Journal of Applied Horticulture, 9(2): 115-117, July-December, 2007

Thidiazuron effects on physiochemical characteristics of carnation during pre and postharvest periods

Esmaeil Chamani* and Behroz Esmaeilpour

[A]*Department of Horticulture, Faculty of Agriculture, University of Mohaghegh Ardabili, Ardabil, Iran.*
[*]*E-mail*: *echamani@yahoo.com*

Abstract

Experiments were conducted to determine the effects of Thidiazuron (TDZ) applied at preharvest stage under glasshouse conditions on *Dianthus caryophyllus* 'Lunetta'. Thidiazuron at 0, 1, 10, 100, and 1000 µM was applied as a foliar spray arranged in completely randomized design. Time to flowering was recorded, and relative stem length, total nitrogen and tissue water content were measured at harvest. Postharvest vase life, relative fresh weight changes, and solution uptake were also measured. TDZ treatments decreased relative stem length compared to the control (0 µM). TDZ treatment tended to decrease total nitrogen and water content of tissues slightly, but not significantly ($P > 0.05$). TDZ at 100 µM significantly increased the vase life of cut carnation flowers compared to the control. TDZ treated flowers tended to maintain higher relative fresh weight, with positive differences for the 100 µM TDZ treatment being apparent at day 5, 7 and 9 of vase life. Solution uptake was higher in TDZ treated flowers.

Key words: *Dianthus caryophyllus* 'Lunetta', preharvest, postharvest, Thidiazuron, vase life.

Introduction

Various studies have demonstrated improvement of the postharvest life of cut flowers as a result of cytokinin treatments (Lukaszewska *et al.,* 1994; Paull and Chantrachit, 2001). However, the effects of preharvest treatment on postharvest characteristics of cut flowers are largely unexplored. Preharvest variables can be an important determinant of the quality and longevity of cut flowers and foliage (Celikel and Karaaly, 1995). For example, mean relative humidity in the greenhouse is an important variable accounting for vase life differences in the one cultivar produced in different greenhouses (Marissen and Benninga, 2001).

Thidiazuron (N-phenyl-N-1, 2, 3-thidiazol-5-ylurea; TDZ) is a relatively novel urea-type compound having plant growth regulator-like activity. It has been used commercially at high concentrations as a cotton defoliant (Malik *et al.,* 2002). At low concentrations, it has been used for regeneration in tissue culture (Singh and Syamal, 2001). TDZ appears to be stable in plant tissues (Ferrante *et al.,* 2002a; Mok *et al.,* 2000). Although the exact mode of TDZ action is not known, it has been reported to modulate cytokinin biosynthesis and / or metabolism (Mok *et al.,* 2000), influencing ancillary endogenous hormones, proteins, and enzymes (Murthy *et al.,* 1998). TDZ seems to mimick both auxins and cytokinins (Murthy *et al.,* 1998). It is around 50 - 100 times more active in inducing cytokinin-like effects than common cytokinins (Genkov and Iordanka, 1995).

Bosse and Van Staden (1989) reported that DHZ (dihydrozeatin) used as a pulse treatment for 6-24 h at a concentration of 2×10^{-4} M significantly delayed carnation flower senescence. An increase in the longevity of carnation flowers by 15 d was recorded at 4×10^{-6} M. Lukaszewska *et al.* (1994) showed that exogenous application of zeatin, zeatin ribiside, 2iP, and 2iPA in holding solutions delayed rose senescence by 34-56 %, and thereby prolonged longevity. Zeatin and zeatin ribiside were most effective on roses at 1×10^{-7} M, and prolonged rose longevity by 13 d. Treatments with TDZ effectively prevented leaf yellowing in *Alstroemeria* (Ferrante *et al.,* 2002a). It was most effective as a 10 µM pulse treatment or at 1 µM as a continuous treatment. TDZ treatment was also useful on phlox inflorescences at < 50 µM (Sankhala *et al.,* 2003). Treatment with TDZ greatly reduced flower shedding and induced additional flower buds during vase life. The efficacy of TDZ treatments depends upon the genotype and the concentration. TDZ treatment of chrysanthemum and tulip inhibited leaf yellowing, but did not enhance the quality of the flowers (Ferrante *et al.,* 2003). TDZ in comparison with BA had little effect on vase life of cut *Eucalyptus parvifolia* (Ferrante *et al.*, 2002b). Pulse treatments with 10 µM TDZ decreased the vase lives of 'Champagne', 'Laser', 'Magnum' and 'Neon' roses, but slightly increased that of 'Tresor 2000' (Chamani *et al.*, 2006). A 10 µM TDZ pulse treatment increased the vase life of 'First Red' rose, and TDZ in combination with sucrose had a greater positive effect on vase life than either TDZ or sucrose alone.

