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Chrysanthemums

By
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R. H. Hanchey and W. D. Kimbrough

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LOUISIANA STATE UNIVERSITY
AND AGRICULTURAL AND MECHANICAL COLLEGE
AGRICULTURAL EXPERIMENT STATION
Charles W. Upp, Director
The chrysanthemum is one of the most popular flowers grown in the United States. It is a very important commercial flower and is also quite frequently grown around the home. It normally blooms in the fall, for it is what is known as a "short day" plant. However, by regulating shading and lighting to adjust day length, commercial growers now produce chrysanthemums the year around.

In south Louisiana chrysanthemums are commercially important especially at one particular time of the year, and that is All Saints' Day (November 1). Fortunately many varieties are normally in bloom at that time. Many growers produce flowers for this occasion only. In such cases it is imperative that blooms be ready for sale within a week prior to All Saints' Day. Otherwise the demand for them would be very limited.

Chrysanthemum flowers have good lasting qualities as cut flowers, pot plants and on the plants grown outdoors. There is a wide range in color of flowers among varieties. Flower form is also quite variable, with the following being the main ones: single or daisy, pompon, decorative, cushion, anemone, spider, spoon and quill. Some of these types are illustrated in Figure 1. The size of blooms varies from small to very large, this being determined by the variety and to some extent by the amount of disbudding practiced. The height of plant will vary from about one foot to over six feet, depending on variety, cultural conditions and disbudding. The varieties are divided into general groups, according to the time of blooming. Thus there are 7-, 8-, 9-, 10-, 11-, 12-, 13- and 14-week varieties. This grouping is determined in general by the time required for the plants of a variety to bloom after being exposed to lighting conditions favorable for flower bud formation. This of course means that the fewer the weeks, the earlier the variety. However, climatic conditions have some influence on the time of bloom; thus the time grouping is not specific.

This bulletin was written to meet the demand for information concerning chrysanthemum culture. It is divided into three parts: (1) production of standard or large flowers that have one bloom per stem; (2) mums for the yard; (3) forced disbuds and other pot mums.

New varieties of chrysanthemums are produced from seed or from mutations or sports of existing varieties. Varieties will not come true from seed. In general, plants of varieties are commercially propagated from cuttings. This method is recommended as the best one. The cuttings root readily in any good medium under favorable conditions. Plants may also be increased by using the stolons that form around the base of the plant or by dividing the
crowns of older plants. The latter methods are more favorable to the spread of diseases but are often used by home gardeners.

PRODUCTION OF STANDARD MUMS

The term “standard chrysanthemum” refers to the types that generally have very large flowers on long stems. There is only one bloom per stem and one to four stems per plant.

Location and Preparation of the Bed

The bed should be in full sun, and the drainage of the soil must be excellent. It should be fairly level so as not to make irrigation too much of a problem. The soil should be well prepared sometime in advance of transplanting the plants. Organic matter such as manure, leaf mold or peat should be worked into the soil. The soil should be treated with methyl bromide, Vapam or Mylone to reduce plant diseases, nematodes and weeds and grass. When using these materials, directions as given by the manufacturers should be followed. Methyl bromide is more effective than the others but is more difficult to apply. If steam is available it may be used to pasteurize or sterilize the soil. Fertilizer at the rate of about 3 pounds of 8-8-8 or equivalent per 100 square feet should be broadcast over the bed and worked into the soil about 10 days before the plants are to be set out.

The same location may be used over and over if it is treated and the organic content replenished each time before it is planted. The soil should not be allowed to become compact.

Obtaining Plants

It is of course possible for the grower to propagate his own plants from cuttings if suitable stock plants are available. This procedure is not recommended, however, because of the likelihood of the presence of diseased plants. It is generally best to obtain plants from a reliable wholesale grower or from a retail source that obtains plants from such a company. These companies specialize in propagating plants. They have trained personnel that see to it that disease is reduced to a minimum and that excellent plants are produced and reach the grower in good condition. Plants may be ordered to arrive at approximately any designated date, if orders are received by the propagator sufficiently ahead of time.

Transplanting

The time of transplanting is of considerable importance. The time greatly affects the height of plants but has little to do with the time or size of bloom unless the plants are set very late. There is no advantage to early planting, as that means only that care is necessary for a longer period of time, the plants will grow taller than necessary and the lower leaves will likely be lost. The effect of date
FIGURE 1.—Some types of chrysanthemums. A, single; B, anemone; C, spoon; D, spider; E, pompon; F, decorative; G, standard.

of planting on length of stems and size of blooms is shown in Table 1. The data show that height varied directly with the date of planting. This was not true for flower size, though flowers of the later plantings of the Betsy Ross tended to be a little smaller. It would seem that about June 15 is the best time to set plants in south Louisiana for mums for All Saints’ Day. (See Figure 2.) Stems three to four feet in height are long enough.

Plants should be removed from the packages and transplanted as soon as received. They will normally arrive in excellent condition. If it is possible to do so, there is some advantage to setting plants in peat pots and letting them stay for about a week before they
FIGURE 2.—Effect of planting date on plant growth of two varieties of chrysanthemums, Betsy Ross on the left and Yellow Ambassador on the right. Planting dates were, from left to right, June 2, 16, 30, July 14 and 28.

are set out in a permanent location. This will add to the expense but should help get the plants off to a good start and reduce losses. The soil should be in good condition when plants are transplanted, and they should be watered at that time and loose soil then put over the wet soil. It is beneficial to set bare rooted plants on cloudy days or in late afternoon. In beds, the plants should be spaced one foot apart each way. If grown on rows, they should be set one foot apart.

