International Journal of Natural and Engineering Sciences 3 (1): 95-98, 2009
ISSN: 1307-1149, www.nobel.gen.tr

Effects of Foliar Gibberellic Acid Applications on Vegetative Growth of Pear, Apple and Cherry Seedlings

Fatih Ali CANLI[1] Hikmet ORHAN[2]

[1] Department of Horticulture, Faculty of Agriculture, Suleyman Demirel University, 32260, Isparta, Turkey

Corresponding Author
e-mail: canlifat@ziraat.sdu.edu.tr

Received: August 9, 2008
Accepted: December 25, 2008

Abstract

The objective of the study was to see whether the growths of pear (*Pyrus comminus*), apple (*Malus domestica*) and cherry (*Prunus avium*) seedlings could be expedited with the applications of gibberellic acid (GA_3). The apple and pear seedlings growing in open field or under low plastic tunnels were sprayed ones or twice with different levels (0, 200, and 400 ppm) of GA_3. The cherry seedlings growing in open field were also subjected to the same GA_3 treatments. The treated seedlings were evaluated in terms of seedling diameter and length at the end of the growing season. GA_3 sprays significantly increased lengths of pear and cherry seedlings. The effects of plastic covering on seedling diameter and length were both significant for pear and cherry seedlings. None of the treatments yielded plants with higher lengths and larger diameters as compared to control in apple seedlings. The pear seedlings grown under plastic tunnel were significantly taller and ticker than the ones growing in the open field. Maximum plant height (38.11 cm) and stem thickness (6.6 mm) in pear seedlings were obtained with 2 x 400 ppm GA_3 and with 1 x 400 ppm GA_3 applications in combination with plastic tunnelling, respectively, while minimum values for the mentioned parameters were observed in control. The highest length (39.7 cm) was recorded in cherry seedlings treated with 1 x 400 ppm GA_3 applications, but all GA_3 applications resulted in reduced stem thickness in cherry seedlings. No treatments yielded seedlings that could be grafted in the late fall of the same season.

Key Words: GA_3, nursery plant, PGR, vegetative growth

INTRODUCTION

Most temperate zone fruits are propagated commercially by grafting desirable cultivars on seedlings of wild types. The use of rootstocks may be favourable due to several reasons such as resistance to soil born diseases, better performance of specific rootstocks on certain soil types and the efficiency of some crops on specific rootstocks. However, seedlings of many temperate zone fruits grow very slow in nurseries and nursery growers have to wait for a very long time to bring them to marketable sizes.

Plant growth regulators (PGRs) have important roles in plant development, growth and regulation. The major types of plant bio-regulators are auxins, gibberellins, cytokinins, abscisic acid, and ethylene. Among these, the gibberellins are known to promote stem growth dramatically by increasing the cell division and enlargement. There are about 110 known gibberellins, customarily abbreviated to GA. Most of the GAs produced by plants is inactive and most likely functioning as precursors to active ones [1-3]. The use of GA to advance the growth and development of plant species is very old and well documented [1- 10]. Ferguson et [11] reported that GA_{4+7} increased the plant height in orange seedlings. Likewise, Wang et al. (2002) reported that application GA induced stem longitudinal growth in *Pinus sylvestris* seedlings. Increased plant heights were also obtained in lime trees [12] and loquat seedlings [4] by external GA applications.

Air temperature is also a main factor effecting plant growth and development. Most plants require a range of optimum temperature to perform well, and low temperature is one of the most limiting factors inhibiting plant growth and development [13]. The combination of optimum temperature and external GA applications may play an important role in the hastening of plant growth and development.

Keeping in view the role of GA and temperature in plant development, this study was carried out to see whether enhanced growth could be attained with the use of these two, i.e. GA and plastic tunnelling and to see whether seedlings could be brought to grafting size in shortest possible time.

MATERIALS AND METHODS

Plant material

These experiments were carried out in 1992 using pear, apple and cherry seedlings growing under standard nursery care in Egirdir Horticultural Research Station. In the fall of 1991, apple, pear and cherry seeds were sown on six-row beds; three rows 15 cm apart, a 30 cm space and three more rows 15 cm apart. Most of the newly emerging seedlings were pulled off and discarded in June so that seedlings were spaced 10 cm apart in rows. The seedling beds were irrigated by wild irrigation every fifteen days. The apple and pear seedlings that were given plastic covering treatment were covered on April 1st and the plastic covering was gradually removed by the end of the June.

GA_3 sprays and data collection

Newly growing seedlings of the spring were treated ones or twice with one of three concentrations of GA_3 (0, 200, or 400 ppm, AgroGib). In apple and pear, first GA_3 foliar sprays were carried out on June 10, 1992, and second GA_3 sprays were given on June 22, 1992. Cherry seedlings were sprayed with GA_3 on June 26 and then again on July 11, 1992. GA_3 was dissolved in 95 % ethanol and then brought to final concentration using tap water. The control seedlings were being treated with tap water only.

