



TIBA INDUCED MORPHOLOGICAL AND ROOT ANATOMICAL CHANGES IN LENTIL

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ABSTRACT

A field experiment was conducted to evaluate the effect of 2,3,5-triiodobenzoic acid (TIBA) at 0, 10, 20, 30 and 40 ppm on the morphological and root anatomical changes of lentil (*Lens culinaris* Medik. cv. BARI Mosur-7). Foliarly applied TIBA decreased plant height significantly with the increasing concentrations of TIBA. Significantly maximum number of branches and leaves per plant were recorded due to 10 ppm TIBA treatment. Leaves were darker green in plants receiving 10 ppm TIBA due to high chl-a, -b and low carotenoid contents compared to control. Ten ppm TIBA increased root length significantly and root diameter non-significantly than the control plants. Root diameter in plants treated with 10 ppm TIBA increased due to the increase in the width of the cortex, decrease in vessel diameter and enhancement of the formation of more secondary xylem vessels.

Keywords: BARI Mosur-7, TIBA, Foliar application, Growth, Anatomy

INTRODUCTION

Among the synthetic plant growth regulators, TIBA, a polar auxin transport inhibitor is widely used. It antagonizes and may completely negate the effect of IAA. However, at low concentration TIBA has weak auxin effects. Therefore, depending on the plant species and the concentration applied, TIBA may either stimulate or inhibit plant growth as such affecting morphological and anatomical modifications.

Physiological modifications as well as improved yield and yield attributes caused by TIBA are available in various economically important crop plants viz., soybean (Jahan and Khan, 2014), rice (Adam and Islam, 2015), tomato (Mondal and Dutta, 2002), mungbean (Adam and Jahan, 2014) and chickpea (Islam and Jahan, 2016). While the effects of TIBA on the external appearance of plants are well known, limited information is available as to its effects upon the internal structure (Kroll and Moore, 1981).

Lentil (*Lens culinaris* Medik.) is a small legume and its seed is the second most important pulse crop in Bangladesh. The present investigation was undertaken to study the effects of TIBA on

the morphological and root anatomical changes of lentil.

MATERIALS AND METHODS

A field experiment was carried out at the research field of the Department of Botany, University of Dhaka during Rabi (November-March) season of 2017-2018. Seeds of BARI Mosur-7 were collected from BARI (Bangladesh Agricultural Research Institute), Joydebpur, Gazipur. The experimental soil was analyzed and low levels of potassium and very low levels of nitrogen and phosphorus were recorded (FRG, 2012). Cowdung, urea, TSP and MoP 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 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. Five foliar treatments viz., water spray (control), 10, 20, 30 and 40 ppm TIBA were tested against lentil var. BARI Mosur-7. The foliar spray was done at 45

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days after sowing by using separate sprayers. Three weeks after treatment, control plants and TIBA treated plants were collected. Data on length of stem and root, number of branches and leaves per plant, stem and root diameter were recorded. The plants were preserved in FAA (formalin-aceticacid-alcohol) solution for anatomical study. Free hand cross sections of root were taken and stained in safranin. Root sections were taken 0.5 cm below the root collar. Photomicrograph of the stained specimens were taken using Trinocular Res. Microscope with digital camera system (Axiocam ERc 5s, Zeiss, Germany). Crude leaf chlorophyll extracts were made using 80% acetone. Spectrophotometer (UV-1800, Shimadzu) readings were recorded at 663, 645, 440.5 nm and the concentrations of chlorophyll-a and -b were determined by using specific absorption coefficients of MacKinney (1941). The amount of carotenoid was determined by the equation of Von Wettstein (1957). The data were compiled and subjected to statistical analysis and treatment means were

compared for significance by using statistical program software 'R' at 5 % level of probability.

RESULTS AND DISCUSSION

Results presented in Table 1 and Fig. 1 revealed that TIBA treated plants resulted in shorter and thinner stems compared to the control plants. With the increasing concentrations, there was decrease in plant height. Significantly tallest plant was obtained from control and it was statistically at par with 10 ppm TIBA treated plants. The shortest plant resulted from 40 ppm TIBA treatment. Stem diameter was also reduced except in the plants treated with 10 ppm TIBA where the diameter increased by 8.70% over the control. 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). Tsegaw *et al.* (2005) reported thicker stems due to growth retardant PBZ.

