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Full Length Research Paper

Stem diameter and height of chrysanthemum cv Yoko ono as affected by gibberellic acid

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The effect of gibberellic acid has been shown mainly to promote cell division and elongation. This study was aimed to evaluate the development of height and diameter of the stems of chrysanthemum cultivar Yoko ono by the applications of gibberellic acid (GA_3) in the field. The treatments were composed of four doses (0, 40, 80 and 120 mg L^{-1}) at 15 and 30 days after transplanting. From the findings, It can be concluded that GA_3 significantly affected the diameter of stem at higher doses, and was unable to affect the height of stem.

Key words: *Dendranthema grandiflora*, flowers, plant regulator, concentration.

INTRODUCTION

The nine main genera of cut flowers produced in Brazil are: roses, gypsophila, alpineas, strelitzia, heliconia, orchid, primrose, cyclamen and chrysanthemums (Ibraflor, 2002). Chrysanthemums, often called mums or chrysanths, are of the genus *Chrysanthemum*, constituting approximately 30 species of perennial flowering plants in the family Asteraceae which is native to Asia and northeastern Europe (Ibraflor, 2000).

Both the quality and other characteristics of flowers can be changed by applying plant growth regulators, which are organic substances with important functions in regulating growth, acting both as stimulants and inhibitors, depending on their concentration and other intrinsic characteristics of the plant (Teixeira and Marbach, 2000). Many of these substances are actually similar chemicals generated by hormones (Davies, 2004).

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Abbreviations: GA_3, Gibberellic acid; **ABA**, abscisic acid; **IAA,** indoleacetic acid.

The major hormone groups are auxins, cytokinins, abscisic acid, ethylene, polyamines, jasmonates, salicylic acid, brassinosteroids and gibberellins (Salisbury and Ross, 1992). Some authors showed that the role of gibberellin affect the process of cell elongation and/or cell division, which is stimulated from the apex of the branches, especially from the basal cells of the meristem (Salisbury and Ross, 1992), and induce growth by changing the distribution of calcium in the tissues (Rodrigues and Leite, 2004; Taiz and Zeiger, 2004).

Among the exogenous gibberellins, gibberellic acid (GA_3) has been used to increase the length or height and diameter of plant, increase the number of flowers and induce flowering (Medina and Saavedra, 1999; Taiz and Zeiger, 2004). In bulbous plants such as cyclamen (Treder et al., 1999), tulip (Rudnicki et al., 1976) and dahlia (Khan and Tewari, 2003), there was an increase in plant height after application of GA_3. Small changes in diameter were also observed by Schmidt et al. (2003) in chrysanthemum cultivar Viking. In chrysanthemum cultivar Faroe (Vieira, 2008) and *Anthurium andreanum* (Wang, 1999), GA_3 was not enough to increase the height and diameter of the stems or stimulate flowering.

The results of studies on the effectiveness of GA_3 on the flowers are contradictory. This study was aimed to evaluate the development of height and diameter of the stems of chrysanthemum cultivar Yoko ono subjected to GA_3 applications in the field.

MATERIALS AND METHODS

The experiment was conducted in plastic greenhouses in Cordeirópolis, São Paulo, Brazil (22° 28' 55" S, 47° 27' 24" W). Medium sized seedlings of chrysanthemum (*Dendranthema grandiflora* Tzvelev) cultivars Yoko ono were used; they are characterized by dichotomous leaves with alternate disposition on the stem, a globular inflorescence formed by small green petals and no visible internal disk flowers. In the cultivation conditions of Cordeirópolis, plants were cultivated for 7½ weeks for flower induction.

