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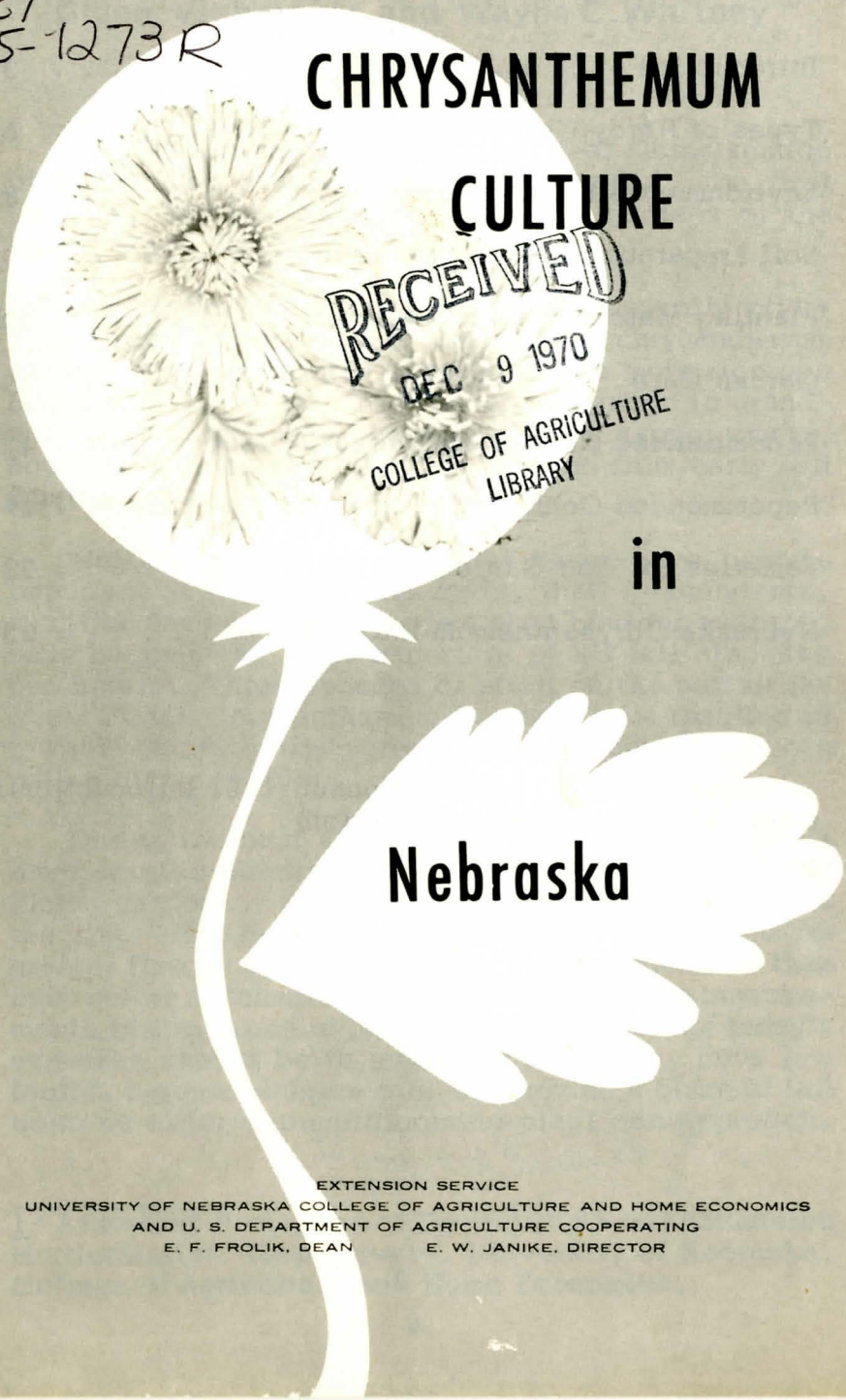
CHRYSANTHEMUM CULTURE in Nebraska



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Cover picture: Left, Astronaut (1961 introduction); right, Mustang (1960 introduction).

Chrysanthemum Culture in Nebraska

by

Glenn Viehmeyer and Wayne C. Whitney 1/

INTRODUCTION

The chrysanthemum came to the Great Plains section of the United States with, or soon after, the first settlers, and has been grown in the gardens of the region since that time.

Coming from the lower altitudes and generally milder climate of the East, most of these earlier chrysanthemum varieties proved poorly adapted to the more rigorous climate of the West. The flower, as grown in grandmother's garden, was something of a disappointment, and rarely bloomed without protection from early fall frost.

