Lesson B1-5:

Growing Potted Chrysanthemums

Unit B. Floriculture

Problem Area 1. Greenhouse Crop Production

Lesson 5. Growing Potted Chrysanthemums

Learning Goal: Understand the fundamental concepts, principles and interconnections of the life, physical and earth/space sciences.

Learning Standard: Know and apply concepts that explain how living things function, adapt and change.

Learning Benchmark: Explain changes within cells and organisms in response to stimuli and changing environmental conditions (e.g., homeostasis, dormancy).

Skill Standard: Plant and care for potted plants in the greenhouse and nursery.

Student Learning Objectives. Instruction in this lesson should result in students achieving the following objectives:

1. Discuss the history and importance of the chrysanthemum.
2. Explain the classifications of chrysanthemums.
3. Describe how chrysanthemums are propagated.
4. Schedule a potted chrysanthemum crop.
5. Identify major chrysanthemum pests and disorders, as well as controls.
List of Resources. The following resources may be useful in teaching this lesson:

Recommended Resources. One of the following resources should be selected to accompany the lesson:


Other Resources. The following resources will be useful to students and teachers:


McMahon, Robert W. *An Introduction to Greenhouse Production*. Columbus, OH: Ohio Agricultural Education Curriculum Materials Service, The Ohio State University, (Textbook, Chapter 11)

List of Equipment, Tools, Supplies and Facilities

Writing surface  
Overhead projector  
Transparencies from attached masters  
Copies of student lab sheets  
Computer  
LCD projector  
Industry catalogs

Terms. The following terms are presented in this lesson (shown in bold italics):

Center bud removal  
Chrysanthemum  
Disbudding  
Grading cuttings  
Hard pinch  
Response group  
Roll out pinch  
Soft pinch
Interest Approach. Use an interest approach that will prepare the students for the lesson. Teachers often develop approaches for their unique class and student situations. A possible approach is included here.

Set several types (different sizes, flower types, and flower colors) of potted chrysanthemums on the front desk or table at the head of the classroom before the students enter. As students enter class they will be curious as to why the plants are there. They may find them attractive and ask what they are. Avoid answering their questions to create more mystery. When class begins, ask the class a series of questions including what the plants have in common, how they are different, and whether they are the same. From there, move into the lesson.

Summary of Content and Teaching Strategies

Objective 1: Discuss the history and importance of the chrysanthemum.

Anticipated Problem: What is the history and importance of the chrysanthemum?

I. Chrysanthemums, commonly referred to as mums, have their origin in China, Japan and Europe.
   A. Up until the 1940s, chrysanthemums were grown in the United States primarily as garden plants. Since then, they have been grown widely as cut flowers and potted flowering plants. Chrysanthemums rank second to poinsettias in terms of the number of pots sold in the United States.
   B. Chrysanthemums are photoperiodic and thermoperiodic.

Begin the lesson on chrysanthemums by focusing on the history and importance of the plant. Have the students read the appropriate sections in Chapter 8 of Floriculture: From Greenhouse Production to Floral Design and seek additional information through the Internet. Lead a class discussion on the history of chrysanthemum, during which students should be required to take notes. Use questioning to determine the level of student understanding of the topic.

Objective 2: Explain the classifications of chrysanthemums.

Anticipated Problem: What are the classifications of chrysanthemums?

II. Chrysanthemums are classified based on their response group, plant height, and flower forms.
   A. **Response group** refers to the number of weeks it takes for the chrysanthemum to flower from the time they begin receiving short day treatments.
      1. Response groups range from 6 weeks to 15 weeks.
      2. Most potted chrysanthemums fall into the 9-week or 10-week response groups.
   B. Chrysanthemum varieties are classified as being short, medium or tall.
1. Short varieties grow less than 15” in height.
2. Medium varieties grow around 15” in height.
3. Tall varieties grow more that 15” in height.

C. Chrysanthemums are grouped in one of nine major flower forms including standard, spray, button, spoon, decorative, daisy, spider, pompon, and anemone.

Acquire industry catalogs (they need not be of the current year) for use by the students to help them understand how chrysanthemum cultivars are classified. Show the students how the catalogs are organized. Assign portions of Chapter 8 of Floriculture: From Greenhouse Production to Floral Design that address the classification of chrysanthemums. Purchase samples of the major floral forms from a wholesale florist for the students to identify. Use transparency master TM: B1-5A, Chrysanthemum Flower Forms to illustrate the different chrysanthemum flowers.

**Objective 3:** Describe how chrysanthemums are propagated.

**Anticipated Problem:** How are chrysanthemums propagated?

III. Chrysanthemums are propagated asexually by stem cuttings.

A. A few major companies produce 95% of the cuttings used in commercial production. Those companies provide rooted or non-rooted cuttings free of viral disease.

