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THE PRODUCTION OF CHRYSANTHEMUMS FOR CUT FLOWERS

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Introduction. The commercial production of chrysanthemums for cut flowers in California involves a large investment and furnishes a gross return to growers that is surprising. In 1938, Japanese growers in central California reported 36 acres in chrysanthemums, with a total investment of $140,000 and gross sales of $250,000. In 1941, San Mateo County alone reported 340 acres of chrysanthemums valued at $1,079,973. More recent figures covering the early part of the war showed a decline in acreage, but the total value had gone up somewhat because of increase in the price of flowers. In 1945, there were about 33 growers in Santa Clara County, with 46 acres of chrysanthemums; the gross value of the flowers was placed at about $500,000. At the same time in San Mateo County, about 111 growers of chrysanthemums operated on 154 acres; the value placed on these flowers by the Agricultural Commissioner was $1,698,650, which makes a total for the two counties of 144 growers, about 200 acres, and a total value of something like $2,000,000. In 1946, some 30 Japanese growers were members of the Japanese Chrysanthemum Growers' Association at Redwood City. About 28 Chinese growers had stalls on the San Francisco wholesale flower market in 1946.

No very exact estimate of production of growers in Southern California is available. Interest seems to be centered mostly on the smaller flowers. One grower with 3 acres of chrysanthemums at Santa Barbara sold pompons on the San Francisco market for the first time in 1946.

To get some idea of the relative position of the chrysanthemum cut flower industry, a report of the San Mateo County Agricultural Commissioner's office gives the total value of flowers for San Mateo County in 1945 at $7,627,512; of this amount $1,698,650, or approximately 21 per cent of the total, came from chrysanthemums. Many people will be surprised that the enormous value of cut flowers places the industry in a very advance position compared with the value of many crops and animals.

Chrysanthemum production is a highly specialized industry in which a relatively small number of people are involved; although it is limited to only a few counties, many wholesale florists in other parts of the United States depend upon the chrysanthemums raised in California. A very large number of carloads of chrysanthemums have been shipped from the vicinity of Redwood City in San Mateo County. In 1945, some 1,068 carloads of flowers were shipped from the San Francisco and Peninsula area mainly to Chicago and New York. In normal times, chrysanthemums made up about one fourth this number.

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Another branch of the industry consists of raising chrysanthemums in a nursery for the sale of young plants. A number of these chrysanthemum nurseries are located in Southern California, especially in Los Angeles County, where conditions seem to be favorable for the early production of rooted cuttings. Farther north in California, it may be necessary to root most of the chrysanthemum cuttings in a greenhouse or under cloth. It is also difficult to get the cuttings early enough to have them ready in time for planting, so cuttings from earlier districts may have to be shipped in for rooting, or cuttings may be rooted in greenhouses and shipped to distant points. No value has been placed on the chrysanthemum plants raised in nurseries, but they have formed an appreciable part of the business in those few nurseries where the owner has been justified in issuing a catalog limited to chrysanthemums.

The commercial production of chrysanthemums in California differs distinctly from production in the colder states. Most of the cut flowers are raised under cheesecloth in what may be termed standard cloth houses--although these cloth houses are not at all the same in design as some of the cloth houses in eastern states. Since the early cut blooms bring the best prices, it has been customary in recent years to shade the flowers with black cloth in order to reduce the length of daylight to approximately 9 to 10 hours each day; in this way, the flowering season has been advanced as much as 2 months. The earliest flowers are ready for cutting sometime in August, the cutting season extending into the early part of the rainy season, which usually starts in late October and early November. This production of cut flowers under cloth is possible only because of the absence of summer rains and the presence of a long, favorable growing season without extreme temperatures. Although the latest blooms raised under cloth may come during the early part of the rainy season, growers are usually able to protect the more valuable flowers from rain injury by means of a tarpaulin or a piece of cheesecloth pulled over the wires used for the shading cloth. In this way there is not very much loss unless heavy rains come early.

Many of the small cut flowers are raised outside without shading or protection. These smaller-flowered varieties are grown mostly by Chinese; they form a very large part of the wholesale supply, late in the season, on the San Francisco wholesale flower market. In Southern California there are various modifications of the planting methods to be described. Some of these methods are far from standard; however, on a small scale such differences in planting methods are probably not very important.

Cloth Houses for Commercial Chrysanthemum Production. As already stated, most of the chrysanthemums in California are produced under cheesecloth. The design of these cloth houses has been standardized to a considerable degree; only slight variations are found among the more important nurseries. There is some difference in the methods of planting used by the Japanese and by the Chinese growers, although this difference is decreasing as results become more evident. When the habit of growth of the small-flowered varieties is compared with that of the large-flowered varieties, certain good reasons may be found for such differences in planting. The large-flowered kinds are disbudded so that only one flower is produced on the stem. The method of planting is adapted to the use of a standard cloth house which will not be described.

Permanent redwood posts about 2" x 3" in diameter are set in the ground, spaced 10 feet apart each way. The clearance above ground is normally 8 feet, and where the redwood posts are set in the ground a depth of at least 1½ feet, a 10-foot post will normally be ordered from the lumber yard. The unit to be described will

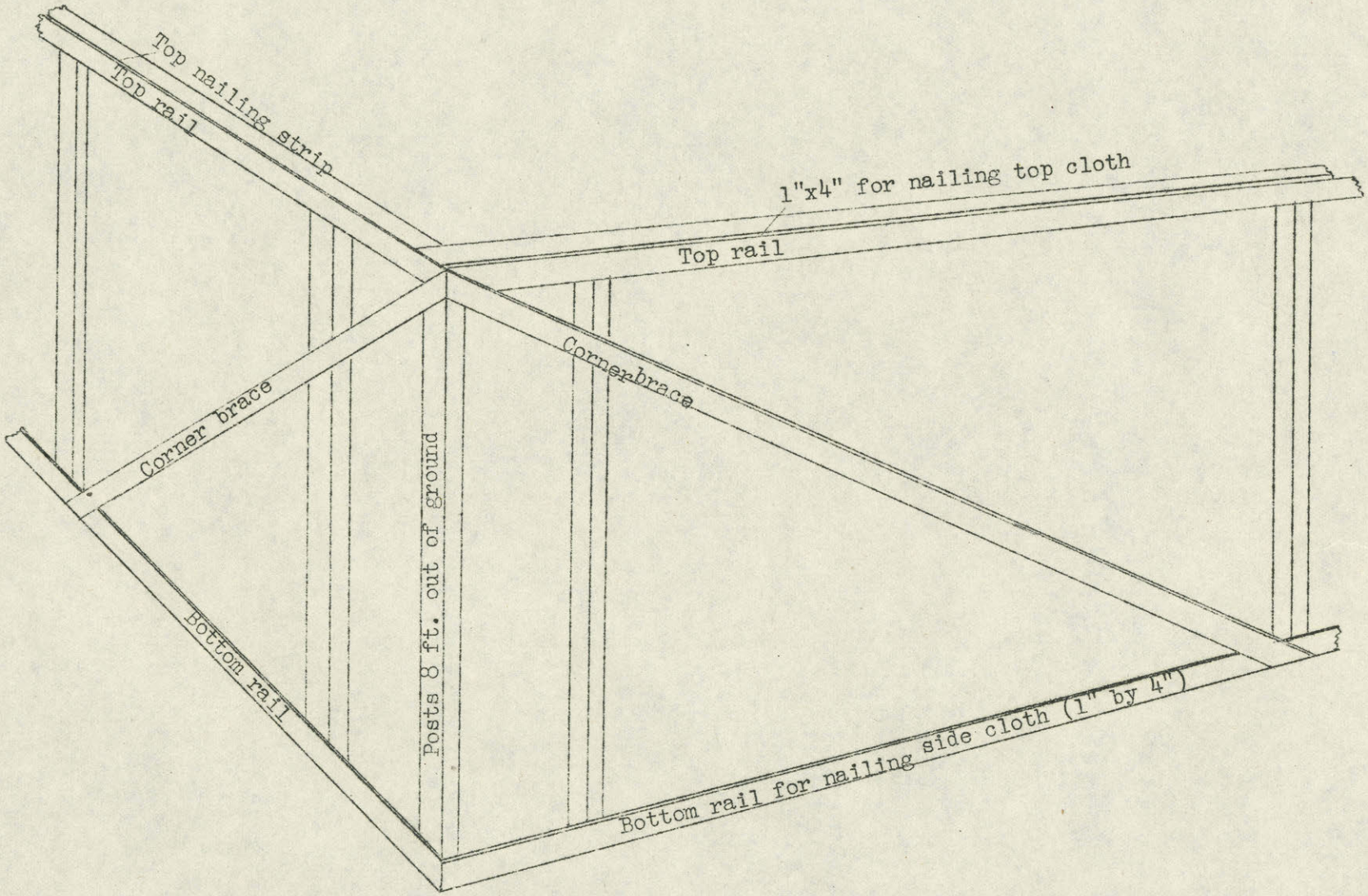


Fig. 1. Corner bracing of cloth house. Corner view of cloth-house frame to show position of bottom and top rails and corner bracing, also nailing strip on top rails for top cloth. Boards used are 1" x 4". Supports are 2" x 3", or heavier.

occupy very close to one acre, or 43,560 square feet. The unit will be square and, with only a very few modifications, can be repeated as many times as necessary to cover the desired acreage. The cheesecloth used to cover the sides and top will normally last only one year; it is then removed to allow the grower to plow and to get ready for the next season's crop. The best of the old cloth removed should be saved and used for any extra inside shading that may be needed on varieties which have a tendency to fade, or used as an additional covering during rain. It has also been used to protect the bunches of flowers after picking. After the season is over, outside wire netting, which is normally about 6 feet wide, is removed. It is rolled up to give clearance in working, but can easily be replaced when needed. Any of the galvanized wire used to support the shading cloth is usually raised high enough to give clearance after the season is over.

The posts used for supporting the cloth on the roof of the cloth house, as well as the wires used in shading, are spaced 10 feet apart each way, as stated above. In order to have a 2-foot path around the outside of the house, an extra row of posts is set out 2 feet, each post exactly opposite an inside post. The corners of the cloth house are carefully braced with 1" x 4" boards, running from the top of the corner posts down to the bottom of the outside post 12 feet away (fig.1). A top rail is run completely around the house on the outside, and a bottom rail to which the cloth is fastened, is set against the ground. In order to give the framework a little more rigidity, and to make it easy to nail the ends of the top cloth, a 1" x 4" strip is nailed on the top rim of the house over the top rail. Ordinarily, 3-foot plaster lath is cut up into pieces of 12 to 18 inches for use as cleats in nailing down the cheesecloth to the framework just mentioned. The accompanying floor plan of this unit house (Fig. 2a) shows the exact position of the supports, and another sketch (Fig. 2b) shows how a section of this house appears.

The inside bracing of the posts consists of a continuous line of 1" x 4" boards running crosswise of the house, and nailed to the top of the house with the top edge at 8 feet. The top edge of this line of boards will serve as a place on which to tack the cheesecloth used for the roof. Another line of 1" x 4" boards is run crosswise of the house to brace the posts and make the framework rigid. This line of boards is normally fastened at the lower level. It may be used to support the shade cloth where it is set at the proper level, although most growers use galvanized wire for this purpose.

Cheesecloth used for covering this framework comes in various grades. A fine mesh, 20 x 24 meshes to the inch, is preferable, but during the war the choice was often very limited, so many growers were forced to use a coarser type of cloth--12 x 20 meshes to the inch. Cheesecloth also comes in a still finer weave, 24 x 28 meshes to the inch. The 20 x 24 and the 24 x 28 weave of cheesecloth comes in 100-yard bolts, with 1,000 yards to the case, while the 12 x 20 cheesecloth has been put up in 5,000 yards to the roll. Since the width of the cheesecloth is approximately 40 inches, or a little more than 3 feet, it takes three widths running horizontally to cover each side of the house with a liberal overlapping at the edges.

The cloth is carefully fastened to the top rail on the outside by means of lath cleats. Some growers wrap the lath nailing strips with newspaper. In this way the strips fit more snugly and are less likely to tear the cloth during wind. Where the cheesecloth overlaps on the sides, the edges are sewed together with white cotton twine. A darning needle may be used to make stitches approximately 5 to 6 inches in length. The twine used for sewing the sides together should not be stronger than necessary to stand the strength. Four-ply cotton twine runs about 5,000 feet to a pound; 3-ply twine runs about 6,700 feet to a pound. A bag holds 5 pounds. Where one bolt of cloth is fastened to another to make a continuous line, it is sewed together on a sewing machine before being used. The edges of the strips of cheesecloth on the roof are usually sewed together on a machine. In this way,

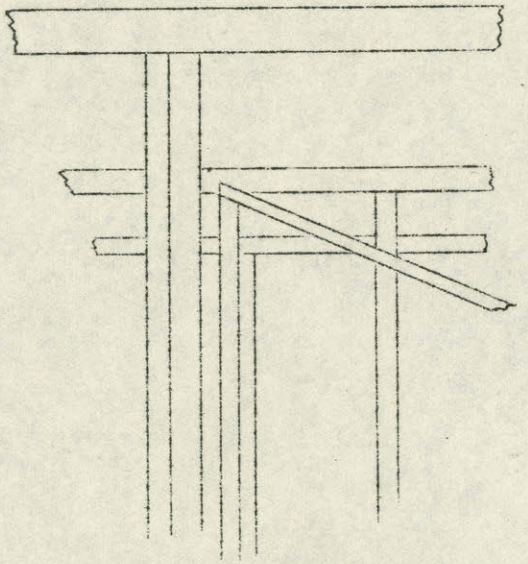


Fig. 2b. Section of opposite sketch to emphasize relative position of braces.

