

The Effects of *Pistacia terebinthus* Leaf Extracts and Giberellic Acid on Plant Height, Inflorescence Survival and Inflorescence Numbers of *Pelargonium* ‘Ringo Deep Scarlet’

Yahya BULUT

Atatürk University, Faculty of Agriculture, Department of Landscape Architecture, 25240 Erzurum, Turkey.

Ömer ATABEYOĞLU

Atatürk Üniversitesi Ziraat Fakültesi Peyzaj Mimarlığı Bölümü, 25240 Erzurum (atabey6@hotmail.com)

Şaban KORDALI

Atatürk University, Faculty of Agriculture, Department of Plant Protection, 25240 Erzurum, Turkey.

Geliş Tarihi : 26.02.2007

ABSTRACT : In this paper, the effects of petroleum ether, chloroform and ethyl alcohol extracts of *Pistacia terebinthus* leaves at 100 and 200 ppm doses and Giberellic Acid (GA₃), which is used commonly as plant-growth hormone were investigated on plant height, inflorescence survivor and numbers of *Pelargonium* ‘Ringo Deep Scarlet’. The applications of GA₃ and all extracts lengthened the inflorescence survivor of pelargonium in comparison to untreated control group. However, two doses of GA₃ significantly reduced the inflorescence numbers of pelargonium. Contrarily, 200 ppm doses of ethanol and petroleum ether extracts increased the inflorescence numbers. As expected, all doses of GA₃ significantly increased the plant height as compared with control group (p<0.01). However, all treated doses of ethanol extract of *P. terebinthus* showed the weak inhibitory effect on the plant height of pelargonium.

Keywords: Pelargonium, pictacia, leaf extract, GA₃, Allelopathy

INTRODUCTION

The chemical interactions that occur among living organisms including plants, insects and microorganisms are called allelopathy, and organic compounds involved in allelopathy are called allelochemicals. Allelopathy is defined as the direct or indirect harmful or beneficial effects of one plant on another through the production of chemical compounds that escape into the environment (Rice, 1984). The term allelopathy has traditionally been considered as only chemical warfare of one organism upon another to inhibit of the plant growth. Modern researches suggest that allelopathic chemicals could be both stimulative and inhibition effects on the growth of economically important plants. However, allelochemicals have various effects on the growth of plants depending on treatment dose of chemicals and plant species. Allelochemicals may negatively or positively influence other organism in to the environment (Coder, 1999). Furthermore, plants produce the allelochemicals in the stem, leaves, roots, flowers, inflorescence, fruits and seeds. Of these plant parts, leaves seem to be the most consistent producers of these allelochemicals (Lavabre, 1991).

The genus pelargonium comprises more than 250 species of perennial small shrubs which are limited in their naturally geographical distribution. About 80% of these species distribute to the southern parts of Africa (Van der Walt and Vorster, 1983). Some species are also found in eastern and south regions of Turkey and Middle East (Iraq, Iran). A

few species are endemic to Madagascar (Anon., 2000). Thousand of hybrid pelargonium types have been created from the original species to grown for the beauty of their flowers as a pot and bedding plants in the garden and urban parks.

Plant growth regulators are widely used in ornamental plant production to control the development of plant size, leaf shedding, growth cessation, seed germination and etc. (Hennessey and Dougherty, 1984). For instance, the injections of Giberellic acid (GA₃), which is a commercial plant growth regulator, to *Tulipa ‘Appedoorn’* reduced the duration of the glasshouse period, enhanced flower survival and flower length, and reduced stem length at flowering (Hanks, 1984). Welander (1984) reported that formation of axillary shoots and initiation of inflorescences and leaves in vegetative propagated *Pelargonium×hortorum* plants were promoted by an increase in quantum flux density, whereas application of Giberellic Acid (GA₃) had a negative effect. However, application of cycocell (CCC) caused an increase in numbers of axillary shoots, inflorescences and leaves of pelargonium. Monthly foliar spraying of GA₃ on geranium (*Pelargonium graveolens*) also resulted in an increase of plant height and herb production (Mohammed et al. 1983). Moreover, the application of GA₃ on hybrid geranium increased flower diameter and plant height (Armitage, 1986). Nakamura et al. (1994), examined the effects of GA₃ on weeping of the Japanese cherry, *Prunus*

spachiana. GA₃ changed the direction of branches during their growth. Oliveira and Browning (1993) reported that when applied to spurs of mature *Prunus avium* before floral initiation, gibberellins GA₁, GA₄ and GA₃ inhibited floral initiation by 9–17%, GA₇ by 43%, GA₃ by 65–71% and 2,2-dimethyl GA₄ by 78%. GA₉ and GA₂₀ were inactive. (Chang, Sung 2000), (Facteau, Rowe, Chestnut 1989), (Guardiola, Monerri, Agusti 1982) studied on this topic.

