companion coverage
Grower 101: Bulb Soak Basics . . . . . .page 44

PGR Bulb Dips

Photo courtesy of U.S. Netherlands Flower Bulb Information Center

Now that you have learned the basics of bulb soaks, from page 44, find out, with this Cornell University research, if plant growth regulator dip solutions "wear out" with repeated use.

By William Miller, N.K. Damayanthi Ranwala and Anil Ranwala

Each year, many new lily hybrid cultivars are introduced to the market, mainly for use as cut flowers, and long stem length is an obvious characteristic of cut flowers. These cultivars, when grown as pot plants, require effective height control methods to keep the plant in aesthetic proportion to the container. Moreover, shorter plants are easier to handle and require less space during transportation, which makes them more economical to ship. The industry-preferred height of a lily in a 6-inch pot is approximately 22 inches including the pot.

Methods of Control

Height control in lilies is mainly through chemical plant growth regulators (PGRs). Foliar sprays, soil drenches and pre-plant bulb dips are all common methods of PGR application, and each has pros and cons. For example, foliar sprays have the advantage of being labor and material efficient, but sometimes lack effectiveness on oriental hybrids, which tend ➧

The effects of bulb washing and repeated dips into the same Bonzi or Sumagic solution with LA hybrid 'Fangio'. Two liters of Bonzi (200 ppm) or Sumagic (2.5 ppm) were used to dip 15 sets (only eight shown) of bulbs (six bulbs per set) repeatedly, one set at a time for 1 minute. In each photo, left to right: Control (no dip), water dip, then PGR dips (one bulb per set) from eight sets — 1, 3, 5, 7, 9, 11, 13, 15.

Bonzi, unwashed

Bonzi, washed

Sumagic, unwashed

Sumagic, washed

The effects of bulb washing and repeated dips into the same Bonzi or Sumagic solution with LA hybrid 'Fangio.' Two and a half liters of Bonzi (100 ppm) or Sumagic (2.5 ppm) were used to dip 24 sets (only eight shown) of bulbs (six bulbs per set) repeatedly, one set at a time for 1 minute. In each photo, left to right: Control (water dip), then PGR dips from eight sets (one bulb per set) — 3, 6, 9, 12, 15, 18, 21, 24.

Bonzi, unwashed

Bonzi, washed

Sumagic, unwashed

Sumagic, washed

to "spike up" before a foliage canopy capable of intercepting the spray is developed. Drenches can be highly effective but not with cultivars that are slow-rooting (the plant can't absorb the drench if no roots are present) and are affected by adsorption into, for example, pine bark.

Pre-plant growth regulator bulb dips are an alternative to spray and drench applications and have proven effective in the industry for controlling hybrid lily height. The advantages of pre-plant bulb dips over other methods of PGR application are early plant height control; correct dosage; and (potentially) cost, time and labor savings. Disadvantages are strength of the dip solution over time (after repeated dips), response variation throughout the year and disposal of the dip solution. Unexplained variation in dip effectiveness might be due to the bulb itself and include factors such as size, "tight" vs. "loose" scales and scale moisture content, which undoubtedly decreases during cold (frozen) storage. Non-bulb variables could include the dip solution temperature, presence of media particles in the dip solution, water pH and chemistry, etc.

As far as the dip solution is ➧

concerned, it is important to know whether the concentration or effectiveness of the solution changes with time as more bulbs are dipped in it. There is a powerful economic reason as well. Dip solution concentrations tend to be greater than those used for spray or drench applications. Therefore, the cost per bulb is directly related to the number of bulbs that can effectively be treated, hence the number of "repeated dippings."

It is also possible that cultural practices, such as washing the bulbs prior to dipping (to re-hydrate them and presumably improve uniformity), might alter the amount of PGR absorbed. Washed bulbs may not absorb as much PGR as unwashed bulbs. On the other hand, substrate particles on unwashed bulbs may adsorb some PGR that would otherwise be absorbed by the bulbs. In summary, all of these factors could influence the efficacy and repeatability of PGR bulb dips. A better understanding of these factors would help improve industry utilization of this technique, and this research was conducted to address these questions.

