Effect of soil-water tension on cut chrysanthemum floral quality and longevity

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Abstract

The experiment was carried out on the Steltenpool property, in the Holambra II District of the Paranapanema (SP) municipality. The research principal objective was to identify the soil water tension which would result in improved quality and greater longevity for cut chrysanthemums, Dark Orange Reagan cultivar. The treatments were defined for ten tension levels: 5, 10, 15, 20, 25, 30, 35, 40, 45 and 50 kPa. In the last evaluation, when the chrysanthemums were showing open flowers, some plants were taken to the FCA/UNESP Department of Horticulture laboratory and submitted to two treatments to maintain longevity. The treatments were: T1, treatment with distilled water; T2, treatment with distilled water + gibberellic acid (GA_3 30 mg.L^{-1}). Daily analyses with specific formulae were realized, with notes attributed to each plant. Three repetitions for each tension treatment were used, with 30 stems for T1 and 30 for T2, totaling 60 stems. The stems were conditioned in pet bottles filled with 500 mL of water. The notes were given according to the following criteria: (1) generalized yellowing, soften stems, advanced wilting and discard; (2) onset of yellowing and wilting; (3) onset of falling leaves; (4) some wilted leaves; (5) normal green inflorescent turgid leaves (best quality). The conclusions drawn from the results obtained were that a greater number of A1 packets, of the best quality standard, were found with tensions of 20 and 50 kPa and that greater longevity was achieved using gibberellin (GA_3) at a concentration of 30 mg.L^{-1}, at tensions of 30 and 50 kPa .

Key words: *Dendranthema grandiflorum* Ramat. Kitamura, post-harvest, irrigation

Introduction

The chrysanthemum (*Chrysanthemum morifolium* Ramat.) is one of the most popular flowers in the world and - along with roses, carnation and more recently the gerberas - it is part of the basic cast of all flower shops (Grusznski, 2001).

Irrigation is an essential practice for chrysanthemum growing, but its adequate handling has been neglected by growers, resulting in vegetable growing loss and consequent productivity and quality decrease of the final product.

The plants response to soil-water tension has been studied as a way to control irrigation, since deficit in irrigations reflect directly in production decrease, whereas excessive irrigations harm the quality of flowers.

Scatolini (1996) monitored soil-water tension for chrysanthemum cultivation and always found low tensions that reached little higher values for short periods only at 0,10m depth. Water-soil tension values at 0,10m depth ranged from 10,1 kPa to 58,7 kPa, with an average close to 20 kPa. At 0,20m depth the tension ranged from 10 kPa to 47 kPa, with an average close to 17,5 kPa and for 0,30m depth the soil-water tension ranged from 14,9 kPa to 42,3 kPa, with an average close to 25 kPa.

Another important point is that the production of cut flowers demands conservation techniques that contribute to keep post-harvest quality of flowers. The main causes of post-harvest deterioration involve exhaustion of reserves, especially carbohydrates, respiration to bacteria and fungi occurrence, ethylene production and excessive water loss, according to Nowak et al. (1991) quoted by Brackmann et al. (2005).

According to Davies (1995), giberelines are phytoregulators that take part in important aspects of germination and plant flowering. Their use has been spread by their action, when applied exogenously, delaying coloration of fruits and leaves of some species. Some authors have found similar results regarding treatment of cut stems of flowers, such as Alstroemeria (DAÍ e PAULL, 1991), roses (GOSZCZYNSKA et al., 1990) and chrysanthemum (D´HONT et al., 1991)

Laschi et al. (1999) found different responses concerning the type of giberelines by studying the effect of gibberellic acid GA_3 and GA_4 + GA_7 in chrysanthemum and solidago post-harvest. Chrysanthemum stems have better longevity with the use of GA_3 20 and 10 mg.L^{-1}, and in solidago stems this increase is noticed by the mixture GA_4 + GA_7 a 10 mg.L^{-1} .

Flórez-Roncancio et al. (1996) observed in cut chrysanthemum that treatment with GA_3 0,058 mol.m^{-3} differed from controll the , with 1, 2 day-increase in average floral longevity.

This study aimed to identify soil-water tension that might result in higher quality and better longevity of cut chrysanthemum, cv. Dark Orange Reagan.

Material and methods

The experiment was carried out on January 28th 2004 at Steltenpool property, Holambra II District, municipality of Paranapanema – SP, and finished on April 14th 2004. An experimental delineation was performed with factorial arrangement of 10x2 (10 tensions and 2 longevity treatments) with three repetitions, divided into 30 portions, each one controlled by record, with four drip tapes (1,3 L.h^{-1} of outflow) per emitter, in working pressure of 1 kgf. cm^{-2}, installed in central rows of plants. A conduction system was used, where a seedling was planted in each plot. Each flowerbed was 2,80m length and 2,60m wide and there were 11 plant/rows with four drip tapes 0,20m spacing. The total experimental area was 42m length and 5,70m wide. Short day-induction was carried out with black polyethylene (plastic) curtains with 120 microns. Treatments were defined by 10 soil-water tension levels: 5, 10, 15, 20, 25, 30, 35, 40, 45 and 50 kPa. The corresponding mercury column height was estimated for each tension and the irrigation depth for each treatment (Table 1).

