

RESPONSES OF POT-GROWN CHRYSANTHEMUM MORIFOLIUM 'YELLOW DELAWARE' TO MEDIA, WATERING AND FERTILIZER LEVELS

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ABSTRACT

Variable media and fertilizer and watering levels were tested to determine best combinations to produce high quality potted chrysanthemums. In general, highest quality plants were produced in $\frac{1}{2}$ sand- $\frac{1}{2}$ peat or $\frac{1}{3}$ sand- $\frac{1}{3}$ peat- $\frac{1}{3}$ sorbolite with 800 or 1200 pounds per acre each of N and K and 17 fluid ounces of water per pot per day. Plants produced under these regimes averaged 95 days from planting to maturity, 22 to 26 flowers per pot and 23 days keeping quality. Increasing N and K levels increased growth measurements, while watering rates higher than 17 ounces per pot per day decreased growth.

INTRODUCTION

Pot chrysanthemums are an important floral crop in Florida, and varietal improvements should improve its importance in the future. Pot plant production presents special problems of watering, fertilizing and handling. Frequent watering of restricted soil volumes necessitated by high top-root ratios causes leaching, and media components must be selected that will maintain high moisture and aeration and be retentive of nutrients.

Research (3,4) on factors which affect desirability of various media components has shown that levels of soil organic matter above 50% generally cause a decrease in cation exchange capacity on a volume basis. Addition of higher levels of organic matter were successful in increasing water holding capacity on a volume basis, but resulted in very light weight media. One of the best media for pot grown chrysanthemums was a 1:1 ratio of peat moss and fine sand.

During the last 10 years considerable research has been reported on fertilizer levels required for pot chrysanthemums. Waters (6) found that optimum growth of Oregon and Yel-

low Delaware occurred when 4 grams of 6-6-6 was applied per 6 inch pot per week. Recent work (1) showed that increasing N and K levels from 200 to 800 pounds per acre surface area produced a linear increase in growth and flowering response in 'Yellow Delaware' and 'Oregon' pot chrysanthemums.

Production recommendations for greenhouse grown pot chrysanthemums have changed considerably in recent years where complete mechanization is possible. Present recommendations (2,5,8) are injection of 200 ppm each of N and K into irrigation water with each irrigation.

Watering presents problems in pot plant production due to rapid transpirational losses from high top-root ratios and low soil volumes. Because plants need to be watered more than once a day in pot-grown chrysanthemum production, recent recommendations (8) were designed for a fully automatic irrigation system. The authors recommended applying to six inch pots, 12 ounces of water once a day for the first 3 weeks, twice a day for the second 3 weeks and 3 times a day for the remainder of the crop cycle.

METHODS AND MATERIALS

A 3 x 3 x 3 factorial experiment was initiated to test responses of media combinations and fertilizer and watering levels on growth, flowering and keeping quality of *Chrysanthemum morifolium* 'Yellow Delaware'. Media consisted of equal by volume ratios of sphagnum peat moss and Arredondo fine sand, sphagnum peat moss, No. 2 horticultural perlite and Arredondo fine sand, and sphagnum peat moss, sorbolite (a calcined clay) and Arredondo fine sand. Each medium received $2\frac{1}{2}$ pounds of single superphosphate, 8 pounds of dolomite and $1\frac{1}{2}$ pounds of "Perk"* per cubic yard at time of mixing.

Nitrogen and K from ammonium nitrate and potassium nitrate were supplied at rates of 400, 800 and 1200 pounds per acre surface area during the experiment. Fertilizers were applied weekly in 100 ml of tap water starting at time of planting for a total of 12 equal applications.

*A micro element mixture manufactured by Wilson & Toomer Fertilizer Co. Inc., Jacksonville, Florida.

Watering levels were 250, 500 and 750 ml per pot per day, which was equal to 8½, 17 and 25½ fluid ounces per pot. In an effort to prevent excess leaching, the medium and high water levels were made in split applications of 250 ml. The lowest water level was applied at 10:00 a.m., the middle level at 9:00 a.m. and 3:00 p.m. and the highest level at 8:00 a.m. and at 1:00 and 4:00 p.m. Irrigation cycles were controlled by solenoid valves and time clocks and water supplied through Chapin long header systems except for the initial watering by hose to establish moisture capillarity in the media.