The present study was conducted to examine effects of preharvest TDZ treatments on the physiochemical characteristics of *Dianthus caryophyllus* 'Lunetta' during the subsequent pre- and postharvest periods.

Materials and methods

D. caryophyllus 'Lunetta' plantlets were obtained from a commercial greenhouse (Pakdasht, Tehran) and transported to the research greenhouse of Mohaghegh Ardabili University, Ardabil. Plants were potted-up into media comprised of 25% sand, 25% cattle manure, and 50% farm soil. 3 weeks after planting, the plants were pinched-back to encourage uniformity of flowering. 6 weeks after pinching, plants were treated with foliar sprays of TDZ. TDZ (Sigma Chemical Co.) was dissolved in 2 mL of 1 M KOH and prepared at 0, 1, 10, 100, and 1000 µM concentrations. pH was neutralized with 2 mL 1 M HCL. The experiment was

duplicated, and 15 plants for each TDZ concentration were used in both experiments. Experiments were arranged in completely randomized designs. The traits measured were: time to flower, relative stem length (%), total nitrogen, tissue water content at harvest, vase life, relative fresh weight changes (%), and solution uptake changes after harvest. Flowers were harvested at the fully open stage (Eisinger, 1977). Postharvest experiments were carried out under vase life evaluation room conditions of 22 ± 2 °C, 60 - 70 % relative humidity (RH) and 12 h photoperiod with cool white florescent lamps. The harvested flowers were kept into vases containing distilled water and 10 µl L^{-1} chlorine (a.i.).

Time to flowering was recorded as days from TDZ application to full flower opening (harvest). Relative stem length percentage (RLP, %) for stems was calculated using the formula: $\{(L_t - L_0) / L_0\} \times 100$; where, L_t = stem length (cm) at time t (week) and L_0 = stem length (cm) at time 0. Time 0 was the treatment day. Water content of tissues (WCT %) was calculated using the formula: $\{(W_t - W_d / W_t\} \times 100$; where, W_t = fresh weight of the stem (g) on day 0 (day 0 was harvest day) and W_d = dry weight of the stem (g) at the end of vase life. Total N was determined in dried tissue samples of 1 g dw by the Kjeldhal method using concentrated H_2SO_4, K_2SO_4 and selenium to digest the sample.

Vase life was recorded as the time (days) after harvest (day 0), when flowers started showing petal in-rolling, which was taken as the first sign of flower senescence (Bosse and Van Staden, 1989). Relative fresh weight (RFW, %) for stems was calculated using the formula: $(W_t / W_{t=0}) \times 100$; where W_t = weights of stems (g) on days 2, 4, 6, etc. and $W_{t=0}$ = weight of the same stem (g) on day 0. Vase solution usage (mL day^{-1} g^{-1} fw) was determined using the formula: $(S_{t-1} - S_t) / W_{t=0}$; where, S_t = solution weight (g) at t = days 1, 2, 3, etc. S_{t-1} = solution weight (g) on the previous day, and $W_{t=0}$ = fresh weight of the stem (g) on day 0.

Statistical analyses: Data were analyzed with Minitab Release 13.1 for Windows (Minitab Inc.). The Duncans Multiple Range Test (DMRT; $P = 0.05$) was used for comparisons of treatment means. Least significant difference (LSD; $P = 0.05$) values were also calculated for mean comparision.