While early varieties could never have become important as garden ornamentals, their descendents, modified and improved by modern plant breeding methods, have become the most important of all fall blooming perennials. Three decades of effort on the part of the Great Plains Chrysanthemum breeders have resulted in a whole galaxy of new varieties that fill autumn gardens with a blaze of color.

During the past 40 years chrysanthemum breeders have created hundreds of varieties adapted to Great Plains gardens. Future years will bring additions to the list. Today we have new flower forms and far greater flower quality in garden chrysanthemums than ever before. Tomorrow will see even greater improvements in this queen of fall flowers. The best of today's varieties should be in every garden. They have few faults, require minimum care and provide a blaze of fall color no other autumn blooming plant can approach.

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Even though the modern garden mum has been available for over a third of a century many growers are still poorly informed as to the best cultural practice. New gardeners are being added each year and these young folks need information about mum culture. In many gardens the cultural methods used fall far short of allowing this fine fall flower to develop to greatest perfection.

In chrysanthemums blooming is determined by length of day and temperature. The length of day response, known as photoperiod, determines bud initiation. The original chrysanthemum was a "short day plant," that did not initiate buds until the short days of fall. In today's mums there is a range of photoperiods, some kinds require short days to initiate bloom just as their ancestral form did, but at the other extreme are varieties that will initiate bloom during the longest days of summer. Thus, it should be possible to have bloom at any time during the season.

Unfortunately, this has not proven to be the case, for a temperature response which may be termed "temperature threshold" is a limiting factor with many varieties. When temperatures rise above a certain level during bud development growth stops, and bloom is delayed until cooler weather returns. With modern mums this temperature response is responsible for the "late bloom" that bedevils growers across the country.

The next big step in fitting chrysanthemums to Great Plains gardens may be the development of varieties with ability to develop normally at high temperatures. Breeders have already produced a few varieties that are less sensitive to temperature and it seems certain that temperature tolerant varieties are in prospect.

Blooming date may be affected by time of planting. This is true of all types of planting material, but is more pronounced where divisions of established clumps are used in the open. The effect is less evident where potted plants are used.

For early bloom, clumps should be divided and reset as soon as active growth starts in the spring, but before much elongation of the new shoot occurs. The stage of shoot growth, not the calendar date, should determine transplanting time. Bloom may be delayed as much as 90 or more days if the new shoots are allowed to become overgrown before dividing and transplanting the clump.

Abnormally early bloom frequently occurs on plants growing in protected sites. In such sites plants may reach blooming size before days become long enough to inhibit flower bud formation. Conversely, the same variety planted in cold sites or in shaded sites may start so slowly that bloom is much delayed.

Overstimulation of vegetative growth has been known to delay bloom. At the North Platte Experiment Station 40 pounds of nitrogen per acre applied to plants in the early stages of budding resulted in aborted buds and greatly increased vegetative growth. As a result of the treatment, plants became abnormally large and bloom was delayed three or four weeks.

Moving certain varieties from one set of environmental conditions to another may affect time of blooming. A number of selections that regularly bloom in late July and early August at Cheyenne, Wyoming, were brought to North Platte, Nebraska for trial. In the North Platte trials these selections failed to bloom before mid-October. Apparently a move of 200 miles eastward, a drop in elevation of 3,500 feet and a slightly higher mean temperature resulted in delaying bloom for over 90 days. This is an expression of the "temperature threshold" effect.

These results indicate that the value of a variety in a given area can be determined only by actual trial. Although most chrysanthemum varieties appear adapted over rather wide areas, certain kinds may prove very sensitive to minor environmental changes.

TYPES OF HARDY CHRYSANTHEMUMS*

In a discussion of an ornamental plant that shows the diversity of flower and form found in the chrysanthemum, it becomes desirable that some sort of classification be attempted. Since it is impractical to classify all the many types of bloom in a publication of this sort, hardy chrysanthemums will be classified by growth habit only. They will be listed as Cushion, Border, and Cut-Flower varieties, each of which is described below.

It is recognized that this classification is an arbitrary one and that much information of possible value to the grower is omitted. It is felt, however, that it will serve here, and that it will, to some extent, assist the amateur in planning his planting.

It is not possible to set a hard and fast rule in classifying chrysanthemum varieties. Under favorable circumstances a cut flower variety may show up well in the border while many of the border types are excellent for cutting.

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* The reader is referred to "Hardy Chrysanthemums" by Alex Cumming, Doubleday, Doran & Co. Inc., Garden City, N. Y. 1945 for more detailed information about chrysanthemum types and history, and "Chrysanthemum Improvement" by G. Viehmeyer, Nebraska Agricultural Experiment Station Bulletin 428, 1955.