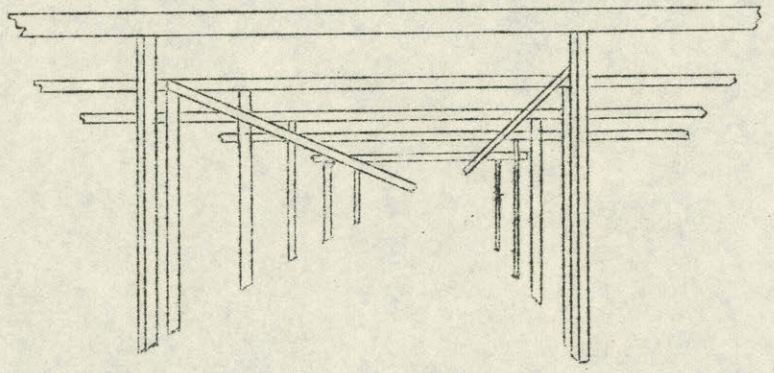


Fig. 2a. View lengthwise of rooms to show top roof supports running crosswise and position of braces running in opposite direction. These lower braces may be used to support shading cloth if placed low enough.

the cloth can be stretched properly in large sheets without sagging. Since the amount of cloth that can be sewed together and handled at one time is limited, provision should be made for fastening these sections together on the roof with lath cleats. The builder works from the edges until the roof is entirely covered and fastened down with the lath cleats. Lath nails are satisfactory for nailing these cleats on the framework. If the grower wishes to go to the expense, he may buy preservatives which are now available for making cheesecloth last longer.

In early years, no attention was given to treating the part of the post supports which were in the soil. With the present methods used to protect posts from rotting or from attack by termites, however, the grower will be justified in considering special treatment. Pentachlorophenol is now made in suitable grades for treating the base of the posts. This chemical has certain advantages over ordinary creosote in being able to protect the post against rot as well as against termites. Good heart redwood, which will last much longer than most other available lumber, in normal times is reasonable in cost. In no case should sapwood lumber be used for posts; it is not sufficiently durable to be economical. Rough lumber is about as satisfactory as surfaced lumber for the purposes mentioned.

The wire used for supporting the shading cloth and for supporting the individual plants will be described in connection with these topics. Special shading cloth, which is also used to advance the blooming season, will be described in connection with shading.

Growers who root their own cuttings will need benches, and these benches may be set up in a section of the standard unit described previously. It has been customary to limit the width of these benches so that all cuttings in the bench can be readily reached from one side. Since the space between the posts is 10 feet, there will normally be one bench set against one row of posts, with a path between. If each bench is 40 inches wide, this will leave the path 40 inches wide, which is quite ample for any purpose. If benches are placed in this space between more than one row of posts, the third row of benches will come flush with a row of posts, so that the sides of two benches come together. As many of these benches may be constructed as are required to furnish the desired number of plants. (Allow about 300 cuttings to a 10-foot section, 40 inches wide, when cuttings are spaced 4 inches each way, or about 520 cuttings with 3-inch spacing.) With the closer spacing, it will take about 20 linear feet per 1,000 cuttings. For 20,000 cuttings, when all are rooted at one time, at least 400 linear feet of this 40-inch wide bench will be needed.

The height of the benches should be very carefully considered. It is tiresome to work with the cuttings where the benches are too high from the ground. The sides of these benches can be made of light boards of only 1" x 4" dimensions, although, if preferred, heavier material can be used. It is very important to support the bottom of the benches with 2" x 3" pieces spaced about 2½ feet apart and running crosswise of the bottom of the bench. These bottom supports are carefully fastened to legs or stakes driven into the ground to prevent sagging at the bottom of the bench. Unless the boards at the bottom and the sides fit snugly, the coarse No. 4 Monterey sand used to root the cuttings will sift out when it is dry. The cracks between the boards will allow excess moisture to drain away without difficulty. The width of the boards used for the bottom will depend somewhat on the total width of the benches, but where the width of the bench is 40 inches, as suggested above, then 4-inch boards will serve very well, although wider boards can be used satisfactorily.

Since chrysanthemums in California have to be carefully watered all during the growing season, water is delivered under pressure in galvanized pipe. The size of the pipe needed will depend upon the area to be irrigated. In most cases, the pipe will need to be at least 3/4 inch, or more in diameter, to furnish sufficient volume of water for irrigation purposes. The pipe should be laid crosswise of the house so that outlets will come in the wide path, constructed crosswise at the ends of rooms, or at the end of every other bed. It is not convenient to handle a hose which is longer than 50 feet; therefore, there should be an outlet about every 100 feet. Two of these outlets will be sufficient to water all of the beds reaching the path within 200 feet.

It saves a great deal of time in spraying the chrysanthemum plants, if a small pipe is laid so that the hose used in spraying can be attached at different places. This spray line may be connected with a large spray tank at a central location, where a small pump can deliver the desired pressure in the spray line. Here again, the spray hose should not be too long, or it will be harder to handle and the friction will reduce the pressure. Where the beds are about 50 feet long, the outlet from the spray line should not be longer than about 55 feet. This will mean a spray outlet in the space between each post support, or a total of 20 in 200 feet. These crosslines will come at every other bed, and may well be placed at the edge of the large path which will be shown in the floor plan for this cloth house. Where a pump is used to furnish sufficient pressure, only a small-sized pipe will be needed to deliver the spray material. There is no objection to using $\frac{1}{2}$ inch pipe for the crosslines, but a smaller-sized pipe will probably serve just as well, unless the spray line is very long and the pressure is too low.

A list of materials needed for the construction of a cloth house is given. Sixteen essential items are included:

LIST OF MATERIALS FOR CLOTH HOUSE
(Acre unit)

1. Redwood posts for roof support:
   531 posts, 2" x 3" minimum dimension, by 10 feet long
   (5,310 linear feet).
2. Top and bottom rails for tacking cloth on outside (allows lap of 6 inches):
   a. 204 pieces, 1" x 4", 12 feet long) or (168 pieces, 14 feet long
      12 " 1" x 4", 10 feet long) (12 pieces, 16 feet long
      (2,460 linear feet) (2,454 linear feet)
   b. Corner braces - 8 pieces, 1" x 4", 16 feet long (128 linear feet).
3. Cross bracing on inside of house, 1" x 4" pieces nailed at, or near, top of posts, one line in each direction (see sketch):
   294 pieces, 14 feet long
   21 pieces, 12 feet long
4. End support for wire used in supporting plants (see sketch) made mostly of light redwood grape stakes or similar sawed strips:
   a. 320 grape stakes 5 feet long to furnish two at each end of each bed; 130 similar strips to be used as end bars for stretching wire supports for plants.
   b. 1,440 light redwood stakes to be placed at rate of about 9 each side of each bed, one each 5 feet, for wire support. Should be 4 to $4\frac{1}{4}$ feet long, depending on height of wire supports.
   c. 320 braces for bracing end bars listed in b. May be light weight grape stakes about $4\frac{1}{2}$ to 5 feet long.

5. Lath cleats to hold cloth in place. Made by sawing 3-foot plaster lath into three pieces, except for a few whole laths nailed at corners:

a. 450 pieces for nailing on outside posts.
b. 552 pieces for nailing cloth to top and bottom rails, including roof at the outside.
c. 880 pieces for nailing cloth on top cross braces.
Total required: about 7 bundles of laths.

6. Lath strips fastened crosswise of beds for plant support (unless individual stakes are used for the plants). Cut laths into 4 narrow strips.
4,580 narrow strips per acre, or 1,145 laths, or about 12 bundles of 3-foot laths.
Note: If individual plant stakes are used for tall plants, allow about 300 per bed, or at the rate of about 24,000 per acre.

7. Wire netting for fencing outside, including two doors. Use 3-inch mesh galvanized wire, 5 feet wide. Allow 816 linear feet.

8. Cheesecloth for covering frame of house (mesh 24 x 28 or 12 x 20).
Cloth usually comes in about 40-inch width, 100 yards to bolt, or 1,000 yards to bolt, or 5,000 yards to case.
a. For sides, allow 816 linear feet for each strip, and 3 strips from top to bottom, or a total of 716 linear yards. (From 900 bolts of 100 yds.)
b. For roof, allow 68 strips at 60 yards, or a total of about 4,595 yards. (From a case of 5,000 yards or 5 of the 1,000-yard bolts.)

9. Shading cloth (see notes for specifications):
a. For top over plants, each 10 feet by 50 feet, allow 4,000 linear feet for 80 beds.
b. For side curtains on rooms every 20 feet, 5-feet widths, allow 2,200 linear feet.
c. For end curtains, 5 lines of 10 pieces each, and pieces 20 feet long, or a total of 1,000 linear feet. (Allowance in b and c amounts to 3,200 linear feet of 5-foot width, which is equal to 1,600 linear feet of 10-foot width. Adding this to the allowance in 8, an acre unit will require about 5,600 linear feet of 10-foot cloth to completely shade the acre when in use at one time.)

10. Wire for plant support (No. 18 gauge galvanized wire suggested).
a. Allow 5 rows to a bed, or 250 linear feet to bed, or about 20,000 linear feet per acre. Cross paths will probably allow enough extra wire for tying wire at ends of each bed.
b. if 6 rows are planted in each bed, allow 24,000 linear feet per acre.

11. Wire for supporting shading cloth (suggest No. 10 or No. 12 gauge galvanized wire):
a. For sides of rooms to support top shading cloth, allow 2,200 linear feet.
b. For cross wire to support top shading, inside, crosswise of beds, including ends, 2,200 linear feet. Total a and b, 4,400. Allow about 4,500 feet for fastening at ends.

12. Twine for sewing edges of cheesecloth together on sides and top:
a. For sides, allow about 1,800 linear feet (5,000 feet to 1 pound of 4-ply cotton twine).

13. Plumbing:
a. Water pipe: 4 crosslines at 200 feet each, or 800 linear feet, perhaps 3/4-inch galvanized pipe as a minimum.
b. Outlet for attaching hose: 2 to each line, or a total of 8.
c. Water hose, probably 3/4 inch, or larger: 50 linear feet except when pressure allows running two or more lines at a time.
d. Spray pipe lines: 2 crosslines set in 50 feet from each side, and 200 feet long, or a total of 400 linear feet, not counting connection with spray tank beyond the cloth house.
e. Spray outlets: one to each 10 feet, or a total of 40 such outlets. This will make it possible to use a pressure hose perhaps not longer than 55 to 60 feet.

14. One, or more, saw horse, built long and low for use in stacking cut flowers when arranging in bunches at picking time.

15. Propagating benches (for a unit of 40 inches wide by 50 feet long by 4 inches deep):
    a. Bottom: 50 pieces, 1" x 4" by 10 feet.
    b. Sides: 10 pieces, 1" x 4" by 10 feet.
    c. Ends: 1 piece, 1" x 4" by 8 feet.
    d. Bottom cleats: 20 pieces each, 44 inches long (2-inch projection allowed for nailing to leg supports); allow 5 pieces, 2" x 3" by 16 feet.
    e. Legs: 35 pieces, 2" x 3" by 3 feet; allow 9 pieces at 12 feet.
    f. Brace beneath bottom cleats: made of 1" x 4"; allow 8 pieces at 10 feet.
16. Hardware:
    Nails: for nailing lath cleats to hold cloth. Lath nails.
    Nails: for nailing 1" x 4" strips, No. 8 p. nails.
    Nails: for propagating frame, if used.
    Nails or staples: for wire used to support shading cloth.
    Rings: for side curtains, and possibly for ends of top shading cloth in rooms.

Plant Support. In order to support the plants, and especially large flowers, it is necessary to provide stakes and wire. Some grape stakes of heart redwood are quite satisfactory for the ends. One stake is driven at either corner of the ends of the beds, where the beds are approximately 3-feet wide. A stake 4-feet long can be driven into the ground at the corner, with enough left above ground to give the desired height when the crossbar is nailed at the ends of the bed. Small-sized galvanized wire is stretched from this crossbar to support the chrysanthemum plants. No. 18-gauge galvanized wire is most often used. A short grape stake, or other redwood strip, can be nailed croswise of the corner stakes from which the wire is stretched. It is also necessary to brace the sides by driving a grape stake in a slanting position at the side of the bed near the end, then nailing this stake to the end support so that, when the wires are stretched, they can be drawn tightly. An accompanying sketch (Fig. 3) will illustrate how this end support appears.

Since cross supports of the plants are also needed, and the wire is stretched lengthwise of beds approximately 50 feet long, it becomes necessary to prevent these wires from sagging by driving in side stakes about 3 to 5 feet apart. If these side stakes are used, there should be no trouble about the wires sagging after the cross supports are fastened in place.

Among some of the large chrysanthemum growers, it is customary to cut an ordinary 3-foot plaster lath into four narrow strips. After the season is over, these narrow strips are tied in bundles for use the next year. Some growers, who do not have enough of these lath strips, are forced to use cotton twine to run crosswise of the beds next to the plants; but such cotton twine is less satisfactory than these lath strips which are tied to the outside wires and placed beneath all of the inside wires running lengthwise of the beds. When this method is followed, the chrysanthemum plants will be supported very nicely without individual tying. Only where the chrysanthemum plants reach a height of 5 to 6 feet, or more, will individual stakes be needed. Where these taller chrysanthemum plants are planted in a bed, the wire supports just mentioned should be replaced with individual stakes (Fig. 4). Sometimes very small-sized copper wire or a special metal tie is used to fasten the plant to the stake. This may also be used to fasten the strips of lath which form the cross support.

