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Longevity of cut shoots of *Molucella laevis* L. as affected by flower preservatives and growth regulators

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ABSTRACT

The effect of preservatives and growth regulators benzyladenine (BA) and gibberellic acid (GA_3) on longevity of cut shoots of *Molucella laevis* L. was studied. Solution of 200 ppm citrate 8-hydroxychinoline (8 HQC) with 2% sucrose (S), routinely used to prolong the vase life of cut flowers, negatively affected the longevity of bells of Ireland. Several products of POKON & CHRYSAL were tested of which the Chrysal SVB® proved to be the best for shoot pulsing. BA and GA_3 reduced vase life in comparison with water controls. Degradation of chlorophyll proceeded faster in the lower calices than in the upper ones and depended on chemicals in a vase solution.

INTRODUCTION

Flower arrangements are increasingly demanded by consumers whose preferences towards flower assortment keep constantly changing. However, a demand for excellent quality and originality of the bouquets always remains high. Bells of Ireland, *Molucella laevis*, provides such an originality within the range of species grown for the florists' green. It is an annual plant with very decorative green calices, gathered in whorls along a strong, erect shoot. Recognition of conditions and treatments which could assure good post harvest quality of this plant material would not only satisfy the needs of florists and consumers but also encourage growers to expand production of this species, especially as it is possible to grow it under covers. So far, studies on the post harvest quality of *Molucella* have been scarce, thence it would seem useful to check a response of its cut shoots to the preservatives available on the market and to the growth regulators known to prolong longevity of the florists' green, benzyladenine (Skutnik 1998 a) and gibberellic acid (Kappers et al. 1998, Han 2000).

MATERIAL AND METHODS

Cut shoots of *Molucella laevis* L. were used in the experiments. Plants were grown in the open field and the shoots – at the same stage of development – were harvested in the morning, immediately transferred to the laboratory where their stems were trimmed to 60 cm and stripped off the leaves. There were 8 shoots in each treatment, individually tagged and treated as separate replications. The experiments were repeated three times.

In the first experiment harvested shoots were pulsed for 24 hours with conditioners of POKON & CHRYSAL (Holand): Chrysal SVB® and Chrysal RVB®, and then were placed either in distilled water or in a solution of 200 ppm citrate 8-hydroxychinoline (8 HQC) + 2% sucrose (S). Cut shoots were also placed directly in preservatives recommended by POKON & CHRYSAL for cut flowers; i.e. Chrysal PROFESSIONAL® and Chrysal CLEAR® or in 8 HQC + 2% S and water (control). In the second experiment shoots were pulsed for 24 hours with benzyladenine BA (0.10 or 0.50 mmol dm^{-3}) or gibberellic acid GA_3 (0.25 or 1.00 mmol dm^{-3}). After pulsing, shoots were placed either in distilled water or in the solution of 200 ppm 8 HQC + 2% S, used to prolong vase life of cut flowers.

Vase life was recorded in days and regarded as terminated when one third of a shoot showed yellowing or drying.

Chlorophyll was extracted in dimethylformamide (DMF) and determined according to Moran and Porath (1980) in modification of Inskeep and Bloom (1985). Results were calculated on a base of calyx dry matter .

Results were statistically evaluated with ANOVA 1 or ANOVA 2. Means were compared using the Duncan's test at probability level $p = 0.05$.

RESULTS AND DISCUSSION

Most of the preservatives available on the market suitable for cut flowers negatively affect longevity of the green elements in flower arrangements since the senescence in leaves proceeds in a different way from that in petals. However, the conditioner Chrysal SVB®, recommended for "leafy" flowers such as alstroemeria, euphorbia or lilies, improved vase life of bells of Ireland by 3 days when the shoots were successively held in water and not in a preservative – 8 HQC + 2% S (Table 1). Also, the chlorophyll degradation was slowed down by Chrysal SVB® conditioning and 14 days after harvest the pigment content was more than 20% higher than that in the non conditioned water control, being only 22% lower than at the moment of harvest (Table 2).