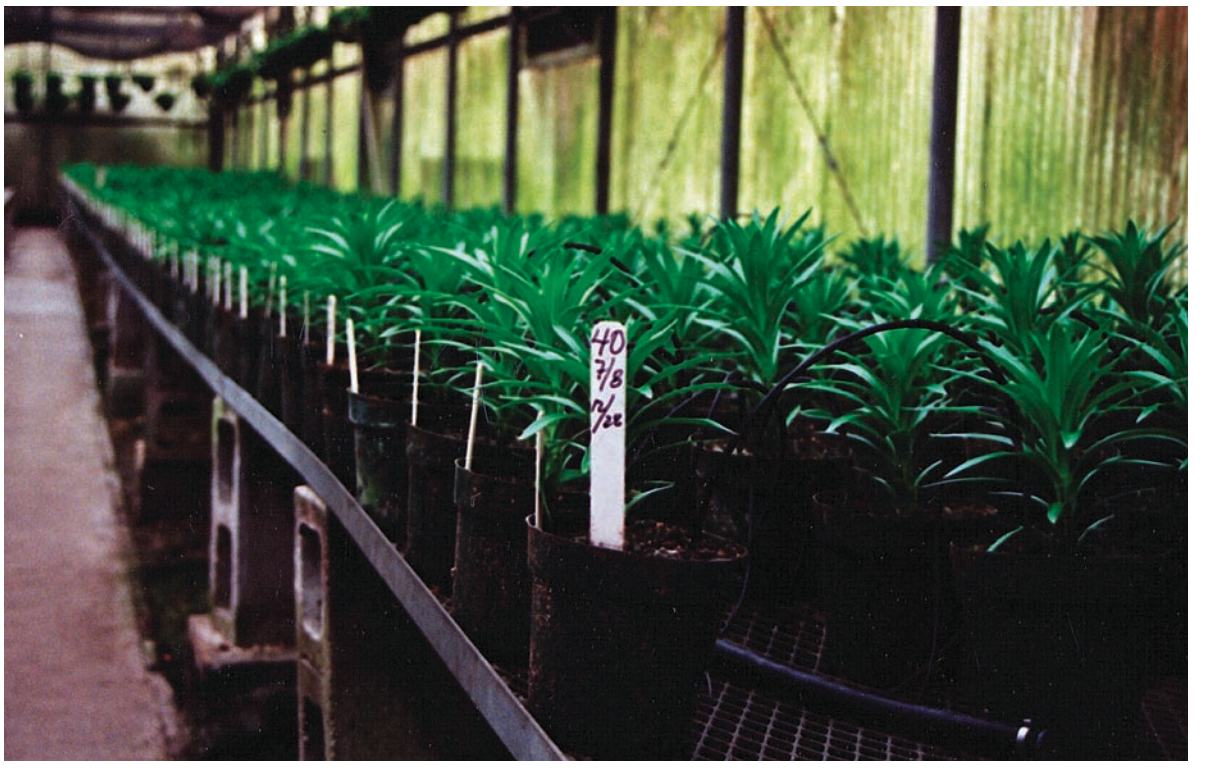
What we did

We conducted experiments based on two objectives: 1) to determine if bulb hydration before dipping changes the amount of PGR (liquid) absorbed and 2) to determine if PGR dip solutions become less effective as the number of bulbs treated increases.

In these experiments, we used precooled

Table 1. Plant height at flowering for LA-hybrid lily 'Fangio' bulbs (14/16 cm). Bulbs were either washed with tap water for 1 minute or left unwashed, then dipped into Bonzi (200 ppm in Experiment 1 and 100 ppm in Experiment 2) or Sumagic (2.5 ppm both experiments). Dip order refers to individual sets of six bulbs, each dipped sequentially into the indicated growth regulator (2 liters in Experiment 1 and 2.5 liters in Experiment 2). For brevity, only ⅓ of the dip order treatments are shown.

Bulb treatment	Dip order	Plant height at flowering (inches)			
		Bonzi		Sumagic	
		Expt. 1	Expt. 2	Expt. 1	Expt. 2
Unwashed	Control	34½	45	34½	45
	3	19	36½	20	29½
	6	17½	36	21½	29
	9	18	38	22	31
	12	20	35	24	29
	15	17	36	22	33½
	18	n/a	37	n/a	30
	21	n/a	36	n/a	32
	24	n/a	34½	n/a	32½
Washed	Control	36	45	36	45
	3	20½	37	22	33½
	6	20	38½	26½	36
	9	19	39½	24½	36
	12	20½	38	23	34
	15	20	38	24	35
	18	n/a	41	n/a	36
	21	n/a	41	n/a	36
	24	n/a	31	n/a	35½



Many new lily cultivars are introduced every year, and nearly all require height control methods.

bulbs (14/16 cm) of the LA hybrid lily 'Fangio'. Bulbs were either used straight from the case (with removal of most of the adhering peat moss used for packing; these were the "unwashed" bulbs) or were liberally rinsed (approximately 1 minute) with tap water to remove almost all of the adhering peat moss (these were the "washed" bulbs).