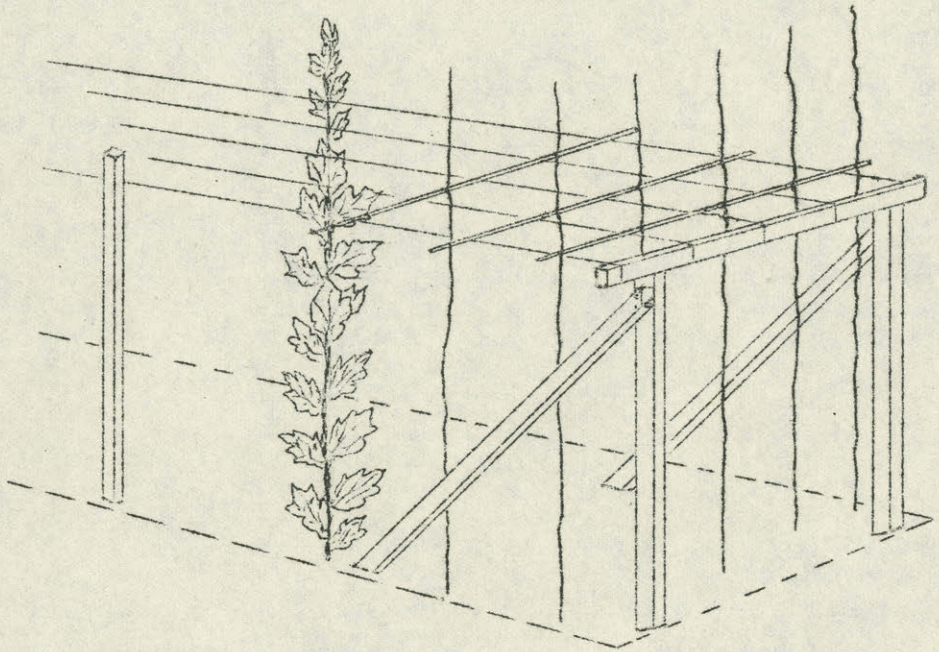


Fig. 3. Method of bracing and supporting plants in the beds. Grape stakes may be driven into ground and nailed to cross piece at ends. Lightweight stakes are driven along the sides of the beds to support outside wires; then when lath strips are tied to these wires, they will hold up the inside wires. Beds are about 3 feet wide by 50 feet long. Height of the wires will be regulated by height of the variety to be supported. Three to four feet will be sufficient for most varieties. Taller kinds may require individual stakes. (Leaves omitted from most of plants, to show details.)

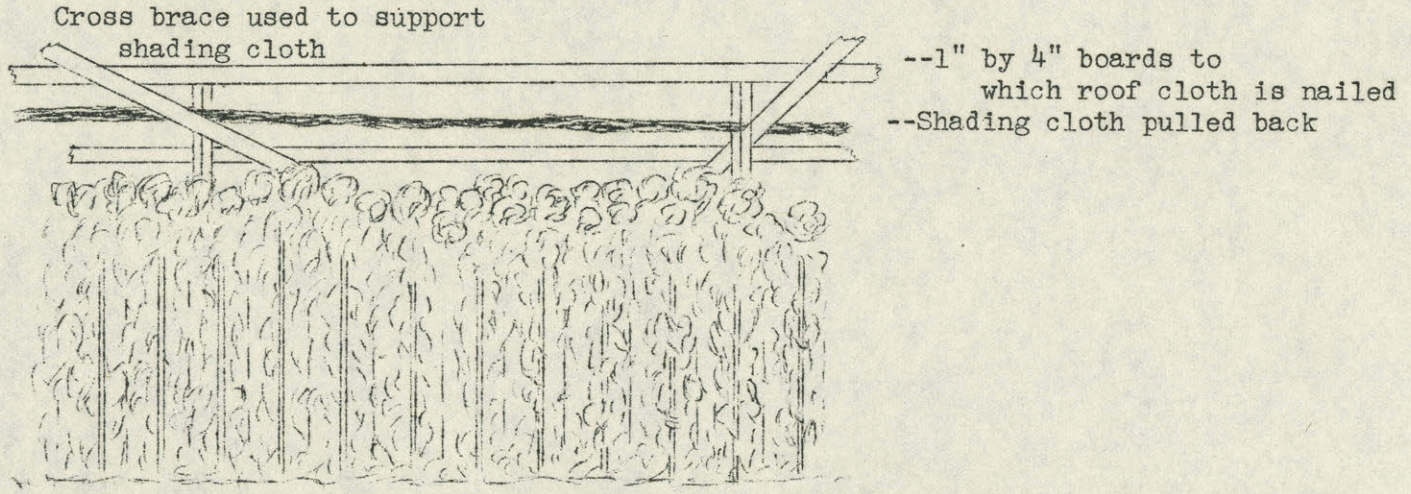


Fig. 4. Relative position of tall staked chrysanthemums to roof supports, including cross braces and shading cloth. In many cases a galvanized wire is fastened somewhat lower down for holding the shading cloth over the lower varieties during the shading period.

Propagation of Chrysanthemums. The clumps of chrysanthemum plants selected to supply cuttings should be kept in a well-drained place neither too hot nor too cold. As it is not feasible to leave the plants in the field where they are grown, the clumps may be carefully dug, with the soil intact, and stored in a cold frame where the production of cuttings is favored. Such varieties of chrysanthemums as the Turners are scanty producers of cuttings, and even some of the other varieties may not produce the desired number of cuttings unless the old clumps are properly handled during the winter. Usually it takes only a relatively small number of clumps to provide a large number of cuttings. Where a variety, such as William Turner, is a scanty producer of cuttings, a much greater allowance should be made, and in some cases it becomes necessary to make root divisions as well as to root tip-cuttings in order to secure the desired number of plants.

Basal shoots from the mother clump of chrysanthemums should be selected for rooting in coarse sand. As already stated, it may become necessary to use some of the offsets or root divisions as well as rooted tips. In that case, as many as possible of the succulent basal shoots should be selected, and when the rest of the sucker has formed a shoot, it may be divided and used for planting. Try to avoid taking the cuttings formed on the more woody shoots; these are usually weaker and produce less satisfactory plants.

Most growers favor rooted tips rather than divisions or offsets, because healthy tip-cuttings are more likely to be free from serious pests and diseases. If it becomes necessary to use the offsets or divisions, then every effort should be made to select only healthy mother plants for propagation purposes. Desirable mother plants should be selected during the growing season to secure offsets or root divisions true to name and free from any serious diseases. All plants intended for propagation purposes should be carefully labeled well in advance of the dormant season so that, when the cuttings are taken, the grower will know exactly what variety is being propagated, and that the mother plant was free from disease during the past growing season.

Some commercial growers try to buy their cuttings rather than select them from their own field. Other growers find it necessary to root their own cuttings selected from their own plants. In that case, propagation benches may be constructed according to the specifications given. The benches (Fig. 5) are usually 4-inches deep, and are filled with a No. 4 sand--such as No. 4 Monterey sand. The cuttings are carefully cut to about 4 inches in length, and the lower leaves are stripped off. The other leaves at the tip may be cut back halfway. The cutting is inserted into the sand to about one half its length. The sand is kept moderately moist, but not too wet, and the cutting should not be shaded too much. If the sand is kept too wet, and the plants are too shaded, many of them will rot before they root. A moderate degree of moisture around the cuttings will result in the formation of the best root system. The propagator should allow 25 to 50 days for the cuttings to root, depending upon the varieties and conditions in the propagation beds. The cuttings are lined out in rows in beds or benches, and are spaced about 3 or 4 inches apart when possible. All cuttings should be labeled to show the variety. Where the grower finds it impossible to construct suitable benches, he may construct beds on the ground in some place which is well drained throughout the period of rooting. It is much more difficult to regulate the temperature in beds located on the ground than in benches. It is also much more difficult to regulate the temperature when heavy rains come late in the spring.

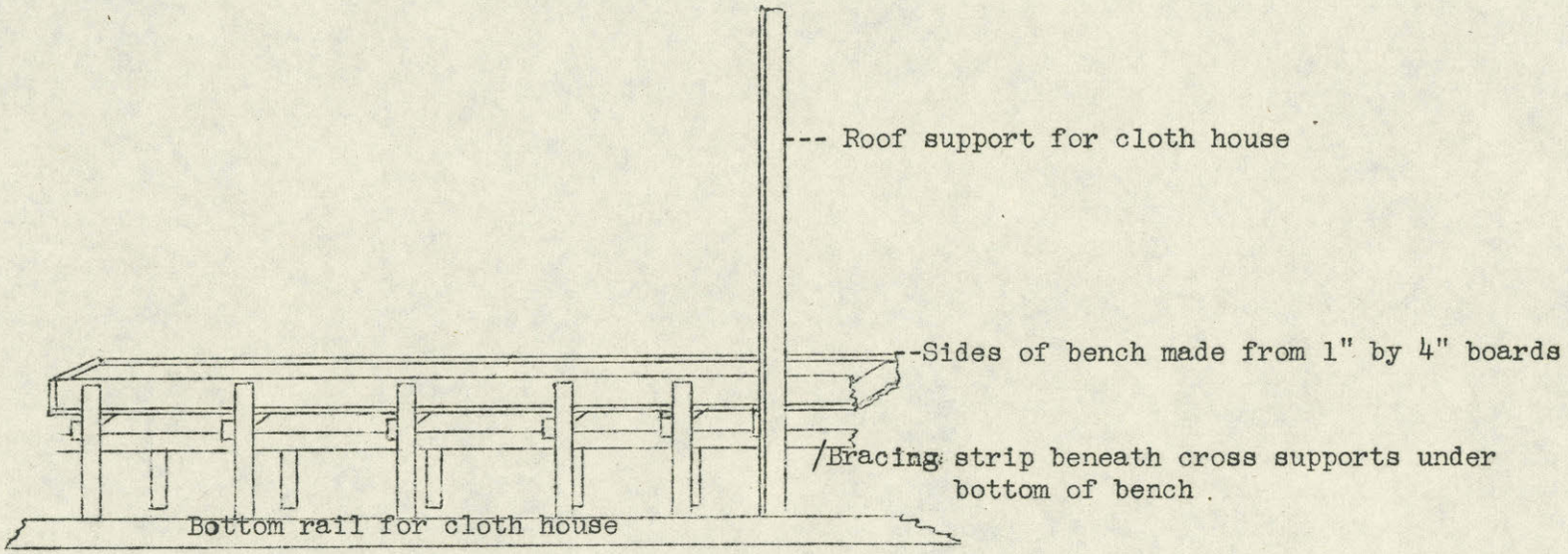


Fig. 5. Bench for rooting chrysanthemum cuttings in coarse sand, built within the standard cloth house. Held rigid by nailing to roof supports on one side. Note strong legs and cross supports under rooting bench.

Eastern growers use heated greenhouses for rooting cuttings. Such cuttings have been listed wholesale at a minimum of $40.00 per 1,000 for easily propagated varieties, and up to as much as $90.00 for scarce or new varieties or for kinds that are expensive to root. The minimum order may be 500 rooted cuttings, and not less than 50 of a kind. Unrooted cuttings have been sold in minimum lots of 250 of one kind, at the rate of $27.50 per 1,000, or $12.50 less than the price for rooted cuttings.

In most cases, growers prefer to transplant the rooted cuttings once before they are set out in the beds. If there is insufficient time in which to do this, some growers plant directly from the cutting benches or beds to the chrysanthemum beds in the field.

Where new varieties of chrysanthemums are preferred in quantity, they are usually shipped, with bare roots and packed in moist spagnum moss, in cartons to escape injury in shipping. These bare-root cuttings will be more likely to pass inspection than rooted potted cuttings shipped with soil about their roots. Furthermore, it is much cheaper to ship the bare root plants than the potted cuttings. Growers should specify exactly what they want when ordering cuttings shipped, and there should be some agreement as to whether or not any substitute in variety is permitted. As a rule, when commercial growers order cuttings, they will not want some substitute for the variety. The dealer may, however, substitute equal or better varieties for items not available, unless the order specifies no substitutions.

The Floor Plan for Planting. Two common methods of planting are used -- one primarily by the large Japanese growers of chrysanthemums, and the other by Chinese growers. The ground plan (Fig. 6) in the Japanese cloth house, and occasionally in some of the Chinese houses, is to have two beds 3 feet wide and approximately 50 feet long with a 2-foot path between the ends. This accounts for the 10-foot space between the upright post supports. As already explained, on the outside of the house a 2-foot path is left on which to walk, and in the central part of the house there will be a 2-foot path between each of the 3-foot beds. The beds at the sides of the house will normally be 50 feet long, but the other beds may be slightly shorter. Two feet will be taken off the second bed from the side to provide a 2-foot path across the cloth house. There is usually a 4-foot path (Fig. 7) across the center of the unit described, which will take off 4 feet from one of the central beds or rooms.

The plants in the bed are spaced so that they will be 5 or 6 rows wide. The more spreading varieties--such as Louisa Pockett--need more room. By having 5 rows instead of 6 running lengthwise of the bed, a little more room is provided. The spacing of the plants in a row running lengthwise will be approximately the same, but may be estimated at about 10 to 12 inches which would make 50 to 60 plants, or 4 to 5 dozen, in each row 50 feet long. If 2 feet were taken off an end of the bed, then there would be two or three less plants per row. In the beds where a 4-foot strip is taken off for a path, each row will contain about 45 to 60 plants, or 225 to 360 per bed.

Turning to the method of planting used by the Chinese in their cloth houses, it may be stated that double rows are used, and there are three sets of these double rows (Fig. 8) between each 10-foot post. We may roughly estimate the spacing of these rows at about 12 inches, and 28 inches for the path. This will allow one furrow between the rows for irrigation, and there are furrows on the outside of each row which will take some room. The space left for walking will be approximately 20 inches.

