Effects of Uniconazole-P and Paclobutrazol Application on the Growth and Flowering of *Euryops Pectinatus* Cass.

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***Abstract*—Effects of uniconazole-P and paclobutrazol foliar application on the growth and flowering of *Euryops pectinatus* Cass. were investigated. Uniconazole-P was more effective than paclobutrazol in inhibiting stem elongation. Uniconazole-P at 12.5 mg/l was suitable for culture in pots 9–12 cm in diameter. To increase the number of flower-bearing shoots, the timing of uniconazole-P application was also examined. The most effective treatment was duplicate application, the first 10–14 days after pinching and the second 2 weeks after the first treatmant. Uniconazole-P decreased the node number necessary for flower bud differentiation of *Euryops pectinatus* Cass. to 4-5.**

***Index Terms*—*Euryops Pectinatus* Cass., growth and flowering control, growth retardant**

I. Introduction

The Euryops daisy (*Euryops pectinatus* Cass.) is a subshrub in the Asteraceae family that originated in South Africa. Each plant contains approximately 14 yellow flowers. Because it is resistant to cold and also grows well in dry conditions, it is cultivated widely in Japan for use in flower beds and pots. It is of high ornamental value, but new shoots can rapidly branch out from the plant and disturb its orderly plant shape [1]. Thus, there is a strong need to develop ways to maintain a compact shape for cultivation in flower beds and pots [2]

. In this study, we examined the effectiveness of dwarfing agents in the Euryops daisy and explored dwarfing treatment methods to shape it in a more desirable form.

II. Materials and Methods

Cuttings from an unknown variety of Euryops daisy were planted in rooting soil (Akadama (red granular) soil: perlite, 1:1) on December 18, 2002. On January 20, 2004, these cuttings were planted in 9-cm-diameter polypots filled with a 6:3:1 mixture of Akadama: leaf mold: vermiculite. On February 20, the plants were settled in 15-cm-diameter plastic pots filled with the same mixture of soils. The first buds were thinned on March 15, with a second thinning on April 10. Eight pots were included in each test. Five side branches in each pot were selected for periodic length measurement. The experiments were conducted in an irrigated glass house with a temperature range of 10–28 ℃. Plants were treated with 4 g /L of slow release fertilizer (N:P_2O_5:K_2O = 13:16:10; Chisso Asahi; long total flower no. 1,100; day type; Tokyo, Japan), which releases approximately 80% of the fertilizer over 100 days. No supplementary fertilizer was used. Concentrations and application methods for testing individual dwarfing agents were chosen based on their characteristics. The test concentrations were chosen based on the standard concentrations for each agent as follows: chlormequat 300× (1500 ppm) and 500× (920 ppm), paclobutrazol 5,000×(40 ppm) and 10,000×(20 ppm), uniconazole 15× (300ppm) and 25×(200 ppm), and ancymidol 50×(5 ppm) and 100× (3 ppm). For each concentration, treatment sections for soil drench application and foliage application as well as a control section were set.

The soil drench application was performed after the thinning on April 10, and the foliage application was performed on April 22 while measuring the length of the side shoots (cm) and the number of leaves. One hundred milliliters of each treatment agent was applied to each pot in the soil drench application, while 10 mL was applied to each pot in the foliage application. The length of the side shoots, the number of leaves, and the date of the first flowering were recorded approximately every 2 weeks.

III. Results

Shoot growth in the soil application treatment is shown in Fig. 1. The most effective treatment for dwarfing was the one with uniconazole, followed by paclobutrazol, ancymidol, and chlormequat. The first three agents were very effective at dwarfing the plant at both concentrations tested, whereas the chlormequat treatment was less effective.

Shoot growth in the foliage application treatment is shown in Fig. 2. The uniconazole treatment was most effective for suppressing shoot growth, followed by paclobutrazol, ancymidol, and chlormequat. Ancymidol was effective for inhibiting growth when applied to the soil, but vigorous growth was still apparent when it was applied to the foliage [1]. Chloromequat was ineffective in both

Manuscript received July 22, 2017; revised November 6, 2017.

doi: 10.18178/joaat.5.1.31-35

cases. Therefore, these two agents were considered to be ineffective for inhibiting growth.

