POLISH SOCIETY FOR HORTICULTURAL SCIENCE

Folia Hort. 23/2 (2011): 139-143

DOI: 10.2478/v10245-011-0021-6

FOLIA HORTICULTURAE

Published by the Polish Society
for Horticultural Science since 1989

Growth retardants in the cultivation of *Chrysanthemum* × *grandiflorum* (Ramat.) Kitam. 'Leticia Time Yellow'

Piotr Zakrzewski, Anita Schroeter-Zakrzewska

Department of Ornamental Plants
Poznań University of Life Science
Dąbrowskiego 159, 60-594 Poznań, Poland
e-mail: anitazak@up.poznan.pl

ABSTRACT

The objective of the presented experiment was the showing of the possibility of replacing daminozide, contained in the preparation B-Nine 85 SP, by metconazole, contained in Caramba 60 SL preparation, in pot cultivation of pot chrysanthemum 'Leticia Time Yellow'. Experiment was carried out in three cycles: in the spring, beginning 10 April; in the summer, beginning 11 June; and in the autumn, beginning 13 August, 2007. The metconazole contained in the Caramba 60 SL preparation was able to impede the growth of 'Leticia Time Yellow' chrysanthemum as effectively as the daminozide contained in the B-Nine 85 SP preparation. However, the effectiveness of metconazole depended on its concentration and on the dose of the preparation, on the number of treatments and on the growing term in the plastic tunnel. In the summer term of cultivation, the effect of metconazole applied only once in a concentration of 300 mg dm^{-3} was comparable with the effectiveness of daminozide applied twice in a concentration of 2,550 mg dm^{-3}, and in the autumn cultivation, the effectiveness was even higher. In addition, no retardation of flowering was recorded, either in relation to the plants sprayed with daminozide or in relation to the control plants not sprayed with any retardant.

Key words: daminozide, metconazole, growth, flowering

INTRODUCTION

The popularity of pot chrysanthemum cultivars is evidenced by data from Dutch flower exchanges, where they occupy the fourth position in the ranking of flowering pot flowers. Cultivars from the Time group enjoy the greatest popularity. This group is recommended for controlled cultivation and is characterised by medium sized inflorescences. Because of the vast number of cultivars that differ in their habit, flowering, colour and flower types, they are most willingly cultivated by flower producers. However, it is not possible to eliminate growth retardants from the cultivation of cultivars from this group. The number of the treatments performed depends on the growth power of the particular cultivars. In cases of high and medium growth power, it is necessary to spray the plants from two to even four times during their growth (Machin 1997). Borkowska (2003) argued that chrysanthemum cultivars characterised by low growth power, such as 'Brill', 'Tea Time', or 'Quarz Time', require the application of the B-Nine preparation only once.

The aim of this experiment was to show the possibility of replacing the daminozide contained in the B-Nine 85 SP retardant with metconazole, which is contained in the Caramba 60 SL preparation and which impedes the growth of chrysanthemums grown in pots and at the same time exerts a favourable effect on the plant habit, as well as on other plant features contributing to the quality of flowering plants.

MATERIAL AND METHODS

The experiment was carried out in three terms: in spring, from 10 April, in summer, from 11 June and in autumn, from 13 August 2007. The 'Leticia Time Yellow' small-flowered type of pot chrysanthemum (*Chrysanthemum* × *grandiflorum* (Ramat.) Kitam., syn. *Dendranthema grandiflora* Tzvelev) with yellow semi-full inflorescences was selected for the study. This cultivar is characterised by medium growth power and its photoperiodic reaction amounts to 7.5 weeks.