Varieties

The variety or varieties of mums grown, as with most other crops, will largely determine the success of the undertaking. Numerous varieties are on the market and new ones are being added every year. Varieties must produce blooms at a time when there is
TABLE 1.—The Effect of Date of Planting on Length of Stems and Size of Blooms

<table>
<thead>
<tr>
<th>Variety</th>
<th>Planting Date</th>
<th>Measurement in Inches</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Stem Length</td>
</tr>
<tr>
<td>Yellow Ambassador</td>
<td>June 2</td>
<td>46.5</td>
</tr>
<tr>
<td></td>
<td>16</td>
<td>42.0</td>
</tr>
<tr>
<td></td>
<td>30</td>
<td>34.5</td>
</tr>
<tr>
<td></td>
<td>July 14</td>
<td>25.0</td>
</tr>
<tr>
<td></td>
<td>28</td>
<td>19.5</td>
</tr>
<tr>
<td>Average, Yellow Ambassador</td>
<td></td>
<td>33.5</td>
</tr>
<tr>
<td>Betsy Ross</td>
<td>June 2</td>
<td>60.0</td>
</tr>
<tr>
<td></td>
<td>16</td>
<td>57.5</td>
</tr>
<tr>
<td></td>
<td>30</td>
<td>46.0</td>
</tr>
<tr>
<td></td>
<td>July 14</td>
<td>41.5</td>
</tr>
<tr>
<td></td>
<td>28</td>
<td>33.5</td>
</tr>
<tr>
<td>Average, Betsy Ross</td>
<td></td>
<td>47.7</td>
</tr>
<tr>
<td>Average, Both Varieties</td>
<td></td>
<td>40.6</td>
</tr>
</tbody>
</table>

D Values for Comparisons

<table>
<thead>
<tr>
<th></th>
<th>(1) Varieties = 1.15</th>
<th>(2) Dates = 1.50</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stem length:</td>
<td>(1) Varieties = 0.24</td>
<td>(2) Dates = 0.32</td>
</tr>
<tr>
<td>Diameter:</td>
<td>(1) Varieties = 0.18</td>
<td>(2) Dates = 0.24</td>
</tr>
<tr>
<td>Depth:</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a market demand. The main preference in Louisiana is for white mums, with yellow being the next most important color. There is a limited sale for so called pinks, reds and bronze colored. The spider types, while often very beautiful, are still more or less novelties.

Over the years a number of varieties have been tested here at the Experiment Station, but of course there are many that have not been tried. So far Giant Betsy Ross has proved to be the best white. Silver Sheen has been the next best white but it has not compared favorably with Giant Betsy Ross. No really satisfactory yellow has yet been tried. Good News and Mrs. Kidder have been as good as any. Improved Indianapolis Yellow has a soft yellow color and is very pretty but it is not as vigorous as might be desired. A recent introduction, Giant No. 4 Indianapolis Yellow, appears to be worthy of trial. Another relatively new yellow variety, Ranier, has shown promise in tests here.

Growers should probably stay with varieties that they have been successful with or that have done well in the area where they are to be grown. New varieties should be tried only on a small scale until they have been proved to be successful.

**Pinching and Disbudding**

When the plants have been in a permanent location for about 10 to 14 days, the terminal or top of the plant should be removed. This is called pinching. Lateral shoots, called breaks, will then be
forced out. The number of breaks to be allowed to grow per plant should be decided upon and the others, if any, removed. Usually two to four shoots per plant are left, depending to some extent on the variety and spacing. From then on all side buds on all shoots should be kept removed. This requires continuous, tedious, careful work.

Leaves must not be damaged when the disbudding is done. If the terminal bud should be injured, a side bud near the top of the stem may be allowed to take its place. This is likely to cause an angle in the stem, and if it occurs late in the season the bloom may be a little late.

Probably because of environmental conditions, the terminal flower bud may develop into what is called a crown bud. This is a rough-looking bud, and until the last few years it was thought that this type of bud would not make a good flower and should be removed. It is now known that a high percentage of the crown buds will produce good flowers and it is now recommended that they be allowed to bloom. Here at the Experiment Station observations over a period of years have shown that it is the rare exception when a bloom from a crown bud can be easily distinguished from one from a normal bud.

Support

From the time they are small plants until the blooms are cut, standard chrysanthemums must receive support. This is to keep them from falling over and to keep the stems as straight as possible. This is usually done by stretching wire down the rows of plants and tying each individual shoot to the wire. This will mean a series of wires starting about six inches from the ground and added at intervals of about a foot until the plants are grown. Strong posts or metal pipe frames have to be at the ends of the rows to which to fasten the wires. Each shoot must be tied to each wire. This is a painstaking, time-consuming job. A new type of support is now being used for plants grown in beds. It is a special 6 x 6 inch mesh woven-wire material similar to a woven-wire fence. There must be supports at the ends of the bed to which the wire may be attached. The material is stretched over the bed when the plants are small and raised as the plants grow. This eliminates the tying of shoots during the growing season and the cutting of strings at harvest time.