The fertilization was performed according to the producer's routine. The fertilizers were placed in a 1000L watertank and the plants received a nutritious solution that was changed according to their cycle. In the vegetative phase 60kg of calcium nitrate and 15kg of ammonium nitrate were used. For generative phase (flowering induction), 2kg of magnesium sulfate; 5kg of potassium sulfate; 400g of boric acid and 20g of sodium molybidate were applied in 1000L.

Tensiometers with mercury manometers were used, one per portion, and they added up to 30 tensiometers. The plants were irrigated according to the tensions. Three deformed samples from layer 0 to 20cm were collected within the experimental area for soil chemical analysis (Table 2).

The cultivar Dark Orange Reagan is daisy type, with a dark orange average size inflorescence and petals composed by one or more external pistilated flower rows and internal flowers in an orange central flattened disc.

In order to analyze post-harvest durability, the plants suffered two longevity maintenance treatments. The treatments were:

T1 – distilled water treatment;

T2 – distilled water + gibberellic acid (GA_3 30 mg.L^{-1}) treatment.

The stems spent 48 hours immersed in treatment solutions and were taken to a cold chamber at 5ºC where they remained for one day. All the stems were cut about 4cm off the base. After removing them from the cold chamber they were "*Pet*" bottled, filled with 500mL natural water, which

Table 1. Tensions, mercury column height and irrigation depth.

Treatment (kPa)	Mercury column height (cm)	Irrigation depth (mm)
5	6,5	3,5
10	10	6,4
15	15	8,8
20	19	12,02
25	23	15,66
30	27	19,5
35	31	21,76
40	35	26,02
45	40	32,66
50	43	38,06

Table 2. Soil Chemical analysis.

Depth	pH	OM	H+Al	K	Ca	Mg	SB	CEC	V	P_{resin}	B	Cu	Fe	Mn	Zn
(cm)	$CaCl_2$	g dm^{-3}	.... $mmol_c$ dm^{-3}						%	.... mg dm^{-3}					
0 - 20	6.4	76	19	7.0	178	35	220	240	92	1612	1.4	9.4	88	12.7	25.8

was changed every two days. Daily analyses were performed, with specific forms and grades for each plant. Each treatment (tension) had three repetitions, with 30 stems for T1 and 30 stems for T2, adding up to 60 stems.

The stems were observed as a whole, including the foliage. The foliage condition was characterized by the color (normal green leaves, onset of yellowing or generalized yellowing) and by the wilting degree (inflorescent turgid leaves, onset of wilting and advanced wilting). Thus, the grades were given following these criteria:

1 - generalized yellowing, soften stems, advanced wilting and discard;

2 - onset of yellowing and wilting;

3 - onset of falling leaves;

4 - some wilted leaves;

5 - normal green inflorescent turgid leaves (best quality)

The results obtained suffered variance analysis through F test at 5% probability-level.

Results and discussion

There was a difference among averages of post-harvest treatment factor levels (T) at 5% probability-level (Table 3). Post-harvest treatment T2 presented a grade average (3,11) higher than treatment T1 (2,92). That means, in practice, that the use of gibberellic acid has promoted an increase in the floral longevity, and such results agree with the ones found by Laschi et al. (1999), who obtained an increase of average longevity of plants using gibereline (GA_3) in 20 and 30 mg.L^{-1} concentrations for the chrysanthemum, cv. Reagan.

For the tension factor, there was a significant difference at 5% probability-level through F-test. Therefore, there is at least one contrast statistically different from zero among average grades in the ten tension levels.

The coefficient of experimental variation for grades 3,04 was low (Table 3), stressing a good control of purposely non-included factors in the experiment. The interaction between post-harvest treatment factors x tension was significant at 5% probability-level through F-test as well.

Therefore, one factor behavior depends on the levels of the other. This way, interaction was unfolded to evaluate a factor behavior in each level of another factor.

Post-harvest treatments presented average grades significantly different through F-test at 5%

Table 3. Summary of variance analysis for chrysanthemum grades, obtained from a completely randomized delineation experiment in factorial arrangement with post-harvest treatment factors (T) and tensions (kPa).

