# 1984 CORNELL BEDDING PLANT GUIDELINES FOR NEW YORK STATE

'Bedding plant' is a term encompassing a diverse set of plant products. All are grown in flats in greenhouses and related structures. They usually are marketed in spring from retail greenhouses, garden centers and mass markets. Bedding plants may include a range of herbaceous plants for landscape use, as well as vegetable transplants.

## PLANT GROWING STRUCTURES

Polyethylene-covered (plastic) greenhouses are more widely used than any other structure for growing bedding plants. Developed for minimum cost, ease of construction and minimum manual effort for ventilation, plastic greenhouses are ideal for bedding plant production.

Currently free-span types of 22 to 30 feet wide are recommended. In New York State, only houses glazed with 2-layer inflated polyethylene should be built. Two layers of plastic, properly installed, reduce heat requirements by 40 percent, reduce moisture condensation and subsequent plant disease problems and provide added insurance in the event one layer should rip. The Plastic Greenhouse Manual by Raymond Sheldrake Jr. and Robert M. Sayles provides detailed construction plans and instructions (available for $3.00 from the Department of Vegetable Crops, Plant Science Building, Cornell University, Ithaca, NY 14853).

**Hotbeds and coldframes.** Although satisfactory for the home gardener, hotbeds and coldframes require too much labor and fail to provide the optimum environment required for starting bedding plants commercially. Persons seriously interested in commercial production should not consider hotbeds as a practical production structure.

Hotbeds can be used to condition plants before sales, but even for this purpose a plastic greenhouse with removable side units will do a better job with less labor input.

Information on construction and operation of hotbeds and coldframes can be found in *Solar Greenhouses for the Home*, available for $3.00 from the Northeast Regional Agricultural Engineering Service, Riley-Robb Hall, Cornell University, Ithaca, NY 14853.

## STARTING PLANTS

**Scheduling.** Date of sowing seeds is determined by the date plants are to be marketed, the species of bedding plant and the greenhouse growing conditions. For May sales, common sowing dates are as follows:

TABLE 1. Common sowing times for May sales of several bedding plants*

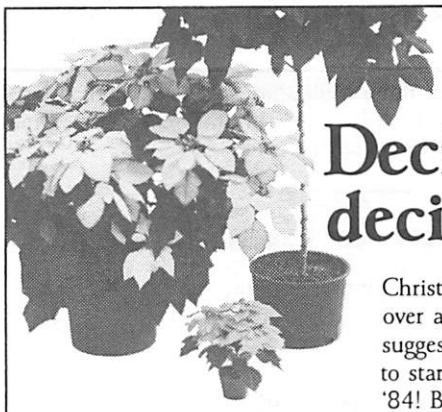
| Month | Approx. weeks sowing to sales | Species |
|---|---|---|
| January | 18-20 | tuberous begonias |
| | 16-18 | fibrous begonia, browallia, geranium |
| February | 14-16 | pansy, double petunia |
| | 12-14 | dusty miller (centaurea and pyrethrum), single petunia, portulaca, snapdragon (dwarf) |
| March | 10-12 | ageratum, carnation, dianthus, dahlia, dimorphotheca, dusty miller (cineraria), gazania, nicotiana, gloriosa daisy, salpiglossis, Salvia splendens (dwarf), sanvitalia, scabiosa, stock, vinca (rosea) |
| | 8-10 | aster, balsam, cleome, coleus, gaillardia, gomphrena, helichrysum, impatiens, Livingstone daisy, dwarf marigold, nemesia, phlox, salvia splendens (tall), snapdragon (tall), statice (sinuata), Thunbergia, verbena |
| April | 6-8 | calendula, celosia, centaurea, zinnia (dwarf) |
| | 4-6 | cosmos, tall (African) marigold, zinnia (tall) |

*Adapted from: Jr. Holden. 1981. Scheduling your product for the eighties. Florists' Review 169(4368):9-10.

**Seed.** Production of quality flower and vegetable transplants can only occur when the grower obtains the best seed possible. Savings on seed purchases can result in significant dollar losses on the final product.

Once seed is obtained it should be stored under conditions that will maintain its viability. Storage temperatures of 32-50°F (0-10°C) and 50-65% relative humidity will maintain viability of most seeds for at least one year. Do not store seed under extremely warm, humid conditions, as viability may be drastically reduced.





**Germination Percentages.** The germination percentage of seed is affected by many factors. Preharvest conditions over which the bedding plant grower has little control are of the greatest influence. As a result of these conditions and genetic variability of species, germination percentages may range from a low of 55 to a high of 85%. Improved methods of cleaning and sorting seeds which reduce the number of immature and poor seeds have improved the germination percentages reported on seed packets.