Rooted cuttings obtained from the nursery of the firm M.M. Szaj in Poznań were pinched off above the fifth leaf counting from the base three days after planting into pots of 14 cm diameter; seven days after being pinched, when the lateral shoots reached the length of 10-15 mm, daminozide in the concentration of 2,550 mg dm^{-3} (contained in the B-Nine 85 SP preparation) and a fungicide showing the properties of the metconazole retardant (contained in the Caramba 60 SL preparation) in the concentration of 300, 600, 1200 mg dm^{-3} were applied. Flowerpots were placed on elevated beds in a spacing of 30 × 30 cm in an unheated plastic tunnel. The plastic tunnel was equipped with darkening curtains made from a two-layer material of Obscura A/B + B type. Plants were darkened during the hours from 6:00 p.m. to 8:00 a.m. In addition to performing the function of photoperiod control, the curtains protected the plants against spring early frost and autumn early frost.

The substrate, consisting of commercial peat substrate TS 1 with pH = 6.0, was obtained from Klassman Co. The plants were irrigated twice during the day and night. Fertigation was applied using a doser from Dosatronic Co. Superba Brązowa fertiliser (14:10:25) was used for fertigation in a concentration of 0.1% and was begun in the second week after the transfer of plants into pots.

The experiment, which included one cultivar, consisted of 10 combinations (type and concentration of growth retardants × number of sprayings) in each term of cultivation. Each combination consisted of 20 flowerpots, whereby one replication included one pot with five plants in each pot.

Plants from each given combination were sprayed with growth retardants in different concentrations, once, twice and three times in one-week intervals. In the spring term, the designated combinations were sprayed with metconazole in a concentration of 1,200 mg dm^{-3}, and in the summer and autumn terms, the concentration was decreased to 300 mg dm^{-3}. The growth retardant application scheme is shown in Tables 1-3. Spraying treatments were carried out using the Venus high-pressure sprayer by Kwazar Co. The amount of solution was 17.5 ml per pot.

Measurements and observations were performed in the stage of full flowering, when one half of all flower heads was completely developed. The measurements and observations of plant features that determined plant quality were: number of flower heads from five plants in each pot (developed and not developed), flower head sizes, height and width of plant (five plants per pot) aboveground parts, and number of shoots. The measurement results were statistically elaborated using a one-factor analysis of variance and the significance of differences between the mean values of the features were estimated by the Duncan test at the level of $\alpha = 0.05$.

RESULTS AND DISCUSSION

The growth amount of the pot chrysanthemum cultivars from the Time group varied; however, most frequently it was average or high. Therefore, these plants require the use of retardants in a concentration of 0.3-0.4%, applied twice, thrice and even four times during their growth and development in short-day conditions (Machin 1997).

B-Nine preparation, whose active substance is daminozide, is most frequently used for impeding the growth of chrysanthemums cultivated in pots. In spite of the fact that actually this preparation is not recommended, it is used because it is much more effective than chlormequat or paclobutrazol and it gives the plants a more shapely habit (Zalewska 1989). However, daminozide possesses short lasting dwarfing properties; therefore, it has to be applied several times in order to obtain the adequate plant habit (Startek 2000).

In order to decrease production costs, studies have been carried out on the introduction of other preparations exerting a favourable effect on plant quality during cultivation. One such preparation is Caramba 60 SL, a fungicide with the properties of a retardant whose active substance is metconazole.

In our studies, the effectiveness of metconazole and daminozide were compared. The effects of these substances depended on their concentration and on the number of treatments.

In the spring period of cultivation, metconazole impeded plant growth most intensively, significantly, but at the same time excessively, reducing their height as well as the number of shoots. The most handsome habit was displayed by plants treated

twice with daminozide in a concentration of 2,550 mg dm^{-3}. Similarly, in the summer period, the most handsome plant habit was obtained thanks to this retardant. On the other hand, in the autumn cultivation cycle, the most shapely habit was found on plants sprayed once with metconazole in a concentration of 300 mg dm^{-3}. Higher concentrations and greater numbers of treatments with this retardant exerted an unfavourable effect because it caused an excessive impediment of growth (Tabs 1-3).

Altmann and Lősekrug (2002), who twice applied the Caramba preparation in a concentration of 0.3%, observed a favourable and uniform regulation of the habits of 'Elmira Frosted' and 'Pizi Time' chrysanthemum cultivars. However, the abovementioned researchers did not indicate the dose of the preparation they had applied.