Table 1. Effect of preservatives and conditioners from POKON & CHRYSAL on vase life of cut shoots of *Molucella laevis* L. [days]

Treatment	H_2O (control)	8 HQC + 2% S	Chrysal PROFESSIONAL®	Chrysal CLEAR®	Chrysal SVB® 24 h		Chrysal RVB® 24 h	
					H_2O	8 HQC + 2% S	H_2O	8 HQC + 2% S
Longevity	17.3	11.0	10.2	16.3	20.4	11.1	18.1	12.6
$LSD_{0.05}$ = 3.09								

Table 2. Effect of preservatives and conditioners from POKON & CHRYSAL on total chlorophyll content [mg g^{-1} d.m.] in calices of *Molucella laevis* L. 14 days after harvest; initial chlorophyll contents: lower calices – 10.0 mg g^{-1} d.m., upper calices – 9.0 mg g^{-1} d.m.

Treatment		Calyx position		Mean
		Lower	Upper	
H_2O (control)		5.2	6.9	6.1
8 HQC + 2% S		3.1	5.8	4.5
Chrysal PROFESSIONAL®		3.0	5.8	4.4
Chrysal CLEAR®		6.3	6.6	6.5
Chrysal SVB® 24 h	H_2O	7.9	6.8	7.4
	8 HQC + 2% S	2.9	3.8	3.3
Chrysal RVB® 24 h	H_2O	5.4	7.4	6.4
	8 HQC + 2% S	2.8	3.6	3.2
Mean		4.6	5.8	
$LSD_{0.05}$ for:	calyx position = 0.27 treatment = 0.70 interaction = 0.99			

The preservatives from POKON & CHRYSAL – Chrysal CLEAR® and Chrysal PROFESSIONAL® – were ineffective (Table 1). Neither the solution of

8 HQC + 2% S, routinely used to prolong vase life of cut flowers, improved the longevity of bells of Ireland. This, however, was no surprise as only four out of nineteen species grown for the florists' green positively responded to this solution in earlier studies (Skutnik and Łukaszewska 2001). This solution – together with Chrysal CLEAR® – was very harmful to chlorophyll as 14 days after harvest the pigment content in calices of shoots from the preservatives was on the average 26–47% lower than in water controls. Generally, the loss of chlorophyll was faster in the lower calices (Table 2).

Growth regulators such as cytokinins and gibberellins are reported to delay senescence in cut leaves, cytokinins being effective, for example, *in Hosta* sp. and *Asparagus densiflorus* 'Sprengerii' and gibberellic acid in *Zantedeschia aethiopica* and *Hippeastrum hybridum* (Skutnik and Łukaszewska 2001). However, in *Molucella laevis* both regulators proved ineffective as pulsing for 24 hours and did not improve vase life in comparison with water control in the concentrations applied. On the contrary, the shoots treated with the growth regulators lasted shorter (Table 3). Similar observations were made earlier in this species (Skutnik 1995, 1998 b). Shorter vase life was related to a lower chlorophyll content in calices (Table 4). Chlorophyll degradation proceeded faster in shoots placed after pulsing into the preservative (8 HQC + 2% S). However, comparison of average chlorophyll content as affected by growth regulators (Table 5) shows an interesting tendency: benzyladenine seems to partly counteract the harmful effect of the preservative on the chlorophyll degradation. Untreated shoots held in the preservative lost 32% more of the initial pigment content than did the untreated ones in water control, the GA_3-treated calices lost over 50% of chlorophyll while in the BA-pulsed calices this loss on average was only 20%. This antisenescence effect of BA was not so pronounced, as for example, in *Hosta* sp. (Skutnik 1998 a) but was in line with general cytokinin action (Brault and Maldiney 1999).

