Influence of Plant Age on Nutrient Absorption for Marigold Seedlings

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Abstract. Seedlings of 30-, 35, 40-, 45, and 50-day-old marigold (*Tagetes erecta* Big. 'Inca Gold') in 500-ml plastic pots containing a 1 peat : 1 perlite (v/v) medium were treated with several fertilizer levels (N at 20, 50, 80, and 110 mg-liter⁻¹); solution nutrient levels in the medium were determined 6 hours later. Older/larger container-grown plants absorbed more N, P, and K from the medium solution than younger/smaller plants. Also, older plants (>40 days) absorbed at least 88% of the solution N regardless of N treatment. Nitrogen absorption, regardless of plant age, increased as N application rates increased. The latter result implies that even though total N absorption increases with plant age/size, nutrient levels in the medium solution for optimal growth and nutrient uptake may be similar regardless of plant size.

A plant's nutrient requirement increases with age/size during periods of exponential growth. Therefore, the supply and uptake of nutrients must be increased to maintain maximum plant growth. This well-established concept has been demonstrated with plants growing in recirculating solution culture systems (Edwards and Barber, 1976a, 1976b; Edwards and Asher, 1974; Ingestad, 1979, 1981; Ingestad and Kahr, 1985).

Greenhouse crops are commonly fertilized at one application concentration throughout most of the production cycle, without regard to plant size or age. For example, floriculture crops (Mastalerz, 1977) and bedding plants (Mastalerz and Holcomb, 1985) are usually fertilized two to three times a week at 150 to 200 mg N/liter in the irrigation water. These recommendations are made without mention of plant age in relation to nutrient requirements. Little attention has been given to identifying nutrient requirements of container-grown plants as related to plant age or stage of development. Such research could determine optimal fertilizer application rates based on plant requirements for nutrients. The purpose of this research was to investigate the influence of plant age/size on nu-

trient removal from a container medium solution supplied with different N levels.

'Inca Gold' marigold seeds were germinated under intermittent mist at 5-day intervals starting on 8 Sept. 1985 and ending on 28 Sept. Seeds were sown directly in 500-ml plastic pots containing a medium of 1 peat : 1 perlite (v/v) amended with 1 kg Micromax/m³ (Sierra Chemical Co., Milpitas, Calif.) and 6 kg dolomitic lime/m³. Germination occurred in 3 to 4 days, after which plants were grown in a greenhouse vented at 24C during the day and the night minimum was maintained at 18C. Plants were placed on raised benches and arranged in a randomized complete-block design with 80 plants per age group in each of five blocks.

After emergence, plants were irrigated with 200 ml of a nutrient solution containing (mg-liter⁻¹) 200 N from NH₄NO₃, 25 P from H₃PO₄ and 150 K from K₂SO₄. After every two nutrient solution irrigations, plants were irrigated with 200 ml of tap water to prevent excessive salt accumulation in the medium. Frequency of irrigation depended on plant need for water.

On 28 Oct. 1985, there were five plant ages (30, 35, 40, 45, and 50 days from seedling emergence) with dry weights of 0.3, 0.8, 1.1, 4.2, and 7.8 g, respectively. At 2200 HR 10 plants of each age were irrigated with 1 liter of either 20, 50, 80, or 110 mg N/liter (from NH₄NO₃) to equilibrate the medium solution with the applied solution. This treatment was repeated at 0700 HR on 29 Oct. One hour later, medium solutions were extracted from five pots per N treatment per age using the pour-through technique (Yeager

et al., 1983) in which 45 ml of distilled water was applied to the surface of the medium and the leachate collected. Medium solutions were extracted again on a different group of five plants per N level per age at 1400 HR. This testing date was designated pour-through (PT) 1. Medium solution extraction at 0800 and 1400 HR was repeated 10 days later (PT 2) using the same group of plants. During this 10-day interval, plants of each group were fertilized daily with the 20, 50, 80, and 110 mg N/liter treatments noted earlier.

Uniform moisture levels of all treatments were maintained between 0800 and 1400 HR by wrapping containers in plastic film to minimize water lost by evaporation. Every 15 to 30 min, containers were weighed and any water lost via transpiration was replaced with distilled water. Thus, moisture levels were maintained at container capacity and at the same levels each time nutrient extractions were made. Leachates were analyzed for NH₄-N and NO₃-N using ion-selective electrodes, for P using a calorimetric technique (Watanabe and Olsen, 1965), and for K by atomic absorption spectrophotometry.

Medium solution N, P, and K concentrations measured at 0800 and 1400 HR were multiplied by the volume of medium solution (200 ml) to express the amount of nutrient removed from the medium solution on an absolute basis. Volume of medium solution was calculated as the difference between wet weight of a saturated medium sample and an oven-dried medium sample. Regression analysis was performed using Proc Stepwise in SAS (SAS Institute, 1985).

Controls were established to determine if the medium either adsorbed or desorbed nutrients during the 6-hr test. Two days before PT 1, two plants per block per N treatment for the 30- and 50-day-old plants were cut at medium level. On 29 Oct. these containers were subjected to the same N treatments and PT procedure as described previously.

Plant nutrient absorption was quantified by the difference in initial and final medium solution nutrient values for the 6-hr test. Initial solution extraction occurred 1 hr after nutrient treatment application. Initial solution N, P, and K concentrations (Table 1) were less than those applied, with the difference increasing with plant age/size. For example, solution N concentrations for 30-day-old plants were 72%, 79%, 80%, and 92% of the applied 20, 50, 80, 110 mg-liter⁻¹ values, respectively, whereas concentrations for the 50-day-old plants were 33%, 45%, 55%, and 62%, respectively. This trend indicates that older plants were absorbing more N before treatment applications, resulting in different medium solution N concentrations following treatment.

Nitrogen absorption increased with in-

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