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Leaf number and plant height of three *Canna x generalis* cultivars

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Summary: The aim of this three-year study was to evaluate the effect of three treatments (tiophanate methyl, charcosal dust, and control) on leaf number and plant height on three *Canna x generalis* cultivars (City of Portland, Richard Wallace and Robert Kemp). Results showed that the 3-year means of leaf number ranged from 13.7 to 22.4 for the three cultivars. The largest leaf numbers were for cultivar Robert Camp (22.4 in 2010) and the lowest for cultivar City of Portland (13.7 in 2011). Tiophanate methyl treatment produced the highest number of leaves and the values were significantly different at $P < 0.05$ from the control for all years and for all cultivars. Numbers of leaves in charcosal dust treatments were larger than the control treatments but it was not significantly different. Results on plant height ranged from 65.8 to 160.1 cm for the three cultivars. The largest plant height was for cultivar Robert Camp (160.1 cm in 2010) and the lowest for cultivar City of Portland (65.8 cm in 2011). Tiophanate methyl treatment produced the highest plant height and the values were significantly different at $P < 0.05$ from the control for all years and for all cultivars. Plant heights in charcosal dust treatments were larger than the control treatments but it was not significantly different.

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Key words: *Canna x generalis*, leaf numbers, plant height, tiophanate methyl, charcosal dust

Introduction

Canna x generalis L.H. Bailey, is an important ornamental plant decorating gardens (Maas-van de Kamer and Maas, 2008). This plant bears large beautiful flowers and attractive leaves (Doi et al., 2013). It is usually propagated vegetatively mainly through its rhizomes (Wróblewska et al., 2014). Several cultivars of *C. x generalis* are known from the beginning of last century. Flower and leaf features are usually described in most studies and marketing enterprises (Zhang et al., 2004, Yeh et al., 2004). These plants are used mainly for city parks as decorating streets. As this ornamental is a large plant can provides additional fresh air for the citizens. Large plant height and large number of leaves for a cultivar can be useful for human health and for a city marketing (Broschat et al., 2008).

The aim of this study was to evaluate the effect of three treatments (tiophanate methyl, charcosal dust, and control) on leaf number and plant height on three *Canna x generalis* cultivars (City of Portland, Richard Wallace and Robert Kemp).

Materials and methods

Location, plant material and orchard management

A 3-year study (2009, 2010 and 2011) was carried out in an experimental research station in Eastern Hungary, located in Debrecen-Pallag (47°31'60"N, 21°37'60"E), consisted of a cultivar collection of *C. x generalis*, including cultivars City of Portland, Richard Wallace and Robert Kemp. Research station soil type was brown forest soil with alternating layers of clay.

The pest management program followed the Hungarian integrated fruit production (IFP) guidelines (Cross and Dickler, 1994). Three chemical treatments (tiophanate methyl, charcosal dust, and control) were used. Stable manure and compost were applied in March of every other year. The plants were irrigated twice per year during dry periods in July and August.

Plant height and leaf number assessments

From the cultivar collection of *C. x generalis*, including cultivars of City of Portland, Richard Wallace and Robert Kemp were selected for plant height and leaf number assessments in 2009, 2010, and 2011. Four plots were performed for each cultivar. Each plot consisted of 20 plants for each cultivar. When plants reach the seasonal heights at the end of the summer, plant height was measured then numbers of leaves were counted for each cultivar in all the three years.

Data analyses

Measurements of plant height and number of leaves were used to characterize cultivars in all years. Both measurements were averaged to obtain a single value for each year and cultivar. Then, data of each measurement were analysed by analysis of variance. Then means for each measurement were separated by an least significant difference (LSD) test using $LSD_{0.05}$ values. Prior to the analyses, all incidence values were arcsine-square root transformed in order to make the data normally distributed.

Table 1. Leaf number of three *Canna x generalis* cultivars under three treatments (tiophanate methyl, charcosal dust control) at Debrecen-Pallag, Hungary (2009, 2010 and 2011).

