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# GROWTH ANALYSIS OF CHICKPEA VAR. BARI CHOLA-7 FOLLOWING APPLICATION OF TIBA (2, 3, 5- TRIIODOBENZOIC ACID)

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## ABSTRACT

An investigation was made to see the effect of different concentrations (10, 20, 30 and 40 ppm) of 2, 3, 5- triiodobenzoic acid (TIBA) on leaf area index (LAI), leaf area duration (LAD), crop growth rate (CGR), relative growth rate (RGR) and net assimilation rate (NAR) of a cultivar of chickpea (*Cicer arietinum* L.) grown during rabi season of 2015 - 2016. Results revealed that LAI and LAD showed a positive response from flowering stage to maturity (66 - 110 DAS) due to 30 ppm TIBA application with maximum LAI and LAD occurring at the flowering stage. At 66 - 83 and 83 - 97 DAS, CGR was highest with the application of 30 ppm TIBA, while RGR was highest due to 10 ppm TIBA. Peak CGR was recorded at the time of pod setting to pod filling stage (8 - 97) and increased over control by 29.64%. Irrespective of the treatments, NAR was recorded maximum during flowering stage to pod setting (66 - 83 DAS) and thereafter decreased till maturity. At 66 - 83 and 83 - 97 DAS, maximum NAR values were recorded due to 30 ppm TIBA and the increases were 9.09 and 32.69% higher over the control, respectively.

Key words: Growth analysis, Chickpea, TIBA, Foliar application

## INTRODUCTION

Growth analysis is a fundamental technique used to quantify the growth components, represents the first step in the analysis of primary production and is the most practical method for assessing net photosynthetic production. Crop growth processes *viz*. CGR, RGR and NAR control dry matter production and ultimately reflected in the yield (Srivastava and Sing 1980, Thakur and Patel 1998). LAI and LAD are important morphological index of plant leaf which are closely connected with photosynthetic activity of leaves and control dry matter production (Katiyar 1980). Sun *et al*. (1999) reported that optimum leaf area index and crop growth rate at flowering stage are the major determinants of yield. Crop growth parameters can be influenced by foliar application of growth regulator. Various growth regulators have been reported to have effects on growth parameters of a number of pulse crops *viz*. black gram (Prakash *et al*. 2003), soybean (Rahman *et al*. 2004), cowpea (Reddy 2005) and lentil (Islam *et al*.

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2006). Increase in LAI, LAD, CGR and NAR following application of growth regulators has been reported by Karim and Fattah (2007) in chickpea. However, reports regarding the effect of TIBA, a synthetic growth retardant, on the growth and physiological processes of chickpea are lacking from Bangladesh. Hence, the present investigation was undertaken to evaluate the effect of TIBA on some growth and physiological parameters of chickpea.

## 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 2015 - 2016. The experimental soil was analyzed and optimum levels of phosphorus, very low levels of nitrogen and potassium were recorded (FRG 2012). Cowdung, urea, MP, gypsum and boric acid were applied at basal amount during final land preparation. The experiment was laid out in randomized complete block design (RCBD) with four replications. The unit plot size was 1.2 m × 0.7 m. Seeds collected from BARI, Joydebpur, Gazipur were sown on 10th December, 2015 in rows having a gap of 40 cm. Plants in rows were maintained 15 cm apart by thinning seedlings at 15 days after sowing (DAS). Intercultural operations were done as and when necessary. The five foliar treatments tested against chickpea cv. BARI Chola-7 were as follows: $T_0$ = water spray (control); $T_1$ = 10 ppm TIBA; $T_2$ = 20 ppm TIBA, $T_3$ = 30 ppm TIBA and $T_4$ = 40 ppm TIBA. The foliar sprays were done at 45 DAS by using separate sprayers. Data of different parameters were recorded from 12 plants selected at random for each treatment at 45, 66, 83, 97 and 110 DAS as corresponding stages of flower initiation, flowering, pod setting, pod filling and maturity, respectively. Leaf area (LA) was measured by length width method according to Wilson and Tear (1972). LAI, RGR and NAR were calculated using the formula of Williams (1946). CGR was calculated following the formula of Watson (1958). LAD was calculated by the formula as suggested by Power *et al*. (1967) further modified by Kvet *et al*. (1971). Data were analyzed statistically and treatment means were compared by LSD test at the 5% level of significance (Steel *et al*. 1997).

## RESULTS AND DISCUSSION

Leaf area index (LAI) of chickpea with different doses of TIBA showed substantial differences over the growth ages (Fig. 1). At 66 DAS, LAI increased due to all the treatments from control. At 83 and 97 DAS, LAI continued to increase over the control only due to $T_3$ and $T_4$ treatments. However, at maturity (110 DAS), LAI increased due to all the treatments and the maximum was recorded from plants of $T_3$ treatment. Due to the fact that the senescence of leaves was greater in control plants. Throughout flowering stage to maturity (66 - 110 DAS), maximum LAI were retained due to 30 ppm TIBA ($T_3$)

application and the increases were 12.95, 4.45, 2.14 and 31.42%, respectively over the control. Peak LAI was recorded at the time of flowering stage (66 DAS). The increased LAI due to 30 ppm TIBA application might be due to increased number of leaves and vigorous growth of the plants. Similar increase in LAI following chemical application of growth-retarding chemical was also reported by Prakash *et al.* (2003) in black gram and by Ramesh and Ramprasad (2013) in soybean. Jeyakumar and Thangaraj (1996) reported decreased LAI due to mepiquat chloride in groundnut.