On the basis of the side shoot length at the time of flowering (Table I and II), soil drench treatments with uniconazole, paclobutrazol, and ancymidol were markedly effective at suppressing the side shoot growth. A high inhibitory effect was also observed when uniconazole was applied to the foliage. The number of leaves on each side shoot tended to be proportional to the length of the shoot [2]. In addition, in cases where the treatments caused slight shoot elongation, the nodes were compressed together, and the leaves also tended to have a lower surface area (data not shown).The flowering dates for all plants with dwarfing agent treatments tended to be earlier than those for the control.

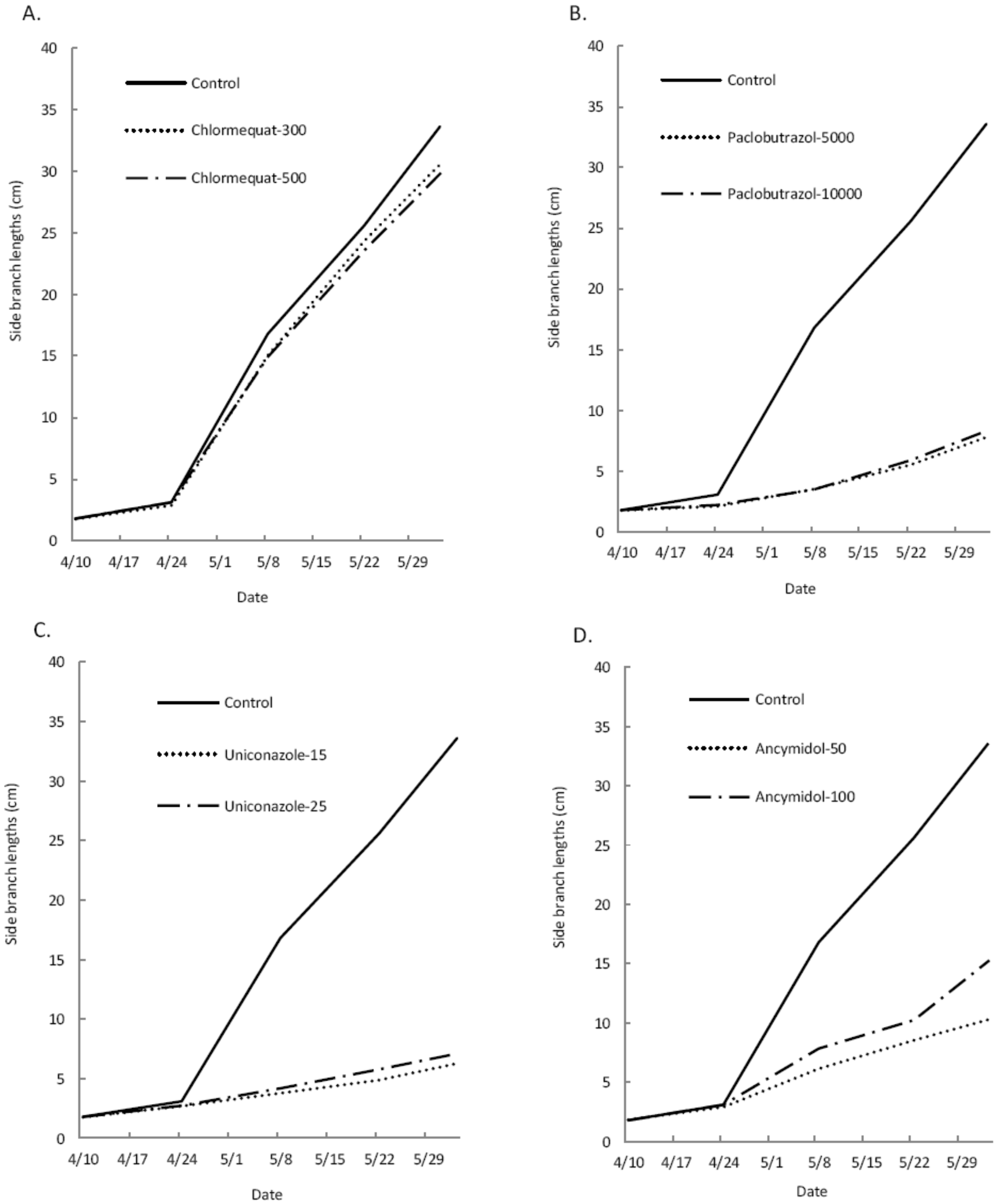

Figure 1. Effect of plant growth retardants treatment (soil drench) on side branch lengths of *Euryops pectinatus* Cass. A. Chlormequat B. Paclobutrazol C. Uniconazole D. Ancymidol