Pistacia species (Anacardaceae), possess wide distribution in the southern regions of Turkey, are grown in the urban parks. Hybride pelargonium is grown for the beauty of their flower as bedding plants in the nearest area of *Pistacia terebinthus* in the garden and urban parks. There are numerous reports on the allelopathic potentials of plants belonging to various genus on the growth of various economically important plants (Tawaha and Turk, 2003; Vandermast et.al., 2001; Watson, 2000; Rafiguel Hohoque et. al., 2003). However, the effects of allelochemicals obtained from plant species on ornamental plant are not sufficiently known. Thus, in this paper, we aimed to determine the effects of petroleum ether, chloroform and ethyl alcohol extracts of *P. terebinthus* leaves on inflorescence survival, inflorescence numbers and also plant height.

MATERIAL AND METHODS

Pistacia terebinthus L leaves were collected from the Fethiye region of Turkey in July, 2003. Petroleum ether, chloroform and ethyl alcohol extracts were individually obtained by maceration (3 x 10 ml) with the solvents from the dried leaves (each 25 g) of *P. terebinthus* with yields of 4.74, 7.12 and 12.88% (w/w), respectively. The extracts were then tested on the pelargonium 'Ringo Deep Scarlet' seedlings.

The seeds of *Pelargonium* 'Ringo Deep Scarlet' were provided from Sluis & Groot Company (Holland) and sown on 9 Feb 2004 under intermittent mist, containing 50 peat:50 perlite (v/v) medium. 4 weeks after seeding, the seedlings were transplanted to 10 cm plastic pots. The plants were fertilized with 200 ppm N, applying liquid fertilizer of 20N-4.5P-16.5K at each irrigation (Cox, 1991). Plants were grown in a glasshouse maintained at 22 ± 2° C during the day and 19 ± 2° C at night, in a thermostatically controlled, steam- heated greenhouse. When the plants had developed five to six expanded true leaves, 10 plants each were sprayed to run off (about 25 ml) with one of the following treatments (Armitage, 1986). For this purpose, 100 and 200 ppm doses of the petroleum ether, chloroform and ethyl

alcohol extracts of *P. terebinthus* and GA₃ were applied. The plants treated with only distilled water was used as control group. The experiments were randomized at three replicates per each treatment used 10 plants.

Vegetative plant height was measured from the surface of the growth medium to the uppermost leaf held parallel to growth medium surface on 14. October 2004 (Cox, 1991). Numbers of inflorescences (which included those with open flowers plus those with only visible buds) of each plant were counted from the first flower initiation to 14. October 2004. Inflorescence survival was measured from flower initiation to become pale of flowers.

In order to determine whether there are statistically significant difference among the obtained data, one-way variance analyses (ANOVA) were carried out using SPSS 9.0 software package and the means were separated by LSD multiple range tests. Values of p<0.01 were considered to be significantly different.

RESULTS

In the present study, the effects of *Pistacia terebinthus* leaf extracts and GA₃ at 100 and 200 ppm doses on plant height, inflorescence life on plants and inflorescence numbers of *Pelargonium* 'Ringo Deep Scarlet' were investigated. The results were given in Table 1. As shown in the table, the growth of pelargonium in terms of inflorescence survival, plant height, and numbers of inflorescences were significantly affected by the treatments of GA₃ and petroleum ether, chloroform and ethanol extracts of *P. terebinthus* leaves.

All treatments were significantly increased the inflorescence survival of the pelargonium as compared with control group (Table 1). The highest inflorescence survival was shown by the 200 ppm dose of GA₃ with 46.33 days. However, the most inflorescence survival was obtained for chloroform extract of *P. terebinthus* with 35.19 and 33.81 days for 100 and 200 ppm doses, respectively among the treated extracts. As shown in Table 3, plant height was expectedly increased by 200 and 100 ppm doses of GA₃, which is a commercial plant growth regulator with 61.33 and 57.00 cm, respectively. However, the treatments of two doses of ethanol extract and 100 ppm doses of petroleum ether extracts slightly decreased the plant height (27.00, 28.00 and 29.00 cm, respectively) of pelargonium in comparison to control group. In contrast to these treatments, 200 ppm dose of petroleum ether extract of *P. terebinthus* leaves were weakly increased the plant height.