Variation sources	G.L.	Q.M.
Treatments	19	0,1920*
T	1	1,8358*
Tension	9	0,1549*
T x tension	9	0,0465*
Residue	40	0,0214*
General grade average	3,04	
CV %	4,81	

** significant to 5% probability-level through F- test.*

Table 4. Summary of variance analysis for grades with post-harvest treatment factor unfolding within tension factor levels (kPa).

Variation sources	G.L.	Q.M.
Post-harvest / tension treatment(5 kPa)	1	0,4508*
Post-harvest / tension treatment (10 kPa)	1	0,2656*
Post-harvest / tension treatment (15 kPa)	1	0,4585*
Post-harvest / tension treatment (20 kPa)	1	0,0285ns
Post-harvest / tension treatment (25 kPa)	1	0,0056ns
Post-harvest / tension treatment (30 kPa)	1	0,4345*
Post-harvest / tension treatment (35 kPa)	1	0,1815*
Post-harvest / tension treatment (40 kPa)	1	0,0504ns
Post-harvest / tension treatment (45 kPa)	1	0,2212*
Post-harvest / tension treatment (50 kPa)	1	0,1576*

** significant at 5% probability-level through F-test; ns non significant.*

probability-level in 5, 10, 15, 30, 35, 45 and 50 kPa tensions (Table 4). In these tensions treatment T1 presented average grades lower than treatment T2. In cases which there was no significant difference (20, 25 and 40 kPa tensions), treatment T1 also presented average grades lower than treatment T2. Consequently, as a general rule, treatment T2 is superior to T1, that is, with higher average grades, resulting in a better flower longevity (Figure 1).

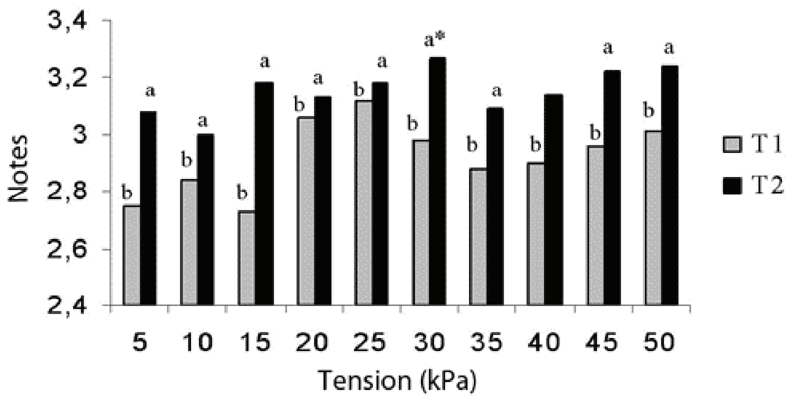
The tensions presented at least one significantly different contrast of grades through F-test at 5% probability within the two levels of post-harvest treatment (Table 5). Therefore, two tests of grade averages have been done to evaluate what tension levels presented grade averages statistically different in each post-harvest treatment.

Considering post-harvest treatments T1 and T2, the grade averages in different tension levels followed by at least one letter, do not differ among them, at 5% probability-level through Tukey test (Table 6).

Flórez-Roncancio et al. (1996) reports that for quality maintenance and better floral longevity of cut chrysanthemum the floral stems should be immersed in gibberellic acid after harvest and it is necessary to submit them to pulsing maintenance and hydration treatment.

The use of gibberellic acid, therefore, can promote an increase in floral quality and longevity, irrespective of the tension in which the chrysanthemum is irrigated. As of the soil-water tension levels, it is recommended that the tension levels within each post-harvest treatment are based in Table 6.

Figure 1. Post-harvest durability for the different soil-water tensions when submitted to treatments T1 and T2.



*Averages followed by the same letter do not differ statistically through F-test, at 5% probability.

Table 5. Summary of variance analysis for grades with tension factor unfolding (kPa) within post-harvest treatment factor levels.

Variation sources	G.L.	Q.M.
Post-harvest treatment / tension 1	9	0,1375
Post-harvest treatment / tension 2	9	0,0639

** significant at 5% probability-level through F-test; ns non significant.*

Table 6. Grade averages for chrysanthemum, evaluated in different tension levels (kPa) in post-harvest treatments T1 and T2.

T	Tensions (kPa)	Average grades	
1	25	3,2407	a
1	20	3,0814	ab
1	45	3,0184	abc
1	40	2,8944	abc
1	35	2,8574	abcd
1	50	2,8459	abcd
1	30	2,8163	bcd
1	15	2,7811	bcd
1	5	2,6463	cd
1	10	2,4876	d
2	45	3,4024	a
2	30	3,3545	a
2	15	3,3339	a
2	25	3,3019	ab
2	20	3,2193	ab
2	35	3,2053	ab
2	5	3,1944	ab
2	50	3,1700	ab
2	40	3,0778	ab
2	10	2,9084	b

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