EFFECT OF TIMING OF NITROGEN, PHOSPHORUS AND POTASSIUM APPLICATIONS ON GROWTH AND FLOWERING OF POT-GROWN CHRYSANTHEMUM MORIFOLIUM, VARIETY HUMDINGER

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The production of pot-grown chrysanthemums — standards and pompons — is increasing rapidly in Florida for local and out-of-state markets. No critical research has been done on amount or frequency of fertilization necessary for maximum production of high quality pot-grown mums. Regardless of this many recommendations on the subject have been and are being made.

Fertilization practices constitute a large percentage of the production costs for pot chrysanthemums in labor and materials. Since labor costs per application of fertilizer often are more than material costs, this experiment was initiated to determine the minimum number of applications necessary for high production of quality plants and flowers.

METHODS AND MATERIALS

The experiment was initiated on October 25, 1958, when three rooted cuttings of Chrysanthemum morifolium, var. 'Humdinger', a ten-week variety, were placed equidistant in five-inch plastic azalea pans containing one part imported peat and two parts fine sand. The plants were pinched and short-days initiated on the day of potting.

Treatments (Table 1) were placed in a randomized block design and replicated three times, using one pot of three plants as the experimental unit. Fertilizer equivalent to a 6-6-6 commercial grade was applied at the rate of three grams per pot total.

Growth measurements were taken after the majority of flowers on the plants were opened and mature. Stem length, stem diameter, number of stems and number of nodes constituted the vegetative growth measurements. Flower size, number of flowers and flower yield constituted flowering response measurements. Flower size was determined volumetrically by submerging flowers in a graduated cylinder filled with water and measuring volume of water displaced. Flower yield, a measurement of total flower production, is the product of flower size times the number of flowers.

RESULTS

The data (Table 1) show that as far as stem length and diameter are concerned nitro- gen alone or in combinations with potassium and phosphorus was just as effective when applied twice—at 7 and 21-day intervals—as when applied three times—7, 21 and 35-day intervals. Applying the element or elements two or three times during growth of the plants was superior to one application 35 days following pinch. Where phosphorus and potassium were mixed in the potting soil adding nitrogen once — 7 days following pinch — was as good or better than applying nitrogen two or three times during the growing period. On treatments where phosphorus only or none of the three elements were added to the potting mix the one application frequency was not as good as applying the elements two or three times.

As far as stem diameter was concerned no differences resulted from adding phosphorus, phosphorus and potassium or none of the elements to the potting soil at any of the frequency rates tested. With stem length, however, the potting mix did cause differences at the various frequency rates. Where only one application of materials seven days following pinch was used better results were obtained when potassium and phosphorus were added to the soil mix than when phosphorus alone was added. Just the opposite situation occurred when the two-application frequency was utilized.

Number of nodes per stem and number of breaks per plant were not significantly affected by treatment.

The largest number of flowers per plant were produced by treatments 2, 6, 7, 9, and

Acknowledgment: Plants for this experiment were provided by the California-Florida Plant Corp., Stuart, Florida.
10. On treatments 2, 6 and 9 applications of elements were made 7 and 21 days following pinch. There was no difference caused by adding some of the elements to the potting soil or not doing so. Results of treatments 7 and 10 show that an additional application 35 days following pinch did not help in the production of flowers where phosphorus alone or none of the elements were added to the potting mix. In treatment three where only nitrogen was added at intervals the third application proved detrimental to flower production. One application of the element or elements, whether made 7 or 35 days following pinch proved far inferior to the other treatments.

The largest flower size was obtained with treatments 8 and 11 where nitrogen and potassium and nitrogen, potassium and phosphorus were applied once, 35 days following pinch. These treatments produced by far the fewest number of flowers per plant, and, even though statistical differences occurred on flower size, there were such small variations between any of the treatments it is doubtful if they are biologically or commercially important.

Flower yield followed the same pattern as number of flowers.

### Discussion

No treatment was included in which nitrogen was added to the potting mix before potting since Taylor (1) found that when the total supply of nitrogen, phosphorus and potassium was added to the potting mix in this way there was a reduction in number of flowers produced and total yield.

Neither growth nor flowering response varied whether nitrogen, or phosphorus and potassium were added to the top of the soil during the timing frequencies tested or whether phosphorus or phosphorus and potassium were added to the soil mix prior to potting. Phosphorus is normally added to the potting soil by most growers since this is generally known to be a non-leachable element. Potassium, on the other hand, usually has been added to most pot plants at regular intervals with nitrogen on the assumption that it is very leachable from the potting mixture and thus requires constant replacement. Data from this experiment indicate that with the potting mix used potassium is not as leachable as previously thought and thus remains in the soil in ample quantity for normal growth.

### Table 1. Effects of Nitrogen, Phosphorus and Potassium Timing on Growth and Yield of Chrysanthemum Morifolium Var. 'Humdinger'. December 27, 1958