Table 1. The effect of *Pistacia terebinthus* leaf extract and Giberellic Acid (GA₃) on vegetatif growth of *Pelargonium* ‘Ringo Deep Scarlet’.

Treatment	Concentration (ppm)	Inflorescence survival	Plant height (cm)	Inflorescence number (per plant)
<i>P. terebinthus</i> extracts				
Chloroform	100	35.19bc	32.67cd	4.14cd
	200	33.81bcd	32.00d	4.39bc
Ethanol	100	32.14cd	27.00e	4.30bcd
	200	31.00d	28.00e	5.24ab
Petroleum ether	100	30.57d	29.00de	4.24cd
	200	30.00d	36.00c	5.58a
Giberellic Acid (GA ₃)	100	36.71b	57.00b	3.42de
	200	46.33a	61.33a	2.86e
Control	-	20.95e	32.33cd	4.83abc

Means followed by different letters are significantly different in columns

The treatments of GA₃ at concentration significantly reduced the inflorescence numbers in comparison to control group (Table 1). However, the treatments of the extracts of *P. terebinthus* slightly reduced the inflorescence numbers except 200 ppm doses of ethanol and petroleum ether extracts of *P. terebinthus*. These treatments showed a significant increase in terms of inflorescence numbers with 5.24 and 5.58 numbers, respectively.

DISCUSSION

In this research, the effects of *P. terebinthus* leaf extracts and GA₃ at 100 and 200 ppm doses on plant height, inflorescence survival and inflorescence numbers of *Pelargonium* ‘Ringo Deep Scarlet’ were investigated. Inflorescence survival of pelargonium increased with GA₃ and extract applications. Moreover, treatments of all doses of GA₃ as well as 100 ppm dose of chloroform extract of *P. terebinthus* were most effective on the inflorescence survival as compared with other treatments. In addition, GA₃ strongly stimulated the plant height of pelargonium. Previously, it has been reported that GA₃ caused an increase on the plant height, however a decrease on the inflorescence number of *Pelargonium* (Armitage, 1986; Hamza et al., 1981). These results are compatible with our results (Table 1). However, in the literature, any report on the effect of GA₃ on the inflorescence survival was not come across. Our results showed that GA₃ also increased the inflorescence survival. Our results showed that GA₃ has a reducing effect on the inflorescence number. As can be seen from Table 1, *P. terebinthus* extracts tested in the present study increased the inflorescence number. Based on these results, it can be concluded that there is an advantages the use of *P. terebinthus* extracts in comparison to GA₃.

Commonly it is known that plant extracts have an inhibitory effect on the plant growth belonging to

various genus. Likewise, there is numerous reports on the inhibitory effect of plant extracts (Kocacalışkan and Terzi, 2001; Ercisli et al., 2005; Jefferson and Pennacchio, 2003; Rietwelt, 1983). However, the extracts obtained from some plants had the stimulatory effect, depending on the kind of extract and treatment doses on the plant growth (Coder, 1999). Similar results were found in our study. The extracts obtained from *P. terebinthus* had both stimulant and inhibitory effects. For example, 200 ppm dose of petroleum ether extract showed stimulant effect on the plant height of pelargonium, but not 100 ppm dose. Contrarily, ethanol extract at all doses had inhibitory effect on the plant height of pelargonium.

In conclusion, our results revaluated that GA₃ has an increasing effect on inflorescence survival and plant height, however a reducing affect on inflorescence number. On the other hand, the extracts have positive effects on the inflorescence survival. In contrast to GA₃, it had more slight effect on the plant height. Based on the present results, the extract of *P. terebinthus* may be used to increase the inflorescence numbers and survivors of pelargonium. However, detailed works has been done to assess the effect of allelochemicals on growth and flowering of ornamental plant experimentally.