Table 1. Effects of TIBA on leaf, stem and root characteristics of BARI Mosur-7.

Plant parts	Control		TIBA treatments			LSD (0.05)	CV (%)
	(ppm)		(ppm)				
	0	10	20	30	40		
Leaf							
No. of leaves per plant	33.75 ab	36.08 a	32.17 a-d	26.75 e	33.00 abc	5.10	13.66
Chlorophyll a (mg g ⁻¹ fresh weight)	1.03	1.06	0.85	0.84	0.93	NS	22.30
Chlorophyll b (mg g ⁻¹ fresh weight)	0.61	0.64	0.49	0.47	0.52	NS	23.14
Carotenoids (mg g ⁻¹ fresh weight)	2.61	2.57	3.85	4.86	5.05	NS	41.33
Stem							
Stem length (cm)	34.83 a	32.83 ab	30.34 bc	27.50 d	25.34 d	2.72	12.88
No. of branches per plant	15.92 abc	16.46 a	15.50 a-d	13.67 e	16.00 ab	1.62	8.97
Stem diameter (mm)	0.23±0.07	0.25±0.11	0.20±0.07	0.20±0.07	0.18±0.08	NS	43.42
Root							
Root length (cm)	5.60 d	10.08 a	4.93 e	9.73 b	6.88 c	0.16	29.09
Root diameter (mm)	0.23±0.08	0.25±0.11	0.20±0.07	0.21±0.07	0.20±0.07	NS	40.36
Root vessel diameter (µm)	38.75±18.50	33.75±12.93	42.50±5.59	38.75±9.60	36.25±11.39	NS	34.25

*Means in a horizontal row followed by same letter do not differ significantly at 5 % level

*Values after ± indicates standard deviation

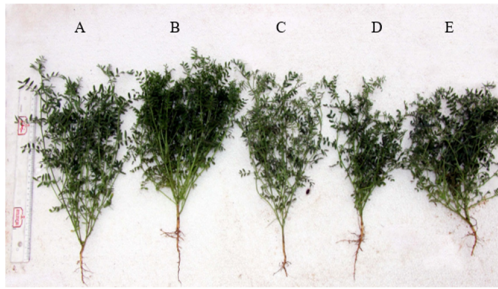


Fig. 1. Lentil plant height reductions in response to TIBA treatments. A (control), B (10 ppm), C (20 ppm), D (30 ppm) and E (40 ppm).

Number of branches and leaves per plant showed both increase and decrease due to TIBA treatments over and from the control. (Table 1). The maximum number of branches (16.46) and leaves (36.08) per plant were recorded from 10 ppm TIBA though it was statistically identical with control, 20 and 40 ppm TIBA treatments. Significantly lowest number of branches and leaves per plant were obtained due to 30 ppm TIBA treatment. Increase in number of branches and leaves 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 among treated plants, plants receiving 10 ppm TIBA had the darker green leaves compared to the control plants (Table 1). The darker green leaves resulted due to high chlorophyll-a (1.06 mg g^{-1} fresh weight), -b (0.64 mg g^{-1} fresh weight) and low carotenoid (2.57 mg g^{-1} fresh weight) contents. Due to 10 ppm TIBA, chlorophyll-a and -b increased by 2.91 and 4.92%, respectively over the control and carotenoid content decreased by 1.53% from the control. However, leaf pigments varied non-significantly among the treatments. Similar results of increase and decrease in leaf pigments due to TIBA treatment have been reported in soybean (Jahan and Khan, 2014). This result is also in agreement with the findings of Tsegaw *et al.* (2005).

