Control of Height and Flowering of *Ixia* Hybrids as Container Plants

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Abstract. Growth and flowering of *Ixia* hybrids as potted plants can be controlled environmentally by cool preplant storage of corms, regulation of greenhouse forcing temperatures, and application of a growth retardant. Paclobutrazol applied as a preplant corm soak, a postemergent drench, or a postemergent spray in combination with a 2- to 4-week preplant storage of corms at 7 °C, and an 18 °C day/10 °C night forcing temperature produced attractive and marketable plants. Chemical name used: β -[(4-chlorophenyl)methyl]- α -(1,1-dimethylethyl)-1H-1,2,4-triazole-1-ethanol (paclobutrazol, Bonzi®).

Ixia is a genus of ≈ 50 species native to South Africa. Commonly known as corn-flowers or corn lilies, they are winter-growing, summer-dormant perennials. Hybrids are grown as cut flowers in Europe, and as garden plants in warmer regions of the United States. [U.S. Dept. of Agriculture hardiness zones 8–10, 6–8 with protection]. *Ixia* corms produce lance-shaped leaves and a spike with star-shaped flowers (3–4 cm across) consisting of six tepals in a variety of colors. Pot production of *Ixia* in the United States is limited because plants grow tall (60 cm+) and require staking or wire-framed supports to be held upright (DeHertogh and LeNard, 1993; Everett, 1982).

The performance of *Freesia*, a relative of *Ixia* in the family Iridaceae, is influenced by preplant storage temperatures, forcing temperatures, and plant growth regulator applications. Ancymidol [α -cyclopropyl- α -(4-methoxyphenyl)-5-pyrimidinemethanol] and paclobutrazol reduced plant height and flower stalk length of *Freesia*, but did not affect the number of flowering spikes per pot or the number of days to flower (Gianfagna and Wulster, 1986). Preplant storage of corms at 5 °C reduced leaf and flower stalk length and hastened bloom. Combinations of plant growth regulator applications and cool preplant treatments of *Freesia* corms produced the greatest reductions in leaf and flower stalk length (Wulster and Gianfagna, 1991).

Preliminary work by the senior author suggested that *Ixia* responds to temperature and plant growth regulator applications in a manner similar to *Freesia*.

The objective of this study was to evaluate the suitability of *Ixia* as a container crop using chemical and environmental treatments similar to those that were successful in growing several *Freesia* cultivars for the container market.

Materials and Methods

Two thousand corms (6 cm diameter) each of a red-flowering and a white-flowering *Ixia* hybrid (no cultivars stated) were ordered through The Langeveld Bulb Co., Freehold, N.J., in Sept. 1996. On 21 Nov. 1996, the corms were planted (5 per 810 mL pot) 2 cm deep in a growing medium consisting of 35% sphagnum peat, 35% vermiculite and 30% rockwool supplemented with (kg·m⁻³): 4 dolomitic limestone, 1 0N–8.7P–0K, 1.2 5N–4.4P–4.2K, 0.03 fritted trace elements (Peters, Fogelsville, Pa.), and 0.07 Aquagrow granular surfactant (Aquatrols, Pennsauken, N.J.). After emergence, the plants were fertigated once weekly, alternating 100 mg·L⁻¹ N as 20N–4.3P–16.6K with 100 mg·L⁻¹ N as CaNO₃ (15.5N–0P–0K).

Corms (500 of each cultivar) were placed at 7 °C in open trays 0, 2, 4, and 6 weeks prior to 21 Nov., when all were removed and planted. The pots were held under a “cool” (18 °C day/10 °C night) or a “warm” (22 °C day/18 °C night) temperature regime established in separate sections of a glasshouse. Temperature treatments were not replicated and consequently were treated as blocks in the statistical analysis. Paclobutrazol (all concentrations in a.i.) was applied in three different ways: soaking of corms; soil application following planting; and as a foliar spray. Corms were soaked overnight (15 h) in paclobutrazol solutions (0, 50, or 100 mg·L⁻¹)

immediately prior to planting. Paclobutrazol was applied as a soil drench (0.25 or 0.50 mg/pot) when plants were 3 cm tall, or sprayed twice (100 or 200 mg·L⁻¹) on the plants when they were 8 and 20 cm in height. The four storage durations and seven growth regulator treatments were arranged factorially, giving 28 treatment combinations for each cultivar in each glasshouse, with seven pots per treatment.

The days from planting to anthesis were recorded for the first plant to bloom in each pot. After all the flowers in each pot had senesced, leaf and flower stalk length (from medium surface to tip) and the number of flowers in each pot were recorded. The SAS statistical procedure GLM (SAS Institute, Gary, Ind.) was used for analysis of variance of all variables because of missing data in some treatments. Means were separated by a Fischer's protected LSD at $P \leq 0.05$ when F values were significant.

Results and Discussion

Reduction of leaf and flower stalk lengths, and of number of days to anthesis was generally proportional to the number of days of exposure to the 7 °C pretreatment (Table 1). The white *Ixia* hybrids produced fewer flowers than did the red hybrids, but the flower numbers of both hybrids were reduced to a similar degree by the longest pretreatment (6 weeks). *Ixia* responded to cool preplant storage treatments in a manner similar to *Freesia* (Wulster and Gianfagna, 1991).