Seriously interested chrysanthemum growers will find it worth while to join the National Chrysanthemum Society and receive its bimonthly bulletin. The Society Secretary is Miss Dorothy Tuthill, 345 Milton Road, Rye, New York.

Cushion Chrysanthemums: The old variety "Pink Cushion" is representative of this type. The term as used here, refers to a type of plant that is low-growing and symmetrical in form. Cushion 'mums make a low mound of many short branches that terminate in clusters of rather small flowers. Stems should be strong so that the plant does not break apart in storms. The general effect is one of compactness, with no irregularities in placement of flowers, development of branches or plant conformation. Cushion varieties are desirable where low formal plants are needed, i. e., in mass border plantings and as foundation plantings.

Border Chrysanthemums: Into this classification go those other varieties that are attractive in both flower and plant but lack the formal shape of the cushion 'mums. These might be further classified as low, medium and tall border 'mums, but this is not necessary since nurseries furnish this information in describing the varieties.

Cut-Flower Chrysanthemums: Certain varieties have flowers that are excellent for cutting, but have plants that are coarse and straggling or that have other defects that make them poor subjects for the border. Such kinds are classed as cut flower varieties and are best grown in the cut flower garden.

The Space Age and Football Chrysanthemums: During the past decade the University of Nebraska has created and introduced two new types of garden mums for northern gardens. The Space Age Mums are a race with quilled ray-flowers and large flower heads. They are outstanding for cutting and arranging. The Football mums are a race of large flowered cut-flower types that combine hardiness, quality and size. They are superior to the so-called English Chrysanthemums in that they are far hardier and are also earlier blooming than the latter.

ENVIRONMENTAL REQUIREMENTS

Soil: Chrysanthemums are not particular as to soil type and will do well on any soil that will produce good vegetables. They will grow on the poorer soils but ample plant food is necessary if they are to reach perfection.

Drainage: Perfect drainage is absolutely necessary to both dormant and growing chrysanthemum plants. They will not tolerate "wet feet" and are doomed to failure if planted on a poorly drained site. In the heavier soils drain tile may be laid to provide drainage, and sand, coal ashes or similar soil conditioners added to provide an escape for excess water.

In selecting a site for the chrysanthemum planting the grower should make sure of both surface and subsurface drainage throughout the year. Depressions that might collect water should be leveled and heavy soils lightened and loosened to provide subsurface drainage. The use of tile or the addition of sand, coal ashes or some other soil conditioner will provide an escape for excess water.

Light: Chrysanthemums love the sun. Plant vigor and flower quality is lowered as the amount of light is reduced. They reach their greatest perfection where they receive full sun all day, though they do quite well when shaded in the morning or evening. Plants shaded for the greater part of the day will be weak and flowers will be small and of low quality.

Spacing: Chrysanthemums are strong growers and must have room. Overcrowding the planting is one of the commonest mistakes the grower makes. They should be spaced 18 to 24 inches apart and an equal distance from other plants if they are to develop properly. Close spacing results in leggy plants and poor bloom. Varieties differ in the amount of room required for full development; tall, narrow kinds require less room than widely branching ones, but in any case, the plant will repay adequate spacing in more and better flowers.

SOIL PREPARATION AND FERTILIZATION

Soil Preparation: A little extra time spent in soil preparation pays dividends. Soil may well be worked to a depth of 12 inches, to provide favorable conditions for plant growth. Fertilizers and soil conditioners may be worked into the soil as the bed is prepared.

Fertilizers: Such organic fertilizers as leaf mold, barnyard manures, compost, etc., are preferable to more concentrated fertilizers. They are, in fact, all that is needed in most cases. This type of fertilizer improves soil structure, increases the rate of water infiltration to lower soil strata, and increases the water-holding capacity of the soil; things which the more concentrated, inorganic fertilizer cannot do.

Raw, fresh animal manures and/or excessive amount of dry vegetable matter should not be applied to the soil immediately before planting time. If they must be used they should be worked into the soil the season before planting, so that they will have time to break down and release plant food.

Such material added to the soil immediately before planting may actually reduce soil fertility for a period and delay or stunt the crop. Plant food may be used by bacteria and other organisms that break down manure and plant residues, leaving little available for the growing crop. This effect may be overcome to some extent by the use of quickly available fertilizers to take the place of elements so tied up. It is, however, better to avoid situations of this kind by applying such coarse organic materials a year in advance of planting time.

