

GROWTH AND YIELD RESPONSES OF CHICKPEA VAR. BARI CHOLA-7 FOLLOWING APPLICATION OF TIBA

SAIFUL ISLAM* AND NARGIS JAHAN

*Plant Physiology Laboratory, Department of Botany, University of Dhaka,
Dhaka-1000, Bangladesh*

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Abstract

A field experiment was conducted to evaluate the effect of TIBA (0, 10, 20, 50 and 100 ppm) on the growth and yield attributes of BARI Chola-7 laid out in RBD. Foliar application of TIBA at flower initiation stage, decreased plant height significantly with increasing concentrations of TIBA. Number of branches and leaves per plant were found to increase from 21 and 14 days after spray (DAS) onwards, respectively due to all the TIBA treatments and the maximum number of branches and leaves per plant were recorded due to 100 ppm TIBA which was statistically at par with 20 and 50 ppm TIBA. Dry matter per plant was recorded maximum from 21 DAS up to harvest due to 20 ppm TIBA. Except 100-seed weight, other yield contributing characters *viz.* number of seeds per plant, yield per plant, yield per hectare were also found to maximum due to 20 ppm TIBA treatment. The highest harvest index was recorded from 20 ppm TIBA.

Introduction

Chickpea (*Cicer arietinum* L.) is one of the major pulse crops grown in Bangladesh and serves as an important source of protein. It ranked fifth in area and production but second in consumption priority (BBS 2016). However, the average yield (1.32 t/ha) of chickpea is very low compared to other countries of the world. Moreover, domestic pulse production in Bangladesh can satisfy only less than half of the country's needs. The rest, some 140,000 tons, is to import at a cost of about US\$ 32.2 million per annum (MOA 2002). In addition, Bangladeshis consume about 12.0 g of pulses per capita per day, far below the 45 g per day recommended by FAO/WHO (Islam and Ali 2002). Therefore, increasing the production of chickpea needs further attention.

Several reasons have been identified for low yield realization of chickpea. Among them pronounced vegetative growth, nonsynchronous flowering/pod setting, flower and pod drop, and competition between pods and vegetative parts for photosynthates pose significant physiological constraints to its productivity. Use of growth retarding chemicals can be a potential tool to overcome these physiological barriers. Many plant growth retardants are known to reduce internodal length and plant height enhancing source-sink relationship, improve pod setting by decreasing flower and pod abscission and stimulate the translocation of photo-assimilates helping in effective flower formation, fruit and seed development and ultimately increasing productivity of the crops. TIBA (2, 3, 5-tri-iodobenzoic acid), a synthetic growth retardant, has been used to modify the canopy and induce greater growth, yield and yield attributes of many pulse crops *viz.* mungbean (Adam and Jahan 2014), soybean (Jahan and Khan 2014), pigeonpea (Baldev and Sinha 1974), cowpea (Ganiger *et al.* 2002) and Bengal gram (Sinha and Ghildiyal 1973, Tickoo *et al.* 1974).

However, the effects of TIBA on any variety of chickpea has not yet been studied in Bangladesh. Therefore, the present work was undertaken to find out the effects of TIBA on growth, yield and yield attributes of BARI Chola-7.

*Author for correspondence: <saiful.botany@du.ac.bd>

Materials and Methods

A field experiment was carried out at the research field of the Department of Botany, University of Dhaka during Rabi (December-March) season of 2017-2018. The experimental soil was analyzed and very low levels of nitrogen, phosphorus and low levels of potassium, sulphur and boron were recorded (FRG 2012). Cowdung, urea, TSP, MP, gypsum and boric acid were applied as basal amount during final land preparation. The experiment was laid out in randomized block design (RBD) with four replications. The unit plot size was 2 m × 1.1 m. Seeds of chickpea cv. BARI Cola-7 collected from BARI, Joydebpur, Gazipur were sown on 29th November 2017 in rows having a gap of 40 cm. Plants in rows were maintained 15 cm apart by thinning seedlings at 15 days after sowing. Intercultural operations were done as and when necessary. The five foliar treatments tested were as follows: T₀ = Water spray (control); T₁ = 10 ppm TIBA; T₂ = 20 ppm TIBA, T₃ = 50 ppm TIBA and T₄ = 100 ppm TIBA. The foliar spray was done at 45 days after sowing by using separate sprayers. Twelve random plants were sampled from each replication for recording data. Data on plant height, number of branches per plant, leaves per plant and total dry matter (TDM) per plant were recorded at an interval of 7 days after spray (DAS) up to 49 DAS and at harvest. Final harvest was done on 20th March, 2015. Number of seeds per plant, 100-seed weight (g), seed yield (g/plant and t/ha) and harvest index (%) were calculated after harvest. The data were subjected to statistical analysis and treatment means were compared for significance by using LSD test (Steel *et al.* 1997) at 5% level of probability.