Results and discussion

Treatment with TDZ at 1000 µM significantly ($P \leq 0.05$) delayed flowering compared to 10 and 100 µM TDZ treatments (Fig. 1). Thus, flowers were produced earliest with treatments of 10 and 100 µM TDZ. TDZ treated flowers generally had proportionally lower stem lengths compared to the control (Fig. 2). Significant differences were initially apparent at 2 and 3 weeks after treatment; *e.g.* control vs. 100 µM TDZ treated flowers. The lowest stem length percentage in the end was for plants treated with 1000 µM. TDZ treatments tended to slightly decrease total carnation stem N and tissue water contents at harvest, but these effects were not significant (Table 1).

TDZ applied at 10 and 100 µM increased the vase life of cut carnation flowers compared to the 0 µM control (Fig. 3). TDZ treated flowers sometimes maintained a higher relative fresh weight, with significant differences at 5, 7, and 9 days after treatment between 100 µM TDZ treated flowers and the control (Fig. 4). Highest relative fresh weight was specifically associated with plants treated with 100 µM TDZ. Vase solution usage tended to be higher in TDZ treated flowers, although no significant difference was found between TDZ treated flowers and control (data not shown).

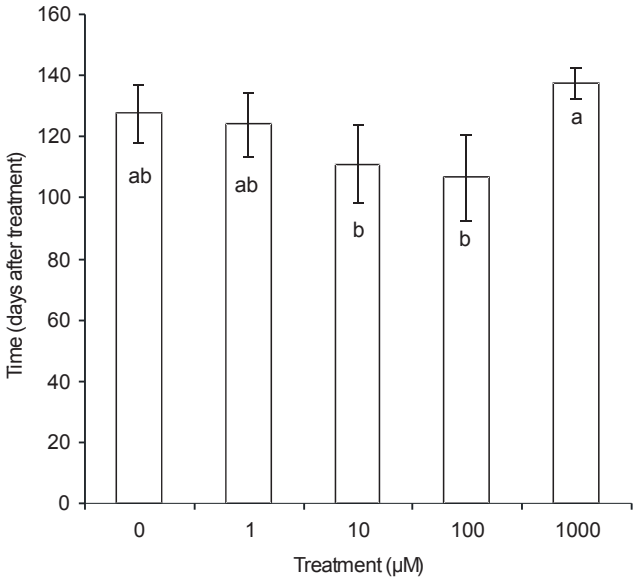

Fig. 1. Effects of different TDZ concentrations on the time to flowering of cut 'Lunetta' carnation plants.

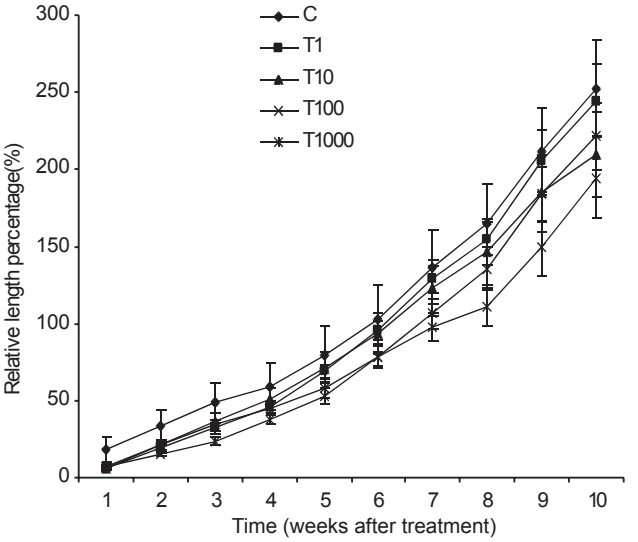

Fig. 2. Effects of different TDZ concentrations on preharvest changes in relative stem length percentage of cut 'Lunetta' carnation flowers

The vase life of cut Lunetta carnation flower could be increased by preharvest application of 10-100 µM TDZ. Increase in the postharvest life of carnations by the application of cytokinins has been reported previously (Shibuya *et al.*, 2000; Eisinger, 1977). Bosse and Van Staden (1989) used DHZ as a pulse treatment for 6 - 24 h at 2×10^{-4} M to delay carnation flower senescence. Similarly, a 10 µM TDZ pulse treatment increased the vase life of 'First Red' rose, which exhibited greater water uptake and higher