The experimental design was randomized blocks, each containing four plots. Treatments were composed of four doses (0, 40, 80 and 120 mg L^{-1}) of GA_3 (Pro-Gibb® - 10%, Valent). GA_3 was applied 15 and 30 days after transplanting the seedlings. Plants were sprayed in the morning with 100 ml of various concentrations of treatment. Experiments were carried out with four replication on 40 plants (cultivated at a density of 64 plants/m^2). Plants on the borders were discarded. In all the treatments, 30 ml/100 L^{-1} of a non-ionic surfactant (Extravon®, Syngenta Agro S/A), to improve wetting and spray distribution, was added. The apparatus used for GA_3 application was a CO_2 backpack tank, equipped with a sprayer nozzle-shaped fan.

Immediately after harvest, we analyzed the height and diameter of the 12 stems identified within each parcel of each treatment. To measure the height of the stem, we used a tape graduated in inches and a caliper reading of stem diameter.

Analysis of variance was performed to detect differences between treatment means, which were separated by Tukey's test ($P < 0.05$) using SAS software.

RESULTS AND DISCUSSION

Increase in stem diameter at both time of application (Figures 1 and 2) was observed at 120 mg L^{-1} doses of GA_3 (10.15 and 8.68%) application as compared to the untreated plants. Similar observations were recorded by Schmidt et al. (2003) on Viking cultivar of chrysanthemum. However, Vieira (2008) observed no changes in the main stem diameter of Faroe cultivar of chrysanthemum by GA_3 application. King et al. (1987) reported that depending on species, variety and plant organ, the mode of action of gibberellins may differ. This may explain the contradictory responses observed in chrysanthemum cultivar Yoko ono, as it is a cultivar of the variety pompom, the same chrysanthemum cultivar Faroe. These results reveal that there is a reaction between different cultivars. Trewavas (1981) suggests that the sensitivity of a plant tissue depends on its age and the presence of hormone receptor proteins.

The diameter of the stems treated late had less development when the application of GA_3 was done at 15 days. This means that the role of gibberellins in the control of phase change is complex, varying among species and involving interactions with other factors (Taiz and Zeiger, 2004). The applications of 40 and 80 mg L^{-1} had no significant effect in this work.

For plant height, there was no significant effect from the application times (15 and 30 days) and different doses of GA_3 did not differ between treatments after harvest (92 days), with an average height of 112.81 and 112.72 cm, respectively (Figures 3 and 4). These results observed in chrysanthemum cultivars Yoko ono do not tally with Schmidt et al. (2003) in chrysanthemums Viking, which confirmed that the application of 300 mg L^{-1} done in the fourth week after planting, resulted in an increase in plant height of 16.78%; the effect on plant height is more pronounced when applications are made early, even with the use of lower dosages. This effect is explained by Trewavas (1981) as quoted earlier, which shows that this behavior may be associated with the growth substance (receptor protein) and decreased with increasing plant age. Grzesik, (1989) and Booij, (1989) also corroborate this affirmation. Grzesik et al. (1989) also states that the application of GA_3 in order to stretch the rod can be much more related to the time of application than the product concentration. However, this study did not show any change in height of the stems of chrysanthemum cultivar Yoko ono treated at 15 and 30 days. These results differ from that of Raven et al. (2001) who explained that gibberellins promote stem cell growth, a transverse arrangement of microtubules, which govern the direction of the deposition of cellulose microfibrils.

These, when placed in the transverse direction, offer less resistance to cell expansion in the longitudinal direction.

Several works have demonstrated alteration of the stem through the application of GA_3. In Better Times rose, an application of GA_3 at concentrations 10 to 100 mg L^{-1} increased the stem height (Castro, 1998). In *Hemerocallis hybrida*, the results indicated that the optimal number of applications went up too, differing statistically from all other applications (Ottmann, 2006). Al-Khassawneh et al. (2006) reported changes in the growth of *Iris nigricans* Dinsm using plant growth regulators, especially the GA_3 concentrations tested (125, 250, 375 and 500 mg L^{-1}).