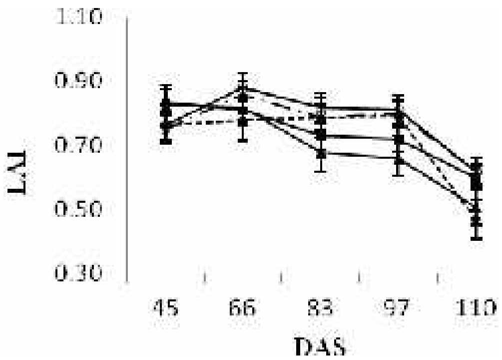


Fig. 1. Effect of TIBA on leaf area index of BARI Chola-7 at different days after sowing (mean ± SE).

The LAD is a useful concept not only in depicting the efficiency of photosynthetic system but also in showing a linear relationship with dry matter accumulation (Chetti and Shirohi 1995). Findings of this experiment revealed that LAD was higher at earlier stage and decreased thereafter irrespective of treatments in the subsequent stages (Fig. 2).

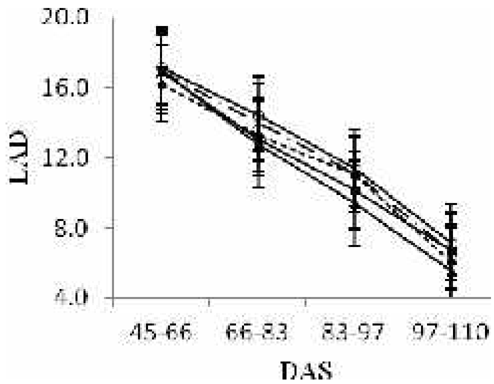


Fig. 2. Effect of TIBA on leaf area duration of BARI Chola-7 at different days after sowing (mean ± SE).

In all the growth ages, maximum values (17.16, 14.47, 11.42 and 7.17) of LAD were recorded due to 30 ppm TIBA application, though it varied non-significantly. Plants treated with 20 ppm TIBA resulted in minimum LAD from flowering stage to maturity (66 - 110 DAS). Comparable values of LAD over control plants following application of growth regulator was also reported in chickpea by Karim and Fattah (2007). Saishankar (2001) reported that application of miraculan had stimulatory effect on LAD in green gram. Islam and Jahan (2016) obtained increased LAD with NAA application in wheat.

CGR is an important index of agricultural productivity and depicts the daily average increment in biomass production. Fig. 3 shows that except CGR of control plants which reached peak at 66 - 83 DAS, CGR of plants due to other treatments increased progressively reaching peak at pod setting to pod filling stage (83 - 97 DAS) and then declined till maturity (97 - 110 DAS). Maximum values of CGR at 66-83 DAS (1.667 g/$m^2$/day) and 83-97 DAS (1.933 g/$m^2$/day) were recorded due to 30 ppm TIBA. The increase in CGR due to application of TIBA might be due to the result of increase in dry matter production with time course. Similar increase in CGR following mepiquat chloride was recorded by Reddy (2005) in cowpea. Rahman *et al*. (2004) reported increased CGR due to maleic hydrazide in soybean.

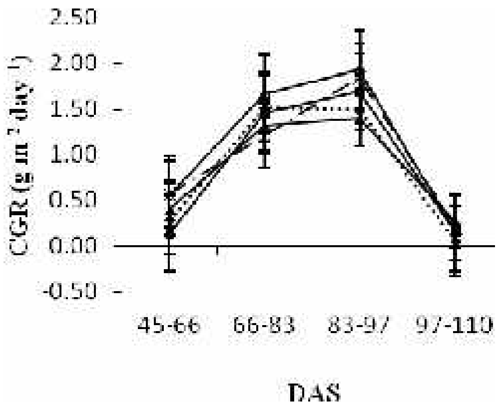


Fig. 3. Effect of TIBA on crop growth rate (g/m/day) of BARI Chola-7 at different days after sowing (mean ± SE).

RGR was more at early stages (45 - 66 DAS) except $T_1$ and $T_2$ treatments and regardless of the treatments showed a decreasing trend with the advancement of plant age (Fig. 4). The decrease in RGR was probably due to the increase in metabolically active tissue, which contributed less to the plant growth. It has also been suggested that the decrease in RGR could be attributed to the shading of the lower leaves by upper leaves (Thorne 1961). At 45 - 66 DAS, the highest RGR (0.073 g/g/day) was obtained from plants treated with 30 ppm TIBA but it was significantly not different from $T_0$, $T_2$ and $T_4$ treatments. At 66 - 83 and 83 - 97 DAS, maximum values of RGR (0.068 and 0.028 g/g/day, respectively) were recorded from plants receiving 10 ppm TIBA and the minimum values were recorded from control plants. Reddy (2005) reported increased

RGR over control due to mepiquat chloride application in cowpea. Ramesh and Ramprasad (2013) also reported higher RGR compared to control following mepiquat chloride and chlormequat chloride application in soybean.