Table 1. Effect of different TDZ concentrations on the N and water content of 'Lunetta' carnation flower stems at harvest

Treatment	Total Nitrogen (%)	Water content (%)
Control	2.28	82.7
TDZ (1 µM)	2.04	82.5
TDZ (10 µM)	2.05	81.9
TDZ (100 µM)	2.06	81.7
TDZ (1000 µM)	2.15	82.2
LSD (P=0.05)	0.21	Non significant

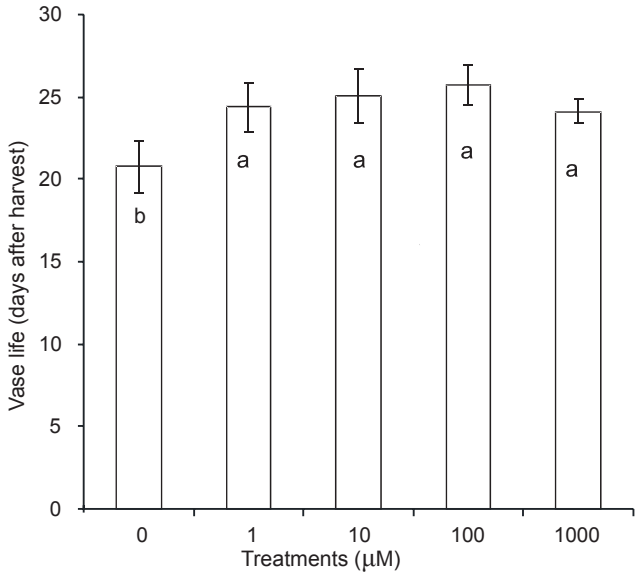

Fig. 3. Effect of different TDZ concentrations on the vase life of cut 'Lunetta' carnation flowers.

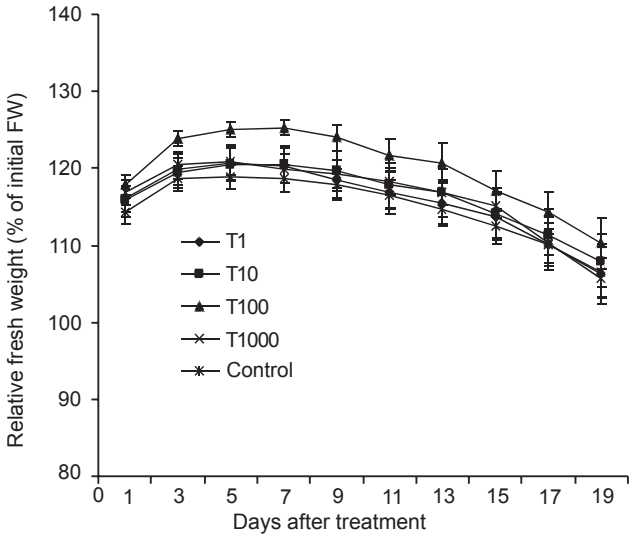

Fig. 4. Effect of different TDZ concentrations on postharvest changes in relative fresh weight of cut 'Lunetta' carnation flowers (experiment 2).

relative fresh weight (Chamani *et al.,* 2006). Increased vase life of cut Lunetta carnations may be associated with solution uptake maintenance by TDZ and / or inherently low levels of cytokinins in their tissues. BA treatments can maintain water uptake (Paull and Chantarachit, 2001). In anthurium, a decline in water uptake was related to reduced vase life (Paull and Goo, 1985). Paull and Chantrachit (2001) reported that various *Anthurium* cultivars showed different vase life responses to BA treatment, from a 20 % reduction to a 2.5-fold increase. They suggested that a lack of response to BA may be due to high natural levels of cytokinins already in the tissue.