Treatments were placed in a randomized block design in a clear glass, water-cooled greenhouse in Gainesville, Florida and replicated 4 times with one 6 inch clay pot containing 5 plants constituting the experimental unit. Daily maximum temperature was maintained at 80 to 85°F until May 1, and then at 85° to 87°. Night temperature was maintained at approximately 70°F.

Rooted cuttings were potted and placed under lights April 3, 1968, pinched April 16th and short day schedule initiated April 23rd. Pots were spaced 16 inches on center for duration of the experiment.

Due to treatment differences, a single termination date for the entire experiment was not possible. Some treatments were marketable while other were still in bud, therefore, termination dates varied from June 29 to July 19, 1968 for individual pots.

Measurement of treatment growth effects included average diameter of the 4 largest flowers per pot in centimeters (cm), growth index (height + width) in inches, stem diameter

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measured one inch below base of flower in cm and total number flowers per pot showing color. Other data obtained included number of days from planting to maturity and keeping quality. Keeping quality was determined by placing plants in an air conditioned room maintained at 74 degrees with a light level of 400 foot-candles at plant height for 9 hours each day. Plants received 4 ounces of water a day while in the keeping quality test which was sufficient for normal maintenance of turgidity. Number of days plants maintained a quality sufficient to be desirable to a consumer were recorded.

Data were analyzed by standard statistical procedures and treatment comparisons made by

orthogonal single degrees of freedom.

RESULTS AND DISCUSSION

Type of medium, fertilizer level and watering level influenced the date when 50% of flowers in each treatment were in bloom (Table 1). Generally, maturity was reached most rapidly in the sand-peat-sorbolite medium, at the 2 highest fertilizer levels and lowest watering level. These factors were modified by interactions of media and fertilizer and media and watering level. Increasing fertilizer levels decreased time to maturity only slightly in sand-peat-perlite (Fig. 1), possibly due to lower cation exchange capacity. In sand-peat-sorbolite time to maturity decreased 11 days as fertilizer level was increased from 400 to 1200 pounds of N and K. Effects of media and watering level on maturity date (Fig. 2) indicates that increasing water level on sand-peat-perlite delayed maturity more than in sand-peat-sorbolite. These data indicate that chrysanthemum maturity may be obtained earlier by adjusting the fertilizer-leaching rate through strict water and cation exchange capacity control to obtain maximum growth.

Flower number, an important indicator of

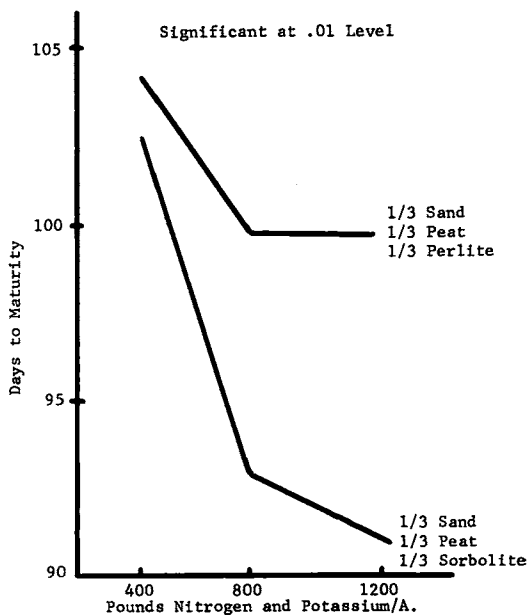


Figure 1.—Interaction of Media and Fertilization on Days Required for *Chrysanthemum morifolium* 'Yellow Delaware' to Reach Maturity.

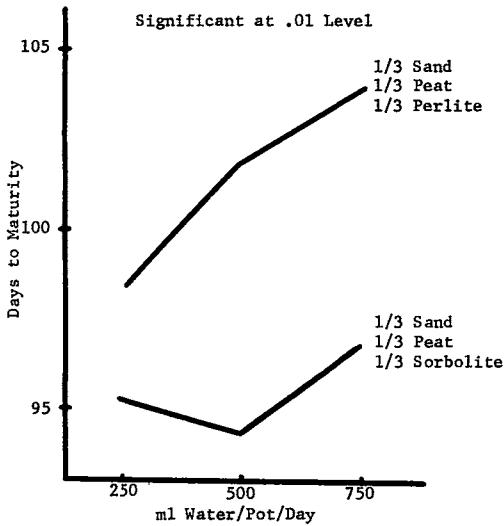


Figure 2.—Interaction of Media and Water Levels on Days Required for *Chrysanthemum morifolium* 'Yellow Delaware' to Reach Maturity.

quality chrysanthemums was largest in sand-peat-sorbolite and at the 2 highest fertilizer levels (Table 1). Water levels, however, had a deleterious effect, as there was a linear decrease in numbers of flowers as amount of water supplied increased. Fertilizer and watering level interacted to modify flower number (Fig. 3).