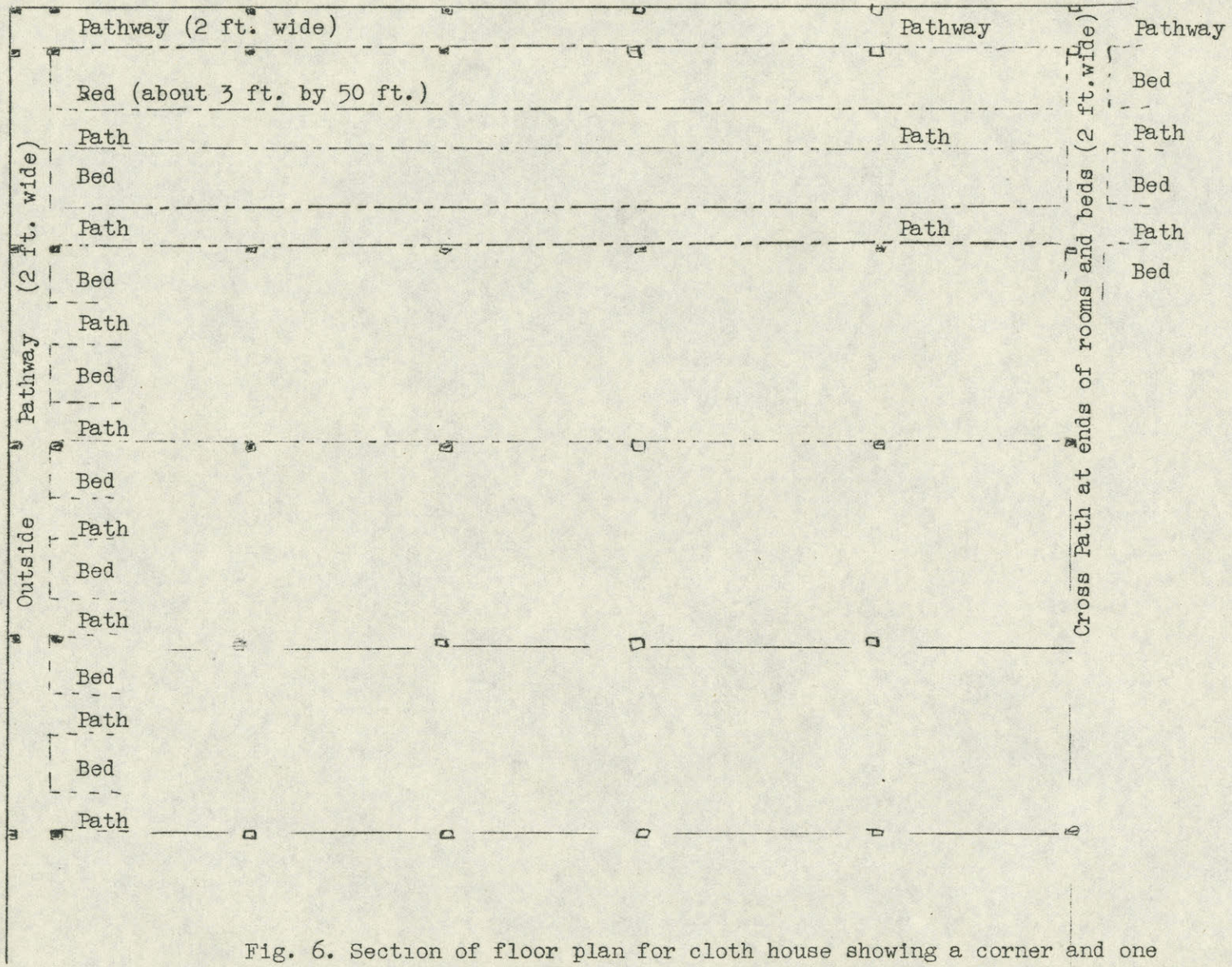


Fig. 6. Section of floor plan for cloth house showing a corner and one of the rooms. This room has two 3-foot beds and two 2-foot paths. An outside pathway around the entire cloth house provides a narrow path on each side of every bed. The beds are approximately 50 feet long.

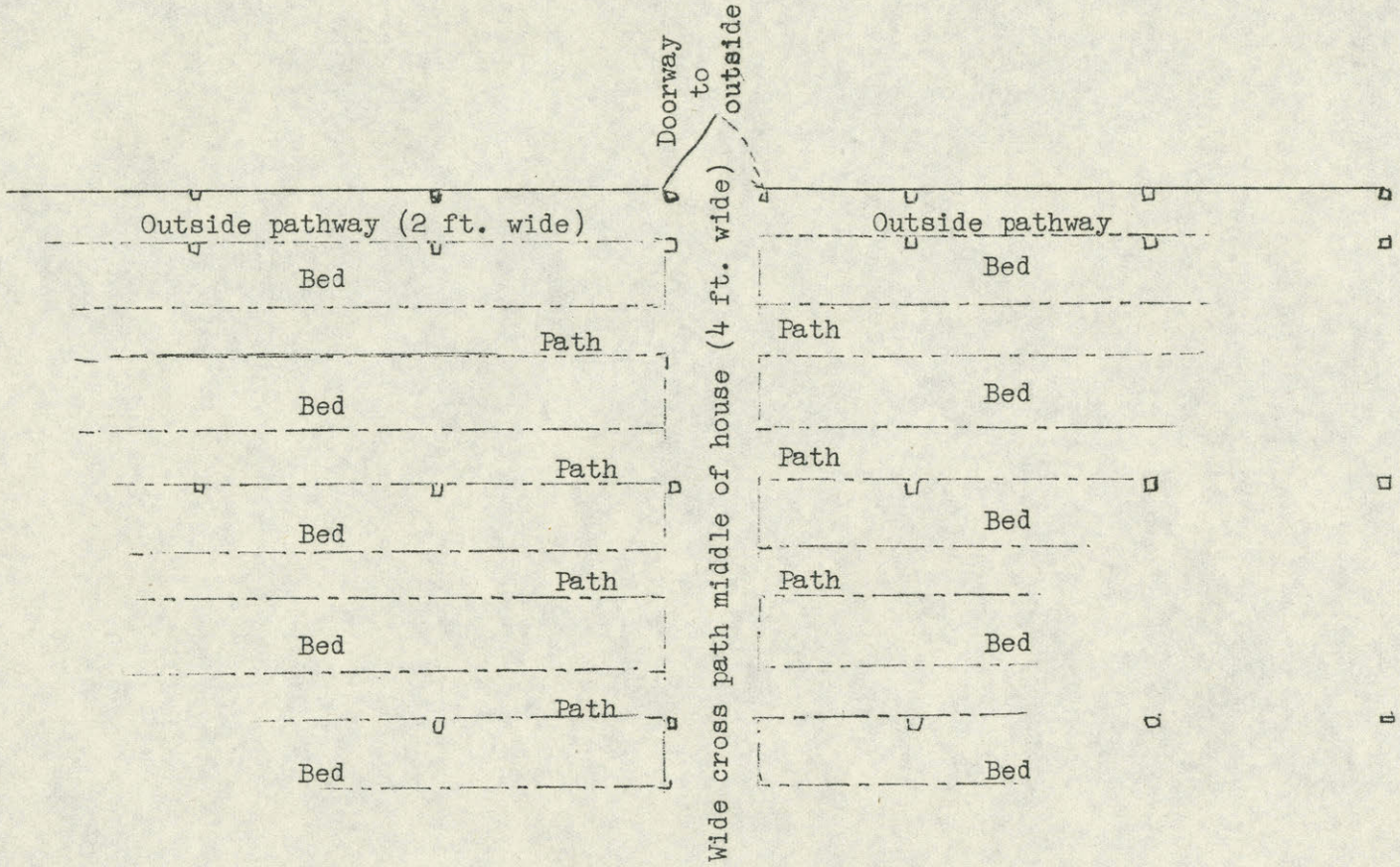


Fig. 7. Middle section of floor plan for cloth house, showing cross path and outside entrance. Two rows of beds are located on either side of this wide path. The flowers are usually assembled in this wide path after being picked. Post supports set 10' x 10' each way, except as noted, for outside pathway.

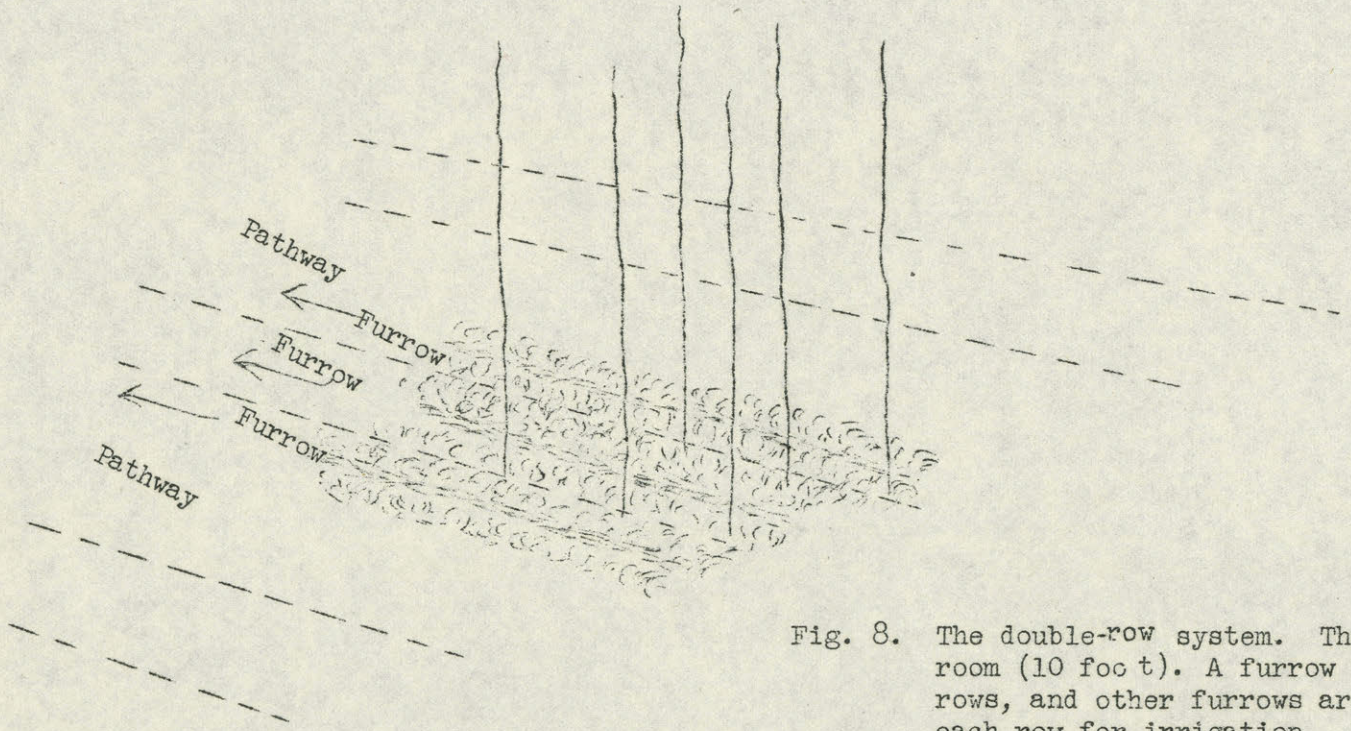


Fig. 8. The double-row system. Three double rows in each room (10 foot). A furrow is placed between the two rows, and other furrows are placed on the outside of each row for irrigation. Individual stakes are used for the taller varieties. A pathway is left between the double rows so that workmen may have access to the plants.

This means that there will be 3 paths, and 3 of these double rows in each room. Allowing for about the same spacing in the row as is used by the Japanese, we find that there are only about one half to three fifths as many plants as in the other method of planting. This smaller number of plants can be justified where the smaller-flowered varieties have many wide sprays of flowers, or where the very large-flowered varieties require more room to develop to a good size. It is very much easier to disbud the large-flowered varieties in the double row than in the bed with 5 or 6 rows. It is very easy to break off tender buds when leaning over plants at the time of disbudding. If there is plenty of room and the cost of the land is not too much, it may pay well to use this method under some soil conditions, even though it is not too popular among commercial growers. Prices will also determine whether or not it pays to give this much room to the production of an enormous flower in the double-row system.

Planting. The earliness of the variety will largely decide the proper time to plant. It is necessary to have the plant high enough to form a good crown bud which will mature early in the season and bring the best price. In the commercial cloth houses, it is possible to get some of the plants out as early as March; others are planted in April and on up to the first of May. If the planting is done too early, considering the normal time in which flowers can be expected to develop, the plants may grow so tall that the flowers are small in size and the plants are hard to manage. For varieties which grow very tall, the first planting should be delayed somewhat. Where the height of the commercial varieties exceeds 6 feet--as sometimes happens--there is a strong probability that the plants have been shaded excessively or planted too early.

Where the beds are 36 inches wide, and there are 6 rows, with the outside rows planted at the edge of the bed, the space between the rows will be about 7 inches. If there are only 5 rows in this bed, then there will be 9 inches between the rows. If we allow approximately 1 foot between the plants in the row, then the plants will be spaced approximately 7" x 12", or 9" x 12", which is a reasonable allowance for the great majority of large-flowered commercial chrysanthemums. With a bed 3 feet by 50 feet, with the plants spaced 9" x 12", there will be approximately 240 plants to the bed. With a closer spacing of 7" x 10", or 7" x 12", there would be about 300 to 360 plants to the bed. This will give a rough estimate of the number of plants to allow for each bed. Since there are 2 beds for each 10 feet, allow twice the number just mentioned for each 10 feet across the house. An acre unit will contain 80 of these beds, or 40 rooms, and will require a minimum of about 19,000 up to about 25,000 plants, depending upon the spacing mentioned above. With the widest spacing, less than 20,000 plants to the acre unit will be needed. Some of the cuttings may break in handling, or they may be too slender, or be objectionable for some reason; therefore, when planting, it is well to have extra rooted cuttings on hand. Somewhere between 20,000 and 25,000 good cuttings for the acre unit are recommended when the 3-foot beds are planted.

On the other hand, if there are 120 plants to each double row and 360 plants for each 10 feet in width, the acre unit will need approximately 20,000 plants.

Stopping, or Pinching Back Young Plants. After the rooted chrysanthemum cuttings are set out, they will soon start growth, and in most cases will become established in about 2 weeks. It is then time to pinch out the tip of the rooted cuttings to encourage branching. By this time the plants have 3 or 4 eyes out of the growth, which means 3 or 4 buds in the axils of the leaves. Select 3, or more, new shoots when they develop, and use these to produce the cut flowers. Because the market will rarely pay enough more for a single large flower than for a plant on which 3, or more, flowers are left, this is the customary method of handling the majority of varieties. On varieties that are prone to grow too tall, it may be necessary to stop the growth several times. An excessive amount of pinching back, or stopping, may prevent the production of large flowers or delay the time of flowering. If the plants have been

pinched back and the flowers run smaller, these flowers will be graded out as seconds and may not bring enough to justify such severe stopping. Most of the pinching back, or stopping, is done between June 1 and July 15, except where the planting of early varieties necessitates pinching back at an earlier date.

The last stopping of a plant is normally given about 40 days in advance of the time that shading begins. For example, if the last stopping of Silver Sheen is given on May 10, the plant should be ready for shading by June 19. Detroit News, last pinched on May 14, may be shaded by June 23. With weekly plantings, the date will be delayed accordingly, so that Silver Sheen planted late and pinched last on June 7, may be shaded July 17. Detroit News, pinched as late as July 9, would be shaded about August 18. In time, there will be no advantage in shading when planting is greatly delayed.

