North Carolina Flower Growers' Bulletin

VOL. 22 NO. 2

JUNE 1978

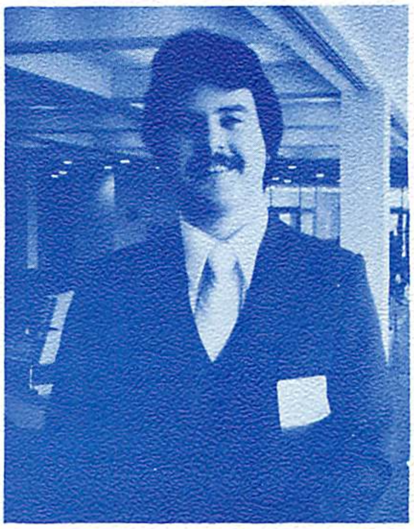
OFFICIAL PUBLICATION OF THE N. C. COMMERCIAL FLOWER GROWERS' ASSOCIATION

EFFECTS OF WATER TEMPERATURE ON EASTER LILIES (Lilium longiflorum)

Andy McMurry[1]

Temperature of irrigation water and its effects on plant growth and flowering has long been of interest to floriculturists. Experiments have been conducted to measure soil and water temperature effects. Allen (1) reported optimum soil temperatures for the following greenhouse crops: stocks, calendulas, snapdragons, and freesias. Pfahl, et al. (5) concluded that the application of warm water to roses did not increase growth, production, nor quality of flowers. Kohl, et al. (3), also working with roses, further reported that soil temperature above 65°F caused reductions in root growth and flower production. Carpenter and Rasmussen (2) found that cold irrigation water had an observable effect on stomatal behavior, leaf turgidities, and growth on roses and potted chrysanthemums. They recommended that flower producers in cold climates consider heating the irrigation water. Mastalerz and Cathey (4) however, earlier reported that soil and water temperature had no effect on the height of Easter lilies, bud count, or time of flowering. Carpenter and Rasmussen (2) and Seeley and Steiner (6), at Michigan State University and Cornell University, respectively, observed that mid-winter irrigation water is sufficiently cold to lower soil temperatures below optimum levels. At The Pennsylvania State University Pfahl, et al. (5) found that in 60°F greenhouses, the soil temperature returned to normal 7 to 8 hours after the application of 44°F, 75°F, or 80°F water, and within 3°F of the air temperature 4 hours after watering.

This project attempted to combine the best ideas of these earlier researchers. In conjunction with the obvious concerns about a typical floricultural crop, i.e. root and plant growth, degree and time of flowering, other objectives of this project included observations on fungi development and soluble salt accumulation at different water temperatures. Easter lilies (Lilium longiflorum) were chosen as the experimental crop because tap water can be quite cool during the Easter lily season and air temperature has a great influence on its growth and flowering.



Andy McMurry

[1]This study was conducted as an Honors Research problem (ALS-499H) at North Carolina State University. Roy Larson was advisor to the author on the project.

Lily bulbs (cv. Ace) used in the experiment were obtained from Fred C. Gloeckner and Company, Inc. The bulbs had been case-cooled, and were 8/9 inch circumference bulbs. The bulbs were received on December 15, 1977 and planted on that date in 6" standard pots, one bulb per pot. Prior to planting, the bulbs were dipped in Benlate fungicide for 5 minutes. The potting medium was composed of three parts pine bark humus, one part acid peat moss, and one part sand, on a volume basis. The peat moss and sand were sterilized, but the pine bark humus was not sterilized. After shoot emergence, the plants were lighted from 10 PM to 2 AM for 7 nights. The greenhouse temperatures were 65°F night, 75°F day. The experiment began on January 13, 1978. The average height of the lilies on this date was 12.4 cm.

The plants were separated into four water temperature treatments:

Group A	55°F	(13°C)	.......Equal to unheated tap water at this time of year ±2°F
Group B	65°F	(18°C)	
Group C	75°F	(24°C)	
Group D	85°F	(29°C)	

There were 12 plants per treatment and the plants were randomized on the bench. At the start of the experiment, the plants received 150 ml (approximately 6 ounces) of water per pot at each watering. On Febraury 2, the amount of water applied to each pot was increased to 200 ml because of increased plant growth. Two-hundred and fifty ml was the final amount of water applied and this change occurred on February 26. The lilies were watered at approximately 1 PM. Temperatures were recorded following irrigation to determine the extent and longevity of temperature change in the soil, using Taylor's Soil Testing Thermometers.