The experiments carried out by Khobragade et al. (2002) indicate that increased concentrations of retardants caused a retardation of inflorescent bud setting and a resulting retardation of flowering. Zalewska (1989), who used a Alar 85 SP preparation three times in a concentration of 0.125% and 0.250%, observed flowering retardation by 1-3 days in the chrysanthemums of the 'Paloma' and 'Poranek' cultivars, in comparison with chrysanthemums not treated with retardants. After the application of the B-Nine 85 SP preparation, Przymęska and Lisiecka (2001) observed an eight-day retardation in the flowering of the 'Hellen' chrysanthemum spray cultivar.

In our experiment, we observed a retardation of flowering when daminozide was used only in the spring term and after the application of a high concentration of 1,200 mg dm^{-3} of metconazole also in the first term of cultivation. Depending on the concentration of the preparation and on the number of treatments, the retardation was between 4-5 to 13 days in the case of daminozide and 7-13 days in the case of metconazole. However, the time of cultivation did not exceed the period of 10 days in any of these combinations. Thanks to this fact, it was possible to harvest three yields of plants from the unheated foil tunnel in the period from April to October.

Przymęska (2006) reported that the term of plant planting and not the application of B-Nine 85 SP preparation exerted an effect on the number of flower heads produced and on their diameter in the 'Breeze' spray cultivar.

In our experiment, differences in the number of flower heads were observed in each cultivation cycle. The type of preparation, its concentration and number of treatments exerted a significant influence on the number of inflorescences produced as well. In the spring cycle, plants that were sprayed three times with metconazole (1,200 mg dm^{-3}) produced 50% fewer flower heads, in comparison with the control plants, as well as in comparison with plants sprayed twice with daminozide in a concentration of 2,550 mg dm^{-3} (Tab. 1). In the summer term of cultivation, plants treated with daminozide in a 2,550 mg dm^{-3} concentration created the greatest numbers of flower heads. Cultivations that were sprayed once, twice or three times produced equally large numbers of flower heads, with an average of 20 flower heads more than plants sprayed once with metconazole in a 300 mg dm^{-3} concentration (Tab. 2). In the last growing cycle, the applied retardants (except metconazole applied once in the

Table 1. Term of cultivation and growth and flowering of plants in the spring term

Retardant (mg dm^{-3})	Number of applications	Full flowering and term of cultivation (days)	Height of plants (cm)	Width of plants (cm)	Number of shoots	Number of flower heads	Flower head diameter (cm)
control	0	4.06.07 (57)	26.4 g*	33.7 f	18.6 cde	126.0 g	7.4 d
daminozide 2550	1	8.06.07 (61)	20.5 f	30.5 e	18.1 cd	118.0 f	7.0 bc
daminozide 2550	2	9.06.07 (62)	20.3 f	29.9 de	19.9 e	126.5 fg	6.8 abc
daminozide 2550	3	17.06.07 (70)	17.2 cd	29.7 de	18.4 cde	133.5 g	6.7 abc
metconazole 1200	1	11.06.07 (64)	18.3 de	28.6 d	18.2 cd	88.2 d	6.8 abc
metconazole 1200	2	13.06.07 (66)	16.4 bc	25.3 b	12.7 b	78.4 c	7.1 cd
metconazole 1200	3	16.06.07 (69)	14.1 a	23.6 a	11.1 a	62.5 b	6.6 ab
metconazole 600	1	17.06.07 (70)	19.6 ef	29.4 de	18.8 de	99.1 e	7.0 bc
metconazole 600	2	11.06.07 (64)	17.1 cd	27.2 c	17.0 c	92.3 de	6.6 a
metconazole 600	3	13.06.07 (66)	15.1 ab	24.1 ab	14.1 b	83.7 cd	6.5 a

*Means followed by the same letters do not differ significantly at $\alpha = 0.05$

