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Co-editors, R. E. Widmer*, H. F. Wilkins
Department of Horticultural Science
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GROWTH OF POT CHRYSANTHEMUMS IN MOSS PEAT[1]

Karen E. Zicarelli and Richard E. Widmer[2]

Growth of chrysanthemums in various peat media has been studied in Europe. Puustjarvi (4) obtained better yields in peat than in soil. Atkins (1), at the Levington Research Station, found that plants grown in an all-peat medium could be placed in short days as soon as potted. A fertilizer solution of 200 ppm nitrogen in summer and 100 ppm in winter was recommended. Kaukorvirta (3) reported that 'Bonnafon de Luxe' chrysanthemums grew more vigorously in peat than in sand or loam. Flowering was earlier and more uniform, and more flowers were produced per plant.

Objectives of this study conducted in St. Paul Campus research greenhouses were; to determine the suitability of various peat media for pot plant production in the upper midwest; and to determine preferred fertilizer regimes for such media.

Materials and Methods

Media used in the study (listed in Table 1) were: commercially available nutrient-enriched moss peats (Peat 1 - med. nutrient content and Peat 2 - high nutrient content); 1-1 mixes of each of these peats with vermiculite and with perlite; a 1-1 mix of Peat 2 with a nonnutrient enriched peat (Peat 2 had more than twice the nutrient content of Peat 1 with some of the nitrogen in a slow release form); a nonnutrient enriched (Peat 0) to which nutrients listed in Table 1 were added; two commercial peat-vermiculite preparations with medium and high nutrient content (PV1 and PV2); and 1-1-1 and 2-1-1 (silt loam, peat, perlite) soil mixes with superphosphate incorporated.

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[1] Paper No. 8922 Scientific Journal Series, Agricultural Experiment Station, University of Minnesota.

[2] Former graduate student in floriculture and professor, Department of Horticultural Science and Landscape Architecture, respectively.

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Crops were grown for winter, spring, and summer bloom. For the first crop, six rooted 'Princess Anne' cuttings were planted per 15-cm (6-inch) plastic azalea pot Jan. 3, 1973. Plants were grown in long days until Jan. 11 and then pinched. No growth regulators were applied. For the second crop, six rooted cuttings of 'Yellow Mandalay' were planted per 15-cm (6-inch) plastic azalea pot Feb. 10. Plants were pinched Feb. 24 and shifted from a long to a short photoperiod Feb. 26. The growth regulator B-Nine was sprayed on the foliage twice: 250 ppm on Mar. 3; and 1500 ppm on April 11. For the third crop, one rooted cutting of 'Yellow Mandalay' was planted per 12 1/2 - cm (5-inch) standard plastic pot May 22. Short day treatment was initiated May 28, and the plants were pinched on May 29. B-Nine was sprayed on the foliage twice: 2500 on June 11; and 1500 ppm on July 3.

Fertilizer was applied at 400 ppm nitrogen from a 1-1-1 ratio fertilizer every third (crops 2 and 3) or fourth (crop 1) watering. The fertilizer consisted of equal parts of di-ammonium phosphate, potassium nitrate, and calcium nitrate. The day of the first application varied with the medium and the crop.

A 16.5°C (62°F) night and 22°C (72°F) day temperature was maintained except on hot days when somewhat higher temperatures developed. All plants were pinched at the seventh node above the medium surface. There were 4 pots per treatment in crop 1, 5 pots per treatment in crop 2, and 12 pots in crop 3 in a random block design.

Detailed observations were made during crop development and at the termination of each crop.

Results

Results with crops 1 and 2 are summarized briefly, and full particulars are provided for crop 3.

Crops 1 and 2. Significant differences among plants in the various media were noted before and after the pinch. Plants grown in the richer media (Peat 2, Peat 2 mixes with vermiculite, or perlite and the commercial peat vermiculite 2 mix) and in the Peat 1-perlite mix were retarded to various degrees. Plants grown in the Peat 1, Peat 2-Peat 0 mix, and Peat 0 nutrient-enriched media were the most advanced.

Number of shoots (breaks) developing after pinching was greatest on the most advanced plants. The number of side shoots in the flower cluster usually was inversely related to the number of breaks from the pinch.

Plants in crop 1 were tall and had weak stems. This was the result of relatively poor winter light conditions and the lack of application of B-Nine. Plant height range of plants in crop 1 was 13 cm and in crop 2, 4 cm. Plants grown in a mixture of nutrient-enriched peat and perlite were shorter than plants in straight nutrient-enriched peat. Plants in the richest media also tended to be shorter and less uniform than plants in the other media.