Disbudding. Beginners who have not tried to disbud chrysanthemums may be confused by such terms as crown buds and terminal buds (Fig. 9). As experience is gained, the grower will probably have little difficulty in selecting the proper buds on larger commercial varieties of chrysanthemums. The first bud to form on a chrysanthemum plant is usually known as the crown bud. This crown bud often produces the largest blooms. Later on, buds form below, so that where the crown bud is saved, all of the side buds should be removed. If the crown bud is not to be saved to produce large flowers, then allow the top shoots to remain. On some varieties, the crown bud aborts and, in such cases, one of the terminal buds will be used instead. A later bud sometimes gives the best color. For example, a delay of 2 weeks in disbudding Wm. H. Waite results in more brilliant color.

The chrysanthemum plants will in time produce terminal buds in clusters of 3 to 6 or even 7 on the large-flowered varieties. The strongest of these terminal buds should be saved for one large flower. Only where a spray of blooms is desired, as on the smaller-flowered varieties, should several of these terminal buds be left. Disbudding is usually limited to the decorative or early flowering kinds of chrysanthemums. Market prices rarely justify any extensive disbudding of the small-flowered varieties, except the large anemone, single, and pompon.

Considerable surplus lateral growth may form in time, and additional buds will develop after the first disbudding has been completed; therefore, it may be necessary to go over the plants occasionally to remove unwanted new shoots or any undesirable lateral buds.

Disbudding of chrysanthemums is usually left to women because their slender fingers permit them to do the work much better than most men. Incidentally, the cost of woman labor is usually less than for man labor. With a little advice at the beginning, the older girls, as well as the women, can soon learn how to disbud the chrysanthemums.

Restriction of Side Shoots. In the production of chrysanthemum flowers, after the first pinching back or stopping, it is customary to leave from 1 to 3 stems on each plant. If the very largest flowers are wanted, then only 1 stem is left. This will insure the very best size, color, and shape of bloom. In the pompon and anemone class it is customary to leave up to 6 or 8 stems, which may or may not be disbudded, depending upon the nature of the variety and the prices paid. The habit of the plant dictates the number of stems to leave, as well as where disbudding is feasible. A large single variety, such as Alex Stribling, might justify disbudding because the plant is extremely vigorous and will support several stems. On the other hand, the disbudding of W. E. Buckingham, or Bronze Buckingham, and similar small single varieties will probably not result in any great increase in size of the individual blooms. In fact, the general effect of a spray of these weaker-growing varieties

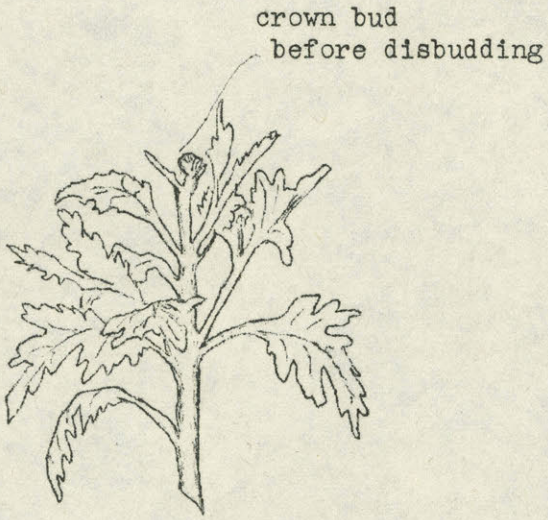


Fig. 9a. The crown bud appears along with laterals that later on will produce terminal buds.



Fig. 9b. The same crown bud, shown at left, with all laterals, or side shoots, disbudded.



Fig. 9c. A diagram to show how terminal buds spread out and ultimately produce flowers. No further buds develop after these terminal buds appear. To remove side growth, when selecting crown buds, would ultimately produce terminal buds like the one above. Any disbudding for terminal buds should be done as early as possible. And note that no further side shoots or laterals form after these terminal buds appear.

without disbudding would probably be more pleasing than where a number of buds were taken out. It should, therefore, be remembered that in regulating the side growth as well as in disbudding, the final results desired will determine what methods to follow. Only by being familiar with the varieties, the growing conditions, and the market demand will it be possible to decide what practice is best.

Chrysanthemum Pests. One of the main reasons for growing commercial chrysanthemums under cloth is to avoid serious insect pests, such as the tarnished plant bug and the spotted western cucumber beetle, Diabrotica punctata Mann. The tarnished plant bug, sometimes known as the Lygus bug, comes about May and can continue to cause damage to the plants unless the plants are sprayed regularly. The cloth house may not entirely exclude these insects, since the doors are sometimes opened, and the insects may get a start.

Recently, very satisfactory results have been secured with a 20 per cent DDT spray, diluted at the rate of 1 part to 400 parts of water. Such a spray material will be offered under various trade names. Forty per cent nicotine sulphate sprays, such as Black Leaf 40, have been very popular for spraying chrysanthemum plants; they are used at the rate of about 1 pint to 100 gallons, which is approximately 1 teaspoonful per gallon. This spray material sticks a little better when a spreader is added. On a small scale, powdered soap may be used for a spreader, at the rate of 2 tablespoonfuls per gallon; all the soap should be carefully dissolved before it is added to the spray material. Sometimes a refined summer oil spray is used, and chrysanthemums will tolerate a 2 per cent strength, which amounts to $2\frac{1}{2}$ ounces per gallon. The oil spray is usually more expensive than the 40 per cent nicotine sulphate or the DDT spray, and is used only as a last resort for controlling certain sucking insects.

The spotted cucumber beetle and similar flying insects are usually excluded satisfactorily with the ordinary covering of cheesecloth. The DDT sprays will help control these pests, should they appear.

Chrysanthemums are infested with certain kinds of aphids, but the spray materials mentioned above, when applied every week or 10 days, should prove entirely satisfactory for control.

The shady, moist conditions in the cloth house favor both snails and slugs; it is very important to get rid of these pests, well in advance of planting time, or they may do considerable damage and involve extra expense. Good surface tillage before planting will leave the surface dry and help to destroy slugs and snails without any special treatment. If they gain a foothold, use poisoned slug or snail bait. Prevention is much better than trying to control them after they enter the cloth house.

Certain spiders or mites are known to attack chrysanthemums at times. Occasionly, the two-spotted mite is a pest on chrysanthemums. This pest belongs to the spider family and the mites are very small, yellow, or pale green, or sometimes reddish with or without two or more dark spots on the body. These mites feed on the under side of the leaves, where they spin a web of considerable size. The presence of these webs on the under side of the leaves, along with an injury to the surface cells, will indicate the presence of mites or red spiders. The usual spraying for other pests, every week or 10 days, will probably discourage these mites. Dusting with sulphur has been used on other crops, but such a treatment for chrysanthemums should be avoided, if possible, because the sulphur leaves an objectionable residue on the foliage. Since much of the trouble of this nature can be traced to infestations of red spiders or mites on weeds around the chrysanthemum houses, cleaning up all of the weeds or other host plants on which mites are present will be an important step in eliminating the need of control by spraying or dusting.

A new organic insecticide is promising for trial where proved insecticides are scarce or unavailable. This product, known as Vapotone, has been used effectively for the control of certain chrysanthemum insects, such as red spiders, mites, aphids, leaf-eating worms, beetles, and thrips. It does not leave a noticeable residue and does not have an objectionable odor. A dilution of 1 part to 800 parts of water is suggested for trial against red spider, aphids, and similar pests. Since this insect spray breaks down rapidly on exposure to moisture or when diluted in water, it should be used immediately after being diluted. No spreader is needed. According to the manufacturer, it is not compatible with tartar emetic, bordeaux mixture, calcium arsenate, lime or alkaline materials. The spray material should be used in brass or steel containers, and the sprayer should be washed out when the day's spraying is over. This new material has been used in a fog machine for some plants, but for chrysanthemums it is safer if applied with the usual sprayer at the dilutions mentioned.

The chrysanthemum leaf miner lays eggs which hatch out into small maggots; these burrow their way on the upper side of the leaves, just under the surface, and make the leaves unsightly. The small white maggots are easily killed within their burrows by applying 40 per cent nicotine sulphate diluted in the proportion of 1 part to 600 parts of water.

Some mention has been made of the chrysanthemum gall midge, but a check with commercial growers in central California fails to indicate that this pest is common or serious. The adult insects lay a large number of small red eggs in the summer. These eggs hatch out into small worms, which produce pointed galls on the leaves or stems; they also seriously injure the terminal buds. Where the pest occurs, ordinary nicotine sulphate spray, with a little soap added for a spreader, should prove entirely effective in control. It is also very important to trim the plants down to the ground in the spring to eliminate the insects that may hold over from one season to the next. By selecting clean plants for propagation and by properly spraying and caring for them prior to the time that the cuttings are taken, such pests as mites and gall midges should not be serious.

Chrysanthemum Diseases. Many diseases are known to attack chrysanthemums under certain conditions; yet, if healthy plants are selected in the beginning and are properly cared for throughout the growing season, chrysanthemums grown under a cloth covering are remarkably free from serious injury. Among the most important diseases of chrysanthemums may be listed rust, powdery mildew, leaf blight, and verticillium wilt. The leaf nematodes, which also attack begonias, have sometimes been troublesome where new plants were introduced before their freedom from disease was fully determined.

Rust should not be serious in California on chrysanthemums grown under cloth or in the open fields, if healthy plants are always selected. When rust is introduced, it blights the leaves and covers the underside with small pustules of dark red spores of the fungus. Some varieties seem to be susceptible. Either destroy the affected plants as soon as they show signs of this disease, or else dust them with sulphur when any indication of rust is noticed.

Powdery mildew may attack the leaves of plants grown in too much shade, where the surface of the leaves remains moist, especially late in the season. Powdery mildew appears as a white mildew fungus over the surface of the leaves.

The suggested methods of control are to dust with sulphur, or to spray with 1 per cent lime sulphur solution or wettable sulphur. In order to reduce the cost of separate spraying, it is feasible to combine the nicotine spray for aphids with the sulphur treatment for powdery mildew.

Occasionally, commercial growers have trouble with leaf blight. The affected leaves, starting from the ground and gradually working upward on the stems, turn yellow prematurely, then wither and fall. This leaf blight is attributed to various causes, but the most common is crowding in the beds. It may also be aggravated by poor watering and by attack of red spiders or mites. Under some soil conditions, the plants may not be getting sufficient plant food to produce succulent leaves. It has also been noted that some of the large-flowered varieties, such as the Pocketts, are much more susceptible to leaf blight than others. It has already been stated that when chrysanthemums are planted in 3-foot beds, with 5 or 6 rows to the bed, there will be about twice as many plants on a given area as are found in the double-row system described. Where leaf blight has been troublesome, a greater space between the plants and perhaps a revision of the methods of fertilizing and watering may be effective preventives. There is considerable evidence to show that leaf blight is nutritional in nature, and, if the grower can determine the cause of the poor nutrition, he will be able to solve the problem.

Verticillium wilt, which is due to a fungus, causes a yellowing and browning of the leaves. The leaves usually die near the base of the plant, and the trouble works upward. Flowers on the affected plants may be seriously reduced in size. The fungus injures the feeding roots on the plants and prevents them from absorbing the normal amount of moisture and plant food. The amount of wilting is in proportion to the amount of root injury. The fungus is favored by poor drainage and excessive soil moisture.

Control of verticillium wilt is difficult, because to steam fertilize the soil over an acre or more of land may not be practical. However, this method f of treatment could be used effectively in steam-heated greenhouses. It is important to use new ground where susceptible host plants, such as tomatoes, strawberries, and dahlias, have not been grown recently. The repeated use of land for chrysanthemums, year after year, may increase trouble with this disease, if it gains a foothold. Use healthy cuttings and resistant varieties where such are available.

Certain virus diseases are known to attack chrysanthemums. Some of these virus troubles appear as a kind of mosaic, the leaves being decidedly mottled regardless of soil conditions. Since virus diseases are not curable, the only thing to do is to start with healthy plants and rogue out any plant that shows definite symptoms of mosaic diseases. Growers located in an area where lime-induced chlorosis is a problem should not confuse its symptoms--the yellowing of the leaves between the veins--with the symptoms of some virus diseases. In such instances, there is no relation to virus disease.

Shading for Early Blooms. It has been discovered that by regulating the light reaching the chrysanthemum plants, it is possible not only to affect the ratio between carbohydrates in the leaves and nitrogen intake through the roots, but also to regulate the time of blooming of most varieties of chrysanthemums. If the shading is done properly, it may advance the harvest season as much as 25 to 56 days, and sometimes more. The shading tends to reduce the length of the stem somewhat. It is customary to pull the shade cloth over the plants at 5:00 p.m., and pull back the cloth the next morning somewhere between 7:00 a.m. and 8:00 a.m. The object is to limit the length of daylight to about 10 hours during June, July, and August. The season for shading early varieties may start in early June for the very early varieties, such as Dark Pink Jewell, but mid-June in most places for Hilda Bergen, Silver Sheen, and Pink Pearl. The shade cloth not only regulates

light intensity but helps to increase the moisture of the soil and the air. The temperature is about 1° to 3° higher when the shading cloth is used. Careful tests under eastern conditions have shown that less watering is needed under cloth than outside. To insure somewhat longer and stronger stems on the chrysanthemums, where the weather remains very dark during the normal period of shading, the shading has sometimes been done only on alternate days.

Black shading cloth was scarce during the war and may not become readily available in the right grade for some time. Some of the cloth used in California comes in 10 foot strips, 50 foot long. A black sateen cloth, with mesh 64 x 104, proved most satisfactory in Ohio tests. A light-weight rubberized cloth has also been recommended, but the cost may be too great for the grower. In the Ohio tests with shading cloth, the most satisfactory proved to be Windsor cloth No. 375. Growers who can afford the rubberized cloth will likely find it durable and the temperature somewhat higher than under the ordinary black cloth. It entirely excludes the light under greenhouse conditions; whereas Windsor cloth No. 375, with a tread of 64 x 104, allowed about 1.9 foot candle or 0.04 per cent of light to be transmitted to the plants.