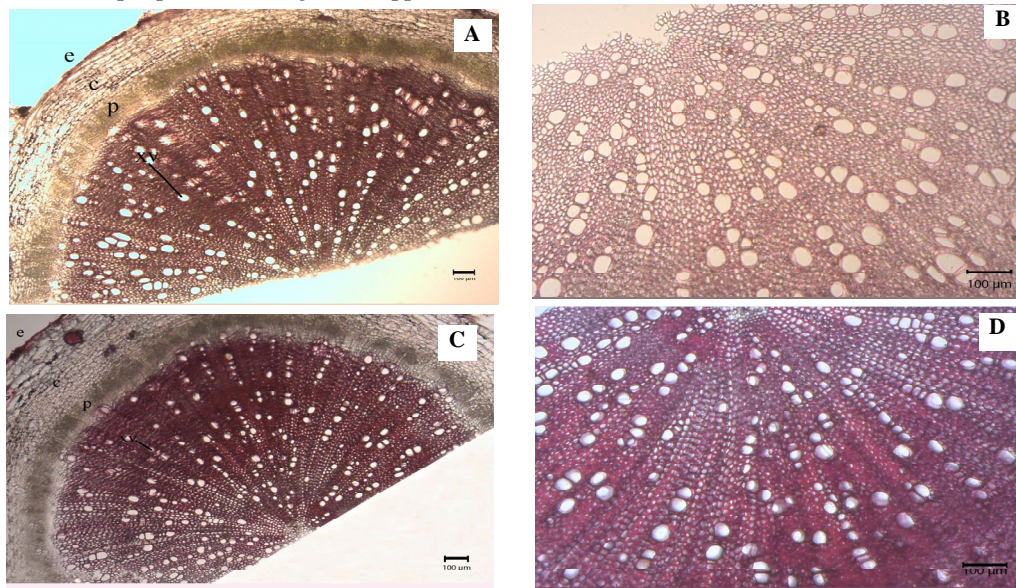


Fig. 2. Transverse section of root of the control (A, B) and TIBA treated plants (C-D, E-F, G-H and I-J at 10, 20, 30 and 40 ppm, respectively) of *Lens culinaris* Medik. cv. BARI Mosur-7. e = epidermis, c = cortex, p = phloem and xv = xylem vessel. A, C, E, G and I (50× magnification); B, D, F, H and J (100× magnification).