Fertilizing

Fertilizer is applied to make up for nutritional deficiencies that occur in the soil. All chrysanthemums grown commercially in Louisiana receive fertilizer of some sort. Since chrysanthemum plants must not be stunted, but should grow continuously, it is best that needed nutrients be available at all times. Fertilizer is a relatively small part of the cost of growing mums. Therefore it is better to
apply more than necessary rather than too little, as long as no damage is done. Even so, it is believed that the average grower applies more fertilizer than he should. As long as plants are growing well and the foliage has good color, fertilizer is not a limiting factor.

Fertilizer applied just prior to the opening of blooms is wasted. A fertilizer test conducted with chrysanthemums at the Experiment Station showed little difference in growth or flower production between plants that received all of the fertilizer at the start of the experiment and those that were fertilized at various intervals.

The amount of fertilizer needed will vary with the type of soil, the amount of rainfall and irrigation. It is suggested that 3 pounds of 8-8-8 or equivalent be applied per 100 square feet or 100 feet of row. On sandy soils this amount may be repeated at monthly intervals for three applications. On silt soils nitrate of soda, or equivalent, may be applied at rates of 1.5 pounds per 100 feet of row per month if needed.

**Irrigation**

Moisture conditions will likely have more to do with successful growing of chrysanthemums than any other factor. Again it is pointed out that good drainage is absolutely necessary. In a location where plants may normally be grown without difficulty, they may be lost during periods of excessive rainfall. This happened during the past season. When drainage is not a factor, the lack of sufficient water at certain times becomes important. Not enough water will definitely slow or stop growth. This should not be allowed to happen with chrysanthemum plants. Water for irrigation must be available, and it should be applied when needed and without delay.

The soil should be thoroughly soaked each time water is applied. Water should be kept off the foliage as much as possible. It is especially important for plenty of water to be available at the time the blooms are opening.

**Protection**

When the flowers start to open some protection is usually necessary. This is often supplied by a light muslin material, which of course must be supported above the flowers. The material will prevent beating rains from damaging the flowers, especially white ones, and will protect against light frost. It also will reduce the amount of dust residues on the flowers.

In some cases plastic greenhouses have been used to grow chrysanthemums. The plastic should not be put on the houses until about time for blooms to open, and the sides should be left open for ventilation. Fans may be used to improve ventilation, if necessary. When the humidity is continuously high disease problems are increased. At the Experiment Station at Baton Rouge chrysanthemums have been successfully grown in a plastic screen house for a
number of years. The screen reduces the intensity of the sunlight about 20 per cent, and that is beneficial during the summer. The screen also breaks the hard rains, but does not give as much protection as muslin.

Harvesting and Marketing

To supply the important market of All Saints’ Day the mums must be ready a few days prior to November 1. After maturity the flowers will hold for about 10 days, depending a little on variety. If cold storage is available flowers may be kept for as long as two weeks at 35° to 40° F. Storage, even if available, means additional expense. Blooms should be cut with stems as long as the market demands. Three feet should usually be more than enough. Immediately after the flowers are cut the stems should be placed in water.

There is considerable expense and a lot of work involved in growing standard chrysanthemums. Before it is undertaken there should be a reasonable assurance of a market for the product. If the chrysanthemums are well grown and profitably sold, it is a worthwhile enterprise. Many growers are supplementing their incomes in this manner. As with all perishable products, however, if the market is flooded, the growers do not profit.

CHrysanthemums for the Yard

Chrysanthemums are very popular plants for many home gardeners in the state. They add a great deal of color to the landscape for a period of about 10 weeks in the fall if a series of early to late varieties are planted. Usually the so-called pompon varieties are grown. This is a misnomer, as the pompon is one type and, as mentioned in the introduction, there are many types. The flowers vary in size but the largest are much smaller than standards. They are not disbudded but are allowed to produce a profusion of blooms. Some varieties, if given enough space, will produce uniformly shaped plants covered with blooms. However, they are often not too good for cut flowers. Other varieties produce taller more straggly plants and sprays of flowers that are excellent for cutting.

The spray types are grown to some extent commercially as cut flowers in Louisiana. In some areas, such as in Florida, they are of considerable commercial importance. They are a lot less trouble to grow than are standards. Standard varieties are sometimes grown in yards without disbudding but in general are not too satisfactory.

Location

Well-drained locations with as much exposure to the sun as possible should be selected. Chrysanthemum plants will thrive on a wide range of soil types, but the soil should have a relatively high organic matter content. It should be in such condition that it will not become compact. Mums should not be allowed to grow year
after year in the same location, for, if so, they will deteriorate badly. This usually happens even the second year. For this reason it is best to change the location of the chrysanthemum planting every year. If the plants are taken out and the soil worked up, treated, fertilized, etc., they can often be reset in the same location. However, moving is often easier.

Plants

In many yards plants are carried over from year to year. To start a planting of chrysanthemums or to get new varieties plants may often be obtained from friends. This is usually done by using stolons that form at the crown of old plants. Only the outer stolons should be used, as the center ones are more likely to be diseased. The stolons are usually transplanted in early spring. Disease is always likely to be a problem when this is done. This also means that the plants will occupy space in the yard and require attention the year around. Mums are mainly attractive only when they are in bloom. The longer plants are left in a place, the more difficult it is to control diseases, and badly diseased plants are not attractive and do not produce very well.