Table 2 lists the number of seeds per ounce, medium temperature for fastest germination, light or dark requirements and the number of days to germination for selected flower seeds.

TABLE 2. Germination Requirements of Selected Flower Seeds*

| Crop | No. Seed per oz. | Temp (F) for Best Medium faster germ. | No. of Days to germ. | Germination enhanced with Light (L) or Dark (D) |
|---|---|---|---|---|
| Ageratum | 210,000 | 80 | 5 | L |
| Alyssum | 80,000 | 70 | 5 | D |
| Aster | 12,000 | 80 | 7 | D |
| Begonia (fibrous) | 1,920,000 | 70 | 21-35 | L |
| Browallia | 125,000 | 80 | 7 | L |
| Celosia | 29,000 | 80 | 7 | D |
| Coleus | 112,000 | 70 | 10 | L |
| Dianthus | 26,000 | 70 | 5 | D |
| Gazania | 12,000 | 60 | 7 | D |
| Impatiens | 65,000± | 70 | 15 | L |
| Lantana | 1,300 | 80 | 28-35 | — |
| Lobelia | 725,000 | 80 | 14 | D |
| Lupinus | 1,500 | 54 | 14-28 | D |
| Marigold | 10 000 | 80 | 5 | D |
| Pansy | 22,000 | 70 | 20 | D |
| Petunia | 280.000± | 80 | 4 | L |
| Phlox (annual) | 15,000 | 60 | 10 | D |
| Portulaca | 300,000 | 70 | 7 | D |
| Primula (malacoides) | 384,000 | 70 | 21-28 | L |
| Salvia—splendens | 7,500 | 70 | 14-21 | L |
| Snapdragon | 220,000± | 60 | 7 | L |
| Verbena | 10.000 | 70 | 14 | D |
| Zinnia | 2500-4000 | 80 | 5 | D |

*Adapted from Cathey, H.M., USDA Florist Review, Aug. 21, Aug. 28 and Sept. 4, 1969.

Regardless of the number of seeds expected to germinate, only about 75% of these will produce vigorous well-developed seedlings for transplanting. The knowledgeable grower always sows more seeds than the number of plants needed for transplant, and transplants more seedlings than the number of plants needed for sale.

The preferred medium for seed germination is Cornell Peat-lite Mix A, a combination of sphagnum peat moss and number 3 horticultural vermiculite. Since germination is poor in the presence of wetting agent, DO NOT USE A MIX FOR SEED GERMINATION WHICH CONTAINS A WETTING AGENT.

Although bedding plant and vegetable seeds contain within them all the nutrient elements needed for germination, the developing seedlings must have an external nutrient supply to produce maximum, high quality growth.

The formula for the seed germination Peat-lite mix A is given in Table 3.

TABLE 3. Peat-lite Mix A for Bedding Plants.

| | One cubic yard* | One bushel |
|---|---|---|
| Sphagnum peat moss | 0.5 cu. yd. (13 bu.) | 0.5 bu. |
| Vermiculite (#3 for seed germination, #2 or 3 for transplanting) | 0.5 cu. yd. (13 bu.) | 0.5 bu. |
| Dolomitic limestone | 10 lb. | 205 gms. (10.3 T**) |
| 20% Superphosphate OR | 1 lb. | 20.5 gms. (1.2 T) |
| Treble superphosphate | 0 5 lb. | 10.25 gms. (0.6 T) |
| Gypsum | 2 lb. | 41 gms. (2.5 T) |
| Calcium OR potassium nitrate | 1 lb. | 20.5 gms. (1.2 T) |
| Aqua Gro (DO NOT IN GERMINATION MEDIUM) | 3 oz. liquid or 1 lb. granular | 4 ml (0.5 t**) liquid *or* 26 gms. (2T) granular |
| Trace elements | *** | *** |

*One cubic yard = 27 cu. ft. or 22 bu. Due to a 15 to 20% shrinkage that occurs in mixing use an additional 2 bu. each of peat moss and vermiculite or a total of 26 bu. to obtain a full cu. yd. of mix.
**T = level tablespoonful; t = level teaspoonful
***Apply 2 oz. of 503 or 555 per cu. yd. (2.5 gms. or 0.25 teaspoonful per bu.) as well as a liquid fertilizer containing trace elements to be applied during crop growth OR 4 lbs. of ESMIGRAM per cu. yd. (81 gms. or 4 T per bu.) OR 4 lbs. of PERK per cu. yd. (81 gms. or 4 T per bu.) OR 1.5 lbs. of MICROMAX per cu. yd. (31 gms. or 1.7 T per bu.).