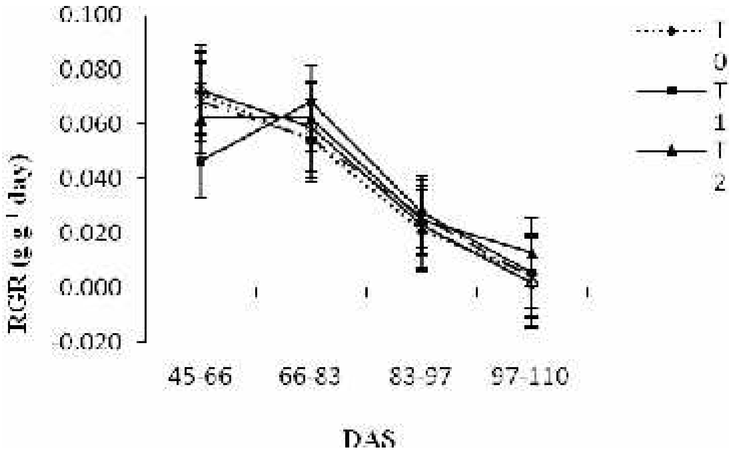


Fig. 4. Effect of TIBA on relative growth rate (g/g/day/) of BARI Chola-7 at different days after sowing (mean ± SE).

NAR represents the dry matter production per unit assimilated area per unit time and is the most important index of mean photosynthetic efficiency of a crop under a particular environment (Clawson *et al*. 1986). Results revealed that regardless of the treatments, NAR increased progressively reaching peak during 66 - 83 DAS and thereafter declined till maturity (Fig. 5).

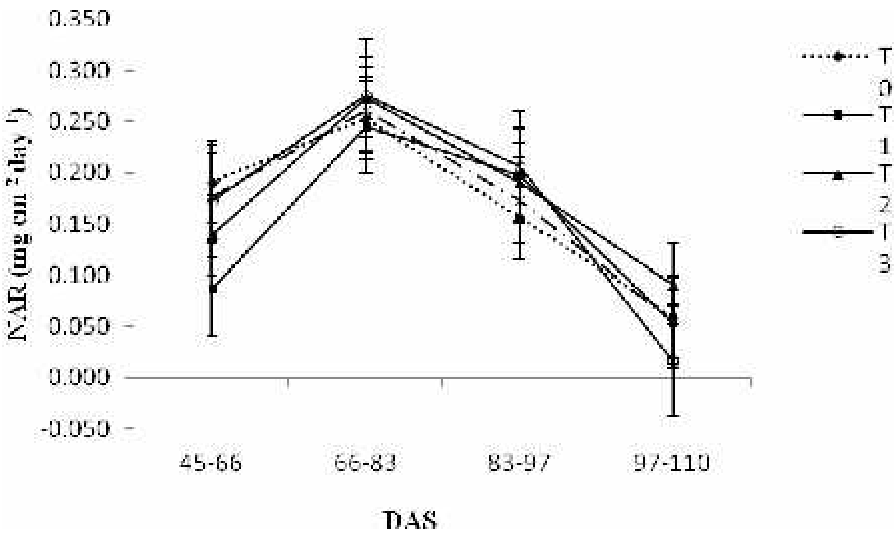


Fig. 5. Effect of TIBA on net assimilation rate (mg/cm$^2$/day) of BARI Chola-7 at different days after sowing (mean ± SE).

The decrease in NAR at later stages of growth could be attributed to shading of lower leaves and increase in the number of older leaves which lost photosynthetic efficiency (Pandey *et al*. 1978). At early stage (45 - 66 DAS), significantly higher NAR was recorded from control plants. However, maximum values of NAR at 66 - 83 (0.276 mg/cm$^2$/day) and 83 - 97 DAS (0.207 mg/cm$^2$/day) were recorded due to 30 ppm TIBA application but varied non-significantly. Due to 30 ppm TIBA, at 66 - 83 and 83-97 DAS, the increases in NAR were 9.09 and 32.69% over the control. Increase in NAR from flowering to pod filling stage might be related to the increased sink demand and pod photosynthesis (Pandey and Sing 1980). Rahman *et al*. (2004) reported increased NAR with maleic hydrazide application in soybean. Increase and decrease in NAR following CCC were reported by Ashraf *et al*. (1987) in rai, by Chandra *et al*. (1989) and also Anamika and Deka (2003) in pea.

Results obtained indicated that TIBA had both stimulatory and inhibitory effects on different growth parameters of plants. Results further indicated that 30 ppm TIBA if sprayed on chickpea plants at first flowering stage (45 DAS) could be positively effective for growth and development of plants with higher values of physiological characteristics.

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