Increase in the height of the stems can also be attributed to auxin because it can cause the synthesis of gibberellins and vice visa, and also cause cell elongation (Taiz and Zeiger, 2004). Tawar et al. (2003) showed an increase in stem height of Gladiolus, with applications of GA_3 (100, 150, 200 and 250 mg L^{-1}), IAA (100 and 250 mg L^{-1}) and ABA (50 and 100 mg L^{-1}) and found that this increase followed the concentration of the respective plant growth regulators. However, high concentrations may also cause an increase in height, which can compromise the product at the time of distribution (Khan and Tewari, 2003). There are several studies showing the lack of effect of GA_3 on vegetative growth of several species, but also many other studies reveal contrary

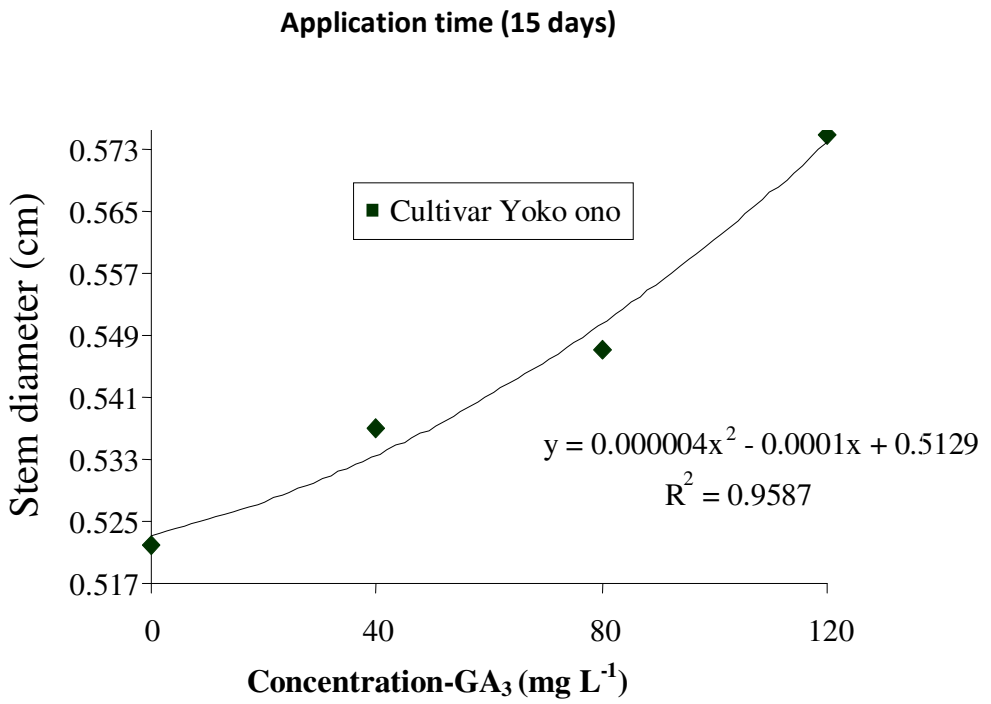

Figure 1. Diameter of the stems in chrysanthemum 'Yoko ono', with the application of different concentrations of GA_3 at 15 days after transplanting seedlings; Cordeirópolis SP, 2007.