In shading the standard varieties of large-flowered chrysanthemums, at least 30 to 35 days are needed to secure the desired results in earlier blooming. In some of the large-flowered varieties, the cloth has been used from 35 to 40 days. In most cases, the shading cloth should not be used after the flower buds begin to show color. Counting from the time shading starts, figure on about 2 months to harvest stage for early varieties, such as Hilda Bergen, and 10 days longer for some of the later varieties.

When growers wish to experiment with some of the rubberized black cloth sold under such trade names as Parachrys, it should be remembered that this cloth comes in approximately 54 inch widths. As long as postwar conditions prevail, such cloth may not be readily available for testing. It might have considerable advantage in the early part of the rainy season in protecting the flowers overnight against rain, and could take the place of canvas sometimes used for this purpose. Commercial growers in California do not have the protection of a greenhouse, so very late varieties may be injured by early rains unless some such protection is provided. Plants cannot be left covered with the black cloth very long, but if the rain is of short duration, such shading might greatly reduce the damage from the rain.

Growers who use shading should remember that the duration of light, rather than the intensity, affects the flower-bud formation. Shading often causes the formation of terminal buds instead of crown buds, as usually expected under normal conditions.

Irrigation. From what has been said about the layout of the beds or rows, it is easy to understand what type of irrigation is required. In the beds where 5 or 6 rows run lengthwise, it is impossible to make individual furrows between the rows; instead, the edges of the beds are raised slightly to allow flooding. The beds must be reasonably level crosswise to prevent the water from running all to one side. In most cases the beds will slope lengthwise to allow the water applied at the upper end to flow gently to the lower end. If, for any reason, the ground is a little too sloping to start with, it should be laid off in contours so that the beds will not be too steep to allow the water to soak in properly as it flows down to the lower end.

Where the double-row system is used, and 3 furrows are made as described, it is very easy to place the hose at the upper end of the row and allow the water to run down to the lower end. These furrows are left permanently so that the roots of the chrysanthemums will not have to be disturbed. Unless the rows are fairly wide apart, the furrows cannot be made deep enough to carry all the water required, especially as the plants grow older and some suckers begin to appear around their base.

The object in irrigating the plants is to saturate the soil in the root zone. No more water is applied until the plants have a chance to use up most of the available moisture. Chrysanthemums should never have their growth checked by insufficient soil moisture. Any setback will favor mildew, rust, and other diseases; and, furthermore, the check in the growth will tend to harden the wood and to result in partial formation of buds.

There must be a reasonable amount of soil moisture to make the necessary nutrients soluble and available to the roots. Excessive amounts of water tend to wash out the soluble nitrogen beyond reach of the roots. It is a wasteful practice in more than one respect. Excessive soil moisture favors verticillium wilt. The irrigation should be sufficiently frequent to prevent the leaves from wilting. All experienced growers recognize healthy succulent leaves on the chrysanthemum plants, and soon learn how often to irrigate. This may be twice a week or occasionally more frequently. In still other cases, when the weather remains cool for a long time, the interval between irrigations may be somewhat longer. In home gardens, overhead sprinkling is often used, but this method of irrigation is practically never employed in commercial plantings. Late in the year, excessive humidity may favor mildew on the foliage.

All growers are cautioned about using water that is not free from alkali salts. Growers located close to the San Francisco Bay, in central California, where chrysanthemums are raised commercially, have learned that well water may contain an injurious amount of common salt. Where the well water contains as much as 400 parts of salt per million, it is not safe to use; even 300 parts of salt per million may prove dangerous in time. Where the local well water contains too much salt, water will have to be purchased, brought in from the outside, even though the cost is considerable. When growers are locating their chrysanthemum houses, they should take this factor into consideration and try to find a safe and cheap source of water.

Fertilizer. Commercial chrysanthemum plants need generous feeding. They are spoken of as gross feeders. While the plants can exist and produce flowers without additional fertilizer, the flowers will not be of high grade without generous applications of fertilizer during the growing season.

There are two or three types of fertilizer treatment which should be mentioned. When the land is being prepared for planting, where chrysanthemums have not been grown before, it may pay to grow a green-manure crop that is popular in the area; seed should be planted sometime in September and the crop turned under in time for it to rot before chrysanthemum planting time. A green-manure crop provides up to 20 tons of green substance per acre. There may be some trouble in turning the crop under in sufficient time to plant by late March or April. However, this organic material is badly needed for two important reasons: it improves the physical condition of the soil, so that the soil tills better; and it also supplies a certain amount of plant food needed by the plants. Furthermore, it encourages microörganisms in the soil, which help make available the plant foods already in the soil.

Where it is not feasible to grow a green-manure crop, it may be possible to apply manure in the fall so that it will be completely rotted by planting time in the spring. Almost any kind of high-grade barnyard manure, if it is completely rotted, will serve the purpose.

Fanciers of chrysanthemums often speak of using manure water at frequent intervals for watering the plants to insure large blooms, but the use of manure water on a large scale is not very practical. Commercial growers are forced to apply certain kinds of commercial organic fertilizer, and occasionally inorganic fertilizer, to insure large blooms. During the war, when the usual kinds of fertilizers were scarce or unavailable, many of the California chrysanthemum growers used hoof and horn meal and applied this two or three times during the early part of the growing season.

The first application is made about 2 weeks after pinching back, or stopping. The fertilizer should not be too strong. The purpose is to stimulate healthy, vigorous growth and to produce succulent healthy leaves. All fertilizing should stop when color begins to show in the buds. Many beginners learn by sad experience that overfertilizng may cause cracks to form in the necks of the large buds; sometimes the heavy fertilizing causes what is known as bull heads. Nothing short of actual experience in handling the local soils will indicate just how much fertilizer is needed to produce the best grade of cut flowers. A rough estimate of the amount needed might be given, but any such estimate should be adapted to local soil conditions.

If manure is used, in place of the covercrop, to prepare the soil for planting, up to 10 tons per acre is practical. This manure is usually expensive in terms of available nitrogen, yet it is needed for the two reasons given previously.

The commercial organic fertilizers not only provide some organic substance, but they usually supply the plant foods most likely to be deficient. Nitrogen is readily soluble in the soil and can be washed down beyond reach of the roots by too much rain or too much irrigation. On the other hand, the phosphorous and potash, which are used in large quantities by the plant, are usually fixed in the soil until used by the roots. California soils are rarely deficient in potash, but some of the soils may be slightly deficient in phosphorous.

Practically all soils will become deficient in nitrogen unless they are given manure or fertilizer in some form. The amount of commercial organic fertilizer to apply might be roughly estimated at 100 to 400 pounds per acre at a time. With two or three applications during the season, the requirements of the plants should be satisfied. Such amounts will be based upon the assumption that the organic fertilizer applied will contain only about 6 to 8 per cent nitrogen. If the fertilizer used contains as much as 12 to 15 per cent, or possibly more, nitrogen, then the amount applied at any one time should be reduced accordingly. A 6 per cent organic fertilizer applied at the rate of 100 pounds per acre would furnish 6 pounds of nitrogen. Four hundred pounds of 6 per cent fertilizer would furnish 24 pounds of nitrogen. Three hundred pounds of an 8 per cent fertilizer would supply 24 pounds of nitrogen. If a 12 per cent nitrogen fertilizer were applied, only 50 pounds would be required to supply 6 pounds of nitrogen per acre, or 200 pounds to supply 24 pounds per acre. This range in the total amount of nitrogen will give some rough idea of what the particular soil may require to produce flowers that will reach the highest grade. It is usually more economical to apply the fertilizer in small amounts, and a little more frequently, than larger amounts less frequently; therefore, three applications of the fertilizer in small amounts would probably be preferable to two applications in larger amounts.

Another factor should help to guide the grower in deciding what strength of fertilizer to use. A 4 per cent nitrogen fertilizer recently cost about $50.00 a ton, and an 8 per cent fertilizer cost only a few dollars more. In other words, the grower gets double the amount of nitrogen by spending a few dollars more per ton -- possibly not over $10.00 more per ton. This shows how important it is to determine the economy of the fertilizer in terms of available nitrogen--the most important consideration when deciding what fertilizer to use. There is little, or no, advantage in having a large amount of potash present in the fertilizer in most California soils, and the amount of phosphorous should be no more than will meet the the local requirements. Growers should insist on having what they think is economical under the prevailing soil conditions. Where there is little experience to indicate what is needed, careful tests should be made in plots and the results compared. The plants themselves will be the best indicator of the value of the fertilizer. Since no laboratory test will show the availability of these plant foods, the test-plot method will be the best one by which to determine the comparative value of any fertilizer.

Occasionally, chrysanthemum growers have settled in an area where the soil contains too much lime--as much as 5 to 20 per cent calcium carbonate. This percentage of lime in the soil reacts with the iron to make it largely unavailable to the roots of the plants and, as a result, the chrysanthemum leaves will be yellowish between the veins. If the damage is very great, the plants will be badly stunted. Soil with a high lime content should be avoided, so far as possible, because the greater majority of chrysanthemum producers will not have the difficulty nor the expense of trying to correct the trouble. Iron sulphate may be applied at the rate of about 1 to 4 ounces per square feet, or about 20 to 75 pounds for each 300 square feet, which is the approximate area of the beds in each chrysanthemum room (2 beds, each 3 feet by 50 feet). Apply the chemical evenly to the soil, well in advance of planting and rake it in thoroughly. The water used in irrigating the plants should be relatively free from high lime (calcium carbonate) content; otherwise, the outlook will be rather discouraging.

When the quickly available fertilizers are applied, the ground should be reasonably moist, so that the fertilizer can soak into the ground with the ordinary irrigation. Where the plants are irrigated in furrows, the fertilizer can be sprinkled in the furrows or placed at the head of each so that it can be washed down the full length. In some cases, it will be feasible to dissolve the fertilizer in a large tank and use the solution to irrigate the plants; in this way they will get the proper amount of fertilizer, as indicated above or as determined by actual tests.

Varieties of Chrysanthemums. Two points must be considered when selecting varieties of chrysanthemums. The fancier who expects to exhibit chrysanthemums will naturally select varieties which are good enough to win prizes. On the other hand, the commercial grower has to think in terms of market demand, and what prices can be obtained year after year for the varieties offered for sale. Sometimes an exhibition variety is also a good commercial variety, for sale as cut flowers, but that is not always true. The home gardener and fancier may become interested in certain odd forms of flowers and in some of the very small-flowered pompons which are not of any great interest to the commercial florist. In many of these cases, size is the limiting factor. Even in exhibition work, a good small variety rarely

wins over a good large variety. The commercial florist finds that flowers must be of fair size to enjoy good demand, and this applies to the different classes, all of which may be divided into small, medium, and large. The small-flowered kinds are appreciated for masses of bloom rather than for individual blooms.

The classes of chrysanthemums (Fig. 10) of interest to florists include those commonly listed as: 1) large-flowering commercial varieties, 2) large-flowering exhibition varieties, 3) single, or daisy, type, 4) pompon section, and 5) anemone section. A sixth class includes the standard feather and spidery varieties.

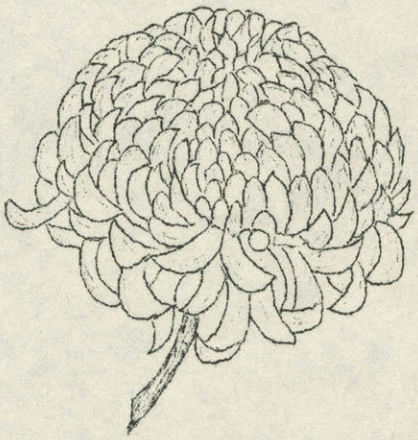
Varieties that do not seem to fit into any of these classes are placed in still another group, including the odd varieties and those with interesting forms. It is sometimes difficult to draw a sharp line between one class and another, since there are gradations. For example, at first glance, some anemone varieties appear to be singles, yet, when we look more closely we find there is a tufted center which definitely places them in the anemone section. Shaggy varieties, such as Peter John and Thanksgiving Pink, are more reflexed than incurved. We may have varieties with spoon-type petals in the singles, anemone, or in the spidery class--so, from an ornamental standpoint, the classifications are more or less arbitrary, yet are needed to give some general idea of the nature of the varieties available.

Many hundreds of varieties of chrysanthemums have been grown in California through the years. As early as 1890, Judge Widney of Los Angeles was growing about 1,100 kinds. Many modern chrysanthemum growers will be surprised to learn that H. Yoshiike, of Oakland, issued a catalog in 1894 listing over 325 varieties of chrysanthemums; he endeavored to list varieties of local interest, involving such well-known names as John Mc Laren and J. Carbone. He, as well as other California nurserymen, tried to list the newer kinds of that day, such as Lillian B. Bird, offered for sale by Blank and Company in 1 89. Many growers of today will remember Lillian B. Bird, which is about as good in form and quality as Rayonnante and Peggy Ann Hoover. In fact, some of the older varieties, such as Lillian B. Bird, may have points of superiority over some of the newer substitutes. That raises the question of what is new among our commercial varieties of chrysanthemums.

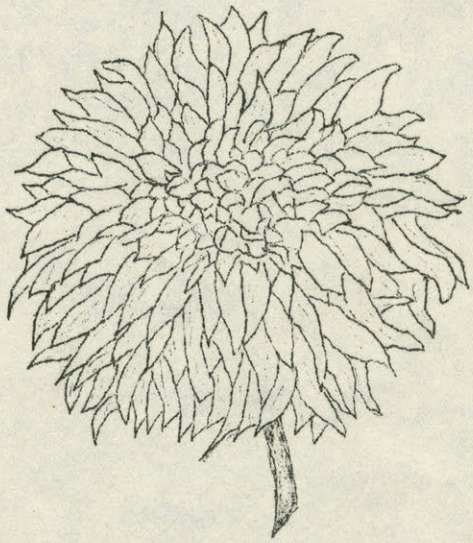
A chrysanthemum variety is not necessarily desirable simply because it is new. Major Bonaffon, originated in 1894, is a large, incurved chrysanthemum, Nellie Pockett ame in 1901, Miss Helen Frick in 1904, Rayonnante in 1908, William Turner in 1911, Mrs. G. G. Mason in 1913, Lillian Doty in 1914, Yellow Turner in 1916, W. E. Buckingham, Nagirroc, Louisa Pockett, Golden Feather, and Wm. H. Waite in 1917, Yellow Pocket in 1921, Bronze Turner in 1924, Ambassador in 1931, Bronze Frick in 1935, and Helena Pockett in 1938. When selecting varieties for the florist trade a list of this kind will emphasize the fact that quality is more important than date of introduction.