As with plants of the standard type, it is recommended that plants be bought from a reliable source. Plants that have been stunted and allowed to harden will not grow as they should. Plants should be transplanted as soon as possible after they are obtained. In Louisiana the plants should be set out about the first of June. Where it can be afforded, new plants should be bought every year. If this is done the plants would occupy space in a yard for only about six months out of the year, and there should be less trouble from disease.

Plants should be spaced from one to two feet apart in the row or bed, depending on the potential spread of the plants. There is considerable varietal difference in vigor and extent of plant growth.

Varieties

The selection of varieties of chrysanthemums, as with most other plants, is of considerable importance. They should be chosen from those that will do well in the area where they are to be grown. Individual preference should usually be a deciding factor. As with other commodities, some of the desired varieties may not always be available. The important propagators carry a large number of varieties but they can not handle them all. Some of the old standby varieties are nearly always available. Breeding work continues and new varieties are being introduced. Some of these are improvements over older similar varieties and will replace them. This means that the variety situation is continually changing. Local retailers can not often carry a large number of varieties. If garden club members would order together they would come nearer getting what they want than on an individual basis. Orders should be placed in plenty of time to insure delivery when desired.
The blooming period may be extended by planting varieties that produce flowers at different times. Extreme earliness in a variety is not always a benefit, for if the plants bloom when the temperatures are still very high, the flowers will not last long and those with color will fade badly. If mums are being grown for sale, the sprays must be ready when there is a ready market.

Many varieties have been grown in plots at the Experiment Station over a period of 13 years. A list of most of them follows.

Adagio  Frolic  Nobleity
Aglow  Fuchsia Fairy  Nokomis
Alert  Gaiety  Norona
Ann Ladygo  Gardenia  Nuggets
Argonne  Gem  Oregon
Astoria  Glamour  Ostosa
Avalanche  Gold Coast  Paradise
Aviator  Golden Herald  Paragon
Ballerina  Goldrush  Pilgrim
Beauregard  Halo  Pink Dot
Benora  Horizon  Pinkette
Blizzard  Humdinger  Polaris
Bluechip  Huntsman  Portrait
Bonfire  Ill. Accent  Pristine
Bonnie  Ill. Bonbon  Profile
Bonaffon Deluxe  Improved Bronze Daisy  Purple Waters
Bright Forecast  Improved Red Daisy  Radiance
Bronzechip  Inca  Rajah
Bronze Daisy  Incurved Delaware  Raspberry Ice
Bronze Dot  Jackpot  Red Daisy
Buccaneer  James Stewart  Red Humdinger
Buckskin  Jessamine Williams  Red Velvet
Caravan  Jessie  Remember Me
Calumet  Jetfire  Remembrance
Carmelita  Joybringer  Resolute
Carmine Queen  Kings Ransom  Reward
Carnival  Larry  Ronnie
Cecelia  Lassie  Rubaiyat
Chalk Cliff  Laughter  Satin
Chas. Nye  Lee-Ette  Schn. Yel. Daisy
Cris. Columbus  Lee-Powell  Sea Gull
Chiquita  Lemonade  Serenade
Classic  Lillian Doty  Silverplate
Climax  Lipstick  Snowclad
Coralhue  Luna  Snow Crystal
Criterion  Luxury  Spellbound
Cupid  Maestro  Stardust
Dark Calumet  Lemonade  Sunburst
Delaware  Lillian Doty  Sunray
Diamond  Lipstick  Sunup
Dolli-ette  Luna  The Titan
Dream Girl  Luxuory  Topflight
Echo  Maestro  Toronto
Elizabeth Hood  Magician  Treasure
Fanfare  Mary Hall  Venoya
Firecracker  May Fair  Wagonwheels
Firefly  Minn. Pink  Waltz Time
Fred Yule  Mirth  White Candle Glow
White Doty  W. P. Snyder  Yellow Doty
White Popcorn  Yellow Calumet  Yellow Ill. Snowdrift
Whitecap  Yellow Delaware  Yellow Spoon
Wilson's White  Yellow Delaware  Yellow Spoon

The varieties that have been the better ones in the experimental plots and some of their characteristics are shown in Table 2.

