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Effect of Thidiazuron and *Naphthalene Acetic Acid* (NAA) on the Vase Life and Quality of Cut *Alestroemeria hybrida*

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Abstract

Alstromeria is a new cut flower in Iran that due to the high performance, long life, and pretty flowers and colors diversity is highly regarded. Premature yellowing of leaves in cut flowers *Alstromeria* before petal fall is the most important factor limiting the vase life of flowers. To delay leaf yellowing and increased quality, factorial experiment based on completely randomized design carried out with the two factors thidiazuron (TDZ) (0, 10, 20 and 50 mg l^{-1}) and naphthalene acetic acid (NAA) (0, 10 and 20 mg l^{-1}). Results showed that the maximum vase life and the value of chlorophyll b were achieved (20 mg l^{-1} thidiazuron 20 mg l^{-1} NAA) and the most petals proteins was related to treatment 10 mg l^{-1} thidiazuron and 20 mg l^{-1} NAA. The most petals carotenoids and dry matter content and the least ethylene production was obtained in 10 mg l^{-1} TDZ and 10 mg l^{-1} NAA, respectively.

Keywords: *Alstromeria*, Carotenoids, *Naphthalene Acetic Acid*, Thidiazuron, Vase life.

INTRODUCTION

Alstromeria (*Alstroemeria hybrida*) is herbaceous cut flower belongs to family Alstroemeriaceae and due to variations in color, cold resistance and pretty flowers is very important in Iran. The main problem of *Alstroemeria* is short life of leaves, so that in the most of its variety, the first signs of inflorescences aging are starts with yellowing of leaves earlier than petal aging. This problem reduces the economic value of this cut flowers (Ferrant *et al*., 2004). So, delay in leaf yellowing with substances which postpone chlorophyll degradation, enhances the economic value of this flower. Cut *alstroemeria* are very sensitive to ethylene. Ethylene production in the final stages of development, reduces vase life by perianth falling (Chanasut *et al.*, 2003; Wagstaff *et al.*, 2005). Thidiazuron is a phenyl urea compound with cytokinin-like activity and researchers discovered that it is good substitute for cytokinins (Reid and King, 2003). Thidiazuron at concentrations above 10 mM for 24 hours delayed aging and yellowing leaves of *Alstroemeria* more than 60 days, while at concentrations less than 1 mM had no effect in delaying leaf senescence (Ferrant *et al*., 2002). Thidiazuron delays yellowing leaves in cut lilies, chrysanthemums, tulips and *Alstroemeria* (Ferrant *et al*., 2002; Ferrant *et al.*, 2003; Reid and King, 2003). Naphthalene acetic acid as a synthetic auxin can delay yellowing of the leaves in some species, such as tulips (Kawa - Miszczak *et al.*, 2005).

Due to the increasing production and export of cut *Alstroemeria*, higher cost of production and high sensitivity to transport and marketing conditions, postharvest problems are very important. Therefore, the present study will improve the quality and longevity of cut *Alstroemeria* with using NAA and TDZ.

MATERIALS AND METHODS

Cut alstroemeria were harvested at commercial stage from a greenhouse in Mahallat and were transfered to the postharvest laboratory. This study carried out as factorial experiment based on RCD with two factors: thidiazuron at four levels (0, 10, 20 and 50 mg l^{-1}) and naphtalene acetic acid at three levels (0, 10 and 20 mg l^{-1}) in 3 replications. Vase life room conditions was 12 hours day length 20 ± 2 º C 60 to 70%, RH and 12 µmol s^{-1} m^{-2} light intensity. Cut alstroemeria treated as contineus method. Traits such as vase life, petals protein, chlorophyll b, petals carotenoid, dry matter and ethylene were measured. Vase life measured as flower wilting (Ferrant *et al.*, 2002). For measurement of petal protein in 5th day sampling was done and evaluation by Bradford (1976) method. In 4th of experiment sampling for chlorophyll b and petal carotenoids was done and these traits measured by Mazumdar and Majumdar (2003) methods. Flower was weight in last day of vase life and dry matter measured by this formula (Hashemabadi, 2012):

DM=dry weight/fresh weight×100

Ethylene production (nl l^{-1} h^{-1} g^{-1} SW) was measured 24 h after pulse treatment. Three flowers were sealed in a glass jar and all jars were kept at 20°C. After 24 h, 10 mL gas samples were withdrawn for ethylene determination. Ethylene content was determined using a Shimidzu gas chromatograph equipped with an activated aluminum column fitted with a flame ionization detector.