B. Steps to propagating chrysanthemums are as follows:
   1. Take cuttings 2 to 3 inches in length with three leaves.
   2. Treat the cutting with a medium-strength rooting hormone.
   3. Stick the cuttings and place under an intermittent mist system.
   4. Maintain bottom heat between 70 and 75 degrees F.
   5. Light the cuttings to maintain vegetative growth.
   6. Fast rooting cuttings form roots in about 18 days.

Assign the section regarding chrysanthemum propagation in Chapter 8 of Floriculture: From Greenhouse Production to Floral Design as a reading activity for homework or during supervised study. After the students have completed the reading assignment, discuss the way chrysanthemums are propagated. Obtain rooted or non-rooted cuttings for the students to pot and grow.

**Objective 4:** Schedule a potted chrysanthemum crop.

**Anticipated Problem:** What is a growing schedule for a potted chrysanthemum crop?

IV. In preparing a production schedule, first determine the sale date. Then count back the number of weeks the plant requires short day treatment and another 2 weeks for vegetative growth. After potting, a potted chrysanthemum schedule can be divided into the following periods.

A. The quality of the crop often hinges on the care taken at planting time.
1. **Grade cuttings** or sort them according to the number of roots, the diameter of the stem, and the length of the stem before potting. This ensures uniform growth in each pot.
2. Use a growing medium with a pH between 6.0 and 6.5.
3. Plant cuttings shallow and angle them outwards over the lip of the pot at about 45 degrees.

B. The most important stage of growth is the vegetative stage. Strong roots and reserves of sugars must be established.
   1. Fertilize at a rate of 250-350 parts per million nitrogen at the first watering.
   2. Drop the rate to 200-300 parts per million nitrogen and potassium with following waterings.
   3. Provide 65 to 70 degree F night temperatures and 75 to 80 degree day temperatures.
   4. Maintain vegetative growth by interrupting the darkness by lighting between 10:00 p.m. and 2:00 a.m.
   5. Grow the plants until the roots appear at the bottom of the pots, then pinch to produce a well-branched plant with many flowers.
      a. Use a **roll out pinch** or the removal of just the tip of the stem in winter.
      b. Use a **soft pinch** or the removal of ½ to ¾ inch of the stem and leaving five to six leaves.
      c. Use a **hard pinch** to remove all but three or four leaves in the summer.
      d. Flower bud initiation is accomplished by turning off the lights to provide a short day treatment. Covering the crop with black cloth might be necessary to simulate short day conditions.
      e. Lower temperatures to 62 to 65 degree F at night.
      f. Reduce fertilizer rates to 200-250 parts per million nitrogen and potassium.

C. The flower bud development stage focuses on forming the flower buds.
   1. Drop night temperatures to 60 to 62 degrees F.
   2. Fertilize at a rate of 200 to 250 parts per million nitrogen and potassium.
   3. Perform **disbudding** or the removal of selected developing flower buds to improve overall quality.
      a. Disbudding of all the lateral buds results in larger terminal flowers.
      b. **Center bud removal** involves pinching off the terminal flower bud. It allows the lateral flower buds to develop.

D. Finishing is the final stage and it involves preparing a plant for sale.
   1. Lower the greenhouse temperature to 55-58 degree at night to increase flower color intensity.
   2. Stop fertilization and allow the media to dry slightly.

*Have the students read portions of Chapter 8 in Floriculture: From Greenhouse Production to Floral Design related potted chrysanthemum production as a homework assignment or during supervised study.*

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**Horticulture Lesson Plan Library**

Unit B. Problem Area 1. Lesson 5. Page 5.
quire students to take notes on the major points as they read the chapter. Follow the reading assignment with a class discussion on how to schedule and grow a crop. Use visual aids to outline key elements involved in crop production. Monitor students’ mastery of the material through the discussion.

Schedule and grow a chrysanthemum crop in the school greenhouse. Involve the students in the production of a crop from potting to sale. Have students perform tasks involved in production including the potting of cuttings, watering, fertilizing, adjusting temperatures, and controlling day lengths. Use transparency master TM: B1-5B Correct And Incorrect Potting Of Chrysanthemum Cuttings to illustrate proper potting techniques. Use transparency master TM: B1-5C, Three Methods Of Pinching Chrysanthemums during the discussion on pinching chrysanthemums. Use Lab Sheet LS: B1-5A, Duration of Light to demonstrate the role of day length in flower bud formation. Use transparency master TM: B1-5D, Center Bud Removal Of Chrysanthemums and TM: B1-5E, Disbudding Of Chrysanthemums to illustrate disbudding techniques.

Where possible, include industry people in the lesson. Seek help from a grower in purchasing plants and scheduling the crop. Arrange to have a grower speak to the class about how to schedule a crop. Set up a field trip to a commercial greenhouse. Assign exercise presented in the lab sheet LS: B1-5B, Chrysanthemum Scheduling. Consider having students complete the lab in pairs.

