A Brushing Apparatus for Height Control of Bedding Plants

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Summary. Height control for vegetable transplants has become challenging with the loss of the industry standard growth regulator, daminozide (Alar). One alternative to growth regulators—brushing—was conducted on two cultivars of *Lycopersicon esculentum* Mill. Five weeks of brushing twice daily resulted in height suppression for both tomato cultivars. Brushing treatments were performed successfully by use of a grower-designed apparatus constructed from readily available materials.

The ban of daminozide (Alar, Uniroyal Chemical Co., Middlebury, Conn.) on any edible crop has forced vegetable transplant growers to seek other methods for height control. Numerous methods of height control have been tested for bedding plants, including container size (Weston and Zandstra, 1986), copper sulfate filters (Benson and Kelly, 1990), seismic (shaking) responses (Latimer et al., 1986), temperature (DIF) (Heins and Erwin, 1990), nutrition (Melton and Dufault, 1991), and drought stress (McKee, 1981). Thigmomorphogenic responses of plants (response to brushing) also have been studied as an alternative to chemical growth regulation, especially for vegetable transplants.

Workers have reported reduction

in stem elongation ranging from 15% to 50%, depending on the vegetable transplant species/cultivar treated (Baden and Latimer, 1992). Potential benefits from brushing include a sturdier, darker-green plant (Latimer and Mitchell, 1988), rendering the plant more aesthetically pleasing for retail and more likely to tolerate shipping and field transplanting (Latimer, 1990). Latimer (1991) offered a review of mechanical conditioning for control of growth and quality of vegetable transplants.

The objectives of this study were to determine the effectiveness of brushing for height control of tomato transplants, and to observe a grower's ingenuity to construct a practical, cost-effective apparatus made from readily available materials and manageable by one employee.

Materials and methods

Lycopersicon esculentum Mill. 'Celebrity' and 'Jet Star' were planted from seed and, upon germination, were transplanted to 3.7 × 3.7-cm cell packs and grown in a 1 sphagnum peat : 1 perlite : 1 vermiculite mix (by volume). Brushing began upon transplanting and the plants were hand-watered uniformly as needed, receiving constant fertilization at ≈250 ppm (mg·liter⁻¹) N and grown under temperature of ≈18/16.5C (day/night).

No commercially available brushing apparatus exists. Therefore, the participating grower designed and built her own brushing apparatus (Fig. 1). Grower concerns in designing the apparatus were costs and time and ease of application of the brushing treatments, as well as flexibility of employment of the device in various areas of the greenhouse. To achieve maximum flexibility of employment, the device was built independently of the bench. The track guide, as well as the variable width adjustments (Fig. 1), precluded the need for hard-surface walkways and allowed the device to be used on any bench in the greenhouse. The prototype in Fig. 1 (dimensions of about 6 × 5 feet) was constructed at a cost of about \$200. The materials used were heavy enough to provide the necessary stability, yet light enough to allow one person to apply the brushing treatment. Brushing was performed twice daily by pulling or pushing the four-bar apparatus across the upper quarter of the seedlings 10 times, thus physically

stroking each plant 40 times twice per day. The multibarred apparatus design reduced the number of trips back and forth per brushing treatment. The four-barred design provided adequate height control as much as earlier models described in the literature (Baden and Latimer, 1992), but potentially with only 25% of the time investment needed for a single-bar apparatus. With the lightweight design and metal track system, the grower was successful in applying the treatments herself. The same individual performed the brushing each day for treatment consistency, devoting <5 min/day to treatments for a 5 × 8-foot bench. Brushing treatment continued daily, with the four bars adjusted higher as warranted by seedling growth. The grower used visual observations to determine when to raise the bar to restrict contact to the upper 25% of the plants' youngest growth. Plants on an adjacent bench were grown in an identical manner, except that they were not brushed throughout the study. Six plants were selected at random from each treatment and measured after 5 weeks of brushing (Table 1).

Results

The brushing treatment controlled transplant height (Table 1). The two cultivars ('Celebrity' and 'Jet Star') were depressed significantly in height—26% and 35%, respectively, in comparison to control plants. This reduction, although adequate for the grower's needs, was less than that achieved with other tomato cultivars in an earlier study (Baden and Latimer, 1992).

The grower achieved the other goal of successfully constructing a relatively inexpensive brushing apparatus from commonly available materials. Also, the grower estimated that the shelf life of the brushed plants was extended ≈2 weeks, thus potentially reducing lost sales. Customers favored the dark-green, compact plants, and thus were willing to purchase older plants. The grower intends to refine the brushing technique and pursue it on a larger scale next season.

Problems encountered

Should different crops of varying germination periods and ultimate mature heights be grown on one bench, it would be impossible to adjust the height of the brushing apparatus to satisfy all of the species' growth needs. Also, various species grown on one bench would

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Fig. 1. Isometric view of brushing apparatus.

likely respond to brushing in varying degrees of height control (Latimer, 1991). Therefore, crops must be segregated by natural growth characteristics (particularly height) in order to mix crops on one bench. Ideally, monocultures should be grown on each bench. Specific brushing treatments then could be applied and then terminated when height control was achieved, as the effects of brushing are temporary. Regardless of the crops being grown, brushing should be performed only on a dry canopy to prevent mechanical damage to the seedlings (Baden and Latimer, 1992) and to preclude the possibility of disease spread (Vavrina, 1993).

In addition, the grower's bench was constructed of welded mesh wire, which tended to sag, except near the bench's periphery. The sagging bench prevented crops from being placed at the exact same height prior to brushing treatments. Consequently, all bench surfaces must be level and constructed of high-quality, sturdy materials to

achieve uniformity in height-control response. The other alternative is periodic rotation of the plants' position on the bench. However, this would not be feasible in most commercial operations. Last, the floor itself was somewhat uneven, creating the same problem encountered with the benches. In this case, floors must be even or the tracks of the brushing apparatus must be rendered level to compensate for this event.

Future work

Oklahoma cooperators are interested in automating the apparatus and comparing the brushing technique described above against fans producing intermittent concentrated air blasts. Air blasts should induce a thigmomorphogenic response as well. Last, growers are interested in comparing crop yields of brushed vegetable transplants against plants grown conventionally.

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Table 1. Response of *L. esculentum* transplants to brushing initiated at the first-true-leaf stage.

Cultivar	Height (cm) ²		Significance
	Control	Brushed	
Celebrity	23.5	17.4	*
Jet Star	24.7	16.1	*

²Means for each cultivar are based on six plants selected at random per treatment.

*Significant at P = 0.05 by F-test.