PRODUCTION OF MINI-HYDRANGEAS BY CONTINUOUS GROWING PROCEDURES

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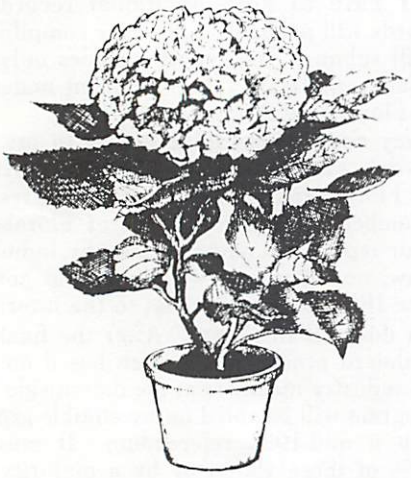
The cost in plants, materials, space, and heat have all but eliminated the once popular Easter/Mother's Day hydrangea from profitable greenhouse production in many areas. Current centers for hydrangea forcing are in California, Florida and Texas. The current interest in small plant production emphasizes high production per unit production area, a quick turnover, and keeping the unit price low.

Hydrangeas have traditionally been produced as flowering pot plants for Easter and Mother's Day sales by procedures involving propagation in late spring, growing through the summer and, following flower initiation in the fall, subjecting the plants to a dark cold storage period during which the plants are defoliated. This is followed by approximately 13 weeks of forcing in the greenhouse during the period of greatest heat requirement. It is virtually impossible to produce small plants by this procedure and attempts to flower hydrangeas in smaller pots have simply aggravated the water loss syndrome which accounts for the early death of most hydrangeas in the market and home.



Many years ago the Joseph S. Merritt Company suggested rooting budded shoots either before or after cold storage but we were never able to grow a satisfactory plant by this procedure because of the poor root system and foliage. Wilkins (3) proposed fall propagation for the production of small plants but defoliation and a cold storage were still utilized. Weiler (2) has outlined continuous growing procedures which result in small plants by the use of all night incandescent light to promote flower development following short days for flower initiation. The production schedule called for approximately 22 weeks from propagation by tip cuttings to produce a single bloom plant. The use of this method for year-round production was suggested as a possibility.

Weiler's method called for rooting cuttings and a 4-week period of growth at 72°F under continuous light followed by a 6-week period at 62°F and short days (not available in summer) to be followed by returning the plants to continuous light at 72°F for flowering. We have attempted to establish some guidelines for year-round production of plants (1) by continuous growing procedures and would like to summarize this work.

A. **Hydrangea Characteristics:** The normal habit of hydrangea includes a cold or rest period during which leaves fall, flower buds become ready for rapid development, and vegetative buds regain juvenile characteristics (i.e., flowers are not readily initiated). A certain amount of growth is the first requisite for flower initiation but floral initiation is greatly promoted by long, cool nights. The longer the period of growth after the dormant period the greater is the tendency to flower, until finally the terminal bud will form a flower at any temperature or photoperiod. Should this occur in midsummer, while temperatures are high and nights are short, the flowers will continue development. Under usual cultural procedures this summer flowering must be prevented by either pinching or late propagation.

The plants become dormant after continued exposure to the factors which accelerate flower formation (i.e., long nights and cool temperatures) and fail to grow until the necessary cold is provided. The one big advantage of defoliated and stored plants is the rapid development and predictable forcing which tend to be lost under continuous growing procedures.

TABLE 1. Mini-hydrangeas produced at various times as propagated at different times through the year.

Propagation			Growing procedures				
Date	Stock	Cutting	Flower initiation	Forcing	GA_3-25 ppm	Date of Bloom±SD[1]	Size
Jan. 19	Regular	1-eye	Black cloth 62°F 3/8-5/1	Shaded ghse	none	June 25±12	Height=16 cm
Feb. 23	Regular	1-eye	52°F lighted[2] 4/23-6/12	Shaded ghse	none	Aug. 10±13	——
July 1	Regular	Tip	52°F lighted[2] 8/26-9/23	62°F lighted[3]	9/30 & 12/9	Jan. 10±15	Height=22 cm
July 1	Regular	2-eye	52°F lighted[2] 9/23-10/12	62°F lighted[3]	9/30 & 12/9	March 1±24	Height=23 cm
Aug. 24	Lighted	Tip	52°F lighted[2] 10/8-11/14	62°F lighted[3]	10/1	March 4±12	Height=24 cm
Aug. 24	Lighted	2-eye	50°F ghse 10/15-11/14	62°F lighted[3]	10/1	March 10±13	Mostly single bloom
Oct. 5	Lighted	Tip	54°F ghse 11/1-12/15	62°F lighted[3]	11/5	March 5±9	Bloom=16.5 cm
Oct. 13	Lighted	Tip	50°F ghse 11/10-12/10	62°F lighted[3]	1/12	April 2±8	Bloom=12 cm
Oct. 13	Lighted	2-eye	62°F ghse 11/15-1/6	62°F lighted[3]	1/12	April 24±7	70% bloom —12 cm
Dec. 6	Lighted	Tip	50°F ghse 2/1-3/15	62°F lighted[3]	1/18	May 3±11	Bloom=16 cm
Dec. 8	Lighted	Tip	62°F ghse 12/26-1/19	62°F lighted[3]	2/1	May 12±9	Bloom±13 cm

[1]The standard deviation indicates variation from the mean date of bloom.
[2]Cooled room with cool white fluorescent lamps providing approx. 100 ft. c. continuous light.
[3]All night lighting with 10 ft. c. incandescent lamps in the greenhouse.