Both red and white *Ixia* grown in the warmer greenhouse “block” had significantly longer leaves, fewer flowers, and greater number of days to anthesis. Warmer temperatures reduced flower stalk length of the red *Ixia*, but not the white (Table 1).

All six paclobutrazol treatments reduced leaf and flower stalk lengths of both the red and white *Ixia* (Table 1), but the 200 mg·L⁻¹ spray was the most effective. The leaf and flower stalk reductions were similar in magnitude to those of the 7 °C preplant storage treatments. No treatment interactions were significant for white *Ixia*; however, a significant interaction was observed between PGR treatment and storage time for the red cultivar for the variables leaf and flower stalk length (Table 1). The effects of spray treatments on height did not change with storage time, while drench and preplant soaks reduced height to a greater extent as storage time increased. We suggest that the reason for this was the reduction in length and consequently leaf area with increasing corm storage time. The leaf area to be sprayed became less; consequently, we were delivering less material in covering the foliage. The flower stalks were not accessible to direct spray, so the amount of material actually available to translocate to the stalk was also reduced. Although a similar pattern was observable for the white cultivar, it was statistically nonsignificant. This is consistent with the observation that the red cultivar in general was more responsive to the various treatments than the white.

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Table 1. Main effects of time of storage of corms, greenhouse temperature, and method of paclobutrazol treatment on growth and flowering of red and white *Ixia*

Treatment cv.	Length (cm)				Flowers per pot		Days to anthesis	
	Leaves		Flower stalks		Red	White	Red	White
	Red	White	Red	White				
Storage of corms at 7 °C (weeks)								
0	41 a ^z	50 a	49 a	64 a	96 b	51 a	150 a	156 a
2	41 a	50 a	46 b	64 a	102 a	54 a	139 b	145 a
4	40 b	47 b	43 c	57 b	93 b	55 a	126 c	120 b
6	36 c	42 c	38 d	52 c	80 c	44 b	101 d	112 b
Greenhouse temperature ^y								
Cool	37 a	42 a	47 a	58 a	112 a	58 a	123 a	126 a
Warm	43 b	52 b	41 b	60 a	73 b	44 b	134 b	141 b
Paclobutrazol treatment								
0	54 a	64 a	85 a	94 a	103 a	54 a–c	122 d	124 a
Corm soak (mg·L ⁻¹)								
50	40 c	47 c	41 c	59 c	96 bc	49 cd	133 b	135 a
100	35 e	42 e	34 d	50 e	76 e	42 e	137 a	141 a
Drench (mg/pot)								
0.25	43 b	51 b	51 b	68 b	100 ab	57 a	124 d	142 a
0.5	38 d	45 d	40 c	55 d	93 c	52 b–d	128 c	128 a
Plant spray (mg·L ⁻¹)								
100	36 e	44 de	33 d	49 e	96 bc	55 ab	128 c	130 a
200	31 f	37 f	24 e	38 f	85 d	47 de	131 bc	135 a
Interactions								
PGR × storage ^x	*	NS	*	NS	NS	NS	NS	NS

^zMean separation within factors and columns by Fischer's protected LSD, $P \leq 0.05$.

^yCool = day 18 °C, night 10 °C, warm = day 22 °C, night 18 °C. Insufficient space prevented the replication of greenhouse temperature treatments which were treated as blocks.

^xPGR × storage was significant at $P \leq 0.05$.

^{ns}Nonsignificant.

The number of flowers produced by the white *Ixia* was reduced by the preplant soak at 100 mg·L⁻¹ and by the spray at 200 mg·L⁻¹. The red *Ixia* was more responsive to treatment, and only the 0.25-mg drench did not reduce the number of flowers. Time to anthesis for white *Ixia* was unaffected by paclobutrazol treatment, but all treatments except the 0.25-mg

drench delayed anthesis for red *Ixia* (Table 1). The variability in days to anthesis was high for white *Ixia*, especially for those grown in the warmer greenhouse, resulting in statistically insignificant differences despite a wider range in flowering times. In addition, the first plants to bloom were consistently those that developed from corms subjected to the 6-week storage

treatment and then grown in the warmer greenhouse without paclobutrazol. As observed for *Freesia* (Wulster and Gianfagna, 1991), the mechanism by which paclobutrazol reduces leaf and flower stalk elongation of *Ixia* may differ from that involved in preplant cooling, because paclobutrazol can delay anthesis, whereas preplant cooling hastens it.

Ixia hybrids can be grown as compact potted plants by manipulating the environment and employing a plant growth regulator. Several of the paclobutrazol treatments reduced leaf and flower stalk lengths without reducing flower number or delaying anthesis. Paclobutrazol in combination with a 2–4 week preplant cool storage, and cool growing temperatures in the greenhouse, produce a marketable plant. Greenhouse production of *Ixia* as a flowering container plant could be scheduled between more traditional fall and spring crops. The nonuniform responses of the two *Ixia* hybrids in this study, however, reflect basic differences that transcend flower color, and should be taken into consideration when growing members of this genus.

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