When a particular soil is deficient in some element needed for good plant growth, the use of commercial fertilizers is indicated. Such materials should never replace organic fertilizers but should be used to supplement them. Nitrogen is the element most likely to be deficient, a good many soils respond to phosphorous, while few Nebraska soils are deficient in potassium.

In the Platte River valleys and on any soil high in lime, chlorosis caused by a lack of available iron often occurs. The symptom is a yellowing of the foliage, stunting, or, in severe cases, even death of the plant. In most cases, this condition can be corrected by working iron sulphate into the soil at from 1 to 5 pounds per square rod. Spraying the growing plant with a one-half per cent solution of iron sulphate is also effective. Solutions containing more than 1/2 per cent of iron sulphate should not be applied to chrysanthemum foliage because severe burning may result.

PLANTING MATERIALS AND PROPAGATION

Several types of planting material may be used to establish the chrysanthemum planting. These may be purchased from commercial sources or may be produced by the grower. Materials commonly used are field clumps, divisions, potted plants, cuttings and seed. Each of these is discussed below.

Field-Grown Clumps: The field-grown clump is not desirable planting material if used intact. The chrysanthemum increases by means of rhizomes sent out from the mother plant during late summer and fall. By the following spring the original plant is either dead or so weakened as to have little value. Each rhizome is, for all practical purposes, a separate plant. To plant a clump intact would mean that from five to fifty plants were planted in an area of approximately a square foot. It seems obvious that this is not good culture, so, if field-grown clumps are secured, divide them and use the divisions for planting.

Divisions: Divisions of healthy clumps are satisfactory either for planting directly in the field or for producing potted plants. It should be recognized, however, that the danger of disease is much greater than if cuttings are used, and for this reason cuttings are preferable if one has propagation facilities.

Fig. 1. Tipcutting at "A" and single eye cutting, "B."

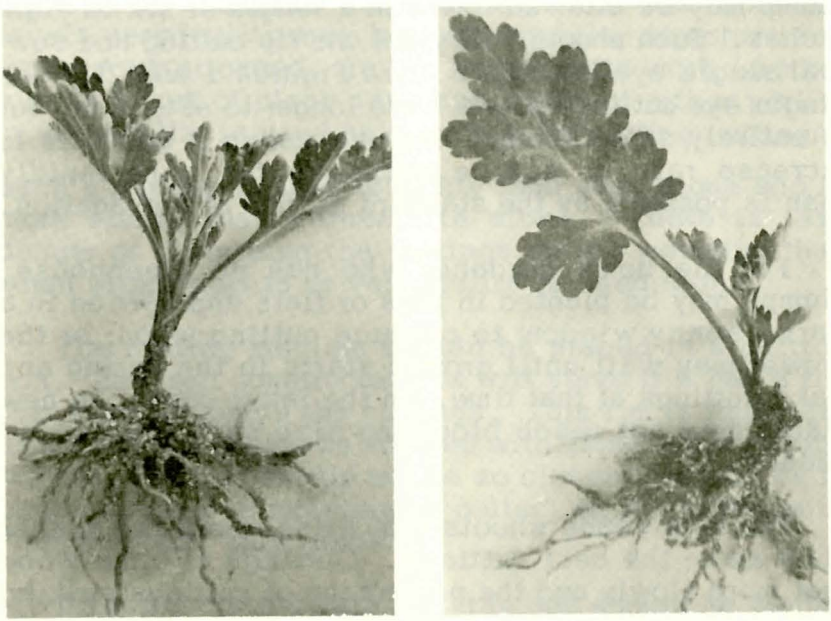

Fig. 2. A, rooted tip cutting. B, rooted single eye cutting.

Potted Plants: Potted plants are the nearest "foolproof" of all types of planting material. They may be secured from commercial sources, or the grower may produce them himself in coldframes, hotbeds or even a sunny window. They may be established in plant bands, or in 2-inch pots. Either rooted cuttings or divisions may be handled in this manner.

Cuttings: Propagation by means of cuttings is used when large numbers of plants are needed, or when stock is limited. Where large scale propagation is carried on, the clumps are commonly lifted in the fall and carried in a greenhouse at temperatures high enough to force the shoots and buds about the base of the plant into growth. As these shoots reach a height of 3 or 4 inches they are clipped off about 1/2 inch above ground and used as cuttings. New shoots will start from the stubs and a second crop of cuttings will be produced in a few weeks.

If stock is in short supply, the shoots of the mother clump may be allowed to reach a length of six to eight inches. Such shoots will yield one tip cutting and several single eye cuttings. (See Figures 1 and 2). The single eye cutting takes a little longer to establish, but is entirely satisfactory. Its use makes it possible to increase rare or scarce varieties far more rapidly than is possible by the standard method of propagation.

