Greenhouse
Get Your Crops Off to a Great Start

Overview

Greenhouse plant propagation can be an important step in producing crops, especially annual vegetables and flowers. Greenhouses are often used for raising young plants for transplanting into the field. Greenhouses enable crops to be raised in an efficient way by concentrating a large number of plants needing intensive care in a relatively small area. Additionally, greenhouses allow for controlling many aspects of the physical environment, such at temperature, moisture and light. Thus, they can help extend the productive period of producing a particular crop that can be grown in a given year.

Raising transplants in a greenhouse requires the use of containers and soil mixes to hold and nourish the young plants. The greenhouse itself needs to have the proper architecture and management in order to provide appropriate light, temperature, and moisture controls to optimize plant growth.

The goal of this activity is to introduce students to ecologically oriented, greenhouse based transplant propagation. Biologically based fertility and pest management practices can reduce or eliminate the need for chemical fertilizers and pesticides, thus preventing the social and environmental costs associated with their use. The health and productivity of young plants can be improved by optimizing the ecological conditions in the greenhouse to favor the crop plants and disfavor pests. The following reference resources are provided to improve your familiarity with the topic.

Resource References

Sowing Materials:
Potting Mixes for Certified Organic Production, ATTRA
http://attra.ncat.org/attra-pub/potmix.html

Organic Plug and Transplant Production, ATTRA
http://attra.ncat.org/attra-pub/plugs.html

Pest management:
University of California Integrated Pest Management Program provides numerous resources and a wide diversity of information related to pest management, including specific information about pests, beneficial insects and their biology, and pest management using organic, biological and other means.
http://ipm.ucdavis.edu/

Integrated Pest Management for Floriculture and Nursuries, by Dreistadt, S and M.L. Flint. 2001. University of California, DANR Publication 3402. Oakland, CA

Integrated Pest Management for Greenhouse Crops, ATTRA
http://attra.ncat.org/attra-pub/gh-ipm.html

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Introduction

This activity is designed to show students how common vegetables, flowers, and herbs are propagated from seed in the greenhouse using ecological methods. The activity focuses on the use of biological and naturally occurring sources of fertility and pest and disease protection. Greenhouses can be viewed ecologically as places where young plants are provided the nutrients, water, air, temperature, and protection they need to germinate and grow for later field planting.

Students will learn how to prepare soil mixes and sow seeds into greenhouse flats or other containers. They will also learn the basic methods of managing greenhouse climatic conditions such as soil moisture, temperature, and airflow. Students will be shown the various stages of transplant development from seed to transplants ready for the field.

To Lead This Activity You Need To Know

Facilitators of this activity need to have the following basic understandings in order to effectively lead students through this activity:

- The reasons greenhouses are used to propagate plants
- Which crops need to be started on the day of the activity and how to sow them
- How to make seed flat mix using organic materials and the purpose of each ingredient
- The ingredients used in common commercial mixes and why they are used
- How and why air flow and temperature are regulated in greenhouses
- How to identify the various crops, particularly their seeds and seedlings
- How to identify common greenhouse pests and diseases in their life cycle stages
- The general practices of managing common pests and diseases using ecological methods, their advantages and disadvantages (including possible health and environmental consequences)
- The general practices of managing common pests and diseases using conventional methods, their advantages and disadvantages (including possible health and environmental consequences)

Key Concepts

- Seed and plant growth requirements (water, temperature, light, air, and nutrients)
- Plant growth and plant growth stages
- Soil-water-plant relations in field soils and in artificial mixes and containers
- Pests and disease promoting conditions
- Biological, cultural and chemical pest control methods

Objectives

- Prepare a soil mix from bulk raw materials
- Plant seeds in trays
- Understand how the greenhouse functions ecologically
- Identify the various needs of seeds and young plants
- Understand the importance of managing the biological and climatic conditions for seedling growth

Materials

- A functioning greenhouse facility
- Seeds of vegetables, flowers or herbs
- Seed flats (new or clean and sterilized)
- Labels and markers
- Possible Seed sowing mix ingredients:
    - Vermiculite
    - Perlite
    - Coco peat
    - Peat moss
    - Compost
    - Worm castings
    - Bone meal (P)
    - Blood or cottonseed meal (N)
    - Greensand (K)
    - Gypsum or limestone (Ca)
    - Other organically acceptable nutrient sources
- Possible supplemental liquid fertilizer:
    - Liquid fish emulsion
    - Kelp
    - Compost tea
- Wheel barrows (1-2)
- Round point shovels (2-4)
- Screen for bulk materials
- Hose or watering can with soft sprinkler attachment

Activity (45-50 minutes)

Preparation and Introduction (15 minutes)

1. Before students arrive, prepare and arrange all materials, including: seeds, planting trays, labels, markers, some previously prepared soil mix, bulk soil mix ingredients, wheel barrows, shovels, hose or watering can and greenhouse bench space.

2. If possible, give each student one tray for sowing seeds that is appropriate for the crops they are going to plant. Larger seeded crops are the easiest for students to learn seed sowing techniques but most students can manage small seeds.
3. When students arrive on the farm introduce them to the operation with a general description of what is grown and how the food reaches consumers. Take them on a brief (5 - 10 minute), tour and point out different crops and their different growth stages. If possible, show them seedlings and mature plants.
4. Bring students to the greenhouse and introduce them to the propagation area. Point out the different facilities (e.g., shade house, hardening off tables, etc.) that may be present and discuss their purposes.