Table 2.—List of the Better Varieties With Some of Their Characteristics

<table>
<thead>
<tr>
<th>Variety</th>
<th>Response Group</th>
<th>Color of Bloom</th>
<th>Height of Plant</th>
<th>Type of Flower</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aviator</td>
<td>10 wk</td>
<td>Bronze</td>
<td>Med</td>
<td>Pompon</td>
</tr>
<tr>
<td>Beauregard</td>
<td>8 wk</td>
<td>Red</td>
<td>Med</td>
<td>Pompon</td>
</tr>
<tr>
<td>Bonfire</td>
<td>9 wk</td>
<td>Lt. Bronze</td>
<td>Tall</td>
<td>Pompon</td>
</tr>
<tr>
<td>Bronze Daisy</td>
<td>7 wk</td>
<td>Salmon Bronze</td>
<td>Med</td>
<td>Decorative</td>
</tr>
<tr>
<td>Bronze Dot</td>
<td>7 wk</td>
<td>White</td>
<td>Tall</td>
<td>Pompon</td>
</tr>
<tr>
<td>Caravan</td>
<td>7 wk</td>
<td>Coral</td>
<td>Small</td>
<td>Pompon</td>
</tr>
<tr>
<td>Classic</td>
<td>7 wk</td>
<td>Golden Bronze</td>
<td>Med</td>
<td>Point</td>
</tr>
<tr>
<td>Coralhue</td>
<td>7 wk</td>
<td>Lt. Lavender</td>
<td>Tall</td>
<td>Pompon</td>
</tr>
<tr>
<td>Dolli-ette</td>
<td>7 wk</td>
<td>Bronze</td>
<td>Tall</td>
<td>Decorative</td>
</tr>
<tr>
<td>Dream Girl</td>
<td>7 wk</td>
<td>Salmon Rose</td>
<td>Small</td>
<td>Decorative</td>
</tr>
<tr>
<td>Firecracker</td>
<td>7 wk</td>
<td>White</td>
<td>Tall</td>
<td>Pompon</td>
</tr>
<tr>
<td>Fuchsia Fairy</td>
<td>7 wk</td>
<td>Silver Bronze</td>
<td>Med</td>
<td>Dbl. Spoon</td>
</tr>
<tr>
<td>Gardenia</td>
<td>8 wk</td>
<td>White</td>
<td>Med</td>
<td>Large Pompon</td>
</tr>
<tr>
<td>Golden Herald</td>
<td>9 wk</td>
<td>Yellow</td>
<td>Tall</td>
<td>Decorative</td>
</tr>
<tr>
<td>Humdinger</td>
<td>10 wk</td>
<td>Purple</td>
<td>Small</td>
<td>Pompon</td>
</tr>
<tr>
<td>Jessamine Williams</td>
<td>7 wk</td>
<td>White</td>
<td>Med</td>
<td>Pompon</td>
</tr>
<tr>
<td>Jessie</td>
<td>9 wk</td>
<td>Pink</td>
<td>Med</td>
<td>Pompon</td>
</tr>
<tr>
<td>Joybringer</td>
<td>7 wk</td>
<td>Salmon Rose</td>
<td>Small</td>
<td>Pompon</td>
</tr>
<tr>
<td>Lee-Ette</td>
<td>8 wk</td>
<td>Silver Bronze</td>
<td>Med</td>
<td>Dbl. Spoon</td>
</tr>
<tr>
<td>Lillian Doty</td>
<td>9 wk</td>
<td>Lt. Pink</td>
<td>Tall</td>
<td>Large Pompon</td>
</tr>
<tr>
<td>Lipstick</td>
<td>7 wk</td>
<td>Cream</td>
<td>Small</td>
<td>Pompon</td>
</tr>
<tr>
<td>Maestro</td>
<td>7 wk</td>
<td>Red</td>
<td>Small</td>
<td>Daisy</td>
</tr>
<tr>
<td>Mirth</td>
<td>8 wk</td>
<td>Pink</td>
<td>Small</td>
<td>Daisy</td>
</tr>
<tr>
<td>Mischief</td>
<td>7 wk</td>
<td>Purple</td>
<td>Small</td>
<td>Pompon</td>
</tr>
<tr>
<td>Morrocco</td>
<td>7 wk</td>
<td>Red</td>
<td>Med</td>
<td>Decorative</td>
</tr>
<tr>
<td>Pink Dot</td>
<td>9 wk</td>
<td>Pink</td>
<td>Tall</td>
<td>Pompon</td>
</tr>
<tr>
<td>Portrait</td>
<td>10 wk</td>
<td>Lavender</td>
<td>Med</td>
<td>Pompon</td>
</tr>
<tr>
<td>Profile</td>
<td>10 wk</td>
<td>Pink</td>
<td>Med</td>
<td>Large Pompon</td>
</tr>
<tr>
<td>Red Daisy</td>
<td>9 wk</td>
<td>Red</td>
<td>Med</td>
<td>Single or Daisy</td>
</tr>
<tr>
<td>Red Velvet</td>
<td>7 wk</td>
<td>Crimson</td>
<td>Med</td>
<td>Decorative</td>
</tr>
<tr>
<td>Remember Me</td>
<td>7 wk</td>
<td>Bronze</td>
<td>Tall</td>
<td>Single</td>
</tr>
<tr>
<td>Sea Gull</td>
<td>9 wk</td>
<td>Ivory</td>
<td>Med</td>
<td>Pompon</td>
</tr>
<tr>
<td>Spellbound</td>
<td>7 wk</td>
<td>Lavender</td>
<td>Med</td>
<td>Decorative</td>
</tr>
<tr>
<td>Toronto</td>
<td>7 wk</td>
<td>Bronze</td>
<td>Med</td>
<td>Decorative</td>
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<tr>
<td>Treasure</td>
<td>7 wk</td>
<td>Yellow</td>
<td>Tall</td>
<td>Pompon</td>
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<tr>
<td>Wagonwheels</td>
<td>9 wk</td>
<td>Silver Coral</td>
<td>Tall</td>
<td>Anemone</td>
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<tr>
<td>White Doty</td>
<td>9 wk</td>
<td>White</td>
<td>Tall</td>
<td>Pompon</td>
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<td>Yellow Dot</td>
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<td>Yellow Doty</td>
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**Care**

When plants are four to six inches tall, depending on the varietal vigor, they should be pinched. Pinching means removing the terminal or top of the plant, leaving four to five leaves. This will cause
more breaks and more profuse bloom on less straggly plants. The plants of many varieties are low to medium in height, compact and need no staking. Others such as the Dots and Dotys are fairly tall and need some support or they will fall over badly. It is easier to give support along the sides of the rows rather than to individual plants.