For the home gardener who has no greenhouse, clumps may be planted in pots or flats and carried in a warm, sunny window to produce cutting wood; or the grower may wait until growth starts in the spring and make cuttings at that time. In the latter case, the new plants may not reach blooming size until the second season.

The firm young shoots that arise about the mother plant make the best cuttings. Cuttings of older wood root more slowly and the percentage of cuttings striking root is lower than is the case when young wood is used. Cutting should be 2 to 3 inches long. The lower leaves should be removed and the cutting set in the rooting medium to a depth of 1 inch. Some varieties will strike

roots within a few days while others may take much longer. The time required for rooting the cutting can be decreased and the number of roots per cutting increased by use of hormone rooting compounds.

In using rooting hormones, the dust form is preferred because it is easier to use and presents less danger of under or over-dosage. The lower 3/4 inch of the cutting is dipped in the powder and excess powder is tapped off by striking the cutting against the container. The cutting should be planted in a hole, not pushed into the rooting medium, since forcing it into the medium will remove the rooting compound and may result in mechanical damage to the cutting.

Sharp clean sand, perlite, vermiculite or various mixtures of the three make excellent rooting mediums. Sand is satisfactory, but lacks water holding capacity. Perlite, an expanded lava rock, is one of the best of all rooting mediums and is highly recommended. Vermiculite works very well if given close attention. If allowed to alternate between high and low moisture levels vermiculite may lose its granular structure and become waterlogged. In the North Platte work, a mixture of 1 part of clean sand and 1 part of either perlite or vermiculite is used as a medium for rooting cuttings.

Such a mixture is less droughty than sand alone and is more stable than vermiculite alone. There is less danger of disturbing the cuttings during watering than when either perlite or vermiculite is used alone.

The rooting medium should be placed in a cutting box. Any well constructed box will serve if it has a rim that reaches above the cuttings. This rim is important since the box should be covered with glass while rooting starts. The box should not be so closely covered as to cause excessive moisture to collect on the cuttings or "damping off" may result.

After the cuttings are set, the box should be placed in a greenhouse, hotbed or warm window and protected from full sun until rooting starts. After the cuttings cullus and rooting starts the glass may be lifted and the amount of light increased.

The best temperatures for rooting cuttings seems to be around 65°F. At lower temperatures (45-55 degrees) rooting is excellent but the time required is greater. Ten to fifteen days are required for rooting at 45°, but some varieties will strike roots in five days, if the rooting medium is held at 65-70°. Extremes of temperature delay rooting and may destroy the cuttings.

As soon as the cuttings are well rooted they should be transplanted to 2 or 3-inch pots or plant bands and carried until well established. They may be planted directly in the open if the grower is prepared to give them considerable attention until established. The amateur, however, can be surer of his results if the cuttings are established in pots before planting in the field.

Chrysanthemums from Seed: Few gardeners grow chrysanthemums from seed. This is unfortunate since it is from seed that the new and better varieties originate. The grower of seedlings may always hope that he may find a new and valuable chrysanthemum variety among his seedlings.

The source of seed is important; much of that offered by seed houses has been collected from varieties too late for the Great Plains region. It is recommended that the prospective grower collect his own seed from varieties that are adapted in his own region. The use of such seed will avoid much of the lateness that appears in progenies of plants from commercial seed. Those who are interested in growing chrysanthemums from seed should obtain University of Nebraska Bulletin 428, Chrysanthemum Improvement.

Chrysanthemum seed should be started in flats during February or March. Seedlings will be large enough for field planting in late April or early May. Well grown seedlings are as easily handled as cabbage or tomato plants and little loss is to be expected during the transplanting operation. Seed can be sown in any good garden soil and should be covered to a depth of 1/8 inch. The flat should be covered with a pane of glass during the germination period.

Seedlings may also be grown in a vermiculite, peat, ground spaghnum moss, sand or mixtures of these materials. These materials contain no plant food and seedlings must be given a nutrient solution. Preparations used for soilless culture of plants should be applied according to the manufacturer's recommendations. The greatest advantage of soilless culture is that the danger of loss of seedlings by disease is eliminated.

Seedlings may be grown in the seed flat until time to plant in the field, provided they are not so crowded as to cause stunting. They are handled better by transplanting to flats of soil as soon as two or three true leaves have developed. Given 2 1/2 x 2 1/2 inch spacing in the transplant flat, seedlings will become strong thrifty plants in time for field planting.