Table 3. Effect of 24 hrs pulsing with growth regulators (GA_3, BA) and the preservative (8 HQC + 2% S) on vase life of cut shoots of *Molucella laevis* L. [days]

Treatment		GA_3		BA		Mean
		0.25 mmol dm^{-3}	1.0 mmol dm^{-3}	0.1 mmol dm^{-3}	0.5 mmol dm^{-3}	
H_2O (control)	19.4	12.4	12.6	11.9	8.1	12.9
8 HQC + 2% S	15.6	9.6	11.3	10.1	4.0	10.1
Mean	17.5	11.0	11.9	11.0	6.1	

$LSD_{0.05}$ for: growth regulator = 1.35
preservative = 0.72
interaction = 1.91

Table 4. Effect of growth regulators (BA, GA_3) and the preservative (8 HQC + 2% S) on the total chlorophyll content [mg g^{-1} d.m.] in calices of cut shoots of *Molucella laevis* L. 10 days after harvest; initial chlorophyll content: lower calices – 9.8 mg g^{-1} d.m., upper calices – 9.2 mg g^{-1} d.m.

Treatment		Calyx position		Mean
		Lower	Upper	
H_2O (control)		7.8	9.7	8.7
8 HQC + 2% S		6.5	5.3	5.9
BA 0.1 mmol dm^{-3}	H_2O	5.1	8.4	6.8
	8 HQC + 2% S	4.2	6.5	5.4
BA 0.5 mmol dm^{-3}	H_2O	6.3	9.1	7.7
	8 HQC + 2% S	6.8	5.8	6.3
GA_3 1.0 mmol dm^{-3}	H_2O	6.2	8.4	7.3
	8 HQC + 2% S	3.1	4.0	3.5
GA_3 0 25 mmol dm^{-3}	H_2O	8.8	8.9	8.9
	8 HQC + 2% S	4.2	4.6	4.4
Mean		5.9	7.1	
$LSD_{0.05}$ for: calyx position = 0.12 treatment = 0.43 interaction = 0.60				

Table 5. Comparison of the treatments with growth regulators (BA, GA_3) and preservative (8 HQC + 2% S) with regard to the mean total chlorophyll content in calices of cut shoots of *Molucella laevis* L. [mg g^{-1} d.m.]

Treatment	Pulsing				
	without	BA		GA_3	
		0.1 mmol dm^{-3}	0.5 mmol dm^{-3}	1.0 mmol dm^{-3}	0.25 mmol dm^{-3}
H_2O (control)	8.7	6.8	7.7	7.3	8.9
8 HQC + 2% S	5.9 (68%)[1]	5.4 (79%)	6.3 (82%)	3.5 (48%)	4.4 (49%)

[1] Percentage of chlorophyll content in comparison with water control

Since the efficacy of growth regulators depends on the type of substance, its concentration and application methods more studies are needed to find a proper treatment improving quality of cut shoots of *Molucella laevis*. Such studies are being continued.

CONCLUSIONS

1. Preservative 8 HQC + 2% S reduced the postharvest longevity of cut shoots of *Molucella laevis*.
2. Conditioner Chrysal SVB®, recommended by POKON & CHRYSAL (Holand), delayed senescence of this species.
3. Pulsing with benzyladenine (BA) and gibberellic acid (GA_3) did not delay senescence of cut shoots of *Molucella laevis*.
4. Degradation of chlorophyll proceeded faster in lower calices than in upper ones and was hastened by a preservative.

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WPŁYW POŻYWEK I REGULATORÓW WZROSTU NA POZBIORCZĄ TRWAŁOŚĆ PĘDÓW *MOLUCELLA LAEVIS* L.

Streszczenie: Badano wpływ pożywek i regulatorów wzrostu na trwałość ciętych pędów *Molucella laevis* L. Pożywka stosowana standardowo do przedłużania trwałości kwiatów ciętych (8 HQC + 2% S) okazała się nieskuteczna, podobnie jak i zastosowane regulatory wzrostu (BA i GA_3). Jedynie kondycjoner Chrysal SVB®, z proponowanych przez firmę POKON & CHRYSAL (Holandia), zwiększył pozbiorczą trwałość ciętych pędów tego gatunku. Degradacja chlorofilu zachodziła szybciej w dolnych niż w górnych kielichach i uzależniona była od zastosowanych substancji.

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