Results and Discussion

Results presented in Table 1 revealed that plant height of chickpea at different ages was affected by TIBA treatments. With the increasing concentration, there was decrease in plant height. Significantly tallest plant was obtained from control at all the ages and it was statistically at par with T₁ and T₂ treatments except at 0, 7 and 28 DAS. At all the ages, the shortest plant was obtained due to T₄ treatment. Similar results of decrease in plant height due to TIBA treatment have been reported in soybean (Jahan and Khan 2014) and mungbean (Adam and Jahan 2014).

Number of branches per plant was positively influenced by TIBA treatments at all the ages of growth except at 7 and 14 DAS, where, the only decrease in number of branches per plant was recorded due to T₁ treatment which was statistically at par with control (Table 2). The maximum number of branches per plant was recorded from T₄ treatment followed by T₂. The number of branches per plant varied significantly at all the ages with only non-significant variation at 35 DAS. Increase in number of branches per plant following TIBA application was reported by Adam and Jahan (2014) in mungbean. The present result is also in consistent with the findings of other investigators (Chung and Kim 1989, Rahman and Rahman 1997). Jahan (1998) obtained increase in number of branches in one variety and decrease in the other variety of soybean.

Results showed that number of leaves per plant increased significantly at all the ages due to foliar application of all the concentrations of TIBA except at 7 DAS, where, only decrease in number of leaves per plant over the control was recorded from T₁ treatment (Table 3). After 7 DAS, number of leaves per plant showed a similar trend of increase as in number of branches per plant. The maximum number of leaves per plant was recorded from T₄ treatment followed by T₂, T₃ and T₁, respectively. Increase in number of leaves following TIBA application corresponds with the findings of Jahan and Khan (2014) in soybean. Significant increase in number of leaves per plant following TIBA application was also reported by Adam and Jahan (2014) in mungbean. Thus, the results are in consistent with those of other workers.

Dry matter of any crop is the accumulated product of photosynthesis and grain yield is positively correlated with the dry matter production after flowering (Yoshida and Ahn 1968).

Table 1. Effect of TIBA on plant height (cm) of BARI Chola-7 at different days after spray.*

| Treatments | Days after spray (DAS) | | | | | | | | | |
|----------------|------------------------|-------|-----------|----------|-----------|----------|----------|----------|------------|--|
| | 0 | 7 | 21 | 28 | 35 | 42 | 49 | 56 | At harvest | |
| T ₀ | 29.82 | 38.42 | 42.92 a | 45.83 a | 51.25 a | 58.00 a | 59.75 a | 61.17 a | 62.13 a | |
| T ₁ | 29.41 | 38.25 | 42.83 ab | 45.67 ab | 49.92 ab | 57.63 ab | 58.17 ab | 60.75 ab | 61.75 ab | |
| T ₂ | 28.66 | 36.50 | 42.67abc | 43.92 c | 49.67abc | 56.50abc | 56.75abc | 59.04abc | 59.58abc | |
| T ₃ | 29.17 | 35.42 | 40.75 a-d | 42.83 cd | 48.25 a-d | 53.50 cd | 55.50 cd | 56.25 cd | 57.08 cd | |
| T ₄ | 28.28 | 35.25 | 37.66 e | 41.25 e | 45.13 d | 52.04 d | 54.25 d | 55.08 d | 55.67 d | |
| CV (%) | 4.92 | 7.18 | 6.43 | 4.65 | 5.94 | 6.0 | 4.46 | 5.87 | 5.52 | |
| LSD (0.05) | NS | NS | 3.01 | 1.52 | 3.18 | 3.71 | 2.32 | 3.33 | 3.03 | |

*Means in a vertical column followed by same letter do not differ significantly at 5% level.