### Plug Seeding

The advent of semi-automatic seeders that can sow one to several seeds per tray location is revolutionizing the bedding plant industry. The procedures used for plug seeding vary with the type machine employed; however, certain conditions are required regardless of the seeding machine used.

After sowing the medium should be thoroughly wetted initially and be kept moist. The small volume of media in each cavity makes the seedlings especially vulnerable to rapid drying and quick death.

Inexpensive seed species such as alyssum, lobelia, portulaca, etc. are sown with four or five seeds in one location. The labor saved in eliminating the transplanting operation more than pays for the extra seeds required. Direct sowing as described is usually done over a period of several weeks to provide plants for sale at different times.

Extremely precise control of medium nutrient content, moisture application and medium and air temperature are necessary for success with this system. As a result growers planning to go into plug seeding should obtain as much information as possible on all systems available and then have at least one years' experience before committing themselves completely to this method of growing. Information on the various seeders may be obtained from suppliers of this equipment. Further information is available from your cooperative extension agent.

### Sowing to Seed Flats

Seed may be either broadcast into seed flats or planted in rows. Sowing in rows reduces the chance that damping-off organisms, once started, might destroy an entire flat of seedlings. Sowing in rows also speeds up the transplanting process, as the seedlings are less difficult to separate.

When sowing in rows a mechanical vibrator makes the job easy. Several types of vibrators are available in the market. Some growers have adapted old electric razors as the vibrator to give a more uniform movement to the unit.

Most growers overgrow seeds. For fine and medium size seeds such as petunias and alyssum, sow 10 to 15 seeds per inch of row. Marigolds, zinnias, and similar large seeds are sown so they slightly overlap each other.

Space rows about 1½ inches apart. Seeds requiring light for germination, such as petunias, snapdragons, impatiens are not covered with medium after sowing. Non-*light requiring* fine seeds need not be covered either. These seeds will fall into the crevices of the medium and upon watring be covered. Non-light requiring coarse seeds should be covered to a depth of twice their thickness. Use the same medium for covering as for planting. Some growers prefer to sift a small amount of no-damp-off *sphagnum* moss over the seeds. **Where the recommendations for sowing call for light, the seeds should not be covered.**

## CULTURE AFTER SOWING

**Use of lights.** To accelerate seedling growth, some producers use HID or other lamps to apply about 500-1000 footcandles of light in seedling greenhouses. Others use a lighted germinator to put the production of seedlings on a controlled production-line basis. The facilities should be an area where air temperature can be maintained between 60 to 80°F with bottom heat.

Fluorescent light sources are commonly arranged to provide approximately 27 watts of energy per square foot of production area. This light level can be obtained from 8, 40 watt fluorescent tubes evenly spaced across a 3-foot-wide bed. Warm white, cool white, natural white and daylight fluorescent lamps have all been used alone or in combination with equal success. Warm white alternated with cool white lamps or natural white alternated with daylight fluorescent lamps have been as effective in promoting good plant growth at less cost than special plant-growing lights. The seeded containers are placed about 6 to 8 inches below the lights. Lights placed closer than this may injure young developing plants; placement further away results in undesirable stretching of the seedlings.

A 14-hour day is recommended. A slight increase in growth does occur if an 18-hour day is used. Lighting the plants for more than 18 hours is a waste of energy. An automatic time clock is used to control the day length.

After the seedlings have reached the stage for transplanting, they are gradually acclimated to the higher intensity of natural light over a period of 2 or 3 days. Following this, the plants are handled the same as plants germinated in the greenhouse.

**Watering.** Proper application of water is critical to successful seed germination and subsequent growth of the seedlings. Because seeds are so easily disturbed by overhead watering, ideally the seed flat should remain sufficiently moist without the need to add water throughout the germination period. One method of doing this is to cover the seed containers with a white plastic sheet or place them in plastic bags after irrigation. Use of white plastic reduces the chances of the seeds being overheated by bright sunlight during late March and early April. If clear plastic is used, special effort should be made to shade the flats as needed to prevent injury. A layer of cheesecloth over the plastic is effective in preventing excess temperature increase.

Regardless of the type of covering material used it is important to remove the covering when germination takes place. Disease is quick to start where adequate ventilation is restricted.

Many growers prefer to use low pressure, intermittent mist and bottom heating during the germination period, and plug growers find mist systems essential for success. Proper control of the misting cycle is important to prevent over-watering. Misting frequency is reduced gradually until seedlings are finally upright and established.

Where neither plastic covering nor low pressure mist is used, watering should be by very fine mist spray nozzle to avoid dislodging the seeds. There are several types of nozzles on the market.

