Indian Journal of Plant Sciences ISSN: 2319–3824(Online)
An Open Access, Online International Journal Available at http://www.cibtech.org/jps.htm
2017 Vol.6 (4) October-December, pp. 41-43/Sealy and Lucas
Research Article

THE EFFECT OF GIBBERELLIC ACID (GA_3) ON THE GROWTH OF TOMATO PLANTS (*LYCOPERSICUM ESCULENTUM* MILL.)

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ABSTRACT
Tomato seedlings (*Lycopersicum esculentum* Mill) were planted in Miracle Grow potted mix in a Growlab at room temperature range (25-30^{0}C). The photoperiod for the seedlings was 18h with cool white fluorescent lights. Miracle grow all- purpose plant food was added to the plants after planting and there after every 4 weeks. The Miracle grow used was one teaspoon per gallon of water. Gibberellic acid was added 100 ppm after one week of planting in a watery solution. The plants were watered daily through a filtered water system to keep the soil moist. The plant food and the gibberellic acid were also added through the filtered water system. After 4 weeks small root hairs appeared on the apical stems of the tomato plants. After 8 weeks apical root hairs on the tomato stems had reached lengths of over 4 inches. At the end of 8 weeks tomato stems were between 24.2 and 37.2 inches long. There was no budding or flowering in the apical regions. These results suggest that gibberellic acid had an effect on stem elongation and the formation of apical root hairs. The reasons for the growth of apical root hairs were not determined.

Keywords: *Seedlings, Gibberellic Acid, Root Hairs*

INTRODUCTION
Gibberellins are a large group of related compounds (more than 125) that are defined by their chemical structure rather than their biological activity (Gibberellins, 2015). Scientists in Tokyo, Japan, isolated three gibberellins from an original plant extract containing Gibberellin A and proved that Gibberellic acid and GA_3 were identical. Gibberellic acid is known to stimulate elongation growth and fruit set (Gibberellins, 2015). Gibberellin when applied to tomato plants are known to induce marked stem elongation, to increase fresh weight, to accelerate flowering and produce greater numbers of flowers per plant and to increase fruit set (Bukovac and Wittwer, 1956; Rappaport, 1956; Wittwer and Bukovac, 1957).
Some plants assume a rosette form in short days and undergo shoot (stem) elongation and flowering only in long days. Gibberellin application results in bolting (stem growth) in plants keep in short days. This research investigated the growth of tomato plants in an 8 week period with a one- time application of Gibberellic acid, a 4 weekly supply of fertilizer and daily watering.

Procedure
12 tomato seedlings (Lycopericum esculentum, Mill.), obtained from Bonnie Nursery (solar fire-heat tolerant hybrid), were grown in three containers in a Growlab chamber at Lynn University, Boca Raton, FL 33431, U.S.A. The chamber was closed and watered daily to keep the Miracle grow potting mix moist. The plants were fertilized after planting and subsequently there-after 4 weekly intervals were used. The fertilizer used was Miracle grow all- purpose plant food in a concentration of one teaspoon per gallon of water.
The plant hormone, Gibberellic acid (Chemsavers: Gibberellic acid 90.77% A 3 Basis, Model: 52258) was added to the plants after one week of planting in a watery solution of 100 ppm (gibberellic acid). The tomato plants were grown in room temperature range 25-30^{0}C.
The addition of Miracle grow plant food, gibberellic acid and daily watering was done through a filtered water system. The tomato plants received lighting for 18h each day (photoperiod) with 40 watt cool white florescent bulbs (Philips 4ft. 40 watt T12 Cool white Supreme linear fluorescent ALTO). The tomato plants were grown for 8 weeks.

RESULTS AND DISCUSSION

Results

Table 1: The Length of Stems of Tomato Plants Grown with Gibberellic Acid after 8 Weeks

Plant	Length of Stem
A	32.4 inches
B	29.3 inches
C	Dead Plant
D	33.5 inches
E	28.2 inches
F	Dead Plant
G	37.2 inches
H	34.6 inches
I	35.4 inches
J	24.2 inches
K	27.3 inches
L	26.4 inches

Average length of Stems: 26.5 inches

Figure 1: Growlab Chamber with Tomato Plants after 4 Weeks

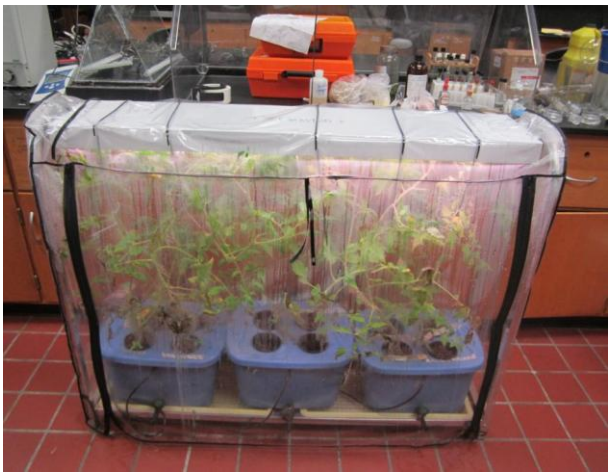

Figure 2: Growlab Chamber with Tomato Plants after 8 Weeks

Figure 3: Tomato Plants Showing the Growth of Root Hairs on the Stems after 8 Weeks

Figure 4: Root Hairs on a Single Tomato Plant Stem after 8 Weeks

Discussion

Table 1 shows the lengths of the stems of tomato plants after 8 weeks. The lengths of the tomato stems ranged from 24.2 inches to 37.2 inches. Two of the twelve tomato seedlings died during the process and the average length of the tomato stems was 26.5 inches. The stems were long and slender and this is not a new phenomenon with gibberellic acid (Paleg, 1965).

Figures 1, 2, 3, and 4 showed the observed growth of the tomato seedlings in the Growlab chamber. Figure 1 shows that there was no significant growth of root hairs on the stems of the tomato plants after 4 weeks and that two plants were already dead. Figures 2 and 3 show the presence of root hairs on the tomato plant stems which range in length from ½ inch to over 4 inches in the apical region of the tomato plant stem. Figure 4 shows the magnitude of root hair development on a single tomato plant stem.

Our observations revealed that there was no flowering or fruit set on the tomato plants after 8 weeks. This is unusual since gibberellins are known to induce early flowering and fruit set (Fos *et al.*, 2000; Fos *et al.*, 2001; Wittwer and Bukovac, 1957; Riley, 2015; Serrani *et al.*, 2007). The phenomenon of root hair development in tomato plants treated with gibberellic acid is new. Root hair or root development is usually associated with auxins (Biksa, 2015). The reason for the growth of root hairs on apical stems of the tomato plants could not be determined because plant extracts from these regions were not analyzed for the presence of auxins. Also there might have been auxin associated with the gibberellic acid as an impurity. Again this was not analyzed. Alternatively, this behavior might be specific for Gibberellic acid treated seedlings at 100ppm (gibberellic acid) in a watery solution. However, it is known that in tissue culture gibberellic acid enhances the growth of roots when supplied to a nutrient media at a concentration of 2ppm (El Hinnawy, 1973). Gibberellic acid was also found to prevent the formation of roots in grape layer cuttings at concentrations of 50, 100, 200, and 400 ppm (Eris and Celik, 1981).

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