If complete fertilizer was applied before setting the plants additional nitrogen may be all that is needed, except on very sandy soils. This may be applied as nitrate of soda, or equivalent, at the rate of 2 pounds per 100-foot row once or twice during the growing season. The growth of the plant and color of the foliage will give an indication of the need of additional fertilizer.

There are almost certain to be periods of drought during the growing season. Since chrysanthemums should be kept growing continuously, it is essential that plants be irrigated when lack of water would stunt them. Plants should receive light cultivation after heavy rains, especially on soils that tend to pack. Of course weeds and grass should be controlled.

Insects and diseases will also require attention. These are discussed in the latter part of this bulletin.

**Growing from Seed**

If blooms are not cut and plants remain healthy, some varieties will produce viable seed. These seed may be planted and plants produced. If the seed are planted in a greenhouse or hotbed in late winter, normal plants and blooms will be obtained the following fall. In general, plants will not come true from seed, and seedling plants are quite variable. Some may be quite similar to parents. Desirable seedlings may be selected and propagated by cuttings.

For several years hundreds of seedling plants have been grown on experimental plots at Baton Rouge. Several promising selections have been made, but so far none has been released. Most of the selections have been of the cushion type and are quite showy. Disease is always a problem in the propagation and maintenance of selections.

**GREENHOUSE CHRYSANTHEMUMS**

Chrysanthemums are the most important flower crop produced in the United States. The real increase in chrysanthemum production began as growers undertook to produce year-round flowering—and as the public accepted it. Today more than half of all mums grown are made to flower "out of season" by being either shaded or lighted to get proper growth and bud set. Many mums are grown and sold as disbud plants in pots. Some of these are produced in Louisiana.

**Soil**

Whether plants are grown as pot plants or in benches, it is essential that the soil have a loose open texture. This can be ob-
tained by the addition of organic matter to any reasonably good field or garden soil. Good soil drainage is of utmost importance, for root growth is retarded in poorly aerated soils. The organic matter, in the form of peat moss or well-rotted manure, should be added at no less than one-fourth by volume; when heavy soil is used, increasing this amount to one-third should prove beneficial. For pot mums, however, it is necessary to add broken pottery, gravel or some similar material to the bottom of the pot to facilitate drainage.

Prior to planting, the soil should be treated to kill disease organisms, insects and weed seed. Steam is probably the most satisfactory method to use for greenhouse purposes. If steam is not available, certain chemicals such as methyl bromide, Vapam, Mylone and others can be used.

Chrysanthemums grow best in a soil that has a pH of 6.0 to 7.0. Stunting and chlorosis of plants may occur when the soil pH is unsatisfactory. Too much water or fertilizer in the soil may interfere with normal functioning of the roots and also produce chlorosis in the upper leaves. Mums can be grown one plant to a 3½-inch pot, two plants to a 4-inch pot, three to four plants to a 5-inch pot, and up to six or more plants to larger pots. Whether they are to be grown as pinched or unpinched plants also is a factor determining the number of cuttings to be placed in the pot. When pinched there may be fewer plants per pot.

**Benching or Potting**

Usually rooted cuttings are spaced 8 by 8 inches in the bench. If the mums are to be grown single stemmed, closer planting can be practiced. The cuttings should be planted just deep enough to keep them from falling over when first watered. Poor root growth and diseases become a problem if the cuttings are planted too deep.

With pot mums, the rooted cuttings are placed directly into the finishing pot. The plants should be watered at least twice soon after potting to insure adequately wetting the soil.

**Fertilization**

Low fertilizer levels should be maintained until the plants are established, which is generally 10-14 days after benching or potting. Then a higher level of fertilization is maintained until the flowers show color.

Where a regular soil test is conducted on bench soil the following ranges of fertilizer are best, based on the Spurway system: nitrogen, 25-50 parts per million; phosphorus, 5 to 10 parts per million; potassium, 20 to 40 parts per million; calcium, 150 to 200 parts per million.

Since frequent soil testing is expensive and many growers do not have the proper facilities for testing available, they fertilize bench mums every two to four weeks with a high-analysis fertilizer at the rate of 1-2 pounds per 100 square feet of bench area. Of course,
the rate and frequency of fertilization should be reduced during the winter. Less leaching occurs during this time of year since watering is done less frequently. Pot mums are fertilized every 7 to 10 days from the time the plants are established until color is showing in the flower. Again, a high-analysis fertilizer is used and applied by the hozon method. In this practice a solution of 1 1/2 pounds of 20-20-20 dissolved in 3 gallons of water is applied with a 1:15 hozon. A quarter teaspoon of a complete fertilizer such as 8-8-8 can be applied per 5-inch pot in lieu of the above practice. One-half teaspoon is used for larger pots.

Where phosphorus has been added to the soil in the bench or potting soil prior to planting, only nitrogen and potassium are generally applied. For bench mums, 3 to 5 pounds of superphosphate per 100 square feet of bench area are incorporated into the soil prior to planting. Superphosphate (20 per cent) is added at the rate of a level 5-inch pot to each 2 1/2 bushels of potting soil. Since excess phosphorus is rarely encountered and as phosphorus is slowly available, it is best to add this material to the soil prior to planting.

Recently, the application of a dilute nutrient solution to the crop at each watering has been found to give satisfactory results, especially with pot plants.