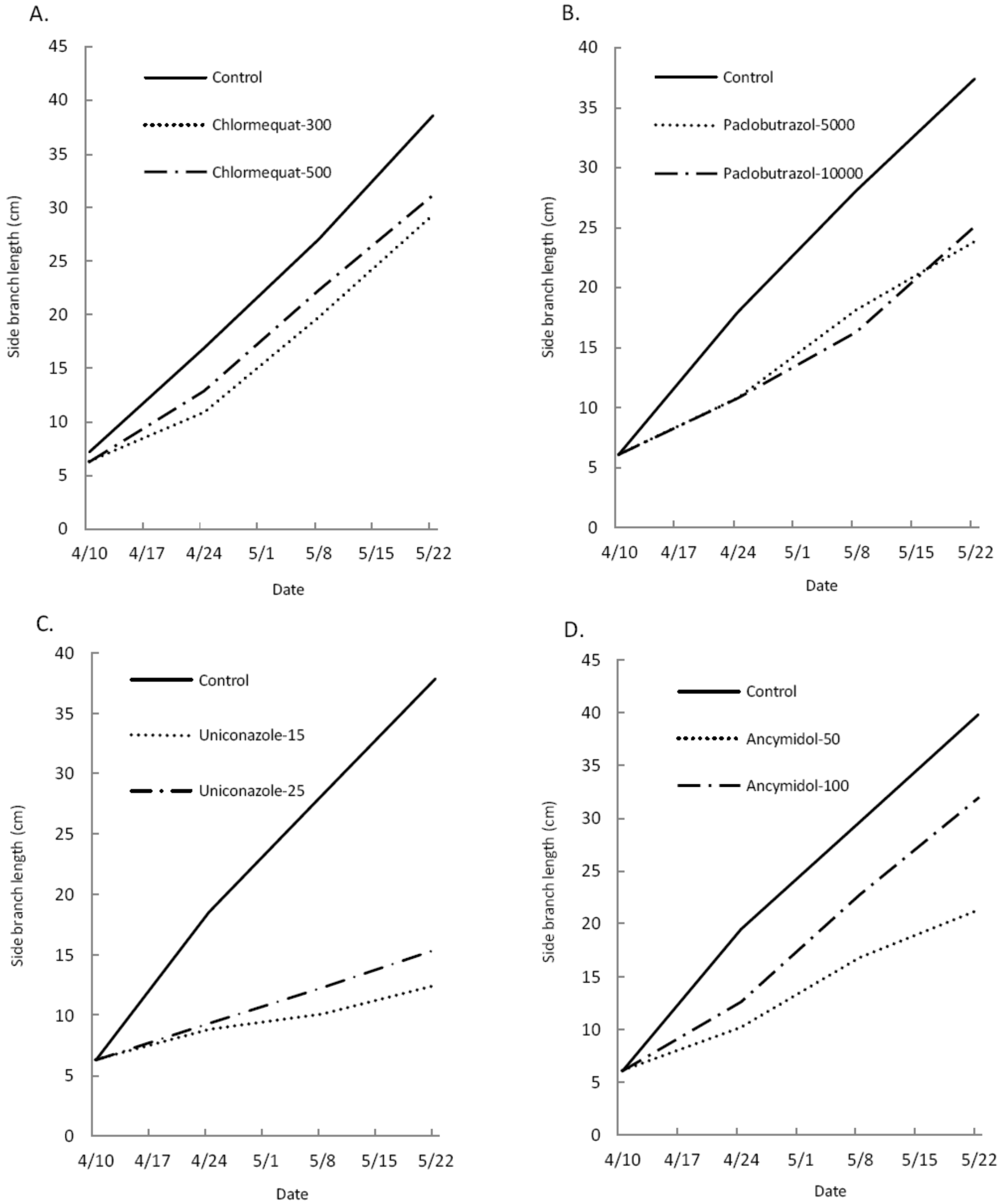

Figure 2. Effect of plant growth retardants treatment (spray) on side branch lengths of *Euryops pectinatus* Cass. A. Chlormequat B. Paclobutrazol C. Uniconazole D. Ancymidol

TABLE I . EFFECT OF PLANT GROWTH RETARDANTS TREATMENT (SOIL DRENCH) ON FLOWERING OF EURYOPS PECTINATUS CASS.