LİTERATURE CİTED

- Anonymous, 2000. <http://razor.ames.si/~mstrli/pp.html>
- Armitage, A. M., 1986. Chlormequat-induced Early Flowering of Hybrid Geranium: The Influence of Giberellic Acid. HortScience 21: 116-118.
- Chang, Y., S., Sung, F., H., 2000. Effects of gibberellic acid and dormancy-breaking chemicals on flower development of *Rhododendron pulchrum* Sweet and *R. scabrum* Don, Scientia Horticulturae, Volume 83, Issues 3-4, Pages 331-337.
- Cox, D. A., 1991. Giberellic Acid Reverses Effects of Excess Paclobutrozol on Geranium. HortScience 26: 39-40.
- Coder, K. D., 1999. Allelopathy in trees. Arborist News 8:53-60.

- Ercisli, S., Esitken, A., Turkkal, C., Orhan, E., 2005. The allelopathic effects of juglone and walnut leaf extracts on yield, growth, chemical and PNE compositions of strawberry cv. Fern. Plant Soil Environ 6: 283-287.
- Facteau, T. J., Rowe, K. E., Chestnut, N. E., 1989. Flowering in sweet cherry in response to application of gibberellic acid. Scientia Horticulturae, Volume 38, Issues 3-4, Pages 239-245.
- Guardiola, J. L., Monerri, C., Agusti, M., 1982. The inhibitory effect of gibberellic acid on flowering in *Citrus*. Physiologia Plantarum 55 (2), 136-142.
- Hamza, A. M., David, S., Rogers, M. N., 1981. The effects of sequential applications of different chemical growth regulators on growth and flowering of *f₁* geraniums (*Pelargonium x hortorum* Bailey). J Amer Soc Hort Sci 106:299-303.
- Hanks, G. R., 1984. Factors affecting the response of tulips to gibberellin. Scientia Hort 23: 379-380.
- Hennese, T. C., Dougerty, P. M., 1984. Characterization of internal water relations of loblolly pine seedling in response to nursery cultural treatments: implications for reforestation success, p. 225-243. In M.L.
- Kocacaliskan, I., Terzi, I., 2001. Allelopathic effects of walnut leaf extracts and juglone on seed germination and seedling growth. J Hort Sci & Biotech 76: 436-440.
- Lavabre, E. M., 1991. Weed control. McMillan Education Ltd., London.
- Mohammed, B. R., El-Sayed, R. A., Fawzi, A. F. A., 1983. Effect of gibberellic acid and chloromequat on yield and oil of geranium (*Pelargonium graveolens*). Acta Hort 132: 265-271.
- Nakamura, T., Saotome, M., Ishiguro, Y., Itoh, R., Higurashi, S., Hosono, M. and Ishii, Y., 1994. The Effects of GA₃ on Weeping of Growing Shoots of the Japanese Cherry, *Prunus spachiana*, Plant and Cell Physiology, Vol. 35, No. 3 523-527.
- Oliveira, C. M., Browning, G., 1993. Gibberellin structure-activity effects on flower initiation in mature trees and on shoot growth in mature and juvenile *Prunus avium*, [Plant Growth Regulation](#), Volume 13, Number 1. 55-63.
- Rafiqul Hoque, A. T. M., Ahmed, R., Uddin, M. B., Hossain, M. K., 2003. Allelopathic effect of different concentrations of water extracts of *Acacia auriculiformis* leaf on some initial growth parameters of five common agricultural crops. Pakistan J Agron 2:92-100.
- Rice, E. L., 1984. Allelopathy. Academic Press, Orlando, Florida, USA.
- Rietveld, W. J., 1983. Allelopathic effects of juglone on germination and growth of several herbaceous and woody species. J Chem Ecol 9:295-308.
- Jefferson, L. V., Pennachio, M., 2003. Allelopathic effects of foliage extracts from four Chenopodiaceae species on seed germination. J Arid Environ 55:275-285.
- Twaha, A. M., Turk, M. A., 2003. Allelopathic effects of Black Mustard (*Brassica nigra*) on germination and growth of Wild Barley (*Hordeum spontaneum*). J Agron Crop Sci 189: 298
- Vandermast, D. B., Van Lear, D. H., Clinton, B. D., 2001. American chestnut as an allelopath in the southern Appalachians. Forest Ecol Management 165:173-181.
- Van Der Walt, P., Vorster, J., 1983. Phytogeography of *Pelargonium*. Bothalia 14: 517-523.
- Welander, N. T., 1984. Effect of GA₃, CCC defoliation and quantum flux density on growth and flowering in *Pelargonium x hortorum*. Scientia Hort 23: 371-377.
- Watson, K., 2000. The effect of Eucalyptus and oak leaf extracts on California native plants. Bulletin of the Torrey Botanical Club 964: 467-475.