Few growers actually depend on a soil test to determine fertilizer schedules. Generally, a regular feeding schedule is set up based on previous experience coupled with visual observation of excess or deficiency symptoms.

Visual symptoms are an invaluable aid in ascertaining the nutritional requirements of plants. A lack of nitrogen causes the entire plant to turn yellow, then bronze or brown. The plant is stunted, becomes woody, and the leaves and flowers are small. An excess of nitrogen is manifested by very dark green crisp leaves. The foliage is brittle and breaks easily. The stems also develop longitudinal cracks when an excess is present.

A yellowing of the leaf margins is characteristic of a potassium deficiency. Later the affected leaves turn brown and may drop off. Excesses of potassium, as well as nitrogen, generally result in root damage causing stunt, wilt or even death of the plant.

Watering

Too little water results in a check of root growth and this in turn retards the over-all growth of the plant. Overwatering also causes root damage due to lack of oxygen.

When plants are benched, an initial heavy watering should be given. The soil should be watered again when indicated by soil condition. Then the waterings should be heavy enough to adequately moisten the soil. As the plants increase in size the frequency of watering will have to be increased. In hot weather plants may need watering that will thoroughly moisten the soil at frequent intervals.
Pot mums are also given an initial heavy watering and then allowed to become fairly dry before additional moisture is supplied. Plants in pots will need very frequent waterings, perhaps two times a day during very warm days.

The time flower buds show color is a critical period so far as watering is concerned. Lack of water results in damage to the expanding flower, while overwatering may injure the roots.

**Pinching**

Pinching is practiced to induce branching of the plant. Only the top $\frac{1}{4}$ to $\frac{1}{2}$ inch of the plant should be removed. If the plant is pinched back too far, into hard wood, the number of breaks is reduced and growth is delayed. In general, bench mums are pinched after they have been growing for two weeks. Pot plants should be pinched anytime from 7 to 14 days after potting, depending on the growth. The proper time to make the pinch is determined by several factors, such as season of year, variety and type of chrysanthemum. For disbudded pot plants, two to three stems are allowed to develop on each of the plants in the pot.

It has been determined that plants should be pinched at a definite time in relation to time of flower bud formation. This is called “time pinching” and is used with natural or out-of-season flowering.

Pinching on the correct date generally assures pompons that have good, open sprays. When standards are correctly pinched, they generally will not produce crown buds.

The actual time for pinching is given in the catalogs of most commercial chrysanthemum plant producers. For timing and pinching of a crop, the recommendations given in these catalogs should be followed.

**Disbudding**

Standard varieties grown in greenhouse benches should be disbudded in the same manner as those grown outdoors. A discussion of disbudding for outdoor standards is given in a previous section of this bulletin.

Small standard varieties grown as pot plants develop the best flowers when only one bud per stem is allowed to flower. Remove the side buds surrounding the central bud. Disbudding should be practiced as soon as the buds are large enough to remove conveniently. All the shoots should be disbudded at the same time if possible. Uneven flowering results when stems are disbudded at different times. This is brought about by the fact that when disbudding has been done, the remaining bud develops more rapidly; if only some shoots are disbudded, uneven flowering occurs.

With pompons no disbudding is generally practiced. Axillary shoots below the spray may begin to develop at the time it produces flowers. These should be removed when the crop is cut.
Light

Moderately high light intensities are most favorable for rapid growth of chrysanthemums. However, in Louisiana, shading of the greenhouse is necessary during the summer. This is done to bring about a reduction in temperature and to reduce petal burn. Shading also makes the greenhouse a more pleasant place for working during the summer. Care should be taken not to reduce the light too much, as this causes weak spindly growth and delays the crop.

In late fall, winter and early spring little or no shading is needed in Louisiana.

Temperature

In the deep South, the temperatures in the warm months are generally too high for production of best quality mums. A temperature of 60° F. at night and from 70° to 75° F. during the day is best for chrysanthemums. If the temperature is too low, below 55° F. at night, flower buds do not initiate in many varieties. On the other hand, high temperatures may cause arrested development of the flower bud.

It has also been noted that flowers of the pink, bronze and red varieties fade during periods of warm weather. It is therefore recommended that only yellow and white varieties be grown for flowering during the hot summer and early fall.

Day Length Control

The chrysanthemum is a “short day” plant. This means it is usually considered to set flower buds when it is exposed to a short day (approximately 12 hours). Chrysanthemums flower naturally in the fall because conditions are favorable for bloom production at that season.

It is therefore necessary that mum plants be either shaded under long day conditions to induce flower bud set or be given additional light under short days to keep them vegetative until flower bud set is desired. To have flowering pot plants in the summer, shading is necessary to bring about flower bud formation. For the same reason, it is necessary to give mums additional light during the shorter days of the year in order to prevent flower bud formation. If this practice is not followed, flower buds form and as a result the flowers are borne on short stems and are of little commercial value.

Because of differences in day length over a year cycle, it is necessary that mums be shaded during a part of the year and given additional light at other times. Schedules for lighting and shading for different localities have been worked out, and most commercial producers of mum cuttings make these available to the grower. In general, it is recommended that these schedules be followed. Because of differences in location, it may be necessary to make adjustments in the schedule given in these catalogs. If ex-
experience shows that a certain variety is too tall, then the duration of the lighting period can be reduced. When plants are too short, more light will be needed during short days, while shading should be delayed under long days.

