Marigold Growth Following Transplanting at Several Stages of Development

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There are several studies investigating the relationship between plug size and subsequent growth. These studies involve large plugs (>7 cm^3). Marr and Jirak (1990) showed that tomato transplant size decreased with smaller root volumes and length of time held in plugs. Total tomato fruit yield after transplanting to the field, however, was not negatively affected. In marigold, transplants with smaller root volumes had decreased height for up to 7 weeks after transplanting into the landscape (Latimer, 1991). There are no reports on the influence of the smaller plug sizes (<7 cm^3) typical of bedding plant production on subsequent transplant development. The objective of this study was to examine marigold seedling growth and development after transplanting as affected by root restriction, canopy competition, and transplant shock.

In the first of these experiments marigold (*Tagetes patula* 'Little Devil Flame') was seeded into each cell of a 392-count plug trays (4 cm^3 per cell). Twelve seedlings were transplanted into 6-packs (42 cm^3 per cell) on Days 0, 5, 10, 15, 20, and 25. On Day 25 leaf area, shoot dry weight, root dry weight, and total root length (via analysis with computer software MacRhizo™) were measured. In the second experiment, marigold seeds were sown in both 392-count plug trays and community flats (512 cm^3) at three densities (20.8 plants m^{-2}, 29.5 plants m^{-2}, and 38.1 plants m^{-2}). On days 0, 10, 20, and 25, 12 seedlings from each planting density were transplanted into 6-packs. Plants were evaluated after 25 days. Twelve plug seedlings, 12 transplanted seedlings, and 12 seedlings directly sown into 6-packs were harvested on days 10, 20, and 25 and the above-mentioned measurements taken.

In the first experiment, shoot biomass of plug seedlings transplanted on Day 10 was significantly lower than Day 5 transplants. Root biomass of day 15 transplants was significantly lower than Day 10 transplants. Leaf area growth, shoot dry weight, root dry weight, and total root length of seedlings 25 days in plugs was significantly lower than those seedlings 25 days in 6 packs. These data suggest seedling development is negatively affected as roots become restricted. The second experiment revealed that seedlings sown directly into 6-packs had significantly more biomass than either plug or community flat seedlings. Plant density, or canopy competition, affects seedling biomass, however, root restriction has the greater effect on reducing seedling size. In the third experiment after 20 days, leaf area, shoot dry weight, and total root length were significantly lower than seedlings grown in 6-packs. Seedlings transplanted from plugs to 6-packs at Day 20 had lower total biomass than seedlings grown in 6-packs. Although the rate of growth post transplanting was higher than seedlings remaining in plugs, the rate was lower than the rate of growth for seedlings grown in 6-packs. These results suggest a minimal effect of transplant shock in the reduction of growth of plug transplants.

The results of this study suggest that transplant shock, shoot competition, and root restriction in the plug are all factors in the reduction of seedling growth following transplanting. Root restriction, however, appears to be the most critical factor in affecting transplant growth in 6-packs.

LITERATURE CITED

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Commercial Micropropagation Laboratories in the United States

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To determine the current status of commercial micropropagation in the U.S., an extensive survey of laboratories was made in March and April, 1996, by doing telephone interviews with the manager or owner of each laboratory. All laboratories contacted and currently doing commercial production provided data.

Commercial micropropagation laboratories are located in at least 26 states and most are situated near important production areas of the horticultural industries that they service. Florida leads in plants produced, followed by California, Washington, and Oregon. California and Florida each have more than 15 laboratories; all other states have fewer than 10 each. Within states, the laboratories are often clustered in certain areas. In Florida, the heaviest concentration is near Apopka, where much of the foliage plant production is located. California labs are clustered mainly in coastal areas near San Francisco, Los Angeles, and San Diego. The Pacific Northwest labs of Washington and Oregon are located west of the Cascade Range stretching from near the Canadian border to the south of Portland.

Production of individual laboratories varies from a few thousand to tens of millions of plants per year. Small laboratories (<500,000 units per year) account for about 60% of the slightly more than 110 laboratories identified; 24 of these small labs produce only 50,000 units per year or fewer. About 30% are medium-size laboratories (500,000-2,500,000 units per year); large laboratories (2,500,000-6,000,000 units) and very large laboratories (> 6,000,000 per year) account for the remaining 10%.

Total production of micropropagated plants is now more than 120 million plants per year, considerably higher than earlier estimates of 61 to 75 million plants (Hartman, 1995; Jones, 1985; Zimmerman and Jones 1991), but a much broader range of crops is now being micropropagated than 5 to 10 years ago. Also, more laboratories were identified and contacted to obtain the figures reported here. Plants now being micropropagated can be grouped according to their uses or area of horticulture as shown in Table 1.

Foliage plants, the largest category, have as the main crops ferns, *Spathiphyllum, Syngonium, Dieffenbachia, Ficus, Calathea,* and *Philodendron.* Orchids are about