Table 2. Term of cultivation and growth and flowering of plants in the summer term

Retardant (mg dm^{-3})	Number of applications	Full flowering and term of cultivation (days)	Height of plants (cm)	Width of plants (cm)	Number of shoots	Number of flower heads	Flower head diameter (cm)
control	0	12.08.07 (61)	27.1 f*	40.2 g	18.3 d	116.2 d	8.0 e
daminozide 2550	1	13.08.07 (62)	21.1 de	35.7 e	15.7 bc	122.1 d	8.4 f
daminozide 2550	2	1308.07 (62)	19.6 c	33.3 cd	15.3 bc	122.0 d	7.6 de
daminozide 2550	3	11.08.07 (60)	17.4 b	32.6 c	16.2 c	123.0 d	6.5 a
metconazole 300	1	11.08.07 (60)	21.7 e	38.3 f	16.1 c	101.5 c	7.1 b
metconazole 300	2	13.08.07 (62)	17.4 b	31.8 bc	14.0 ab	86.3 b	6.8 ab
metconazole 300	3	13.08.07 (62)	16.0 a	30.3 b	15.7 bc	81.1 b	7.5 cd
metconazole 600	1	12.08.07 (61)	20.5 cd	34.7 ce	16.7 cd	106.9 c	7.8 de
metconazole 600	2	13.08.07 (62)	17.8 b	30.7 b	14.0 ab	86.2 b	7.1 bc
metconazole 600	3	13.08.07 (62)	16.1 a	28.6 a	12.7 a	70.3 a	6.6 a

*Explanations: see Table 1

Table 3. Term of cultivation and growth and flowering of plants in the autumn term

Retardant (mg dm^{-3})	Number of applications	Full flowering and term of cultivation (days)	Height of plants (cm)	Width of plants (cm)	Number of shoots	Number of flower heads	Flower head diameter (cm)
control	0	18.10.07 (69)	22.6 g*	33.3 f	17.4 e	64.0 d	8.7 cd
daminozide 2550	1	16.10.07 (67)	19.5 e	28.2 d	11.9 ab	47.7 b	8.6 bcd
daminozide 2550	2	17.10.07 (68)	18.0 d	26.8 cd	12.9 bc	48.4 b	8.5 abc
daminozide 2550	3	17.10.07 (68)	17.0 c	26.2 c	13.0 bc	52.1 bc	8.3 ab
metconazole 300	1	18.10.07 (69)	21.3 f	31.7 e	14.1 cd	60.7 d	8.8 d
metconazole 300	2	17.10.07 (68)	18.2 d	27.9 d	15.5 d	56.3 c	8.5 abc
metconazole 300	3	18.10.07 (69)	15.0 b	24.8 b	13.5 bc	50.9 b	8.3 ab
metconazole 600	1	15.10.07 (66)	17.0 c	27.1 cd	13.7 c	55.5 c	8.6 bcd
metconazole 600	2	16.10.07 (67)	15.1 b	24.6 b	12.5 bc	49.0 b	8.2 a
metconazole 600	3	16.10.07 (67)	13.0 a	22.1 a	10.4 a	41.9 a	8.4 abc

*Explanations: see Table 1

concentration of 300 mg dm^{-3}) produced a smaller number of inflorescences (Tab. 3).

Because of its low price, smaller doses and frequency of application, the Caramba 60 SL preparation contributed to a decrease in production costs. However, both discussed preparations effectively impeded the growth of chrysanthemums of the 'Leticia Time Yellow' cultivar. In order to achieve a favourable effect on plant habit and on other features that influence the quality of flowering plants, it is important to adjust the preparation concentration and the dose per plant, as well as the number of treatments for the specific cultivar.