Seedlings handled in this manner will reach full size and give full bloom in the fall of the year the seed is planted. They do not, however, develop the mature flower form the first season. Doubleness of the flower may increase during the second and third season.

GARDEN CARE

Planting: Regardless of the type of planting material the care used in establishing it in the field determines the success of the planting. Packing the soil firmly about the roots is important. The loosely set plant is handicapped from the start and high mortality is to be expected to follow poor planting.

Divisions should be set with the growing tip just above ground level. It is advisable to set them in a rather upright position so that the lower end of the rhizome is far enough below the surface to avoid surface drying.

Potted plants should be set with the ball of earth slightly below ground level. Seedlings may be handled in the same manner as tomato or cabbage plants.

Watering: It is essential that newly set chrysanthemums be well watered until they have become established in their new location. During this period the soil should be kept uniformly moist, not wet. If this is done, even very small divisions or seedlings are readily established in the open field.

Proper watering throughout the growing season is important if one wants to get the most out of the chrysanthemum planting. Infrequent, heavy applications are preferred to frequent light irrigations. The latter results in shallow rooting while the former will produce both deep and shallow roots. Overwatering is to be avoided. Frequent heavy applications may result in waterlogged soil, which no 'mum will tolerate. If the soil forms "mud balls" when squeezed in the hand, it is too wet. Of course, most soils will ball if tested immediately after water is applied, but a properly watered soil, tested a few hours after irrigation, will not ball but will crumble and appear loose and friable in the hand.

Cultivation: Frequent, shallow cultivation to keep weeds down and prevent soil baking is desirable. As a rule a light cultivation after each irrigation is advisable. Deep cultivation, close to the plants, is not recommended since considerable root damage may occur.

Care of the Established Planting: As far as practical, it is recommended that established clumps be divided each spring. The proper time for this is when danger of hard freezes is past and when early spring growth has started. Single rhizomes having one to three growing points are preferable. Large divisions of many shoots defeat the purpose of division and may result in overcrowded clumps. Remember that chrysanthemums must have room to develop properly.

If for some reason clumps must be left for a second season, they should be thinned to two or three shoots per clump. Such thinning will result in sturdier plants and more and better flowers.

Disease and Insect Control: Grasshoppers, lygus bugs, leafhoppers, aphids and other insects may attack the chrysanthemum. Applications of insecticides or miticides should be made at the first indication of infestation. Thorough applications are necessary for satisfactory control.

RECOMMENDED CONTROL MEASURES FOR INSECT PESTS

Aphids:

Malathion, 50% EC...2 teaspoons to 1 gallon water.

OR Diazinon, 25% E.....2 teaspoons to 1 gallon water.

Stalk borers: Borers migrate to mums from adjacent weeds and plants. Cut out and burn weeds early in spring. 50% Chlordane, DDT, or Sevin wettable powder at the rate of 2 tablespoons to 1 gallon of water used as a spray around the margins of flower beds may help control stalk borers.

Leafhoppers:

DDT 50% wettable powder.....2 tablespoons to 1 gallon water.

OR Sevin 50% wettable powder.....2 tablespoons to 1 gallon water.

OR DDT 5% - 10% dust.

OR Sevin, 5% dust.

Plant bugs ..... same as for leafhoppers

Red spider mites:

Chlorobenzilate 25% EC.....2 teaspoons to 1 gallon water.

OR	Aramite 15% WP.....	2 teaspoons to 1 gallon water.
OR	Dimite, 25% EC	2 teaspoons to 1 gallon water.
OR	Diazinon, 25% E.....	2 teaspoons to 1 gallon water.
OR	Wettable sulfur.....	3 level tablespoons to 1 gallon water.

Grasshoppers:

Chlordane, 45% EC	4 teaspoons to 1 gallon water.
Sevin 50% WP.....	2 tablespoons to 1 gallon water.

Systemic insecticides: Two systemic insecticides are available for home gardens. 2% Di-syston (scope) granules for soil application, and dimethoate (Cygon) for spraying. Systemic insecticides are absorbed into the plant, making the entire plant poisonous to sucking insects such as aphids and mites. If systemic insecticides are used, BE CERTAIN TO FOLLOW THE MANUFACTURERS INSTRUCTIONS AS TO THE AMOUNT AND METHOD OF USE. TO MUCH, OR USE ON CERTAIN PLANTS MAY RESULT IN SEVERE INJURY TO PLANTS.

WARNING:

Remember that all insecticides are poisonous. Keep away from children. Follow the manufacturers recommendations. If you use the new systemic poisons DO NOT USE THEM IN THE VEGETABLE GARDEN UNLESS THE MANUFACTURER SPECIFICALLY RECOMMENDS THEM. THEY CAN KILL YOU!