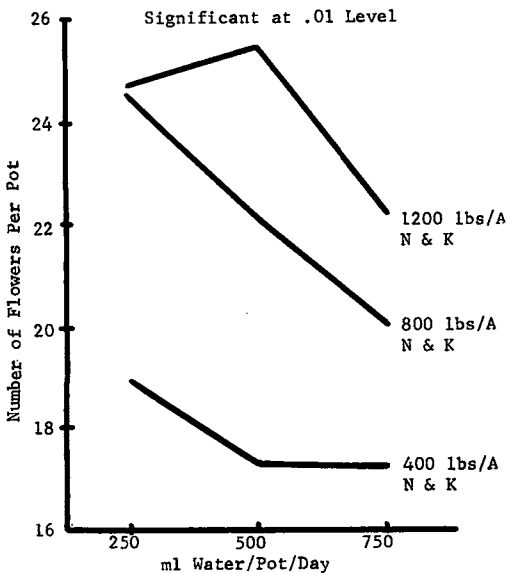


Figure 3.—Interaction of Fertilizer and Water Levels on Number of Flowers Produced per Pot of *Chrysanthemum morifolium* 'Yellow Delaware'.

Increasing water level decreased flower number per pot, but this could be counteracted by raising fertilizer level. Such data indicate that fertilizer level at the higher watering level was not sufficient to counteract leaching. However, neither was the high watering level necessary, as excellent soil moisture was maintained at the second level. In the media used in this experiment, even though split water applications were made, considerable water passed through the media at the highest watering level, some at the median level and none at the lowest.

Fertilizer levels converted to a constant feed program for comparisons at different water levels used in this experiment provided 40, 80 and 120 ppm at the lowest watering level, 26, 54 and 80 ppm at the median watering level and 13, 27 and 40 ppm at the highest watering level. These rates are much lower than those recommended by other researchers (2,8). However, quality of better treatments was about equal in this experiment even though fertility levels were about two-thirds less. These data indicate that such differences are due to use of a sand-peat-perlite medium which has less capacity to hold fertilizer ions and much higher water levels which seem to have no additional benefit except to provide leaching. Cation exchange capacity of media used in this experiment were sand-peat 22 me/100 gm, sand-peat-perlite 20 me/100 gm and sand-peat-sorbolite 24 me/100 gm. When such cation exchange capacity data is converted to volume (3,4) the cation exchange capacity of the sand-peat-perlite medium is about one-half of the other media used.

Keeping quality of chrysanthemum pots was better in sand-peat-sorbolite than in sand-peat-perlite and closely correlated with fertilizer rate (Table 1). There was a linear increase in keeping quality as fertilizer rate increased from 400 to 1200 pounds N and K but was modified by a media-fertilizer interaction (Fig. 4). Increasing fertilizer from 400 to 800 pounds N and K decreased keeping quality in sand-peat-perlite, increased it in sand-peat-sorbolite and had no additional effect at the highest level.

Keeping quality of cut chrysanthemums (9) has been reported to decrease as N rates are increased, even if proper N to K ratios are maintained. Wesenberg and Beck (7) found that fertility level had little effect, however, on keeping quality of pot-grown chrysanthemums. In this experiment indications are that fertilizer

Table 1. Response of potted *Chrysanthemum morifolium* 'Yellow Delaware' to media, fertilizer and watering levels.