Data were analyzed using SPSS statistical software and mean comparison were performed by LSD test.

RESULTS AND DISCUSSION

Vase Life

Results showed that thidiazuron at concentration of 20 mg l^{-1} (11.20 days) was better than controls (7.85 days) ($p \leq 0.01$). Maximum vase life was found in 20 mg l^{-1} thidiazuron + 20 mg l^{-1} naphthalene acetic acid (13.98 days) (Table 1). Due to the cytokinin-like activity and protein synthesis, thidiazuron keeps antioxidant activity at the high-level (Macnish *et al*., 2010) and naphthalene acetic acid as a ethylene production inhibitor, increased the quality and longevity of cut alstroemeria.

Petal's Protein

Results showed that interaction effect of TDZ and NAA was significant at 1% probability. 10 mg l^{-1} thidiazuron + 10 mg l^{-1} naphtalene acetic acid have most proteins (23.33 %) compared to control (11.66 %) (Table 1). Increase in soluble protein is due to new protein synthesis and decreasing in protein degradation. Cytokinin like compounds decreased degradation and loss of chlorophyll and nitrogen during the aging process. Also, it can be stated that these compounds may have a structural role in the chloroplast membrane and may stimulate photosynthesis (da Silva, 2003; Luckaszcwaska *et al.*, 1994).

Petal's Carotenoids

The effect TDZ was significant on petals carotenoids and 10 mg l^{-1} (1.17µg g^{-1} FW) has the highest carotenoid pigments between treatments ($p \leq 0.01$) (Table 1). Thidiazuron is involved in chlorophyll biosynthesis, TDZ inhibits from chlorophyll and carotenoid degradation. Also, it may increases the main pigments such as, chlorophyll and carotenoid in sensitive cut flowers such as alstroemeria (Ferrant *et al.*, 2005).

Leaf Chlorophyll

The mean comparison of the leaf chlorophyll showed that NAA had not significant effect on this trait, but 50 mg l^{-1} thidiazuron (11.10 mg g^{-1} FW) showed the maximum chlorophyll b compared to control (6.05 mg g^{-1} FW) ($p \leq 0.01$). Between different levels of interaction TDZ+ NAA, the highest chlorophyll b was found in 20 mg l^{-1} NAA+ 20 mg l^{-1} thidiazuron (14.55 mg g^{-1} FW) (Table 1). Probably, thidiazuron with cytokinin-like activity activates genes that encode key enzymes of chlorophyll biosynthesis or prevents from the activation of genes that cause to degradation of chlorophyll. Also, NAA increased chlorophyll synthesis in leaves of *Alstroemeria.*

Dry Matter

Only TDZ had significant effect on dry matter and 10 mg l^{-1} thidiazuron (19.08%) had the highest dry matter between other treatments (Table 1). Mostofi *et al*. (2010) stated that dry matter was formed from carbohydrates and proteins. Corts (1973) and Nabighol *et al.* (2006) stated that the final phase of development of flower is associated with a decline in carbohydrate content and the vase life of cut flowers improves by putting cut flowers in vase solutions containing carbohydrates. Cytokinin can increase activity of rubisco 1,6–bis-phosphatase, malate dehydrogenase -dependent NADP and gliceraldehyde 3-phosphate dehydrogenase-dependent NADP and increase photosynthesis (Wingler *et al.*, 1998).