B. **Stock Plants:** Maintaining stock plants in a vegetative condition is the greatest barrier to year-round production. Older stock plants become valuable however, because the cuttings produced initiate flowers much more readily and flower much more predictably. The ideal growing condition for continuous growth of stock might be under saran in South Florida with 10 ft. c. (110 lux) incandescent light all night or at least from 8:00 p.m. to 4:00 a.m. In the greenhouse, a night temperature of 62°F will suffice with the use of incandescent light. Cuttings must be harvested at regular intervals and a spray of 25 ppm gibberellin (GA_3) should be applied shortly after the cuttings are harvested. All shoots should be pinched whether or not cuttings are used.

Stock plant growth following dormancy will be more rapid and crops of tip cuttings may be produced at 6-week intervals until mid-summer. By late summer the rate of growth will necessitate 8-weeks between crops of cuttings and night lighting should begin by mid-August. Night lighting may be necessary all year under semi-tropical conditions as with the chrysanthemum. By September, the stock plant growth must be carefully monitored and a spray of 25 ppm GA_3 made at the first sign of a stoppage in growth, tendency of leaves to become smaller, internodes shorter, or tendency to form a terminal bud. By October it may be necessary to re-apply the GA_3 spray after each crop of cuttings is harvested.

Stock plants will likely need to be renewed each year. *It should be possible* to start new stock from West Coast propagation material as it first becomes available in May. A forcer of normal spring flowering plants may have an abundance of propagation wood when plants are pruned unless the production is all single stem plants. Of course, any plant which has had chilling can be pruned and provide excellent cuttings as is commonly done.

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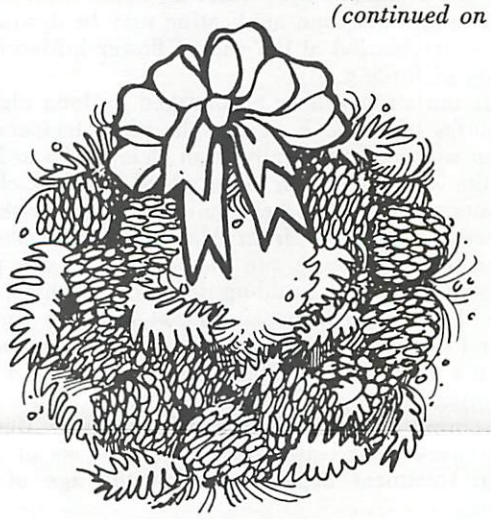

Production of Mini-Hydrangeas (continued)

C. **Propagation:** We have always rooted cuttings in regular soil mix in 3-inch (8 cm) peat pots to reduce both transplanting shock and the need for any special handling after rooting. Greenhouse flats containing 35 plants each can be handled as units for a great part of the production period.

Tip cuttings are desirable as they root quickly and flower rapidly but are expensive as a great many stock plants will be required. Double-eye (butterfly) cuttings are frequently wasted as all too frequently the 2 buds do not develop uniformly and they do require longer to root. For the maximum number of cuttings, make good single-eye cuttings by splitting two-eye cuttings, then treat with a rooting hormone, insert the half-stem up to the bud, and roll under any large leaves so that they do not overlap. Mist adequately so that cuttings never wilt and maintain the usual propagation temperature of 68°F. From October 15 to March 15 it might be advisable to use incandescent light over the propagation bed or the young cuttings may undergo initiation too soon and make very small plants.

D. **Growth and Flower Initiation:** Two additional weeks of lights may be required at a 62°F minimum temperature after rooting for plants to become established and growth to be resumed particularly during December-January but otherwise flower initiation can be encouraged immediately after plants are rooted and growth has begun. Likewise, cuttings which have come from 6-month or older stock plants may require an application of GA_3 at this time and a second application may be desirable in the mid-winter period at the end of flower initiation and beginning of forcing.

Flower initiation will be encouraged by long nights at temperatures of 50-62°F or at split night temperatures. Initiation will occur naturally from October 15 to March 15 and the long nights can be provided by black cloth at other times of year. The heat build-up under black cloth will present a problem from May through September. Shade on the greenhouse and the removal of side panels can alleviate the heat build-up for part of this period. There will be a need for additional growing time for single and double-eye leaf bud cuttings. Leaf buds must remain at a 62°F minimum temperature for up to 4 weeks after rooting and re-selected for uniformity as the young shoots become up to 1-inch long. Tip cuttings will initiate with 4-6 weeks and leaf-buds with 6-8 weeks of flower initiation treatment depending upon the age of stock plants.