RECOMMENDED CONTROL MEASURES FOR CHRYSANTHEMUM DISEASES

We wish to emphasize that prevention is better than control of plant disease. A good program of sanitation, the prompt removal of diseased plants and a preventative spray program are musts in mum growing.

Leaf spots:

Symptoms: Two distinct leaf spots occur on chrysanthemums. Both cause dark brown to black spots on the leaves. One, however, is characterized by small spots and causes the leaf to drop prematurely. The other causes larger spots, 1/2 to 1 inch in diameter, and the infected leaves cling to the stem.

Cause: The two leaf spots are caused by different fungi (*Septoria chrysanthemi* = small spots; *Cylindrosporium chrysanthemi* = large spots). These fungi live over the winter on the infected plant debris.

Control: Spray the plants at first sign of the disease with Zineb 65% wettable powder or Captan 50% wettable powder. Use 1 1/2 tablespoons per gallon of water. For even coverage a commercial sticker-spreader should be added to the spray. If this is not available use a household detergent such as Dreft. Repeat applications at 5 to 7 day intervals until disease is under control.

In the fall, remove and burn all plant parts above the ground. This will reduce the amound of leaf spot and fungi that live over the winter.

Powdery mildew:

Symptoms: A white powdery growth appears on the leaves and causes curled and deformed leaves.

Cause: Fungus (*Erysiphe cichoracearum*). The fungus lives over winter on previously infected leaves.

Control: An effective control against powdery mildew is dusting or spraying with wettable sulphur (2 level tablespoons per gallon) at 7 to 10 day intervals. Two new fungicides which are very effective against powdery mildew are Karathane and Mildex. If either of these compounds are available, you may wish to try them. To help reduce mildew collect and destroy all above ground parts of plants in the fall.

Stem rot:

Symptoms: The lower leaves turn yellow and wither. Finally the whole plant dies. The stems near the ground are black. The vascular tissues (woody tissues) of the stem show a brown discoloration. This discoloration extends some distance above ground.

Cause: Fungus (*Fursarium* sp.). The causal fungus can live in the soil. The disease organism enters the plant through the roots. Later it invades the vascular elements of the stem causing death of the plant.

Control: Remove and destroy any diseased plants. Once the disease has appeared in the chrysanthemum bed, change the location of the bed. Where this cannot be done, sterilize the soil.

Rust:

Symptoms: Blister-like swellings first appear on the leaves. These swellings break open revealing a brown, powdery mass. The powdery mass is the fungus spores (seeds). Plants heavily rusted will be weakened and may fail to bloom properly.

Cause: Rust is caused by a fungus organism (*Puccinia chrysanthemi*). The spores are spread by wind, rain and sprinkling. Moisture on the plant is necessary for their germination.

Control: Dust the plants with sulphur every week or 10 days or spray with Zineb 65% wettable powder or Ferbam 65% wettable powder - 2 tablespoons per gallon of water or Maneb 70% wettable powder - 1 tablespoon per gallon of water.

Stunt:

This is a serious virus disease that destroys much of the ornamental value of chrysanthemums. Spread is rapid and an entire planting can be infected in a single season.

Symptoms: Plants affected by stunt have smaller and paler-green leaves than normal. The flowers are smaller, with the color bleached in some pink and bronze varieties. The plants tend to grow upright. Plants mature at about half their normal height and flower 7 to 10 days prematurely.

Cause: Virus that may be spread by handling healthy and infected plants, by tools or by insects. It is advisable to immediately destroy any plant suspected of being infected by any virus. There is no known control for virus disease.

Control: Since the disease is carried in the planting stock, obtain and plant only disease-free stock. Purchase your planting stock from a reliable concern. Reduce handling hazards as much as possible.

Other virus diseases:

Asters yellows virus attacks chrysanthemums in Nebraska commonly and certain other viruses may be found on this plant infrequently.

Symptoms: In general infected plants are yellow or mottled and usually are stunted. The flowers, if present, are deformed and off-color.

Control: Control of aphids and leafhoppers which may transmit the viruses. Take out suspicious looking plants which may serve as a source of virus for spread by insects. Avoid mechanical transmission by promiscuous handling of diseased and healthy plants.