Table 2. Effect of TIBA on number of branches per plant of BARI Chola-7 at different days after spray.*

| Treatments | Days after spray (DAS) | | | | | | | | | |
|----------------|------------------------|----------|----------|----------|----------|-------|-----------|-----------|------------|--|
| | 0 | 7 | 14 | 21 | 28 | 35 | 42 | 49 | At harvest | |
| T ₀ | 7.63 | 9.62bc | 12.17bcd | 13.75 d | 15.13 d | 16.92 | 17.25 d | 17.29 d | 17.13 d | |
| T ₁ | 7.75 | 9.17 c | 11.17 d | 15.92abc | 17.25abc | 18.08 | 18.09 a-d | 18.13 a-d | 18.04 a-d | |
| T ₂ | 7.71 | 10.92 ab | 13.29 ab | 16.00 ab | 17.88 ab | 18.21 | 18.67 ab | 18.83 ab | 18.75 ab | |
| T ₃ | 7.92 | 10.42abc | 12.92abc | 15.50abc | 17.38abc | 17.79 | 18.46abc | 18.50abc | 18.42abc | |
| T ₄ | 7.67 | 11.33 a | 13.75 a | 16.54 a | 18.25 a | 18.50 | 19.00 a | 19.08 a | 19.00 a | |
| CV (%) | 6.69 | 11.24 | 10.38 | 8.94 | 8.66 | 5.20 | 4.84 | 4.62 | 4.97 | |
| LSD (0.05) | NS | 1.52 | 1.56 | 1.66 | 1.57 | NS | 1.02 | 0.98 | 1.03 | |

*Means in a vertical column followed by same letter do not differ significantly at 5% level.

Table 3. Effect of TIBA on number of leaves per plant of BARI Chola-7 at different days after spray.*

| Treatments | Days after spray (DAS) | | | | | | | | | |
|----------------|------------------------|-------|----------|----------|----------|----------|----------|----------|------------|--|
| | 0 | 7 | 14 | 21 | 28 | 35 | 42 | 49 | At harvest | |
| T ₀ | 10.25 | 11.67 | 16.50 d | 30.75 d | 36.63 cd | 47.13 cd | 48.92 cd | 50.46 cd | 45.33 cd | |
| T ₁ | 10.00 | 12.83 | 21.79bcd | 36.04bcd | 41.79bcd | 49.79bcd | 51.50bcd | 53.08bcd | 47.92bcd | |
| T ₂ | 10.50 | 11.58 | 31.42 ab | 45.67 ab | 48.42 ab | 56.92 ab | 58.58 ab | 60.08 ab | 54.92 ab | |
| T ₃ | 10.58 | 11.00 | 27.83abc | 42.08abc | 44.83abc | 52.83abc | 54.58abc | 56.17abc | 51.00abc | |
| T ₄ | 10.42 | 10.42 | 33.92 a | 49.42 a | 52.17 a | 58.67 a | 60.50 a | 62.00 a | 56.92 a | |
| CV (%) | 7.65 | 12.00 | 32.10 | 22.82 | 16.71 | 11.90 | 11.67 | 11.10 | 12.21 | |
| LSD (0.05) | NS | NS | 9.60 | 10.14 | 9.39 | 7.89 | 7.90 | 7.10 | 7.94 | |

*Means in a vertical column followed by same letter do not differ significantly at 5% level.

Table 4. Effect of TIBA on total dry matter (TDM) (g) per plant of BARI Chola-7 at different days after spray.*

| Treatments | Days after spray (DAS) | | | | | | | | | |
|----------------|------------------------|------|---------|----------|---------|----------|----------|----------|------------|--|
| | 0 | 7 | 14 | 21 | 28 | 35 | 42 | 49 | At harvest | |
| T ₀ | 0.80 | 0.92 | 1.10 d | 3.03 a-d | 4.84abc | 8.09 a-d | 12.02abc | 12.53 ab | 12.90abc | |
| T ₁ | 0.81 | 1.00 | 1.73 a | 3.39abc | 5.34 ab | 8.84 ab | 12.24 ab | 12.44abc | 13.34 ab | |
| T ₂ | 0.77 | 0.96 | 1.72 ab | 3.55 a | 5.51 a | 9.63 a | 12.68 a | 13.33 a | 13.58 a | |
| T ₃ | 0.83 | 0.97 | 1.63abc | 2.22 d | 3.22 d | 7.05 d | 9.57 d | 10.30 d | 11.03 d | |
| T ₄ | 0.78 | 0.93 | 1.54abc | 3.46 ab | 4.90abc | 8.68abc | 11.36abc | 11.57bcd | 12.32 a-d | |
| CV (%) | 17.31 | 13.8 | 21.45 | 24.83 | 30.71 | 21.91 | 13.69 | 16.94 | 11.36 | |
| LSD (0.05) | NS | NS | 0.36 | 0.93 | 1.54 | 1.57 | 1.62 | 1.62 | 1.72 | |

*Means in a vertical column followed by same letter do not differ significantly at 5% level.