**Objective 5:** Identify major chrysanthemum pests and diseases, as well as controls.

**Anticipated Problem:** What are major chrysanthemum pests and diseases and some means of control?

V. Chrysanthemums have both pests and disorders that require attention.

   A. The major pests include aphids, whiteflies, leaf miners, spider mites, cutworms and cabbage loopers. An IPM program should be followed to reduce pest problems.

   B. The major diseases include botrytis, mildews, *Pythium*, *Rhizoctonia*, and *Phytophthora*. Proper watering and controlling humidity levels reduces disease problems.

Have the students read sections in Chapter 8 of Floriculture: From Greenhouse Production to Floral Design related to pest and disorders of chrysanthemums as homework or during supervised study. An additional reading assignment of related sections in Chapter 13 is recommended. If the students are growing a chrysanthemum crop, help them set up a schedule for monitoring pest populations. Involve the students in managing the pests and disorders through approved practices.

**Review/Summary.** Focus the review and summary of the lesson around the student learning objectives. During class discussions, call on students to explain the content associated with each objective. Use their responses as the basis for determining any areas that need re-teaching. Questions at the end of the chapters in the textbook may also be used in the review/summary. Reinforce student learning by scheduling and growing a chrysanthemum crop in the school greenhouse.
Application.

Duration of Light — LS: B1-5A
Chrysanthemum Scheduling – LS: B1-5B

Evaluation. Focus on student achievement of the objectives set for the lesson when evaluating student performance. Use various evaluation techniques, such as student performance during oral review of the material, practical application of skills in the greenhouse setting, completion of laboratory sheets, and a written exam. A sample written test is attached.

Answers to sample test B1-5:

Part One: Matching
1=d, 2=f, 3=e, 4=g, 5=h, 6=b, 7=c, 8=a

Part Two: Completion
1. second
2. photoperiodic, thermoperiodic
3. 95%
4. black cloth
5. shallow, 45
6. stem cuttings
7. response group, plant height, flower form
8. mums
9. vegetative
10. larger

Part Three: Short Answer
1. standard, spray, button, spoon, decorative, daisy, spider, pompon, and anemone
2. Take cuttings 2 to 3 inches in length with three leaves.
   Treat the cutting with a medium-strength rooting hormone.
   Stick the cuttings and place under an intermittent mist system.
   Maintain bottom heat between 70 and 75 degrees F.
   Light the cuttings to maintain vegetative growth.
3. aphids, whiteflies, leaf miners, spider mites, cutworms and cabbage loopers.
4. botrytis, mildews, Pythium, Rhizoctonia, and Phytophthora.
5. Complete the table.
<table>
<thead>
<tr>
<th>Stage</th>
<th>Day length</th>
<th>Temperature</th>
<th>Fertilizer rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vegetative</td>
<td>Long days</td>
<td>65 to 70 F nights</td>
<td>250-350 ppm nitrogen with the first watering</td>
</tr>
<tr>
<td></td>
<td></td>
<td>75-80 F days</td>
<td>200-300 ppm N and K thereafter</td>
</tr>
<tr>
<td>Flower bud initiation</td>
<td>Short days</td>
<td>62-65 F nights</td>
<td>200-250 ppm N and K</td>
</tr>
<tr>
<td>Flower bud development</td>
<td>Short days</td>
<td>60-65 F nights</td>
<td>200-250 ppm N and K</td>
</tr>
<tr>
<td>Finishing</td>
<td>Short days</td>
<td>55-58 F nights</td>
<td>Stop fertilization</td>
</tr>
</tbody>
</table>
Lesson B1-5: Growing Potted Chrysanthemums

Part One: Matching

Instructions. Match the term with the correct response. Write the letter of the term by the definition.

- a. Center bud removal
- b. Chrysanthemum
- c. Disbudding
- d. Grading cuttings
- e. Hard pinch
- f. Response group
- g. Roll out pinch
- h. Soft pinch

_____ 1. Sorting cuttings according to the number of roots, the diameter of the stem, and the length of the stem before potting.
_____ 2. Refers to the number of weeks it takes for the chrysanthemum to flower from the time they begin receiving short day treatments.
_____ 3. Pinch to remove all but three or four leaves usually done in the summer.
_____ 4. The removal of just the tip of the stem usually done in winter.
_____ 5. The removal of ½ to ¾ inch of the stem and leaving five to six leaves.
_____ 6. Plants grown widely as cut flowers and potted flowering plants and have their origin in China, Japan and Europe.
_____ 7. The removal of selected developing flower buds to improve overall quality.
_____ 8. Involves pinching off the terminal bud to allow the lateral buds to develop.

Part Two: Completion

Instructions. Provide the word or words to complete the following statements.