The lilies were fertilized weekly with 35 oz. calcium nitrate (992 g) and 18.3 oz. potassium nitrate (519 g) dissolved in 6 gallons of water (22.7 g) and applied at a water/fertilizer ratio of 15 to 1. The appropriate water temperatures were used when the fertilizer solution was applied.

The plants were not treated with any growth retardants. Plant heights were measured weekly to determine any variability between the groups. Also, no attempt was made to schedule the crop for Easter Sunday, March 26th, by increasing or decreasing air temperature.

RESULTS

The maximum average time necessary for soil to return to preirrigation temperature was when 55°F water was used. Approximately two hours were necessary to return to within 1°F of the original temperature and the average drop in temperature was 8°F (4.4°C) in this group. The 65°F water and 85°F water caused soil temperature changes averaging 4°F below and 3°F above the original soil temperature, respectively. Within 75 minutes after watering, these soils returned to pre-irrigation temperatures. The 75°F water had no effect on soil temperature as it equalled the greenhouse air temperature.

More dense root masses were found in the Group C and Group D pots, (75°F and 85°F treatments, respectively) (Table 1). Roots were found to be particularly dense near the upper soil surfaces of the pots. This dense growth made it difficult to wash off the potting medium from the roots prior to fresh weight readings. Group A and Group B (55°F and 65°F, respectively) were markedly easier to break up. No root rot problems were encountered even though the plants did not receive a Benlate fungicide drench during the growing season. This could be mainly attributable to clean bulbs, good watering practices and sanitary greenhouse conditions.

Table 1. Effects of water temperature on growth and flowering of 'Ace' Easter lilies.

	Group A (55°F)	Group B (65°F)	Group C (75°F)	Group D (85°F)
Height at start of experiment	13 cm	12 cm	12 cm	12 cm
Final flowering height (from edge of pot)	54 cm	53 cm	55 cm	58 cm
Final root mass fresh weight (including bulb)	208 g	193 g	244 g	250 g
Bud count (per pot)	4.4	4.5	4.7	4.8
Average days to flower (from start of experiment)	64	65	65	65
Number of dead basal leaves (from soil line up)	3.7 cm	5.7 cm	4.7 cm	5.5 cm

Figures were established omitting highest and lowest values.

There was relatively little difference between the groups concerning flowering height, bud count, and days to flower (Table 1). The most obvious differences involved final root mass fresh weight. Except for plants in Group B (65°F), the fresh weights increased with increasing water temperature. Plants in Group C and D (75 and 85°F) showed markedly larger and more extensive root systems. This extensive growth was especially noticeable when the bulb and root systems were washed, to obtain fresh weights as noted earlier.

Records were made concerning the amount of dead lower leaves on the plants as this can sometimes present a problem in the overall appearance of the lilies. Differences were found among the four groups but did not follow any consistent pattern.

There were slight differences among the soil samples taken from each group (Table 2). The calcium level in the samples were all in the high range but increased directly as irrigation temperature was increased. Group D (85°F) exceeded the maximum measurement for calcium. Soluble salt buildup was found to be acceptable in all groups.

CONCLUSIONS

Root growth was increased by heating the water. Easter lilies used in this experiment did not differ greatly in height and flowering and all would have sold equally well. Heated water, however, could aid crops, such as foliage plants, which would benefit from increased root growth. It might also be possible to grow plants at lower air temperatures and reduce heating costs and fuel consumption by heating the soil and water. This possibility was not studied in this experiment. The treatments also started after the shoots had emerged, primarily because the Spring semester started then. Greater response to the warmer temperatures might have been realized if the treatments had started immediately after potting.

Table 2. "Soil" test readings obtained from potting medium used in water temperature study conducted on Easter lilies.

Water temperature	Analysis of various elements								
	P	K	Ca	Mg	Mn	NO_3N	SS	pH	Organic matter
Group A (55°F)	7	35	82	100+	16	36	29	6.3	10.0%
Group B (65°F)	5	48	89	100+	15	49	37	6.2	9.8%
Group C (75°F)	6	31	91	100+	16	41	37	6.2	10+
Group D (85°F)	6	32	100+	100+	23	30	32	6.3	10+