Flowering time range for both crops was 5 days. Plant quality of plants in some treatments in crop 2 was very good.

Crop 3. Once again, variations in growth rate were apparent shortly after pinching (Table 2). Average number of breaks was less on plants grown in soil mixes, Peat 1-perlite, and commercial peat-vermiculite mix 1. Plants with the most breaks were grown in Peat 1, Peat 1 or 2 mixed with vermiculite, Peat 2 mixed with perlite, and commercial peat vermiculite mix 2. Average length of breaks on June 12 was shortest for plants grown in soil mixes, Peat 1-perlite, and Peat 2, and longest on plants grown in Peat 1, Peat 1-vermiculite, and commercial peat-vermiculite mix 1. Early differences among plants were not as extreme as those in crops 1 and 2. This could be attributed to better light conditions for crop 3 and because the time of initiating fertilization was better related to the various growth media in crop 3.

Mature plants with the highest number of well-developed breaks from pinch were those grown in the Peat 2-Peat 0 mix followed by Peat 1 and Peat 1-vermiculite (Table 1).

Plants with the most open flowers were grown in Peat 1, Peat 1-vermiculite, Peat 2-vermiculite, Peat 2-perlite, and Peat 0 + nutrients. Start of flowering was similar with a range of 4 days. Plants grown in soil were the latest.

Average plant height varied by 2.1 cm (less than 1 inch). Plant width (fullness) varied by 4.5 cm (less than 2 inches), and uniformity of plants within treatments was very good.

The best foliage color was evident in plants grown in the Peat 2-Peat 0 mix followed by Peat 2-vermiculite and Peat 1. Plants grown in Peat 1-perlite were the most pale.

Root condition and quantity was generally quite good. The poorest roots were on plants grown in soil and in commercial peat-vermiculite mix 1.

Considering all factors, the best plants were grown in Peat 1 and in the Peat 2-Peat 0 mix. Plants grown in straight nutrient-enriched peat were generally better than those grown in mixes. The poorest quality plants were grown in the Peat 1-perlite and soil mixes.

Conclusions and Discussion

Overall, the best plants were grown in a 100-percent moss peat, nutrient-enriched medium. For all three crops, good results were obtained with Peat 1, Peat 2-Peat 0, and Peat 0 + nutrients media. Commercial peat-vermiculite mix 1 rated high for crop 2 (spring) only. Mixing peat with vermiculite was not especially advantageous or disadvantageous; mixing peat with perlite was often undesirable.

The least desirable treatments were the soil mixes, Peat 2, and commercial peat-vermiculite mix 2. The initial nutrient content of these two media was apparently greater than optimum for potting bare rooted chrysanthemum cuttings. Interestingly, the inhibitory effects of the high-nutrient content was greater for the winter and spring crops than for the summer crops when plants grew faster. Initiating supplemental fertilizer applications too soon also aggravated

Table 1. Mandalay potted chrysanthemums; data recorded Aug. 1 for plants potted May 22, 1973. There was 1 pinched plant per 5-inch pot.

Treatment	Aver. # per pot: Flowering shoots	Aver. # per pot: Flowers	Aver. start of bloom	Aver. plant height (cm)	Aver. plant width (cm)	Aver. leaf size (cm)	Plant** uniformity: Flowers	Plant** uniformity: Growth	Foliage** color	Roots** quantity	Roots** quality
Peat 1	5.9	30.5	8-14	24.0	28.1	4.6	3.0	3.0	2.3	2.8	2.8
Peat 1-vermiculite (1:1)	5.9	29.6	8-13	24.2	26.3	4.4	3.0	3.0	2.0	2.5	2.3
Peat 1-perlite (1:1)	5.5	24.1	8-14	22.7	23.3	4.0	3.0	3.0	1.8	2.9	2.8
Peat 2	5.4	28.8	8-13	23.8	26.4	4.3	3.0	3.0	2.2	2.8	2.8
Peat 2-vermiculite (1:1)	5.7	30.8	8-12	24.4	26.9	4.9	3.0	3.0	2.4	2.4	2.5
Peat 2-perlite (1:1)	5.8	30.8	8-14	24.7	26.5	4.4	3.0	2.9	2.2	2.8	2.7
Peat 2-Peat 0 (1:1)	6.2	31.4	8-13	24.8	27.9	4.4	3.0	2.8	2.7	2.9	2.8
Peat-vermiculite mix 2	5.3	26.5	8-14	23.8	25.4	4.5	3.0	2.9	2.0	2.8	2.4
Peat-vermiculite 1	5.2	28.5	8-13	24.4	26.4	4.4	3.0	3.0	2.0	2.8	1.9