Results presented in Table 4 revealed that total dry matter (TDM) per plant was affected significantly by different concentrations of TIBA at all the ages except at 7 DAS. Results also showed that at 7 and 14 DAS, maximum TDM was recorded from T₁ treatment, whereas from 21 DAS up to harvest maximum TDM was recorded due to T₂ treatment. Although number of branches and leaves per plant increased significantly following T₄ treatment, the decrease in total dry matter may be due to significant decrease in plant height. This result is fully in agreement with the findings of Adam and Jahan (2014) who observed that 20 mg TIBA/l increased the dry weight of mungbean. By applying TIBA increase in dry matter of soybean was also reported by other investigators (Jahan 1998, Ravichandran and Ramaswami 1991).

Results revealed that yield contributing parameters were both positively and negatively influenced due to different concentrations of TIBA treatment (Table 5). The highest number of seeds per plant (67.10) was recorded from T₂ treatment which was significantly different from all other treatments except at T₁ treatment. Number of seeds obtained from T₂ treated plants was 28.10% higher over the control. Jahan and Adam (2014) reported that 20 mg TIBA/l increased the number of seeds per plant in mungbean. Similar results of increase in soybean due to TIBA application was also reported by Jahan (1998) and Ravichandran and Ramaswami (1991).

Table 5. Effect of TIBA on yield and yield attributes of BARI Chola-7 at harvest.*

| Treatments | No of seeds /plant | 100 seed weight (g) | Yield/plant (g) | Yield/hectare (t) | Harvest index (%) |
|----------------|--------------------|---------------------|-----------------|-------------------|-------------------|
| T ₀ | 52.38 c | 11.05 | 5.77 c | 0.92 cd | 44.90 |
| T ₁ | 62.42 ab | 11.73 | 7.35 ab | 1.17 ab | 54.87 |
| T ₂ | 67.10 a | 11.14 | 7.47 a | 1.19 a | 55.69 |
| T ₃ | 49.61 cd | 11.13 | 5.33 cd | 1.10abc | 50.65 |
| T ₄ | 49.04 cd | 11.42 | 5.59 cd | 0.89 d | 45.41 |
| CV (%) | 15.81 | 5.70 | 17.82 | 15.81 | 14.75 |
| LSD (0.05) | 7.81 | NS | 1.21 | 0.19 | NS |

*Means in a vertical column followed by same letter do not differ significantly at 5% level.

Results also showed that 100-seed weight increased non-significantly following TIBA treatments. The range of increase in 100-seed weight was 0.72 - 6.15%, the maximum being due to T₁ treatment. Increase in 100-seed weight in mungbean and soybean following TIBA application is available (Adam and Jahan 2014, Jahan and Khan 2014).

Yield per plant (g) and yield per hectare (t) increased significantly due to T₁ and T₂ treatments. The highest increase in yield per plant (7.47 g) and yield per hectare (1.19 t) was recorded from the plants treated with T₂ treatments and the increases were 29.29 and 29.34% higher over the control, respectively. Results revealed that the higher concentration of TIBA (T₄) treatment significantly decreased the yield/plant and yield/h of BARI Chola-7 and the reduction was 3.11 and 3.26%, respectively than the control. Adam and Jahan (2014) reported increase in yield following 20 mg TIBA/l application. Increase in yield due to different concentrations of TIBA had also been reported by other workers (Jahan 1998, Ravichandran and Ramaswami 1991). Both increases and decreases in seed yield per plant of soybean due to application of TIBA were reported by Jahan and Khan (2014). Results presented in Table 5 also revealed that the harvest index was affected non-significantly and the highest (55.69%) was obtained from the plants

sprayed with T₂ treatment. The lowest harvest index was obtained from the control. Adam and Jahan (2014) reported that mungbean plants treated with 20 mg TIBA/l resulted in maximum harvest index.

The overall results of the investigation indicated that TIBA has both stimulatory and inhibitory effect on different growth parameters and the magnitude of effect was different depending on the concentration. The application of higher doses of TIBA (100 ppm) though produced highest number of branches and leaves per plant but decreased dry matter per plant and yield per plant. Of all the five treatments, however, application of TIBA at 20 ppm showed better stimulations on the yield contributing characters of BARI Chola-7 and thus leading to significant increase in seed yield.

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