VARIETIES FOR YOUR GARDEN

There can be no list of chrysanthemums that will perform satisfactorily in all Nebraska gardens. Our soil is too variable and the temperature gradient across the state is too variable. "Temperature threshold" as described on page 4 must be considered as playing a major role in dates of bloom. Many varieties that bloom well in the north and west parts of the state may be too late in Lincoln or Omaha. Conversely, varieties too late for the east end of the state may do well in the higher altitudes and cooler nights of western Nebraska. Providing, of course, that date of bloom is a temperature response rather than a response to length of day.

Since it is impossible to determine performance of a given variety under the various climatic and soil conditions of Nebraska no attempt to include a list of recommended varieties has been made. This is a matter of trial in the various parts of the state. It is suggested that you test a few plants of any new introduction before any extensive planting is made. Visiting nurseries and experiment stations in your particular area will give you better information than is possible in a bulletin such as this which is designed to cover the entire state.

While it is not possible to forecast the behavior of a new cultivar in a given area the following principles may be helpful.

1. As mean temperature falls bloom tends to be earlier. Thus, in most years bloom will be earlier in Scottsbluff than in Lincoln because of a temperature differential.

2. Plant height tends to be greater in the east than in the west.

3. Flower colors are more brilliant and fade less in cooler areas. Thus reds, bronzes, and pinks will be less attractive in the east end of the state. This can be avoided to a degree by using only varieties that bloom after mid-September in the Lincoln-Omaha area and along the south border of the state. (Note that the

temperature response cited above may enable the red-bronze-pink flowered varieties to perform quite well in the south and east.)

NEBRASKA CHRYSANTHEMUM INTRODUCTIONS

(In general the Nebraska introductions have done well across the entire state.)

Variety	Color	Plant Habit	Remarks
Ad Astra	light wine	upright	4-5" quill, space age
Aksarben	suntan	upright	4-5" quill, space age
Apogee	lavender	border	4" quill, space age
Arapahoe*	red	upright	4" decorative, may be late
Asteroid	gold	spreading	4" quill space age, poor plant
Astronaut	orange	spreading	4-5" quill space age, poor plant
Blue sky**	purple	upright	2-3" decorative, flowers in dense clusters
Cheer-leader	pink	upright	4-6" football mum
Cody*	pink	cushion	low mound covered with flowers
Dune Sand*	tan	upright	2" flowers, may be late some seasons

* Varieties so marked probably no longer in commercial channels

E.H. Hoppert*	gold	upright	4" flowers, early
First Lady	pink & white	upright	2" double, good cut flower
Gold Ribbon	gold	cushion	2" double
Kiowa*	orange red	border	1 1/4 very double, best north & west
Leshara*	mulberry	upright	small flowers in large sprays, frost tolerant
Mesa	pink	upright	4-5" salmon pink semidouble, very early
Montaska	purple	upright	double rich purple and exceptionally hardy. A joint introduction by Montana and Nebraska
Moon-flight	creamy white	spider or quill	space age, early, 4-7" flower, good
Mustang	light orange	double	4-5" flowers on strong plants, good
Niobrara*	white	cushion	probably no longer available, a poor variety of little merit
North Platte	light orange	upright	very good and well adapted
Omaha*	orange	cushion	small flowered, late
Oceola	yellow & copper	border	early
Path-finder	yellow	border	carnation flowered

Pearle Parkinson*	red & yellow	border	free flowering, very hardy
Plainsman	red-bronze	border	carnation flowered
Ponca*	purple	border	many small flowers in large clusters
Prairie Dawn	purple	cushion	very free flowering
Prairie Glow	Lt. bronze	tall border	very free flowering
Prairie sunshine	bright yellow	border	plant too open
Prairie sun	bright yellow	border	improved Prairie Sunshine with much better plant.
Quarter-back	rose-buff	cutflower	3-5" double blooms, football type
Santee*	yellow	border	very early and little affected by heat
Space Flight	bronze	border	space age quill
Space Man	bronze	cushion	space age quill
Space Ship	pale yellow	border	early and large flowered space age quill
Space Way	lavender	border	early and large flowered space age quill
Stadium Queen	bronze	border & cut flr.	football 4-7" flowers on long stems
Star Fall	red-bronze	border & cut flr.	space age quill
Star Flite	red-bronze	border	space age quill, brilliant color

Star Lite	lt. orange	low border	space age quill, 6" flrs. on 12" plants
Star Trail	yellow	border	6" semi-spider space age mum
Tecumseh*	bronze	cushion	excellent plant form
Virgin Elegance**	white	cut flr.	joint USDA and Uni. release, good plant
Wahoo Chief	yellow	cushion	very early
White Cloud*	white	border	good cutflower and border plant
W. P. Snyder*	bronze	border	good early variety

** Varieties so marked are USDA-University of of Nebraska introductions