**Varieties**

Chrysanthemums can be flowered at any season of the year. Some varieties will bloom poorly at one season but produce top quality flowers at another. For this reason mum varieties are selected on the basis of performance and are recommended for specific periods of the year. There are a few varieties that perform satisfactorily the year around.

Yellow varieties are the most popular and in some areas account for one-half of the total production. White is the next most popular color, followed by pink. Only a few red and bronze varieties are produced.

New varieties of chrysanthemums are being introduced yearly. Therefore no permanent list of varieties can be recommended. The following is a list of varieties which have proved successful in the deep South.

**Standards:** Indianapolis Yellow, Indianapolis White, Improved Indianapolis Yellow, Indianapolis No. 3 White, Anaconda, Orchid Queen, Silver Queen, Crystal, Lavender Queen, Giant Betsy Ross, Good News and Detroit News.

**Pompons:** Morty, Popcorn, Memento, Keepsake, Alaska, Seagull, No. 2 Whitechip, Acclaim, Sarasota, Gold Coast, Yellowchip, Orange Beauregard, Yellow Beauregard, Bonnaffon Deluxe, Delaware, Yellow Delaware, Lipstick, Bluechip, Shasta, Portrait, Masterpiece, Bronzechip, Red Star, Climax, Humdinger, Princess Ann, Pinkchip, Vedova and Whitetop.

**DISEASES AND INSECTS**

As with all important plants, chrysanthemums are subject to a number of diseases and insects. Only the more important ones will be discussed here.

One group of diseases is caused by viruses. In this group are diseases such as mosaic, yellows and stunt. Once the plants are infected with a virus disease there is no control. To prevent spread of the disease the infected plants should be destroyed. Only disease-free plants should be planted.

Another disease that can not be controlled by fungicides is Verticillium wilt. This is a soil-borne disease. Infected plants should be destroyed. Soil treatment should be practiced to control this trouble. Fusarium wilt is a somewhat similar disease, and the same control measure should be used for it.

There are other fungus diseases that attack the leaves. These can be controlled, more or less, with the proper sprays or dusts. Sprays are, in general, more effective than dusts. Dusting is often
In this market, to detectives found but present on the plant as nearly as possible all of the time. It is best to spray or dust at intervals of one week until the buds show color. In recent years many new spray materials have been put on the market, and other new ones are sure to make their appearance. This means that recommendations for control of pests are not fixed but likely to change.

One of the most important diseases of chrysanthemums in this area is Septoria leaf spot. Infection starts on the lower leaves and progresses upward. The leaves are discolored at the start and later dry up and fall off. Early planted standard plants have often been found to have no leaves for some distance up the stem late in the season. Yard plants left in place have often lost most of their foliage. This disease is not easy to control, although fairly good results have been obtained by spraying with Captan at weekly intervals. Fertanate, Parzate or Zerlate may also be used.

Mildew is an important disease in some areas. It causes whitish powdery places on the leaves and also causes them to be misshaped. If the disease is unchecked, the leaves will turn yellow and wither. So far this disease has not been important here. Dusting sulphur is recommended as the control for this disease. There are two materials now on the market that are effective on mildew on some plants and might be all right for chrysanthemums. These are Mildex and Acti-dione PM.

Rust is another disease that may cause some trouble. The name describes the disease very well. It occurs mostly on the underside of the leaves. So far it has not been important here. Dusting with sulphur or spraying with Ferbam should control it.

Another disease that can on occasion cause serious trouble is Botrytis. This disease usually attacks the flowers. The petals seem to be water-soaked at first and later turn brown. The infected flowers cannot be marketed. Relatively high humidity favors the development of the organism. This emphasizes the importance of good aeration around the plants, which in plastic greenhouses is often difficult to accomplish. Zerlate or Parzate may be used to control the disease, but they will leave a residue on the flower. A new material called Botran is also said to be good and worthy of a trial.

Aphids have been found to be one of the most prevalent insect pests. They are often called plant lice. They are likely to attack the plants at any time and are usually found on the newer terminal growth. Aphids multiply rapidly and can quickly cause great damage if not controlled. They feed on the plant juices and must be controlled by contact insecticides or sytemics. Until time for flowers to open they may be killed by Malathion, Lindane or T.E.P.P. These materials will damage petals of the flowers. Systemics, such as Sytox, are effective against aphids and are especially good late in the
season when other materials can not be used. Aerosol Parathion may be used in greenhouses when handled by those experienced in its use.

Red spiders are serious pests on occasion. They will cause discoloration of leaves. They are usually more serious in greenhouses but may give trouble at times in the open or on plants covered by muslin. This pest is sometimes hard to control as it tends to develop strains resistant to specific insecticides. A number of materials are used for its control. These are Aramite, Malathion, Parathion, T.E.P.P. and Ovotran. Tedion will give very good control of eggs and young mites. Dusting sulphur may be used when the temperatures are relatively high.

Corn ear worms may cause damage by eating the flower buds. They may be controlled by spraying or dusting with DDT. It is best to prevent this damage by using the insecticide before the insect appears. Sometimes the worms are picked off and killed.

Nematodes may be a serious pest. They damage the roots, thus preventing normal growth. The root knot nematode may be detected by the knots on the roots of the plants. Soil treatment is the only control measure and at best is only temporary.

ACKNOWLEDGMENTS

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