During the warmest part of summer we have utilized refrigerated cold storage rooms at 52°F provided with cool white fluorescent lamps to provide 100 ft. c. (1100 lux) of light at plant level and the young plants in greenhouse flats placed under these artificial cold conditions to provide the 4-6 week flower initiation period. The lamps can operate continuously as the cool temperature will provide the flower initiation stimulus.

E. **Forcing to Bloom:** Bringing initiated plants into flower is simply a matter of changing photoperiods and maintaining a warm growing temperature. Short nights are essential and additional incandescent lighting will be beneficial for flower development from mid-August until early May in Maryland (40° north latitude). Actually each increment of light (10 ft. c. or 110 lux from incandescent lamps) will increase the rate of development, stem length and flower (cyme) size. For practical purposes the interruption of the dark period with 8 hours of incandescent light (8:00 p.m. to 4:00 a.m.) has achieved good results in our work. This principle also applies to the regular forcing of plants given cold storage where forcing is begun in November for early bloom.

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For Your Reading . . .

GREENHOUSE OPERATION AND MANAGEMENT

Paul V. Nelson, North Carolina State University
Prentice-Hall, Englewood Cliffs, NJ 07632
2nd Edition, 1981. 563 pages, illus. $19.95

In this second edition of his book, Dr. Paul Nelson continues to emphasize the business management aspects of greenhouse operation and management. However, he has carefully updated all statistics, prices, and recommendations to make the book current. This required a significant amount of effort, because the book is filled with many such items to lead and direct a prospective horticulturist in sequence through the major kinds of management decisions to site, construct, and equip the facility, and then to produce the market flowers. Dr. Nelson also provides insights toward future trends in the U.S. flower business and shares his thoughts on the things greenhouse managers must do to remain viable competitors in the years ahead.

The most substantial changes have been made in the chapters of the book relating to greenhouse construction, heating and cooling, where many new advancements have occurred during the past few years. He treats the newest greenhouse covering materials, e.g., acrylic and polycarbonate panels and thermopane glass, in detail, and attempts to predict the future of these heat-conserving covering materials in our industry.

The book includes substantial new coverage of the principles of operation, construction, and economics of solar heating systems—the first so far that I have seen in book format, directed specifically toward utilization of solar heating for **commercial** greenhouses. There is also a new section dealing with the newest technology for wood-burning boilers.

Other topics discussed in this 2nd edition not included originally are such things as 1) the crossfluted cellulose evaporative cooling pads that have recently come into use, 2) possible problems from fluoridated water supplies with certain sensitive greenhouse crops, 3) low pressure sodium vapor lamps as supplementary lighting sources for greenhouse use, 4) moveable benching systems for improved greenhouse space utilization, and 5) the latest recommendations on heat conservation techniques likely to be most useful for greenhouse producers.

The book continues to serve as an excellent text book for a general greenhouse management course for students in 2-year or 4-year floriculture study programs at the college level. In addition, it would be very useful to growers already engaged in greenhouse management and flower production to update the information base upon which they draw to operate their businesses. The book is well written and easy to read. The only fault I could find with it after lengthy study were two photographs that inadvertently got printed upside down.

This review by Marlin N. Rogers, Professor of Floriculture, University of Missouri, appeared in HortScience, December, 1981.

Hydrangeas (continued)

Shortly after the change to short nights, and the forcing period has begun, the plants must be shifted to 4 or 5-inch pots and spaced. Spacing on 8-inch centers (2 plants per square foot) is adequate for plant development. It should be understood that good cultural procedures in soil mixtures, fertilization, insect and disease control, as well as flower color control should be followed as with the normal forcing of this crop.

F. **Hydrangeas Through the Year:** There are certain advantages of continuous growing procedures. Plants remain short and have leaves close together and completely covering the stem from the pot to cyme. Growth can be at those times not requiring excessive heat input to the greenhouse. Cold storage is not required and flower initiation is not dependent upon early fall cold temperatures thereby benefiting both northern and southern growers. The method is of course adapted to continuous sales of small sizes of pots with a single showy inflorescence or cyme rather than precise timing for a holiday crop.

Table 1 shows representative data for crops through the year based upon actual data from our experiments. Each represents the most successful treatment in a given experiment. We consider Merritts' Supreme to be the best variety for year-round flowering followed by Merveille and Dr. Steiniger. Other varieties may have potential but need more trial and different varieties may be more successful in different areas and at different times of year.

LITERATURE CITED

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3. Wilkins, H. F. 1979. Reference Guide to Commercial Greenhouse Production. Soc. Amer. Florists, Alexandria, Va.