Making the Soil Mix (15 minutes)

1. Show the students what the prepared soil mix looks like and what it contains. Explain each ingredient's function and importance.
2. The goal of a seed flat mix is to supply nutrients, provide drainage, facilitate moisture retention, provide aeration, and discourage pathogens through safe, renewable ingredients that are biologically active.
3. One possible mix contains 40% peat moss or coco peat, 40% vermiculite or perlite, 20% windrow compost or worm compost.
    a. Coco peat and peat moss peat provide water-holding capacity with porosity.
    b. Vermiculite and Perlite provide drainage and aeration.
    c. Composts provide organic matter, nutrients and live microorganisms.
4. If it is your normal practice, you can add sources of nutrients such as: bone meal (phosphorus), blood or cottonseed meal (nitrogen), greensand (potassium) gypsum or limestone (calcium).
5. One possible conventional mix is comprised of 50% fine sand and 50% peat moss, plus potassium nitrate, potassium sulfate, superphosphate and limestone.
6. Briefly demonstrate how to combine the ingredients to make a soil mix, showing them the proportions of each. Have a clear recipe written for them to see. Ask a student to help add water while you demonstrate wetting and mixing the bulk ingredients with a shovel.
7. Return to the pre-made seed sowing mix and demonstrate how to fill the tray with mix in preparation for sowing. Be sure to adequately fill and settle the soil mix within the trays.
8. Ask two of the students to be responsible for the soil mixing process and instruct the other students to start filling the trays. Once the two students complete mixing, have all the students finish filling the trays with the newly made soil mix.
9. Once all the students have their own tray (or a shared tray) designate and hand out labels, markers and seeds to each student. Ask students to make up labels for their tray before sowing. Instruct them to include the variety, species name, date and any other important information. Explain the importance of each of piece of information.

Sowing Seeds (15 minutes)

1. Demonstrate for the students how to sow the seed.
2. Tell the students how many seeds to place in each cell. Explain that different crops and seed sources can have different germination rates and prices and such factors need to be considered in deciding how many seeds to sow in each cell.
3. Ask students to start sowing and assist students as needed.
4. After everyone has finished sowing their seeds, ask students to place the trays in the selected area of the greenhouse. Demonstrate how to irrigate the trays, showing the students how to be sure the trays are well soaked during the first watering. Also show the students how to water in the future by demonstrating on some more mature seedling trays in the greenhouse.
5. Demonstrate to students how the temperature and airflow are regulated in the greenhouse for climate and disease control.
6. Have any examples or signs of pests (insects, rodents, microbial, etc.), and their management methods available to show the students.
7. After the students are finished, take them to a mature seedling tray and show how the plants come out of each cell when the root development is strong and the plants are ready for transplanting. Explain that later the seedlings may receive solutions various products such fish emulsion to promote plant growth.

Discussion and Reflection (10-15 minutes)

1. Ask the students what seeds are. Where do seeds originate? Are they alive? What do they need to grow? Explain that seeds are tiny embryos that develop after a flower is pollinated. We can find seeds in common fruits.
2. Ask students to list common vegetables and fruits that they eat that have seeds in them (e.g. tomatoes, peppers, cucumbers, apples, oranges). Ask them to list other foods that they eat that are actually seeds in themselves (e.g. rice, beans, peas, sunflower seeds, corn). Explain that seeds are living organisms that are dormant and waiting for the right conditions to germinate or sprout. Ask the students what are the conditions seeds need to germinate.
3. Ask the students how long they think it takes different crops to grow to maturity. Show them a seed and then bring them to a mature seedling. Ask them how long they think it took to grow from seed to seedling. Then ask them how long it takes the plant to grow to maturity, set fruit and seed and complete the reproductive cycle. Pick a common crop they know (if possible choose a long season crop) so they can appreciate the time it takes to grow a mature vegetable.
4. Ask the students why farmers use greenhouses. Why don't they plant all seeds directly in the field? Show how the greenhouse may have hundreds of thousands of plants in it and how they can all be cared for efficiently because they are concentrated in one area. It conserves the farmer's time and energy. It also conserves water, nutrients, and pest control efforts because the plants are concentrated in a small readily accessible area instead of spread out over several acres. Explain how much area of the farm will be covered once the seedlings are transported into the field and

contrast that area with area used by the greenhouse. Additionally, farmers can control the temperature inside a greenhouse, and thus start crops earlier than they would be able to start them in the field. Starting plants in the greenhouse also shortens the time needed for a plant to be growing in the field before it produces a harvestable crop.

5. Ask the students what some of the differences are between greenhouses that are ecologically oriented and those that are managed intensively with chemical pesticides and fertilizers.
6. Ask the students to list possible trade-offs between the use of chemical and biologically fertilizers and pesticides. Mention that biological methods may include introducing beneficial organisms that take advantage of resources made available by the greenhouse environment (warm, moist), and soil mix (nutrients), without harming the plants or people. Intensive use of pesticides can eliminate most biological activity in the greenhouse, creating conditions that can be conducive to insect pests and diseases. Pesticides can also have serious negative impacts on the workers' health and the environment.