<table>
<thead>
<tr>
<th>Treatments†</th>
<th>No. Days Following Pinch When Fertilizer was Applied</th>
<th>Stem Length in cm</th>
<th>Stem Diameter in mm</th>
<th>Number of Flowers Per Plant</th>
<th>Average Flower Size in cc</th>
<th>Water Displacement</th>
<th>Flower Yield Size x No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1 N</td>
<td>(A) 7 days</td>
<td>16.10</td>
<td>2.73</td>
<td>11.00</td>
<td>5.01</td>
<td>70.00</td>
<td></td>
</tr>
<tr>
<td>T2 N</td>
<td>(A) 7, 21 days</td>
<td>15.10</td>
<td>2.96</td>
<td>17.00</td>
<td>5.18</td>
<td>87.66</td>
<td></td>
</tr>
<tr>
<td>T3 N</td>
<td>(A) 7, 21, 35 days</td>
<td>11.43</td>
<td>2.70</td>
<td>13.33</td>
<td>5.56</td>
<td>73.33</td>
<td></td>
</tr>
<tr>
<td>T4 N</td>
<td>(A) 35 days</td>
<td>11.43</td>
<td>2.13</td>
<td>8.00</td>
<td>5.42</td>
<td>61.33</td>
<td></td>
</tr>
<tr>
<td>T5 N-K</td>
<td>(B) 7 days</td>
<td>13.76</td>
<td>2.66</td>
<td>11.66</td>
<td>5.30</td>
<td>86.66</td>
<td></td>
</tr>
<tr>
<td>T6 N-K</td>
<td>(B) 7, 21 days</td>
<td>16.63</td>
<td>3.06</td>
<td>16.66</td>
<td>5.26</td>
<td>66.66</td>
<td></td>
</tr>
<tr>
<td>T7 N-K</td>
<td>(B) 7, 21, 35 days</td>
<td>11.93</td>
<td>2.73</td>
<td>16.00</td>
<td>4.83</td>
<td>76.66</td>
<td></td>
</tr>
<tr>
<td>T8 N-K</td>
<td>(B) 35 days</td>
<td>12.26</td>
<td>1.83</td>
<td>8.33</td>
<td>6.63</td>
<td>55.00</td>
<td></td>
</tr>
<tr>
<td>T9 N-P-K</td>
<td>(C) 7, 21 days</td>
<td>16.23</td>
<td>3.03</td>
<td>17.00</td>
<td>5.30</td>
<td>90.00</td>
<td></td>
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<tr>
<td>T10 N-P-K</td>
<td>(C) 7, 21, 35 days</td>
<td>15.60</td>
<td>2.90</td>
<td>15.00</td>
<td>5.36</td>
<td>80.00</td>
<td></td>
</tr>
<tr>
<td>T11 N-P-K</td>
<td>(C) 35 days</td>
<td>10.10</td>
<td>1.96</td>
<td>6.33</td>
<td>6.76</td>
<td>43.33</td>
<td></td>
</tr>
</tbody>
</table>

L.S.D. .05 1.34 0.36 2.98 0.68 15.52
L.S.D. .01 1.82 0.52 4.07 0.93 21.16

For treatments in Group (A) P and K were mixed into the potting soil, in Group (B) only P was added to the potting soil and in Group (C) no amendments were added to the potting mix before planting.
throughout the life cycle of chrysanthemums or that the plant can store sufficient potassium during early stages of growth to last through the flowering period. In many commercial operations adding potassium to the potting mix along with phosphorus may facilitate economic efficiency of production.

Applying one, two or three of the macro-elements nitrogen, phosphorus and potassium in one application, either 7 or 35 days following pinch, proved unsatisfactory. When applied 7 days following pinch apparently sufficient nitrogen had leached from the soil during the later developmental phases of growth to cause nitrogen stress among the plants. Where the one application was delayed until 35 days following pinch a nitrogen stress was apparently prevalent during the time of flower bud initiation and early development and the fertilizer timing was too late to overcome effects of the early deficiency.

In most instances there was little or no differences between the timing frequencies of 7 and 21 days and 7, 21 and 35 days following pinch. With few exceptions the two-application frequency was superior to other treatments, including the three-time frequency. Considerable labor is usually involved with each application of fertilizer and any reduction in number of applications without reducing quality and yield will increase efficiency of production. From this data the two-application frequency is preferred over the three-application frequency of the timings tested.

Commercially pot chrysanthemums are often fertilized daily, twice weekly, weekly or every two weeks. Many other schedules are also followed. This data would indicate that considerable savings in labor and materials used could be accomplished without reducing production or quality.

**Summary**

Three grams per pot total of dryform, commercial grade, 6-6-6 analysis fertilizer were applied to *Chrysanthemum morifolium*, var. 'Humdinger,' in 11 treatments placed in a randomized block design and replicated three times, using one pot of three plants as the experimental units. Three plants were placed equidistant in five-inch plastic azalea pans, containing one part imported peat and two parts fine sand. Treatments were as follows:

1) N applied 7 days following pinch, 2) N applied 7 and 21 days following pinch, 3) N applied 7, 21 and 35 days following pinch, 4) N applied 35 days after pinch (In these four treatments potassium and phosphorus were mixed in the potting soil), 5) N and K applied 7 days after pinch, 6) N and K applied 7 and 21 days after pinch, 7) N and K applied 7, 21 and 35 days after pinch, 8) N and K applied 35 days after pinch (In these four treatments P was mixed in the potting soil), and 9-11, N, P and K were applied 7 and 21, 7, 21 and 35 and 35 days after pinch, respectively.

The two and three-application frequencies produced the best results in growth and flowering. Three applications were no better than two and in some instances two applications produced better results than three.

There were no differences resulting from mixing phosphorus, phosphorus and potassium or none of the three elements to the potting soil.

**LITERATURE CITED**


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**THE COMBER SOIL ACIDITY TEST FOR SOLUBLE IRON IN AZALEA SOILS**

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Gainesville

Few ornamental plants surpass the Formosa variety of azalea in popularity for landscape use in Florida. The wide use of this shrub is well deserved for it can be obtained at low cost, it is easily adaptable, and it yields a profusion of beautiful blooms in the spring of the year.

Like many other shrubs, the azalea plant has its share of cultural problems, which include insects, disease, and nutritional deficiencies. Of the latter, none appears to pose a