**Temperature.** Bottom heat is essential for seed germination when mist is used, and is desirable for all methods of seed germination. Bottom heat is rovided by several methods: steam or hot water pipes, hot air, electric heating cables, etc. Most seeds germinate best when the growing medium temperature is 70 to 80°F. (See Table 2 for specific requirements. A few species germinate better at slightly cooler temperatures. A constant 60°F is recommended for some crops.

If only one greenhouse is available for germination, there may be a problem in maintaining cool temperatures. Usually one end of the greenhouse is cooler than the other and can be adapted to the needs of those crops. Bottom heating also may be adjusted to different temperatures for each bench or area.

Air temperature of 65 to 70°F is preferred for germination. After the seeds have germinated the flats should be removed to a cooler environment. A 55°F night temperature and a 65°F day temperature produces high quality transplants that are not soft or spindly in growth.

### STORAGE OF SEEDLINGS

Seedlings of certain bedding plant species can be held in refrigerated storage for periods up to 6 weeks. Storage is useful when too many seed flats are ready for transplanting at one time.

Use the following procedure:

1. When seedlings have reached the proper transplanting stage, water containers thoroughly. Allow excess water to drain and place containers in polyethylene bags large enough to permit closing using a twistem or rubber band.

2. Place bagged containers in a 35-40°F refrigerator. Place fluorescent lamps, same as for germinating, 12 inches above seedling flats and light 14 hours daily.

3. If plants are stored for 2 weeks or less, they can be used immediately from the cooler. Allow them to warm to room temperature. If stored 2 to 6 weeks, place containers in a cool location 55-60°F, for 24 hours before use to allow them to resume growth.

4. Not all bedding plant seedlings can be stored successfully. Coleus and zinnia will not store well. Ageratum, balsam, cosmos, pepper and tomato will store well for 2 weeks. Alyssum, aster, browallia, dianthus, geranium, lobelia, marigold, petunia, salvia, snapdragon and stock can be successfully stored for up to 6 weeks.

Seedling storage is not a substitute for poor planning; only good healthy seedlings should be stored. Storage is a tool for properly managed bedding plant production.

Fully developed seedlings in plug trays may be held at reduced greenhouse light, temperature, and growing medium moisture levels for up to 3 weeks. Quonset houses covered with white, translucent polyethylene function well for this holding procedure.

## Welcome to New Members

Mr. Paul Li
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16 Argyle Street, Room #1002-3
Mongkok Commercial Centre, 10th Floor
Kowloon, Hong Kong

Lee Cardinale
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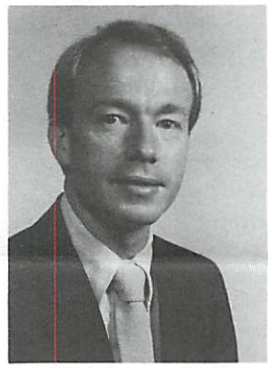
Westbury, New York 11590

# Purdue Professor Visits Cornell

*by Carl F. Gortzig*

Dr. Thomas C. Weiler is serving as Visiting Associate Professor of Floriculture in the Department of Floriculture and Ornamental Horticulture at Cornell University for the period September 1983 through August 1984. He is on leave from his position as Associate Professor of Floriculture in the Department of Horticulture at Purdue University, West Lafayette, Indiana.



Dr. Weiler will work with commercial flower growers through the programs of Cooperative Extension agents as well as through the Department's soil and foliar testing program. He will teach the Department's greenhouse florist crops course during Spring Semester 1984 as well as do some research in floriculture crop production.

During the past fall, Dr. Weiler has worked with Dr. Robert W. Langhans and Robert Spaulding, Joseph Lardner, Robert Whipple and Wendy Wirth, Department technicians, in the on-going computerization of Soils and Foliar Analysis Laboratory reports for growers. This effort will continue into 1984.

Dr. Weiler is a native of Wisconsin. He did his Bachelor's degree at the University of Wisconsin in 1964, and his Master of Science and doctorate degrees under Dr. Langhans at Cornell University in the late 1960's. At Purdue, Dr. Weiler teaches a number of courses in floriculture and interior planting design and management. He is the recipient of the Purdue Department of Horticulture Outstanding Teacher Award. His research has dealt with Easter Lily flowering, efficient flat production of herbaceous perennials, quick-crop hydrangea production, regulation of growth and flowering of *Salvia*, regulation of *Gypsophila* growth and flowering, and others.

Dr. Weiler's address at Cornell is: Department of Floriculture and Ornamental Horticulture, 20 Plant Science Building, Cornell University, Ithaca, New York 14853 and his telephone is 607-256-4532.