CONCLUSIONS

1. The metconazole contained in the Caramba 60 SL preparation can inhibit the growth of the 'Leticia Time Yellow' chrysanthemum cultivar as equally effectively as the daminozide contained in the B-Nine 85 SP preparation.
2. The effectiveness of metconazole depends on the concentration and on the dose of the preparation, on the number of treatments and on the term of plant cultivation in the plastic tunnel.
3. In the summer term of cultivation, the effects of metconazole (Caramba 60 SL) applied once in a concentration of 300 mg dm^{-3} was comparable with the effectiveness of daminozide (B-Nine 85 SP) applied twice in a concentration of 2,550 mg dm^{-3}, and in the autumn growing period, it was even higher. At the same time, no retardation of flowering was recorded either in relation to plants sprayed with daminozide or in relation

to control plants not sprayed with any growth retardant.

REFERENCES

Altmann A., Lösekrug Ch., 2002. Chemische Wachstumeregulatoren bei der Topfterminkultur. Zierpflanzenbau 8: 17-19.

Borkowska J., 2003. Chryzantemy z grupy Time w uprawie całorocznej. Wiadomości Chryzantemowe 23: 35-44.

Khobragade Y.R., Belorkar P.V., Damke M.M., Badole W.P., Nagrare I.M., Hatmode C.N., 2002. Effect of B-9 on improving decorative value of chrysanthemum cultivars. J. Soils Crops 12(2): 308-312.

Machin B., 1997. Pot chrysanthemum production. Grower Guide 5: 3-74.

Przymęska J., 2006. Wpływ daminozydu na pokrój kwiatostanów chryzantemy 'Breeze' z grupy Santini w uprawie sterowanej. Zesz. Probl. Post. Nauk Roln. 507-513.

Przymęska J., Lisiecka A., 2001. Kwitnienie gałązkowych odmian chryzantemy wielkokwiatowej (*Dendranthema grandiflora* Tzvelev) w nieogrzewanym tunelu foliowym. Zesz. Probl. Post. Nauk Roln. 449: 161-172.

Startek L., 2000. Wpływ retardantów i nawożenia na wzrost, rozwój oraz walory dekoracyjne bratka ogrodowego (*Viola* × *wittrockiana* Gams.). Zesz. Nauk. Inst. Sad. Kwiac. 7: 119-128.

Zalewska M., 1989. Growth regulators in pot culture of chrysanthemum cultivars 'Paloma', 'Poranek', 'Promyk'. Acta Hort. 251: 335-340.

RETARDANTY WZROSTU W UPRAWIE CHRYZANTEMY WIELKOKWIATOWEJ (*CHRYSANTHEMUM* × *GRANDIFLORUM* (RAMAT.) KITAM.) 'LETICIA TIME YELLOW'

Streszczenie: Celem przeprowadzonego doświadczenia było wykazanie możliwości zastąpienia daminozydu zawartego w preparacie B-Nine 85 SP metkonazolem zawartym w preparacie Caramba 60 SL w uprawie doniczkowej chryzantemy wielkokwiatowej odmiany 'Leticia Time Yellow'. Doświadczenie przeprowadzono w trzech cyklach: wiosennym od 10 kwietnia, letnim od 11 czerwca i jesiennym od 13 sierpnia 2007 roku.

Metkonazol zawarty w preparacie Caramba 60 SL może hamować wzrost chryzantem odmiany 'Leticia Time Yellow' równie skutecznie jak daminozyd zawarty w preparacie B-Nine 85 SP. Jego skuteczność zależy jednak od stężenia, dawki preparatu, liczby zabiegów i terminu uprawy roślin w tunelu foliowym. W letnim terminie uprawy działanie metkonazolu, zastosowanego jeden raz w stężeniu 300 mg dm^{-3} jest porównywalne ze skutecznością daminozydu zastosowanego dwukrotnie w stężeniu 2550 mg dm^{-3} a w uprawie jesiennej jest nawet wyższe. Nie notuje się przy tym opóźnienia kwitnienia – ani względem roślin opryskiwanych daminozydem ani względem roślin kontrolnych, nie opryskiwanych żadnym retardantem.

Received November 18, 2010; accepted December 12, 2011