The person who is just starting to grow chrysanthemums for the florist trade should probably select only a few kinds that are known to be universally popular. The following list (table 1) of some of the more important kinds has been selected with that idea in mind. An attempt has been made to give the classification, the height of the plant, the date, if known, to start shading, if done and the approximate date of flowering in the open field. These dates will be affected to some extent by the date of planting, as well as by the local climatic conditions, so the dates are only approximate.

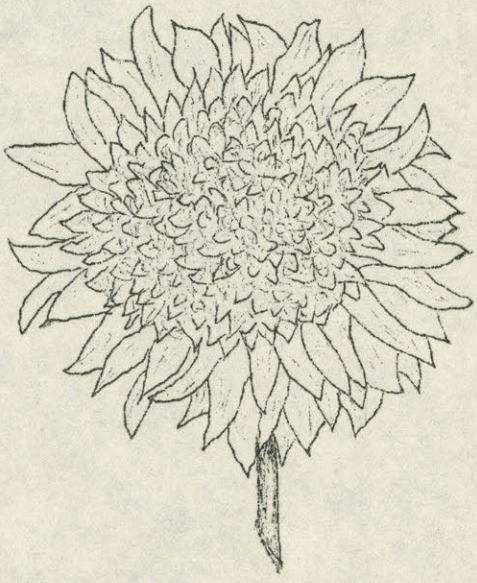
The dates for flowering of a variety may extend over several weeks, depending upon these various factors. Some growers who do not use cloth will be interested in the normal flowering date, and this date will often be as much as 2 months later than the same variety flowered under cloth. The smaller-flowered varieties can often be quite satisfactorily grown in the open; however, the same varieties will have



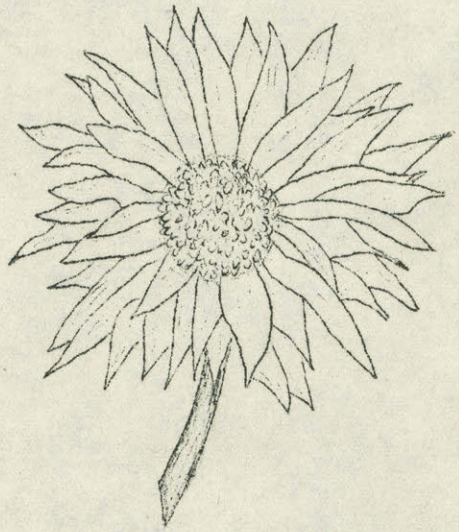
a. Large incurved
(Example: Miss Helen Frick)



b. Large reflexed and shaggy
(Example: Golden Arbini or
Peter John)



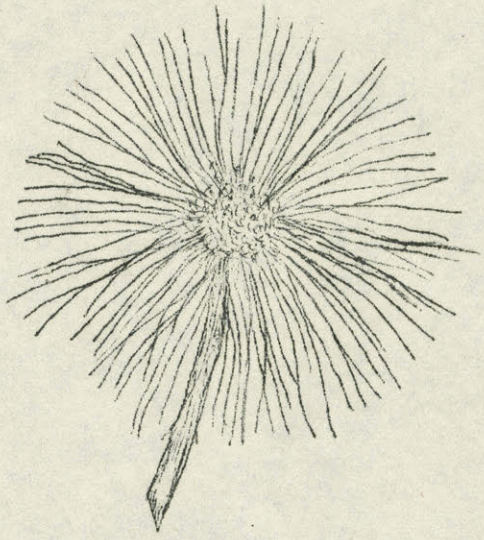
c. Large anemone
(Example: Estrelita)



d. Large single
(Example: Alex Stribling)



e. Pompon
(Example: Arcadia)



f. Spider
(Example: Rayonnante)

Fig. 10. Type of large chrysanthemums.

somewhat higher quality under cloth. The larger-flowered varieties are rarely satisfactory except when grown under cloth and shaded. A few growers may produce some cut flowers in the greenhouse for the late florist trade. The high prices of the early season naturally interest growers who have cloth houses, and it is important to harvest these flowers before heavy rains begin, along in November. It will be very unsafe to risk flowering chrysanthemums under cloth during late November and December. There would be still more risk in trying to grow them outside without cover.

Large-flowered varieties include mostly those with incurved petals, but a few kinds with reflexed or shaggy petals are raised and sold. Many differences, aside from form and color, interest the commercial florist. Such varieties as Detroit News, Honey Dew, and Thanksgiving Pink are greatly prized for their healthy green foliage. Varieties such as the Pocketts and Turners have rather poor foliage, yet have good size and are popular in spite of this weakness. A variety such as Thanksgiving Pink, which may be picked before fully open and will continue to increase in size and beauty, will please the retail florist who may wish to keep the flowers for 10 days or 2 weeks. A weak neck, such as is sometimes found on Thanksgiving Pink, is a fault to consider. Beginners will want to select a few of the standard sorts and add to these as local experience may suggest.

The following list, Table 1, is by no means inclusive of all of the good varieties, but includes a great many. The height is comparative only. With more shade and greater vigor, the plant will grow taller. The flowering season outside may also vary somewhat, depending upon the time the plants were set out and pinched back, the local climatic conditions, and the variety. The season may be a few days earlier in the northern part of the state near the coast where more cloudy days are found. The flowering season for shaded plants is given for only part of the varieties, but may be roughly estimated for others on the basis of the normal flowering season outside. The date given for flowering under cloth is usually the earliest date, but may be extended by weekly planting until the normal outside date is reached. Shading of large flowers usually starts about 6 weeks or 40 days after pinching. About 2 months more are required from the time shading starts until the first flowers mature. Some small-flowered early varieties bloom a little under 2 months after shading starts.

The advance in flowering, as the result of shading, is approximately 8 to 10 weeks, depending largely on the variety and how it responds to shading. There is no advantage in shading unless the flowers come ahead of the normal date under cheesecloth or outside.

Harvesting. Flowers for the florist trade should be cut while they are in prime condition. The grower must anticipate how well the flower, after being picked, will continue to develop in the shop of the retail florist. Because some varieties seem to last much better than others, only experience will clearly indicate the proper stage for any one variety. It is customary to pick the large-flowered commercial varieties when they have about reached their full size and while the foliage is still green and healthy. The singles are usually picked when the first row, or two, of stamens has opened before the central stamens are showing. The petals should be sufficiently unfolded to make the flowers readily salable by the time they reach the market. The pompon varieties should also be sufficiently developed so that, by the time they reach the retail florist, they will give a very pleasing color effect. If there are too many immature buds on these small-flowered varieties, they cannot be displayed to advantage by the retail florist. The anemone type will be picked at about the same stage as the singles. If the flowers are picked while too young, they may wilt far more than when picked in the early stages of maturity.

Table 1

CHRYSANTHEMUM VARIETIES--LARGE FLOWERED FOR CUT FLOWERS, COMMERCIAL AND EXHIBITION

Variety	Class	Type of Flower	Color of Flower	Height of Plant	Flowers Outside	Flowers Shaded
Albatross	commercial	incurved	glistening white	tall	Oct. 25	By Aug. 26
Alex Mason	commercial	incurved	buttercup yellow	medium	early Oct.	
Ambassador	commercial	incurved	creamy white	medium	Oct. 20	By Aug. 26
Anaconda	commercial	incurved	coppery red with bronze reverse	tall	Nov. 15	By Sep. 9
Ben Tashima	exhibition	incurved	amaranth pink with silvery reverse	medium	Nov. 15	
Betsy Ross	commercial	incurved	white	tall	Oct. 20	By Aug. 26
Bonaffon de Luxe	commercial pot plant	incurved	yellow	short	Nov. 20	By Sep. 23
Bonaffon Red	commercial	incurved	wine red	tall	Nov. 5	
Bronze Frick	commercial	incurved	apricot bronze	medium	Nov. 20	By Sep. 23
Bronze Orchid Queen	commercial	incurved	apricot buff	tall	Nov. 1	By Sep. 16
Bronze Turner	exhibition	incurved	light bronze	medium	Nov. 5	By Sep. 16
Chieftain	commercial	incurved	pink	medium	Oct. 15	By Aug. 26
Colonel Appleton	commercial	incurved	yellow	medium	Oct. 25	
Country Maiden	exhibition	incurved	apricot bronze	medium	Oct. 25	
Crimson Pockett	exhibition	incurved	crimson with gold reverse	medium	Nov. 1	
Dark Pink Orchid Queen	commercial	incurved	mauve pink	tall	Nov. 1	By Sep. 16
Detroit News	commercial	incurved	reddish bronze	medium	Nov. 1	By Aug. 26
Friendly Rival	commercial	incurved	yellow	tall	Nov. 15	
Garnet King	commercial	reflexed	deep red	medium	Nov. 25	
Gladys Pearson	commercial	incurved	buff bronze	medium	Nov. 20	
Glenview	commercial	incurved	chestnut bronze	short	Nov. 24	
Golden Arbini	commercial	reflexed	deep yellow	medium	Nov. 20	
Golden Pearson	commercial	incurved	golden yellow	medium	Nov. 20	
Golden Pockett	exhibition	incurved	golden	medium	Nov. 1	
Greer Garson	commercial	reflexed	pink	tall	Oct. 25	
Harvard	commercial	reflexed	satiny dark red	medium	Nov. 20	
Hilda Bergen	commercial	incurved	reddish bronze	medium	Oct. 25	Aug. 19
Honey Dew	commercial	semi-incurved	golden yellow	medium	Nov. 20	
Indianapolis Bronze	commercial	incurved	bronze	medium	Nov. 1	Sep. 2
Indianapolis Pink	commercial	incurved	light lavender	medium	Nov. 1	Sep. 2
Indianapolis White	commercial	incurved	white	medium	Nov. 1	Sep. 2

CHRYSANTHEMUM VARIETIES--LARGE FLOWERED FOR CUT FLOWERS, COMMERCIAL AND EXHIBITION (continued)

Variety	Class	Type of Flower	Color of Flower	Height of Plant	Flowers Outside	Flowers Shaded
Indianapolis Yellow	commercial	incurved	yellow	medium	Nov. 1	Sep. 2
Ivanhoe	commercial	incurved	reddish bronze	medium	Nov. 1	
Jeanne Nonin	commercial	incurved	yellowish white	medium	Nov. 20 on	
Juliet	exhibition	incurved	red with yellow reverse	medium	Nov. 1	
J. W. Prince	commercial	incurved	pink	medium	Oct. 15	Aug. 26
La France	exhibition	incurved	pink with silver reverse	medium	Oct. 25	
Louisa Pockett	exhibition	incurved	white	medium	Nov. 1	Sept. 2
Major Bowes	commercial	incurved	deep lavender	medium	Oct. 20	Aug. 26
May (Mae) Hunter	commercial	incurved	pink with silver reverse	medium	Nov. 20	
Miss Helen Frick	commercial	incurved	orchid pink	medium	Nov. 20	Sep. 23
Mohawk Chief	commercial	reflexed	red with buff reverse	medium	Nov. 15	
Mrs. G. G. Mason	commercial	incurved	blood red with gold reverse	medium	Nov. 5	
Nagirroc(Golden Champion)	exhibition	incurved	golden bronze	medium	Oct. 20	Aug. 19
Nellie Pockett	exhibition	incurved	white	medium	Nov. 1	Sept. 16
Orange Queen	commercial	incurved	bronze	medium	Nov. 20	
Orchid Queen	commercial	incurved	orchid pink	tall	Nov. 1	Sept. 16
Oriole	commercial	incurved	yellow	medium	Nov. 5	
Percy Lancaster	exhibition	incurved	old rose with silver reverse	tall	Oct. 20	Aug. 19
Peter John	commercial	reflexed or shaggy	pink	medium	Nov. 15	Sept. 20
Philip Kay	commercial	incurved	light lavender pink	tall	Nov. 5	
Pink Delight	exhibition	incurved	pink	tall	Nov. 20	Sept. 23
Pink Peter	commercial	reflexed	pink	medium	Nov. 20	Sept. 23
Pink Turner (Mrs. Leslie Davis)	exhibition	incurved	light lavender	medium	Nov. 5	Sept. 16
Rosabella	commercial	incurved	pink	tall	Oct. 25	
Rose Cochard	commercial	incurved	pink	medium	Oct. 15	
Roseum	commercial	incurved	deep pink	tall	Oct. 15	
Rosy Morn	commercial	incurved	old rose	medium	Oct. 25	
Silver Sheen	commercial	incurved	pure white	medium	Oct. 20	Aug. 19
Snow White	commercial	incurved	white	medium	Nov. 1	Sept. 16
Sunnyslope Bronze	commercial	incurved	golden bronze	medium	Nov. 1	Sept. 16
Thanksgiving Pink	commercial	reflexed or shaggy	deep lavender	medium	Nov. 20	
White	commercial	incurved	white	medium	Nov. 1	Sept. 16

CHRYSANTHEMUM VARIETIES--ANEMONE AND POMPON (continued)