1. Chrysanthemums rank ______________________ in terms of the number of pots sold in the United States.
2. Chrysanthemums have ___________________ and ___________________ responses.
3. A few major companies produce ____________ of the cuttings used in commercial production.
4. Covering the crop with __________________ might be necessary to simulate short day conditions.
5. Plant cuttings _________ and angle them outwards over the lip of the pot at about ______ degrees.
6. Chrysanthemums are propagated asexually by ________________.
7. Chrysanthemums are classified based on their ________________, ________________, and ________________.
8. Chrysanthemums are commonly referred to as ________________.
9. Strong roots and reserves of sugars must be established during the ________________ stage.
10. Disbudding of all the lateral buds results in ________________ terminal flowers.

**Part Three: Short Answer**

**Instructions.** Provide information to answer the following questions.

1. List nine major flower forms.

2. List the steps in propagating chrysanthemums.

3. List the major pests of chrysanthemums.

4. List the major diseases of chrysanthemums.

5. Complete the table.

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CHRYSANTHEMUM
FLOWER FORMS

Standard
Spray
Button
Spider
Decorative
Daisy

Pompon
Anemone
CORRECT AND INCORRECT
POTTING OF
CHRYSANTHEMUM CUTTINGS

CORRECT
(shallow and over the lip of the pot at a 45° angle)

INCORRECT
THREE METHODS OF PINCHING CHRYSANTHEMUMS

Roll-out Pinch
Remove just the meristematic tip

Soft Pinch
Remove ½–¾“ leaving 5–6 leaves

Hard Pinch
Remove all but 3–4 leaves

(Courtesy, Interstate Publishers, Inc.)
CENTER BUD REMOVAL OF CHRYSANTHEMUMS

Remove only the terminal bud

Encourages development of auxillary buds

(Courtesy, Interstate Publishers, Inc.)
DISBUDDING OF CHRYSANTHEMUMS

Remove Axillary Flower Buds

Encourages development of terminal bud

(Courtesy, Interstate Publishers, Inc.)
Lab Sheet

Duration of Light

**Purpose:**
Students will gain an understanding of photoperiodic control of flowering of short-day plants.

**Materials:**
- Rooted chrysanthemum cuttings (8- or 9-week response group)
- Growing medium
- 4 ½” azalea pots
- Fertilizer
- A lighted growth chamber or an incandescent lamp
- Timer
- A dark chamber or black cloth

**Procedure:**
1. Pot one chrysanthemum cutting in each pot. Label one set of pots group A and the other Group B.
2. Grow the cuttings until the roots appear at the bottom of the pots. During this period provide 14 hours of light.
3. Once the plants are established, place group A plants in a dark chamber or under black cloth after 10 hours of light everyday. Place Group B plants beneath an incandescent lamp with a timer that will ensure 18 hours of light.
4. Each morning give both sets of plants full light.
5. Provide water and fertilizer for the plants as recommended for a chrysanthemum crop.
6. Continue the light treatment until the flower buds have formed.
7. Record the dates of planting, the dates treatments began, the length of the light periods, and the number of short days it took for flower buds to form.
Chrysanthemum Scheduling

Purpose:
Students will gain a greater understanding of how chrysanthemums are scheduled.

Instructions:
Read the problem stated and offer a solution.

Problem:
A horticulture class wants to grow a crop of chrysanthemums for a Valentine’s Day sale. They would like to grow a 9-week, medium-sized variety. They would also like to start with rooted cuttings. How would you answer the following questions?

1. They have six 5’ x 10’ benches on which to grow the crop. How many 6” pots spaced 15” x 15” do they have room for?

   300 square feet of bench space is available. Each potted plant requires 1.56 square feet (14” x 14” = 196 square inches divided by 144 square inches in a square foot = 1.36 square feet). 300 divided by 1.36 = 220 pots.

2. How many cuttings should they order if they plan on putting 5 cuttings per pot?

   220 pots times 5 equals 1,100 cuttings needed.

3. When should the plants be delivered and potted?

   Count backwards one week to February 7 for marketing purposes, 9 weeks for flowers from the start of short days, and two weeks for vegetative growth after potting for a total of 12 weeks. Have the cuttings delivered one week earlier or thirteen weeks before February 14. Order for the week of November 15.

4. Will the night darkness need to be interrupted and if so how?

   Yes, interrupt the night darkness by lighting the plants from 10 p.m. until 2 a.m. from the time they are delivered until ten weeks prior to February 14.

5. When should they be pinched and what type of pinch do you recommend?

   Pinch the plants at the time short days are given. In the winter months, use a roll-out pinch.

6. When should they be given short days to initiate flowering?
At that time of the year, the nights are long enough to satisfy the short day response. Simply turn off the lights used to interrupt the darkness. If parking lot or security lights shine on the greenhouse, covering the plants with black cloth is required. A little over 12 hours of complete darkness each night triggers flowering.