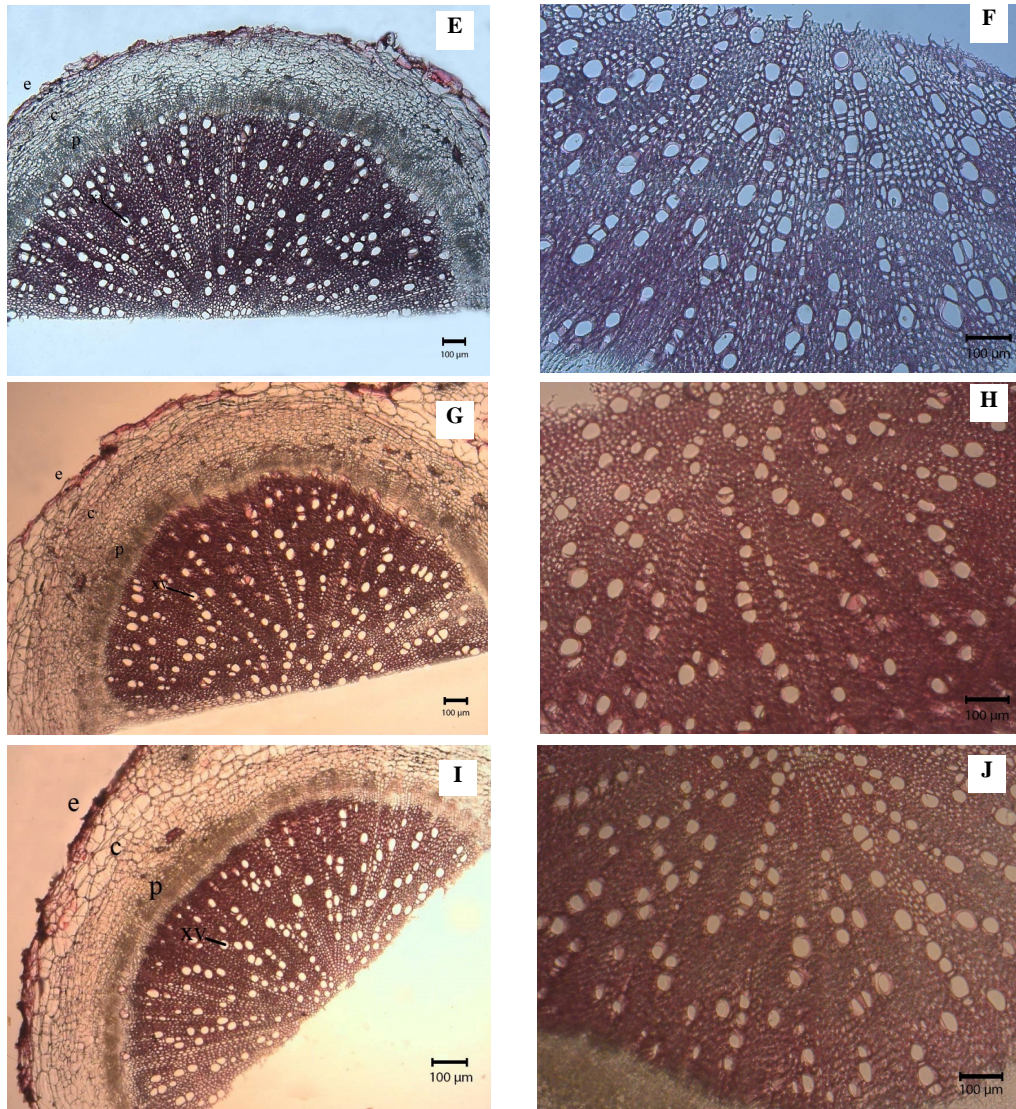


Fig. 2. (contd.)

Root length and root diameter were affected in response to TIBA treatments (Table 1 and Fig. 1). Except in plants receiving 20 ppm TIBA, root length increased significantly in all the treatments compared to control. The maximum root length (10.08 cm) was recorded from 10 ppm TIBA treated plants. Whereas, the only increase in root diameter was found due to 10 ppm TIBA and the diameter

(0.25 ± 0.11 mm) increased by 8.70% over the control. Porlingis and Koukourikou-Petridou (1996) reported stimulatory effect of similar growth retarding chemical PBZ on root growth in mungbean.

The most significant changes that occurred due to 10 ppm TIBA in root was in the cortex and in the number and size of the vessels in root (Fig. 2).

10 ppm TIBA decreased xylem vessels diameter ($33.75 \pm 12.93 \mu\text{m}$) but increased both the width of the cortex and the number of secondary xylem vessels in root was recorded due to 30 ppm TIBA treated plants followed by plants treated with 0 (control), 30, 40 and 10 ppm, respectively. The lowest number of secondary xylem vessels in root was recorded due to 30 ppm TIBA. Increased root diameter has been correlated with larger cortical parenchyma cells in soybean and maize (Barnes *et al.* 1989). Increasing root diameter in chrysanthemum may be due to an increase in the number of rows and diameter of cortical cells (Burrows *et al.* 1992). Tsegaw *et al.* (2005) reported increase in the number of secondary xylem vessels and 52% increase in root thickness following growth retardant application. Krause (1971) reported production of small vessels in soybean following TIBA application.

Galston (1947) suggested that TIBA antagonizes and may completely negate the effect of IAA. It may do this by competing for a carrier or by accelerating the destruction of IAA. Kamien and Skoog (1956) and Hay (1956) concluded that low concentrations of TIBA primarily affected the polarity of auxin, rather than the destruction of it. Aberg (1953) indicated that at high concentration, TIBA antagonized the effect of externally applied auxin and apparently also the natural auxin and caused a growth inhibition. However, at low amounts TIBA had weak auxin effects which might be due to a synergistic action upon residual amounts of the native auxin. Therefore, depending on the plant species and the concentration applied, TIBA may either stimulate or inhibit plant growth and as such affecting morphological and anatomical modifications. The study confirms that the effect of TIBA on the induction of morphological and anatomical changes may be mediated by changing the hormonal balance of the plant. Of all the five treatments, application of TIBA at 10 ppm showed positive stimulations.

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