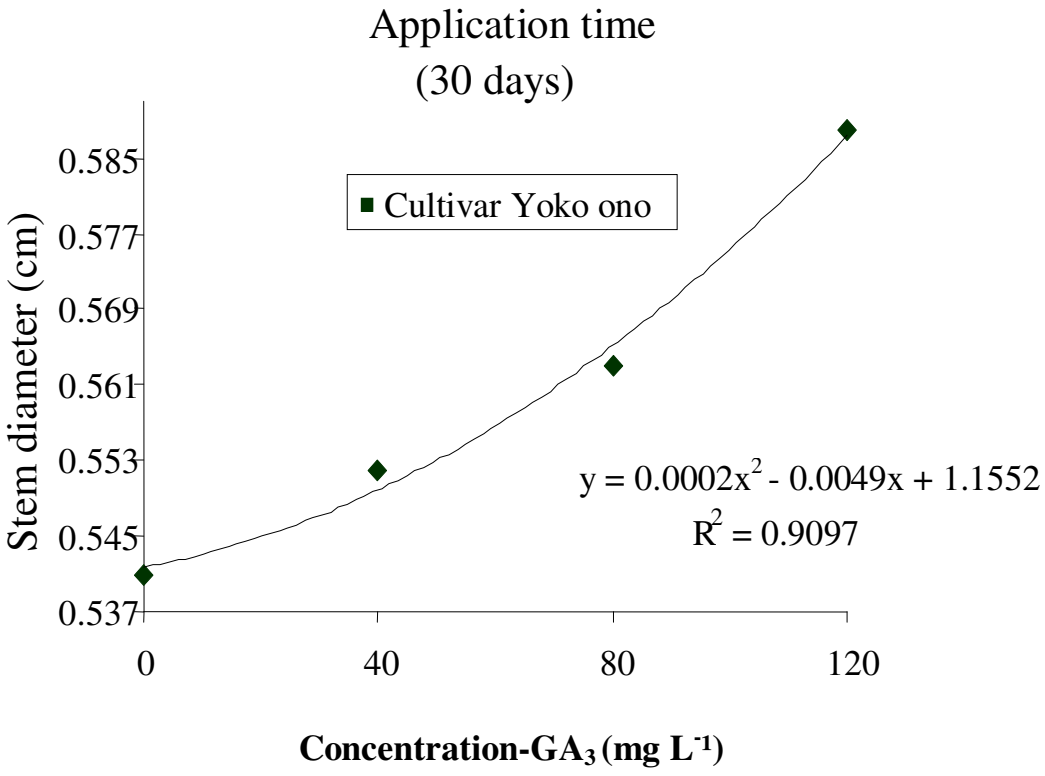

Figure 2. Diameter of the stems in chrysanthemum 'Yoko ono', with the application of different concentrations of GA_3 at 30 days after transplanting seedlings; Cordeirópolis, SP, 2007.

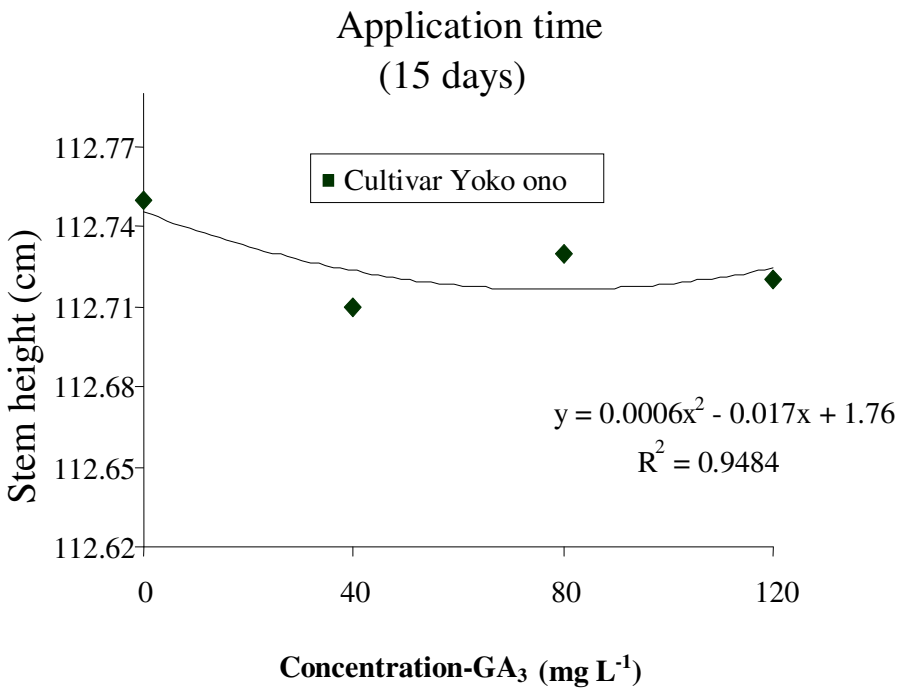

Figure 3. Height of chrysanthemum stems 'Yoko ono' with the application of different concentrations of GA_3 at 15 days after transplanting of seedlings; Cordeiropolis SP, 2007.