In the first experiment, 15 sets of six washed or unwashed bulbs were dipped for 1 minute into 2 liters of a PGR solution containing either 200 ppm Bonzi (paclobutrazol, Syngenta Professional Products) or 2.5 ppm Sumagic (uniconazole,Valent USA). After dipping, bulbs were allowed to drain before planting. All bulbs were weighed before and after dipping to determine the amount of liquid absorbed during the growth regulator dip. The bulbs were grown in 6-inch pots using Metro Mix 360 (Sun Gro Horticulture) in Cornell University greenhouses according to standard cultural practices.

In a second experiment, we increased the number of bulbs dipped into the PGR solution in order to further determine the longevity of dip solution. Twenty-four sets of six washed or unwashed bulbs (144 bulbs each) were sequentially dipped into 2.5 liters of 100 ppm Bonzi or 2.5 ppm Sumagic. Since height control in the first experiment was excessive, we reduced the concentration of Bonzi to provide a more rigorous test of the hypothesis (a less concentrated solution presumably would show greater loss of effectiveness). After dipping, plants were handled and grown as above.

What We Found

PGR liquid uptake in washed v. unwashed bulbs. We expected that washing bulbs would increase their water content and thereby reduce the amount of liquid absorbed during the PGR dip. The data confirmed this prediction: Unwashed bulbs absorbed about 1 ml more liquid (Bonzi or Sumagic) per bulb than did washed bulbs. And, the bulbs that were washed before dipping were somewhat taller than unwashed bulbs. The extent of the reduced height control by bulb washing varied by year and PGR. Bonzi-treated plants had slightly more yellowed lower leaves than Sumagic-treated plants.

Effects of repeated dipping on dip solution effectiveness. In these experiments, we dipped approximately 90 or 115 14/16 cm bulbs into about 2 quarts of PGR solution. In either experiment, plant height was not significantly different among the dip groups, and for both PGRs, the last-dipped bulbs were the same height as the first-dipped bulbs (see Figure 1, left). Thus, there was no change in height control as the Bonzi or Sumagic solutions became increasingly "used," regardless of whether or not bulbs were washed before dipping. The PGR solutions at the end of the dipping were dramatically different: The solution used to dip washed bulbs was quite clean, while the solution used for dipping unwashed bulbs was very dirty. These observations suggest that mineral soil or peat moss residue deposited in the dip solution probably did not absorb a ➧

Ongoing Bulb Research

The 2006 spring season will represent the 6th major forcing year of the Flower Bulb Research Program at Cornell University, Ithaca, N.Y. The first two growing seasons were devoted to upgrading facilities (including new greenhouses), installation of about 700 sq.ft. of state-of-the-art rooting rooms and capacity building of students and technical support. Cornell's flower bulb work is conducted in close cooperation with a research advisory group from The Netherlands and with input from many growers and industry stakeholders in the United States.

According to William Miller, the primary goal of the research program is to understand the internal and external (environmental) controls of carbon partitioning in greenhouse crops. Bulb crops are a large focus of the program, and the main purpose of this line of research is to discover ways to improve horticultural crop quality by exploiting crop carbohydrate content or metabolism. The program incorporates relatively applied whole-plant greenhouse/outdoor studies with more basic laboratory experiments appropriate to the specific questions being asked. Much useful research has come out of this program, including forcing information, evaluation of bulb cultivars, packaging and handling of bulbs, etc. And more cutting-edge research is underway, including:

- Use of GA4+7 as a practical anti-senescence agent in hybrid lily crops and testing of the hypothesis that oxidative stress enzymes and membrane deterioration as key steps in the early-senescence syndrome.
- Purification and characterization of amylases from tulip bulbs, possibly leading to an industry assay for proper temperature treatment of this crop.
- Use of controlled atmospheres to suppress stem growth in "dry-sale," retail lily bulbs and perennials.
- Industry-focused, practical research (forcing studies, growth regulators, etc.) on bulb crops.

The program's Web site contains useful information such as research results and a constant greenhouse camera, so you can see what's happening. Visit www.hort.cornell.edu/department/faculty/wmiller/bulb for more information.

significant amount of PGR since the effectiveness of the dip solution was unchanged even as the solution became quite dirty.

Our findings have an important impact on cost effectiveness of dips, as the more times the solution can be used, the lower the material cost. Based on the specific case from these experiments, using 2.5 liters of 100 ppm Bonzi to treat 144 bulbs costs approximately $0.06 per bulb (assuming $140 per liter for Bonzi). A similar calculation for Sumagic (assuming 2.5 ppm and $110 per liter) yields a per-bulb cost of $0.009. Obviously, the price competitiveness of a particular PGR depends on the concentration needed to obtain the desired response.

Based on this research, we conclude that growers may dip as many as 210 14/16-cm bulbs per gallon of Bonzi or Sumagic without loss of solution efficacy. GPN

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