Data on seedling diameter and length were collected on November 17, 1992 using a calliper.

Experimental design and statistical analysis

All experiments were conducted in a complete randomized design. Each treatment had 3 replications and each replication had 10 seedlings. Data were analyzed by analyses of the variance (ANOVA) with mean separation by SNK using SAS software Version 9.1.

RESULTS AND DISCUSSION

In the low plastic tunnel, the length of apple and pear seedlings were about twice open air seedlings at the beginning of the season. Upon removal of the plastic tunnel, the differences in the sizes of two groups become unnoticeable visually.

In pear, when the effects of GA_3 sprays were evaluated separately for seedlings grown under plastic tunnel and seedlings grown in the open field, the effects GA_3 sprays on diameter were significant in both of the conditions (Table 1). In the open field, the seedlings from one time 200 ppm GA_3 application treatment had slightly larger diameter than the control (Table 1). For the seedlings growing under plastic protection, all GA_3 applications yielded seedlings with larger diameters as compared to control, excluding two times 200 ppm GA_3 application (Table 1). Overall, the stem thickness of pear seedlings was significantly affected by GA treatments. Similar results were reported by Boes and Hamner [14] and Ferguson et al. [11], where gibberellic acid sprays increased stem thickness.

When the growing conditions were disregarded and all treatments were compared together, seedlings growing under plastic cover had slightly wider diameters than the seedlings growing in the open air (Table 1).

The effects of GA_3 spray on length were significant for the seedlings of the both growing conditions. Increasing GA_3 spray from one time to two times significantly increased the seedling lengths for pear seedlings when seedlings were grown in the open air. (Table 1). Similar results were also observed in the seedlings growing under plastic cover (Table 1).

Table 1. Influence of Gibberellic acid applications and low plastic tunnelling on vegetative growth of pear (*Pyrus communis*) seedling (n = 30)

GA_3 treatments (ppm)	Diameter (mm)	Diameter comparisons among all treatments	Length (cm)	Length comparisons among all treatments
Open Field				
Control	3.83 b*	d	12.86 d	e
1x200	4.90 a	cd	19.86 c	d
2x200	4.56 ab	cd	28.30 b	c
1x400	4.23 ab	cd	20.77 c	d
2x400	4.46 ab	cd	31.80 a	bc
Tunnel				
Control	5.20 b	bc	17.14 c	de
1x200	6.23 a	ab	26.69 b	c
2x200	5.96 ab	ab	37.18 a	ab
1x400	6.60 a	a	31.29 ab	bc
2x400	6.10 a	ab	38.11 a	a

* Diameter comparisons within open field and within tunnel; means following the different letters in the same column differ significantly at P=0.05 probability by SNK.

In apple, there was no significant difference among treatments with respect to seedling diameter (Table 2). GA_3 sprays significantly effected seedling length regardless of the growing conditions (Table 2). The lowest seedling lengths were obtained from one time spray of 200 ppm GA_3 in open air and from one time sprays of 200 or 400 ppm GA_3 under protected cover (Table 2).

Table 2. Influence of Gibberellic acid applications and low plastic tunnelling on vegetative growth of apple (*Malus domestica*) seedlings (n = 30)

GA_3 treatments (ppm)	Diameter (mm)	Diameter comparisons among all treatments	Length (cm)	Length comparisons among all treatments
Open Field				
Control	4.83 a*	a	44.39 ab	a
1x200	4.53 a	a	39.46 b	ab
2x200	4.36 a	a	49.92 a	a
1x400	4.53 a	a	47.57 a	a
2x400	4.06 a	a	45.29 a	a
Tunnel				
Control	4.83 a	a	42.33 a	a
1x200	4.13 a	a	32.71 b	b
2x200	4.33 a	a	40.79 a	a
1x400	4.40 a	a	33.22 b	b
2x400	4.76 a	a	45.35 a	a

* Diameter comparisons within open field and within tunnel; means following the different letters in the same column differ significantly at *P*=0.05 probability by SNK.

In cherry, the effects of GA_3 on seedling diameter and seedling length were both significant (Table 3). Increasing GA_3 concentration from 200 to 400 ppm or increasing GA_3 spray from one application to two applications significantly reduced the seedling diameter of cherry seedlings (Table 3). The highest seedling length was obtained from cherry at 2x200 ppm GA_3 application (Table 3).

Table 3. Influence of Gibberellic acid applications on vegetative growth of cherry (*Prunus avium*) seedlings (n = 30)

Gibberellic acid concentrations (ppm)	Stem thickness (mm)	Seedling height (cm)
Control	5.37 a*	34.00 b
1x200	4.74 a	33.16 b
2x200	3.80 b	39.70 a
1x400	3.20 b	34.50 b
2x400	3.17 b	34.25 b

*Means following the different letters in the same column differ significantly at *P*=0.05 probability by SNK.