Treatment	Number days to maturity	Flower number (per pot)	Keeping quality (days)	Flower size (cm)	Stem size (cm)	Growth Index (in)
Media						
1/2 Sand-1/2 peat	97.5	21.0	22.4	13.6	.45	17.1
1/3 Sand-1/3 peat-1/3 perlite	101.3	20.8	20.6	13.2	.40	16.2
1/3 Sand-1/3 peat-1/3 sorbolite	95.5	22.5	23.0	13.7	.44	17.6
Fertilizer						
400 lbs/A N and K	103.6	17.9	21.2	12.6	.36	14.8
800 lbs/A N and K	96.2	22.4	22.2	13.8	.45	17.4
1200 lbs/A N and K	94.5	24.1	22.6	14.1	.48	18.7
Water						
250 ml/Pot/day	96.9	22.8	22.0	13.4	.42	17.1
500 ml/Pot/day	97.6	21.7	21.9	13.7	.45	17.5
750 ml/Pot/day	99.7	19.8	22.0	13.4	.42	16.3
Significant effects						
Media						
1/2 Sand-1/2 peat versus means of 1/3 sand-1/3 peat-1/3 perlite and 1/3 sand-1/3 peat-1/3 sorbolite	*	NS	NS	*	*	NS
1/3 Sand-1/3 peat-1/3 sorbolite versus 1/3 sand-1/3 peat-1/3 perlite	**	**	**	**	**	**
Fertilizer						
Linear	**	**	**	**	**	**
Quadratic	**	**	NS	**	*	*
Water						
Linear	**	**	NS	NS	NS	**
Quadratic	NS	NS	NS	**	**	**

* Significant at .05 level of probability.
 ** Significant at .01 level of probability.
 NS Not significant

levels which produced the best growth were beneficial in increasing keeping quality.

Flower and stem size were influenced by all 3 factors, and were generally larger in peat-sand and sand-peat-sorbolite media (Table 1). In-

creasing fertilizer rate beyond the second level did not increase either flower or stem size, while the median water level produced largest flowers and stems. However, size differences due to water levels were minor from a commercial quality standpoint.

Plant size was influenced primarily by fertilizer rate (Table 1), although media and water also had an effect. Increasing fertilizer level from 400 to 1200 pounds N and K increased growth index by about 4 inches, while the highest water level had a depressing effect. Plant size for all treatments was considered satisfactory for a high quality pot chrysanthemum (5,8).

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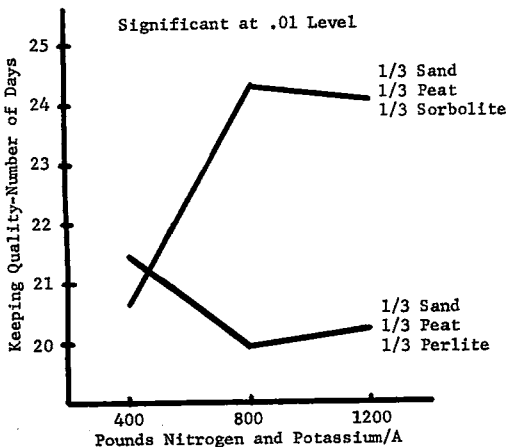


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SOME OBSERVATIONS ON IMPORTS AND EXPORTS OF FLORICULTURAL PRODUCTS WITH SPECIAL REFERENCE TO LATIN AMERICA

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ABSTRACT

During the past five years there has been a rapid growth in the commercial floricultural industry in various areas of the world. A large share of the expansion has taken place in Central and South America. Major countries exporting to the United States and other foreign markets include Brazil, Costa Rica, Colombia, Ecuador, Guatemala, Honduras and Panama.

Four key factors—(1) an abundance of labor, (2) climates favoring year-round production, (3) availability of air freight transportation at reasonable cost and (4) adoption of modern technological break-throughs in production techniques — have contributed to the growth of the Latin American floricultural industry. Despite a myriad of problems facing this industry, prospects are for further continued growth. The threat of competition to U. S. producers is more long-term than immediate in nature. Much of this competition may be offset by increased ex-

ports of flowers from the United States to other countries. Available data show that current flower imports are less than the \$2.6 million in annual exports of floricultural products.

INTRODUCTION

A marked upward tendency has occurred during the past five years in the production and marketing of flowers in various nations of Latin America and elsewhere in the world. A large percentage of these flowers has found its way into the United States market. These imported flowers consist almost entirely of types presently grown commercially in the United States. Although many latin flower growing operations are locally owned, a number of growers in the Latin American floricultural industry are from the United States. Most locally controlled firms rely on United States technological consultation and marketing contacts.

Current information on the extent of these floricultural operations in Latin America and elsewhere is sketchy. Data on the quantities of various specific floricultural commodities imported into the United States are incomplete. Many refinements will be required for the series of statistics on foreign trade in floricultural products to be of maximum effectiveness to interested users.

Objectives of this paper are to present available statistical data on U. S. imports and exports of floricultural products, especially from the tropical Americas, and report observations made by the authors and others on the developing ornamental industries in Latin America.