Variety	Class	Type of Flower	Color of Flower	Height of Plant	Flowers Outside	Flowers Shaded
Bronze Doty		large pompon	bronze	medium	Nov. 5	Nov. 5
Firebird		large pompon	reddish bronze	medium	Oct. 25	Oct. 25
Lillian Doty		" "	shell pink	tall	Oct. 15	Oct. 15
Yellow Arcadia		" "	golden yellow	medium	Oct. 25	Oct. 25
Yellow Doty Improved		" "	yellow	"	Nov. 15	
White Doty		" "	white	"	Oct. 25	Oct. 25
Irene		small button	white	short	Oct. 15	Aug. 5
Jewell		large button	bright pink	"	Oct. 1	Aug. 12
Jewell, Dark Pink		" "	dark pink	"	Oct. 1	Aug. 12
Pink Pearl		" "	rose pink	medium	Oct. 25	Aug. 12
Thyra		" "	lavender pink	"	Oct. 25	Aug. 12
Alex Stribling		large single	white	"	Oct. 15	Aug. 26
Gretchen Piper		" "	brilliant yellow	"	Oct. 25	Aug. 12
October Pink		" "	light lavender pink	"	Oct. 25	Aug. 26
Valencia		" "	orchid pink	tall	Nov. 15	
White Mensa		" "	white with greenish center	medium	Nov. 10	
W. H. Buckingham		intermediate single	pink	"	Oct. 25	Aug. 26
Buckingham, Bronze		intermediate single	bronze	"	Oct. 25	Aug. 26

CHRYSANTHEMUM VARIETIES -- SPIDER AND THREAD-LIKE

Butterfly		thread	intense yellow	medium	Oct. 25	
Kay Takashima		"	white	"	Oct. 1	
Miss Gena Harwood		"	rosy mauve	tall	Oct. 15	
Peggy Ann Hoover		"	light pink	medium to short	Oct. 25	
Rayonnante		"	pale rose pink	medium	Oct. 15	
White Rayonnante		"	white	"	Oct. 15	

CHRYSANTHEMUM VARIETIES--LARGE FLOWERED FOR CUT FLOWERS, COMMERCIAL AND EXHIBITION

Variety	Class	Type of Flower	Color of Flower	Height of Plant	Flowers Outside	Flowers Shaded
Wells Late Pink	commercial	reflexed or shaggy	pink	medium	Nov. 10	
White Helen Frick	commercial	incurved	white	short	Nov. 20	Sept. 23
Wm. H. Turner	exhibition	incurved	white	medium	Nov. 5	Sept. 16
Wm. H. Waite Improved	exhibition	incurved	red with gold reverse	medium	Nov. 5	Sept. 16
Yellow Ambassador	commercial	incurved	lemon yellow	medium	Oct. 15	Aug. 26
Yellow Detroit News (Good News)	commercial	incurved	yellow	medium	Nov. 1	Sept. 16
Yellow Frick	commercial	incurved	yellow	medium	Nov. 20	Sept. 23
Yellow Pockett	exhibition	incurved	light yellow	medium	Nov. 1	Sept. 16
Yellow Turner	exhibition	incurved	light yellow	medium	Nov. 5	Sept. 16

CHRYSANTHEMUM VARIETIES--ANEMONE AND POMPON

Bronze Frieda		large anemone	bronze	tall	Oct. 15	Aug. 5
Frieda		"	shell pink	"	Oct. 15	Aug. 5
Norma, Pink		" "	orchid pink	medium	Nov. 15	
Norma, White		" "	white	"	Nov. 15	
Smith's Innocence		medium anemone	"	"	Nov. 5	Nov. 5
Smith's Innocence Yellow		" "	yellow	"	Nov. 5	Nov. 5
The Titan		large anemone	scarlet crimson bronze red cushion	tall	Nov. 5	Nov. 5
Tuxedo		" "	light pink	"	Nov. 1	Nov. 1
Tuxedo, Bronze		" "	bronze	"	Nov. 1	Nov. 1
Tuxedo, Yellow		" "	clear yellow	"	Nov. 1	Nov. 1
Adelaide		intermediate pompon	mahogany bronze	medium	Oct. 10	Oct. 10
Captain Cook		intermediate pompon	rose pink	tall	Oct. 20	Oct. 20
Christmas Red		intermediate pompon	deep red	medium	Dec. 5	Nov. 15
Jessie (Madeline)		intermediate pompon	deep pink	medium	Oct. 25	Oct. 25
Anna L. Moran		large pompon	scarlet	low	Nov. 15	

In harvesting, the grower places the flowers in bunches. A low saw horse is often placed in the large 4-foot path, and against this saw horse the flowers are leaned as they are picked. Some growers may have large containers in which they place the flowers directly, but it is easier to lean them against the saw horse in making up the bunches.

With the small-flowered varieties, there are from 5 to 8 stems to a bunch. When these bunches reach the wholesaler, he will probably combine 5 of the small bunches in 1 large bunch, or market bunch, as it is called. The large-flowered varieties, on the other hand, are sold by the grower in bunches of 50 stems, but the wholesale florist usually sells the same large-flowered chrysanthemums by the dozen. After the proper number has been placed in the bunch, the bunch is tied snugly with cotton twine (about 6 to 8 ply), and is then ready for packing and hauling to the shipping shed. Tie the bunches near the ends of the stems and in the center.

The flowers intended for sale within a radius of 100 miles, or so, will usually be handled somewhat differently from those intended for distant shipment. Large cartons, or boxes, about 48 inches long, 20 inches wide, and 8 inches deep are used to pack the flowers for distant shipment. A refrigeration unit may be placed in each box. The same carton, without any refrigeration, may be used occasionally for local shipments. However, when the flowers are properly tied in bunches they can be hauled in an enclosed truck, without being packed in a carton, about as easily as when packed in a carton and at less expense. The retail florist will naturally pay close attention to the size, color, and condition of the blooms, the length of the stems, and also the condition of the foliage. Usually the grower will grade the flowers as he picks them, so that No. 1 flowers will go into one bunch, and the No. 2 flowers into a different bunch. The different classes of flowers should not be mixed in the same bunch at picking.

A sharp knife is used in cutting the flowers, and the stems should be just as long as the market demands. There is no advantage in leaving part of the stem on the mother plant, so cut the stem the length desired, even up to 4 or 5 feet in some large-flowered varieties. A lower price is customarily paid for the No. 2 flowers. These flowers are usually smaller, or not in the very best condition, or with short stems. The small-flowered varieties will probably not be graded so closely; however, the quality of all the flowers in a bunch should be the same. A grower who raises his small flowers outside, without the protection of cloth, cannot expect so high a quality in most cases as the grower who raises the same flowers under cloth; and the prices paid on the wholesale market naturally will take these factors into account.

It is customary to strip down the old leaves at the base of the stem before starting to pick. Any of the leaves which have started to turn yellow or brown should be removed completely, because they may seriously detract from the general appearance of the cut flowers. The healthy green leaves should be left on the stems. The grower should endeavor to keep these green leaves in an unbroken condition, because they add a great deal to the cut flowers after they are displayed by the retail florist. Crushing these leaves in the bunches during shipment may lower the price paid for the blooms.

Grading and Handling the Cut Flowers. Chrysanthemum flowers are normally placed in one of two general grades, No. 1 and No. 2. The points considered in making these two grades are similar to, but not always the same as, those used in judging at flower shows. Of the large-flowered kinds, size counts most and is alloted 30 per cent. In judging at shows, color, form, depth, and fullness are each allowed 15 per cent, and stems and foliage are estimated at 5 per cent each. For commercial cut flowers, these same allowances can be used when properly interpreted. Since form, fullness, and depth are all closely related, the grower must give much attention to the growing specimen and pick it when it is in good condition.

The condition of the flower at the time of cutting will, of course, affect its form and color to some extent, and will involve the foliage as well as the flower. Good centers on the flowers, full depth, proper shape for the variety, freedom from fading, good length of stem, and good size will need emphasis. No noticeable faults are evident in the No.1 flower. Some varieties have faults even when well grown, such as poor foliage. If the flower lacks size, or if color and form are visibly defective, the stem is too short, or the foliage is poor, it will probably be placed in No. 2 grade. Since lack of substance in a large flower will show in the form and color of the petals and in the foliage, it is considered even though it may not be mentioned specifically in a grading. A tendency for the foliage to be yellowed, browned, or mildewed instead of a healthy green and standing out in full vigor, will certainly count against the specimen. Late in the season, when so many leaves deteriorate because of wet and windy weather, the grower may be tempted to modify his methods of grading. In some cases, as many as 25 per cent of the No. 2 flowers may find their way into what is offered as No. 1 grade. No experienced buyer is fooled by such a practice, and the grower who maintains strict standard will enjoy preference when competition is keen. When a retail florist learns that flowers grown by a particular grower keep well, he will be willing to pay most for such flowers; correspondingly, when he learns that other blooms which appear in good condition on the wholesale market deteriorate much sooner, he will decline to buy.

After the flowers have been tied in market bunches or bundles, they are ready to be covered for delivery to the market. Newspaper is used for the outer wrap, and soft florist wax tissue paper is used against the blooms. This wax tissue comes in green and other colors 24" x 36" in size, with 480 sheets to the ream. Green paper also comes in rolls, 24 inches wide and about 48 pounds to the roll. It is sold by florist supply houses. Two sheets of newspaper may be laid down in one direction and two more in the opposite direction, with a sheet of florist tissue laid on top. The cut flowers are placed on this tissue paper, which is then folded over the tips of the blooms. The topmost sheets of the newspaper are then folded over the tips, and the side sheets are wrapped around the stems. All is then snugly tied with twine. Since there is some danger that this twine may slip down on the tapering bundle, growers have sometimes used old cheesecloth to wrap around the tip of the bundle before tying. This helps hold the twine in place during the haul to market. Old cheesecloth saved from the previous season will serve well for this outer wrap on the flowers being hauled to market. When cheesecloth was scarce during the war, this wrap was omitted.

On reaching the local market, the old cheesecloth is removed, and also the paper over the tips of the stems, so that the flowers may be displayed in the large galvanized containers used on most wholesale markets. The retail florist selects what he wants, and the paper left intact around the bundle will furnish all the protection needed until the flowers are unwrapped. Before setting the stems deep in water, the retail florist then cuts a short piece from the butts of the stems, and strips away any more of the basal leaves not wanted.

Investment. Each grower should keep a record of his investment. He might find this investment to be at the rate of $120 per room. With 40 rooms per acre, his investment would then mean $4,800 per acre. The minimum cost per acre of planting stock of 19,000 to 25,000 rooted cuttings is around $760 to $1,000, if purchased at wholesale, and this expense recurs yearly. The grower may figure on this expense as an annual cash outlay. Regardless of what the investment may be, each grower, in order to help figure depreciation and taxes, should try to keep a record of what his investment has been.

Cost of Production. Since the flowers are sold in bunches, the cost of production is usually estimated in terms of bunches. The smaller flowers are put up in small bunches of about 5 to 8 stems each, and the production expected is estimated at 600 to 800 of these small bunches per room. With 40 rooms per acre, the total production will be about 24,000 to 32,000 small bunches per acre. It takes 5 small bunches to make a market bunch.

The large flowers are put up in 50 to a large bunch. The wholesale dealer buys these large flowers in bunches of 50 to a bunch, but sells them by the dozen. He may pay from $10 to $15 for a bunch of 50 large blooms, and the very fancy large flowers early in the season may bring as much as $25, but that is well above average. These same flowers involve a wholesale commission of about 15 per cent, so that a bunch that sells at $10 wholesale for No. 1 quality would have $1.50 deducted, leaving the grower $8.50 for 50 blooms, or about 17 cents a bloom. Flowers bringing as much as $15 for a bunch of 50, would have a commission of $2.25 deducted, leaving the grower $12.75 per bunch, or about 25½ cents per bloom. Double the grower's price for 50 blooms and point off two places to the left to find the price the grower gets per bloom.

The cost of producing the smaller flowers depends somewhat on how much labor is hired. Where the work is done without hired labor, the cost per small bunch has been roughly estimated at 15 cents. With one hired man, the cost may be about 20 cents. With two hired men, the cost at present is estimated at 25 cents. Since the price received has been around 20 cents, the grower is likely to lose unless he is very careful about hiring labor. With a production of 24,000 to 32,000 small bunches per acre, the cost of production without hired labor may be estimated at $3,600 to $4,800 per acre. With 1 hired man, the cost may be $4,800 to $6,400 an acre. With 2 hired men, the cost may be as much as $6,000 to $8,000 an acre. Under recent price conditions for flowers and labor, the grower should have some profit unless he hires too much labor. Some growers have reported a loss in producing the small blooms.

Returns from the large flowers are harder to estimate. Cost of disbudding may be considerable if hired help is used. If a grower secured a large percentage of No. 2 blooms that brought him only $6 for a bunch of 50, or $1.50 per dozen, he would theoretically have a fairly large income per acre, but, by the time he subtracted all costs, including disbudding and waste, his net income per acre would not be very large. If he were able to produce mostly No. 1 large blooms and could sell these at $2.50 to $5.00 a dozen, or about $10 to $20 for a large bunch of 50, he might do very well financially. Beginners should figure production and income very conservatively until they learn from actual experience what can be obtained. In some cases it will be safest to work in partnership with some person who has had several years of experience in growing these flowers commercially in the locality.

Regardless of what the costs and returns may be, every grower should keep records which can be used in filing income tax reports, and also in declaring values for property taxes in the county.

REFERENCES

Cumming, Alex, Jr.
1939. Hardy chrysanthemums. 168 p. McGraw-Hill Book Company New York.

Herrington, A.
1929. The chrysanthemum. 170 p. Orange Judd Company, New York.

Laurie, Alex.
1930. Chrysanthemums under glass and outdoors. 110 p. A. T. De la Mare Company, Inc., New York.

Laurie, Alex, and G. H. Poesch
1940. Commercial flower forcing. 3d ed. 565 p. P. Blakiston's Son and Company, Philadelphia.

Macself, A. J.
1939. Chrysanthemum growers treasury. 290 p. W. H. and L. Collingridge, Ltd., London.

Niwa, Teizo.
1936. Chrysanthemums of Japan. 56 p. 80 colored plates. G. E. Stechert, New York.

Portland Chrysanthemum Society
1946. Chrysanthemums: How to grow them out of doors. 97 p. Re. ed. Portland Chrysanthemum Society, 2905 N. E. 38th Avenue, Portland 13, Oregon.

Sanders, T. W.
1930. Chrysanthemums and how to grow them. 32 p. W. H. and L. Collingridge, Ltd., London.

White, E. A.
1930. The chrysanthemum and its culture. 192 p. Orange Judd Co., New York.

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