Ethylene Production

NAA, TDZ and NAA+ TDZ had significant effect on ethylene production in cut *alstroemeria*. 10 mg l^{-1} NAA (0.415 nl l^{-1} h^{-1} g^{-1} FW) and 20 mg l^{-1} thidiazuron (0.390 nl l^{-1} h^{-1} g^{-1} FW) showed the lowest ethylene production than the control. 10 mg l^{-1} NAA + 0 mg l^{-1} TDZ showed the least ethylene production (0.277 nl l^{-1} h^{-1} g^{-1} FW) than controls (1.28 nl $l^{-1}h^{-1}$ g^{-1} FW) (Table 1). Ethylene production in the final stages of development of *Alstroemeria* decreases their vase life by wilting of perianth (Chanasut, 2003; Wagstaff *et al.*, 2005). Thidiazuron as a non-metabolized phenyl urea compound with high cytokinin-like activity affects on some of the characteristics of postharvest through the effect on ethylene biosynthesis and in the flowers sensitive to ethylene, decreases their sensitivity to ethylene (Fathi and Ismaeilpour, 2000). Naphthalene acetic acid as a synthetic auxin, enhances the vase life of cut *Alstroemeria* by reducing ethylene sensitivity of flowers.

CONCLUSION

Treatments of naphthalene acetic acid and thidiazuron improved vase life in cut *Alstriemeria*

compared to control. NAA at 10 mg l^{-1}, TDZ at 20 mg l^{-1} alone and interaction between them, improved vase life compared to control for 1.25, 3.35 and 7.07 days, respectively.

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Tables

Table 1. Mean comparison of different concentrations of NAA and TDZ on the measured traits.

Treatment	Ethylene ($nl\ l^{-1}h\text{-}1g^{-1}FW$)	Petals protein (%)	Chlorophyll b ($mgg^{-1}FW$)	Petals Carotenoids ($\mu g^{-1}FW$)	Vase life (days)	Dry weight (%)
N0 (0 mg L^{-1} NAA)	0.583a	13.10a	5.33a	1.00a	8.6a	15.935a
N1 (10 mg L^{-1} NAA)	0.415c	14.15a	6.25a	1.07a	9.85a	17.07a
N2 (20 mg L^{-1} NAA)	0.514b	11.62a	8.30a	1.04a	8.62a	16.140a
T0 (0 mg L^{-1} TDZ)	0.710a	12.13a	6.05c	0.87 c	7.85c	12.969 b
T1 (10 mg L^{-1} TDZ)	0.409c	16.33a	8.00b	1.172 a	9.32bc	19.084 a
T2 (20 mg L^{-1} TDZ)	0.390d	16.16a	8.33b	0.98 b	11.20a	17.646 a
T3 (50 mg L^{-1} TDZ)	0.507b	15.16a	11.10a	1.11 a	9.85ab	15.828ab
N0T0	1.28a	11.66c	3.215d	0.81a	6.91 d	11.664a
N0T1	0.420f	11.66c	5.683cd	1.06a	10.48bc	20.581a
N0T2	0.387g	11.66c	5.06cd	0.91a	8.13cd	16.937a
N0T3	0.684b	b 17.50	7.195c	1.19a	8.96bcd	15.378a
N1T0	0.277i	b 17.50	4.96cd	0.83a	9.14bcd	14.309a
N1T1	0.384g	a 23.33	7.07c	1.39a	8.63bcd	17.308a
N1T2	0.468e	11.66c	6.55cd	0.969a	10.13bc	17.600a
N1T3	0.531d	b 17.50	8.43bc	1.10a	11.51ab	19.064a
N2T0	0.565c	a 23.33	7.38cd	0.970a	7.49cd	12.936a
N2T1	0.423f	b 17.50	8.79bc	1.055a	8.86bcd	19.363a
N2T2	0.315h	11.66c	14.55a	1.07a	13.98 a	18.400a
N2T3	0.306h	11.66c	11.12b	1.063	10.47bc	13.041a

*Similar letters in each column indicate not significant difference at 1% and 5% (LSD test).