The study revealed that TDZ treatments decreased relative stem length compared to the control. TDZ at 100 µM significantly increased the vase life of cut carnation flowers compared to the control. TDZ treated flowers tended to maintain higher relative fresh weight.

References

Bosse, C.A. and J. Van Staden, 1989. Cytokinins in cut carnation flowers. V. Effects of cytokinin type, concentration and mode of application on flower longevity. *J. Plant Physiol.*, 135: 155-159.

Celikel, F.G. and Y. Karaaly, 1995. Effect of preharvest factors on flower quality and longevity of cut carnations (*Dianthus caryophyllus* L.). *Acta Hortic*., 405: 156-163.

Chamani, E., D.E. Irving, D.C. Joyce and M. Arshad, 2006. Studies with thidiazuron on the vase life of cut rose flowers. *J. Appl. Hortic*., 8: 42-44.

Eisinger, W. 1977. Role of cytokinin in cut carnation flower senescence. *Plant Physiol.*, 59: 707-709.

Ferrante, A., D.A. Hunter, P.H. Wesley and M.S. Reid, 2002a. Thidiazuron – A potent inhibitor of leaf senescence in *Alstroemeria. Postharv. Biol. Technol.*, 25: 333-338.

Ferrante, A., A. Mensuali-Sodi, G. Serra and F. Tognoni, 2002b. Effects of ethylene and cytokinins on vase life of cut *Eucalyptus parvifolia* Cambage branches. *Plant Growth Regul*., 38: 119-125.

Ferrante, A., F. Tognoni, A. Mensuali-Sodi and G. Serra, 2003. Treatment with Thidiazuron for preventing leaf yellowing in cut tulips and chrysanthemum. *Acta Hortic*., 624: 357-363.

Genkov, T. and I. Iordanka, 1995. Effect of cytokinin-active phenylurea derivatives on shoot multiplication, peroxidase and superoxide dismutase activities of in vitro cultured carnation. *Bulg. J. Plant Physiol.*, 21: 73–83.

Lukaszewska, A.J., J. Binaco, P. Barthe and M.T.Le Page-Degirry, 1994. Endogenous cytokinins in rose petal and the effect of exogenously applied cytokinins on flower senescence. *Plant Growth Regul*., 14: 119-126.

Malik, M.N.A., U.D. Shabab, M.I. Makhdom and F.I. Chaudhry, 2002. Use of thidiazuron as an harvest aid in early and late planted cotton. *Internat. J. Agric. Biol*., 4: 71-73.

Marissen, N. and J. Benninga, 2001. A nursery comparison on the vase life of the rose 'First Red': Effects of growth circumstances. *Acta Hortic.,* 543: 285-291.

Mok, M.C., R.C. Martin and D.V.S. Mok, 2000. Cytokinins: Biosynthesis, metabolism and perception. *In vitro Cell. Dev. Biol. Plant.*, 36: 102-107.

Murthy, B.N.S., S.J. Murch and P.K. Saxena, 1998. Thidiazuron: A potent regulator of *in vitro* plant morphogenesis. *In vitro Cell. Dev. Biol. Plant*., 34: 267-275.

Paull, R.E. and T. Chantrachit, 2001. Benzyladenine and the vase life of tropical ornamentals. *Postharv. Biol. Technol.,* 21: 303-310.

Paull, R.E. and T. Goo, 1985. Ethylene and water stress in the senescence of cut anthurium flowers. *J. Amer. Soc. Hort. Sci*., 110: 84-88.

Sankhala, N., W.A. Mackay and T.D. Davis, 2003. Reduction of flower abscission and leaf senescence in cut phlox inflorescence by thidiazuron. *Acta Hortic*., 628: 837-841.

Shibuya, K., T. Yoshioka, T. Hashiba and S. Satoh, 2000. Role of the gynoecium in natural senescence of carnation (*Dianthus caryophyllus*) flowers. *J. Exp. Bot.*, 51: 2067-2073.

Singh, S.K. and M.M. Syamal, 2001. A short pre-culture soak in thidiazuron or forchlorfenuron improves axillary shoot proliferation in rose micropropagation. *Scientia Hortic*., 91: 169-177.