In the current study, the data recorded on plant height in pear and cherry seedlings showed that foliar GA_3 sprays significantly effected plant height. Our findings are in agreement with the findings in many other species [4-7, 11, 15]. The boosting effects of GA_3 on plant height were also reported by Mehrota and Dadwal [16], where foliar spray of gibberellic acid increased the plant height. Gul et al. [17] reported that maximum plant height and stem thickness were obtained in *Araucaria Heterophylla* seedlings that were treated with 300 ppm GA.

Feucht and Watson [1] reported that the improvement of the plant length was due to both increased number and length of cells, but the increase in internode length was primarily caused by cell elongation. However, the effect of foliar GA sprays on apple seedlings was not significant. This variation is probably caused by the fact that the effects of GA sprays on plant height was genotype dependent and further experiments are needed to be carried out to explore the effects of higher and lower GA_3 concentrations on apple seedlings.

The initial boosting in growth of apple and pear seedlings caused by low plastic tunnelling was lost by the advancement of the season. This was due probably to the problems associated with acclimatization; therefore plastic tunnelling was ineffective in increasing final sizes of the pear and apple seedlings. Although the growth of pear and cherry seedlings were promoted by foliar gibberellic acid applications, none of the seedlings reached the grafting size at the end of the season. Consequently, since thicker and taller pear seedlings can be marketed at a better price, foliar GA_3 sprays can only be recommended to the nurserymen for producing cost effective pear seedlings commercially.

REFERENCES

[1] Feucht JR, Watson DP. 1958. The effect of gibberellin on internodal tissues of *Phasiolus vulgaris* L. Amer. J. Bot. 45: 520-522.

[2] Kline JW. 1958 . Growth responses of gibberellin treated celery plants. Bot. Caz. 120: 122-124.

[3] Yermanos DM, Knowles PF. 1960. Effect of gibberellic acid treatment on safflower. Agron. J. 52: 596-598.

[4] El-Dengawy El-RFA. 2005. Promotion of seed germination and subsequent seedling growth of loquat (*Eriobotrya japonica*, Lindl) by moist-chilling and GA_3 applications. Sci. Hort. 105: 331-342.

[5] El-Din IS, Khalil, FA. 1987. Effect of gibberellic acid and chlormequat on growth of 'Coronaiki' olive seedlings. Annals of Agricultural Science, Ain Shams University. 32: 601-611.

[6] Wang Q, Little CHA, Sheng C, Odén PC, Pharis RP. 2002. Effect of exogenous gibberellin $A_{4/7}$ on tracheid production, longitudinal growth and the levels of indole-3-acetic acid and gibberellins A_4, A_7 and A_9 in the terminal shoot of *Pinus sylvestris* seedlings. Physiol. Plant. 86 : 202-208.

[7] Todic S, Tesic D, Beslic Z. 2005. The effect of certain exogenous growth regulators on quality of grafted grapevine rootlings. Plant Growth Reg. 45: 121-126

[8] Singh J. 1966 . Influence of gibberellic acid on vegetative growth and flowering of tomato. Science and Culture. 32: 104-107.

[9] Chang JI, Park YB. 1977. Effects of nursery periods in cold highland districts and gibberellic acid application on the prevention of dwarfing i.e. strawberry plants. J. Korean Society Hort. Sci. 18: 25-35.

[10] Abou-Zied EN , Bakry MY. 1978. The effects of gibberellic acid, CCC and B-9 upon growth , development and organic compounds in Primula obconica. Hort. Sci. 9: 175-180.

[11] Ferguson JJ, Avigne WT, Allen LH, Koch KE. 1987. Growth of CO_2-enriched sour orange seedlings treated with gibberellins/cytokinins. Proceedings of the Florida State Horticultural Society. 99: 37-39.

[12] Parsad A, Singh PV. 1980. Response of nitrogen and gibberellic acid to acid lime. Effect on growth fruiting and yield. Ind. J. Hort. 14: 348.

[13] Went FW. 1953. The Effect of Temperature on Plant Growth. Annual Review of Plant Physiol. 4: 347-362.

[14] Boes PC, Hamner CL. 1961. Effect of various concentrations of gibberellin on growth, flowers, fruit, mineral composition and mineral take-up of tomato plants. Ind. J. Agri. Sci. 31: 216-225.

[15] Mitruit T. 1981 . Application of Gibrescol in the production of trees of the sour cherry cultivar 'Lutowka' on mahalep (*Prunus mahalep* L.). Annales Universitatis Mariae Cruie-Sklodowska, E Agricultura 35: 351-161.

[16] Mehrota MD, Dadwal VS. 1978. Study of the effect of gibberellic acid , urea and Rallis Tracel on the growth of teak in the nursery. I. Enhancement of growth of seedlings to transplantable size in the same growing season - a veritable possibility. Indian Forester. 104: 706-713.

[17] Gul H, Khattak AM, Amin N. 2006. Accelerating the Growth of *Araucaria Heterophylla* Seedlings through Different Gibberellic Acid Concentrations and Nitrogen Levels. J. Agri.Biol.Sci.1:25-29.