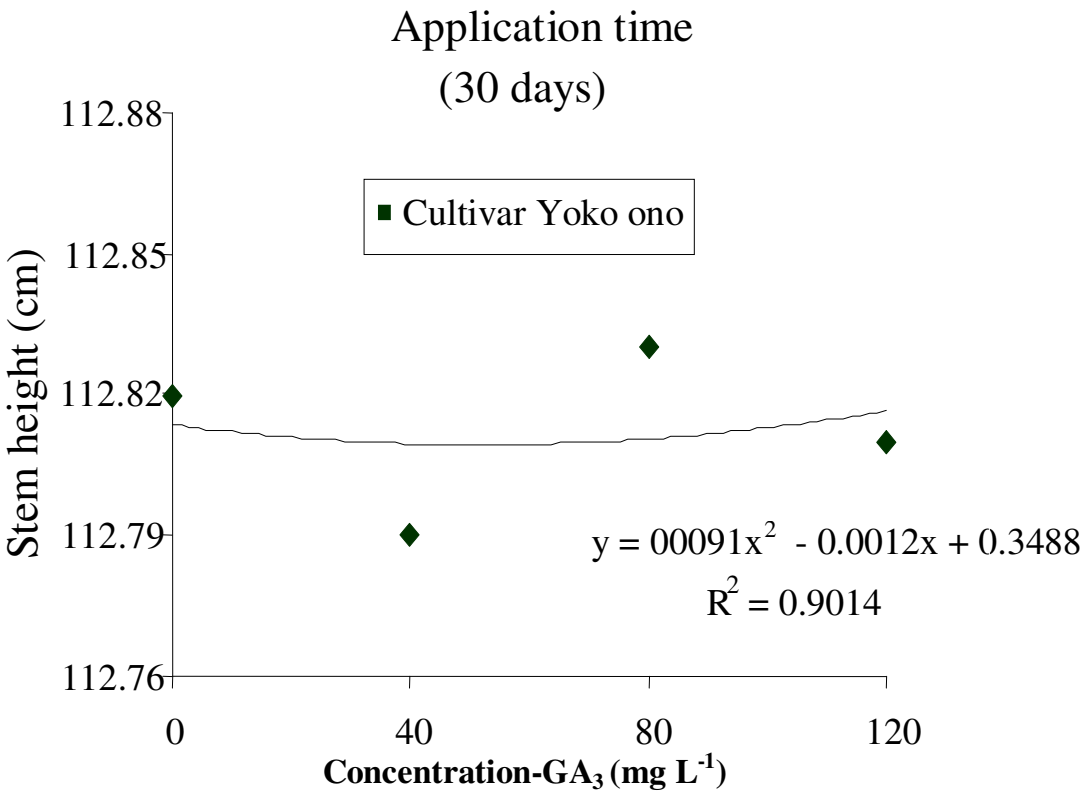

Figure 4. Height of chrysanthemum stems 'Yoko ono' of the application of different concentrations of GA_3 at 30 days after transplanting of seedlings; Cordeiropolis, SP, 2007.

These reports are evident in chrysanthemum cultivar Yoko ono where the application time has an effect on stem diameter, which is more efficient when GA_3 applications are made earlier. The height parameter of the stem did not show any change when compared with the untreated stems. Therefore, assessment of height and diameter of chrysanthemum cultivar Yoko ono under the effect of gibberellic acid deserves more attention, particularly in comparative research with other applications in the field for different cultivars, in order to better define quality according to the consumer market.

Conclusions

The times of application and use of the concentration of 120 mg L^{-1} gibberellic acid (GA_3) affected the stem diameter of chrysanthemum cultivar Yoko ono. Concentrations (0, 40, 80 and 120 mg L^{-1}) did not change the height of the stems.

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