370.00b                  | 94.00a             | 0.49b   |
| G <sub>2</sub> | 4.73a                       | 1576.67a                  | 93.11b             | 0.53a   |
| G <sub>3</sub> | 4.18b                       | 1393.33b                  | 93.33b             | 0.51ab  |
| CV<br>(%)      | 8.95                        | 9.27                      | 0.26               | 4.67  |

G<sub>0</sub> = 0 ppm, G<sub>1</sub> = 50 ppm, G<sub>2</sub> = 100 ppm and G<sub>3</sub> = 150 ppm.

#### Thousand seed weight

Weight of 1000 seed was significantly influenced by GA<sub>3</sub> application. The highest weight of 1000 seeds (3.40 g) was recorded in treatment G<sub>3</sub> (150 ppm), which was statistically similar with treatment G<sub>2</sub> (3.37 g) and the lowest weight of 1000 seed (3.17 g) was recorded from the control ( Figure 1).



Where, 1= G<sub>0</sub> (0 ppm), 2= G<sub>1</sub> (50 ppm), 3= G<sub>2</sub> (100 ppm) and 4= G<sub>3</sub> (150 ppm)

Figure 1. Effect of GA<sub>3</sub> on Thousand Seed Weight

#### Germination

There was significant variation in germination percent due to different doses of GA<sub>3</sub> application. The highest percent of germination (94.00%) was recorded from G<sub>1</sub> (50 ppm) and the percent of germination recorded from G<sub>3</sub> (150 ppm) and G<sub>2</sub> (100 ppm) were statistically similar with control (Table 2).

#### Electrical conductivity

Electrical conductivity value varied due to different doses of GA<sub>3</sub> application (Table 2). The highest electrical conductivity (0.53 mS cm<sup>-1</sup>) was recorded from treatment G<sub>2</sub> (100 ppm). The lowest electrical conductivity (0.49 mS cm<sup>-1</sup>) was recorded from treatment G<sub>1</sub> (50 ppm). The lowest electrical conductivity indicated the higher quality of seed (Table 2).

#### Discussion

The direct comparison of the present findings couldn't be made with the findings of other author(s) due to lack of references. But some workers have reported about the effect of GA<sub>3</sub> on onion seed production. Al-Shdiefat (1992) reported that there had the effect of GA<sub>3</sub> application at concentration of 10, 25, 50, 100, 200, 300, 400, 500 and 1000 ppm on flowering and seed production of onion during 1989/90 growing season. Application of GA<sub>3</sub> significantly affected average number of seed stalks, main seed stalks, secondary seed stalks per plant, average number of small sized umbels per plant and seed vigour. Concentration of 10 ppm produced higher number of seed stalks and main seed stalks per plant, 300 and 1000 ppm gave the highest number of secondary seed stalks per plant, 100 ppm treatment gave the highest number of small umbels per plant; 25 ppm resulted in the highest percent of seed vigour.

El-Habbasha *et al.* (1985) carried out a field experiment to evaluate the effect of different concentrations of GA<sub>3</sub> and IAA on flowering and seed production of onion during the growing seasons of 1978-1979 and 1979-1980. Three times applications of GA<sub>3</sub> at 500 ppm caused an increase in the onion flowering rate and early bolting by 30 days and that high concentrations (500 ppm) of GA<sub>3</sub> increased the seed stalks height, number per plant and seed production. The result of the present study is in agreement with the above report.

Ghale (1985) reported that the spraying of Gibberellic Acid at the rate of 400 ppm singly or in combination with 90 kg N/ha produced significantly longer flowering stalk than those of other treatment combinations. Application of 200 ppm GA<sub>3</sub> without nitrogen increased seed yield over the control. Thiruvellavan *et al.* (1999) reported that Gibberellic acid (GA<sub>3</sub>) treated bulbs of onion showed early sprouting, umbel emergence and flowering, and had better umbel characters and higher seed yield compared to the control. In this study we found higher seed yield per plant, treated with 100 ppm GA<sub>3</sub> which was correlated with the increased scape length, umbel per plant and umbel diameter.

However the findings of this study is fully in conformity with the result of Rashid (2010) who reported that Application of GA<sub>3</sub> @ 100 ppm gave the maximum bulb yield while the minimum value was observed from control.

### Conclusions

From the results it may concluded that onion seed yield and quality may be enhanced through appropriate production technology. GA<sub>3</sub> application significantly varied the scape length, umble diameter, seed yield per plant, thousand seed weight, germination percentage and electrical conductivity of onion. Considering GA<sub>3</sub> application at 100 ppm onion seed production can be increased.

### References

- Al-Shdiefat SMM. 1992. Effect GA<sub>3</sub> application on flowering and seed production in onion. Arab Univ. J. Agril. Sci., 3(2): 109.
- BARC (Bangladesh Agricultural Research Council). 1995. Fertilizer recommendation guide. Bangladesh Agril. Res. Coun. Farmgate, Dhaka. p85.
- BBS. 2004. Monthly (October) Statistical Bulletin of Bangladesh. Bangladesh Bureau of Statistics, Ministry of Planning, Government People's Republic Dhaka, Bangladesh. p. 57.
- Bose TK. and Som MG. 1990. Vegetable crops in India. Naya prokash, Calcutta, 6: 545-582.
- Deore BP and Bharud RW. 1991. Effect of growth substances on the growth and yield of onion (*Allium cepa* L.) Cv. N- 2-4-1. Maharashtra J. of Hort. 5: 2, 64-67.
- El-Habbasha KM, Mahmoud HA, Thabet NG and Abdou PE. 1985. Effect of GA<sub>3</sub> and IAA applications on the flowering and seed production of onion (*Allium cepa* L.). Iraq J. Agric. Water Resouce. Res., 4(2): 13-26.
- Ghale MS. 1985. Flower and seed production of vernalized onion bulbs stimulated by gibberelic acid and with nitrogen fertilizer. Philippines : Central Luzon State University, p69.
- Gomez KA and Gomez AA. 1984. Statistical procedures for agricultural research, 2nd edition. John Wiley & Sons, New York. 680 p.
- Hossain AKM and Islam J. 1994. Status of *Allium cepa* production in Bangladesh. Hort. Abst., 58: 33-36.
- Rashid MHA. 2010. Effect of sulphur and GA<sub>3</sub> on the growth and yield of onion. Progress. Agric. 21(1 & 2): 57 – 63.
- Thiruvvelavan P, Thamburaj S, Veeraragavathatham D. 1999. Studies on flowering and seed yield of AC sp1 aggregatum onion in kharif season. South Indian Horticulture 47(1/6): 223-224.