Table 1. (continued)

Treatment	Aver. # per pot: Flowering shoots	Aver. # per pot: Flowers	Aver. start of bloom	Aver. plant height (cm)	Aver. plant width (cm)	Aver. leaf size (cm)	Plant** uniformity: Flowers	Plant** uniformity: Growth	Foliage** color	Roots** quantity	Roots** quality
Peat 0 + nutrients*	5.6	30.3	8-13	24.5	25.9	4.0	3.0	3.0	2.0	2.9	2.8
Soil 2:1:1 (soil:Peat 0: perlite)	5.5	25.5	8-15	24.3	24.8	4.4	3.0	2.8	2.0	2.6	1.7
Soil 1:1:1 (soil:Peat 0: perlite)	5.5	22.4	8-16	23.7	24.7	4.3	3.0	2.8	2.0	2.8	1.9

* Grams added per bushel of peat: 200 ground limestone; 20 magnesium sulfate; 6 1/4 calcium nitrate; 4 potassium chloride; 12 1/2 superphosphate; 16 coated 14-14-14 (slow release); 0.7 fritted trace element mix (contains sulfur, boron, copper, iron, manganese, molybdenum and zinc).

** Rated on scale of 1-3 with 3 best: Uniformity: 1=poor, 2=medium, 3=uniform.
Foliage color: 1=chlorotic, 2=medium, 3=dark green & glossy.
Root quantity: 1=few, 2=medium, 3=many
Root quality: 1=dark, 2=medium, 3=white

the inhibitory effects. If established plants in small pots had been used, the results with the "high-nutrient" media might have been more favorable.

Fertilizer practices affected growth quality of plants in all media. According to these studies, adding supplemental fertilizer to media such as Peat 1, Peat 1 mixed with vermiculite or perlite, and the soils used in this study should be initiated 7 to 10 days after potting. For Peat 2 mixes with Peat 0, vermiculite or perlite and commercial peat-vermiculite mix 1, fertilizer application should begin 14 to 18 days after potting. In most cases, the first application to Peat 2 and commercial peat-vermiculite mix 2 should be made 1 month after planting. When flower buds start to show color, fertilizer applications should be cut in half or discontinued to avoid salt buildup.

An application of 400 ppm nitrogen solution from 1-1-1 ratio fertilizer was made with every third watering in this study. Presumably in commercial practice either; (1) applying a 130 ppm solution with every watering or, (2) 200 ppm for two consecutive waterings followed by one plain watering and repeating the rotation would provide similar results.

The soil mixes used in this study were obviously not the equal of a peat medium for chrysanthemum growth. Manipulation of soil ratios and of fertilizer content may have improved plant growth, but this point was not explored. Kaukorvirta (3) also reported more vigorous growth in peat than in loam.

Fertilizer applications of less than the usual minimum of 200 ppm nitrogen rate recommended for soil grown plants by Hanzel (2) were optimum for peat-grown plants.

Uniform distribution of nutrients mixed in moss peat before planting is essential for uniform growth results. Therefore, growers may prefer to purchase peat with nutrients already added. If price is of concern, the grower might prefer purchasing the richer media (Peat 2) and mixing in with nonnutrient-enriched peat (Peat 0) on a 1-1 basis, providing he can mix the two peats efficiently.

Faster plant growth and better plant quality, coupled with fertilzer conservation (100-130 ppm vs 200 ppm nitrogen with every watering), make a nutrient-enriched moss peat medium more attractive than a soil medium for greenhouse-grown potted chrysanthemums. Cultural procedures vary for peat and for soil, however, and anyone using a peat medium for the first time should do so on a limited scale. This will enable him to become familiar with the requirements of peat, as outlined by Widmer (5), before growing a large crop.

Summary

1. A nutrient-enriched moss peat medium is recommended for optimum growth of high-quality potted chrysanthemums in a minimum of time.

2. Application of supplemental fertilizer should begin 7 to 18 days after potting, depending on the nutrient content of the starting medium.

3. Fertilizer may be applied with every watering at the rate of 100-130 ppm nitrogen from a 1-1-1 ratio formulation. Application of 400 ppm nitrogen with every third watering was satisfactory.

4. Fertilizer conservation with peat culture may be an added benefit.

5. Fertilizer applications should be cut in half or discontinued (with a rich starting medium) when flower buds start to show color.

6. A growth regulator should be used to avoid overgrowth and insure plant quality.

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