Treatment	Date of flowering (Month・Day)	Length of branch (cm)	Number of leaf (sheets)
Control	5・25	39.2az	33.7a
Chlormequat-300	5・19	30.2c	18.3c
Chlormequat-500	5・19	33.6b	21.7b
Paclobutrazol-5000	5・17	*2.6e	12.3f
Paclobutrazol-10000	5・18	*3.4e	14.4e
Uniconazole-15	5・17	*1.6e	*5.6h
Uniconazole-25	5・17	*2.8e	*8.2g
Ancymidol-50	5・14	*4.5e	13.9f
Ancymidol-100	5・15	*8.6d	17.5d

z: Different letters within columns indicate significant differences by Tukey's multiple range test ($p < 0.05$).

TABLE II . EFFECT OF PLANT GROWTH RETARDANTS TREATMENT (SPRAY) ON FLOWERING OF EURYOPS PECTINATUS CASS.

Treatment	Date of flowering (Month・Day)	Length of branch (cm)	Number of leaf (sheets)
Control	5・25	39.2az	33.7a
Chlormequat-300	5・20	31.2c	16.7f
Chlormequat-500	5・18	33.9b	20.2d
Paclobutrazol-5000	5・17	23.1f	14.3g
Paclobutrazol-10000	5・19	24.6e	16.4f
Uniconazole-15	5・18	*9.6g	*7.2i
Uniconazole-25	5・16	11.3e	*9.2h
Ancymidol-50	5・12	29.4d	22.6c
Ancymidol-100	5・16	26.1e	27.5b

z: Different letters within columns indicate significant differences by Tukey's multiple range test ($p < 0.05$).

IV. DISCUSSIONS

Currently, a large number of flower species produced for cut flowers and potted plants has grown in Japan, and facility-based production methods have been diversified [3], [4]. To address the diverse needs, the search continues for production methods that are more labor saving and produce higher quality products. Because this demand cannot be addressed by cultivation technology alone, growth modulating substances are increasingly being used [5].

The dwarfing agents used in this study suppress shoot growth by inhibiting gibberellin biosynthesis. Uniconazole was found particularly effective when applied to soil or foliage. Uniconazole, paclobutrazol, and ancymidol are thought to act on the same site in the gibberellin biosynthesis pathway of plants [6]. The results from this study may represent the effects of different test concentrations of the agents or different suppressive effects due to their potency differences. Chloromequat showed little inhibitory effect regardless of the concentration or application method. Given that chlormequat can be used for a limited number of plants compared to other agents and shows little dwarfing effect in other plants [7], Euryops daisy also appears to be a plant in which chlormequat is not effective.

Practically, the use of dwarfing agents and other chemicals in flower growing requires considerations on the associated labor and costs. Although the soil drench application has been shown to have a dwarfing effect, the results from our experiment suggest that the foliage application may be more economical because it requires less labor compared with that required by soil drench application. In addition, small concentration differences occurring in the preparation of chemicals for the application can cause a major effect on plant growth. When choosing an agent for use on the Euryops daisy, it is important to select the one in which a small error in concentration would not have a large impact on the effect. Among the dwarfing agents used in this study, uniconazole and paclobutrazol appeared to exert the most potent dwarfing effect.

Uniconazole and paclobutrazol have very similar structures, and are thought to act on the same site. Although our results did not show a large difference in their effectiveness as dwarfing agents, uniconazole has been reported to show a large variability depending on the treatment concentration [8]. Paclobutrazol has been reported to be effective at relatively low concentrations, or even when applied to seeds or cell-formed seedlings. Thus, taken together with our results, these findings suggest that the foliage application of paclobutrazol is suited for dwarfing Euryops daisy cultivation.

Our results confirmed the inhibition of new shoot growth by the application of dwarfing agents, including the particularly strong effect of paclobutrazol treatment. Further experiments on the concentration and time for treatment with dwarfing agents are required to control the shape of Euryops daisy to a more desirable form.

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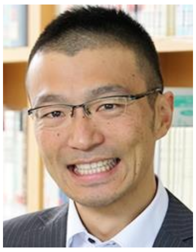

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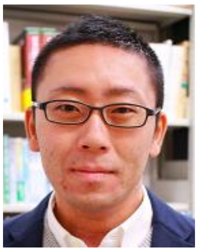

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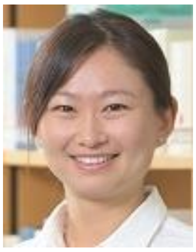

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