Cultivar/treatments	2009	2010	2011	Overall
<i>City of Portland</i>				
Tiophanate methyl	15.9 bc	17.2 bc	16.9 c	16.7 b
Charcosal dust	14.3 a	15.5 ab	14.2 ab	14.7 a
Control	13.8 a	14.9 a	13.7 a	14.1 a
<i>Richard Wallace</i>				
Tiophanate methyl	17.8 bc	17.9 bc	18.9 cd	18.2 bc
Charcosal dust	15.2 a	16.4 ab	16.1 a	15.9 a
Control	14.9 a	15.5 a	15.4 a	15.3 a
<i>Robert Kemp</i>				
Tiophanate methyl	20.1 b	22.4 c	21.8 b	21.4 b
Charcosal dust	17.1 a	18.3 ab	17.8 a	17.7 a
Control	16.5 a	17.9 a	17.4 a	17.3 a

Table 2. Plant height (cm) of three *Canna x generalis* cultivars under three treatments (tiophanate methyl, charcosal dust control) at Debrecen-Pallag, Hungary (2009, 2010 and 2011).

Cultivar/treatments	2009	2010	2011	Overall
<i>City of Portland</i>				
Tiophanate methyl	92.2 c	98.1 c	88.2 b	92.8 b
Charcosal dust	75.4 ab	72.3 a	68.4 a	72.0 a
Control	68.9 a	71.5 a	65.8 a	68.7 a
<i>Richard Wallace</i>				
Tiophanate methyl	121.1 bc	118.1 ab	121.1 b	120.1 b
Charcosal dust	113.6 abc	110.9 a	107.1 a	110.5 a
Control	108.2 a	110.1 a	105.8 a	108.0 a
<i>Robert Kemp</i>				
Tiophanate methyl	154.2 c	160.1 b	152.4 bc	155.6 b
Charcosal dust	134.8 a	137.7 a	128.4 a	133.6 a
Control	129.2 a	132.3 a	121.3 a	127.6 a

Results

Leaf number

Analyses of variance on leaf number indicated significant ($P < 0.05$) differences amongst years and cultivars. There were no significant interactions amongst treatment factors.

The 3-year means of leaf number ranged from 13.7 to 22.4 for the three cultivars and from 13.7 to 17.2 for cultivar City of Portland, and from 14.9 to 18.9 for cultivar Richard Wallace and from 16.5 to 22.4 for cultivar Robert Kemp (Table 1). The largest leaf numbers were for cultivar Robert Kemp (22.4 in 2010) and the lowest for cultivar City of Portland (13.7 in 2011). Tiophanate methyl treatment produced the highest number of leaves and the values were significantly different at $P < 0.05$ from the control for all years and for all cultivars. Numbers of leaves in charcosal dust treatments were larger than the control treatments but it was not significantly different.

Plant height

Analyses of variance on plant height indicated significant ($P < 0.05$) differences amongst years and cultivars. There were no significant interactions amongst treatment factors.

The 3-year means of plant height ranged from 65.8 to 160.1 cm for the three cultivars and from 65.8 to 98.1 cm for cultivar City of Portland, and from 105.8 to 121.1 cm for cultivar Richard Wallace and from 121.3 to 160.1 cm for cultivar Robert Kemp (Table 2). The largest plant height was for cultivar Robert Kemp (160.1 cm in 2010) and the lowest for cultivar City of Portland (65.8 cm in 2011). Tiophanate methyl treatment produced the highest plant height and the values were significantly different at $P < 0.05$ from the control for all years and for all cultivars. Plant heights in charcosal dust treatments were larger than the control treatments but it was not significantly different.

Conclusions

According to above results, *C. x generalis* is a big ornamental plant species but the size of the plants varies greatly. Among the three cultivars, the largest cultivar was Robert Kemp which produced the largest leaf number and plant height in all treatments and years. This cultivar, among the tested ones, seems to be the most suitable for city park decorations.

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