Table 1. Gibberellin Treatment for Seeds of Prunus Species

Species	GA Concentration	Effect
Prunus armeniaca	100 ppm	Dormancy completely overcome
P. avium	100 ppm	Dormancy ⅔ overcome when followed by 4 months (*sic*) stratification
P. cerasifera	Up to 500 ppm	No effect
P. mahaleb	100 ppm	Shortens dormancy
P. persica	500 ppm	Dormancy overcome

mended). Thus the seed takes up the gibberellin. If seed that has already been soaked is immersed in gibberellin, the effect is much less or even nil. We think that gibberellin often helps but is not to be depended on. We know that gibberellin overstimulates seed of some species such as *Robina* and *Corylus* and has little or no effect on oily seeds such as pines. Gibberellin can be purchased from Merck & Co. or locally in areas where it is used on grapes.

Finally, to successfully germinate seeds of *Prunus* species, the key to success is careful examination of each seed lot both before and at frequent intervals during seed manipulation and stratification. This involves cutting and examining a sample of the seeds under magnification. Development of the epicotyl and expansion of the cotyledons are the things to watch. You must then decide if your seed needs longer leaching or stratification or if it is ready to plant.

Failure with stone fruit seed germination comes mostly from not properly pretreating the seeds. Avoid failure by careful attention to leaching, temperature, and time factors of stratification and by frequent inspection of seeds.

BUILDING AND USING A GROWING ROOM FOR SEED GERMINATION OF BEDDING PLANTS

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Intensive use of greenhouse space to maximize one's turnover rate is a key factor in having a profitable bedding plant season. In this situation, the propagator must often compromise ideal germination and growing conditions in an attempt to produce the seed flats in the space available. Valuable time is spent in their maintenance if they are placed in different areas of the range to provide different conditions for germination. At Skagit

Gardens we produce over 60,000 flats of plants in the spring representing approximately a two times turnover rate of all available greenhouse space. About 3,000 seed flats are sown to provide the transplants for this operation. Our usually dark weather in western Washington increases the possibility of grower error in cultural techniques and creates problems with stretching of seedlings. To alleviate these difficulties the idea of a growing room was proposed.

In the corner of our service building we have a 20 × 20 foot insulated room with a drain in the floor and a refrigeration unit hung from the ceiling in one corner. It was originally designed for the storage of cut flowers. Since we no longer grow these the room had become a non-productive storage area. It seemed an ideal place for a growing room.

Our *primary objective in designing this room was to pro*duce a high quality seedling that does well after transplanting, and to do so with a minimum of time and effort. Since we are a young and growing company we attempted to maximize both the capacity and the flexibility of the room in anticipation of greater future neds and alternative uses.

Design and construction was a joint effort on the part of our staff. Valuable information was received from Duane Thompson and Dick Chamberlain who have written of similar projects in their own bedding plant operations, and from Dr. Robert Norton of the Western Washington Research and Experiment Station in Mount Vernon.

Using this information we decided to provide 1,000 footcandles of light intensity at soil level using cool-white flourescent lights. This sets the distance between the tube and the soil at 10 inches. With ceiling mounted light fixtures we have 6 tubes for each shelf holding 16 flats, or a total of 96 flats over an area 8′ long and 45″ wide. By placing the flats on moveable carts the room can accommodate 7 carts making its total capacity 672 flats on 400 sq. feet.

Welded angle iron forms the framework of the carts and 4 × 8 foot sheets of plywood trimmed to 45″ width are used for the shelves. The dimensions are 45½″ wide by 96¾″ long by 81″ high. All parts of the room are painted white as this is the best reflective surface for flourescent light. Low profile casters permit an increased capacity of the room by allowing the carts to be placed adjacent to each other and moved for accessibility.

All wiring is enclosed in conduit and mounted on the ceiling. The carts plug into the ceiling and are grounded through the floor with cords long enough to permit the carts to move a couple of feet in any direction.

We are currently using Sylvania Lifeline F96T12 Cool-White High Output 8′ flourescent lights with high output rapid start ballasts. High output fixtures were chosen because they are more energy efficient than standard fixtures. They represent a 10 percent higher initial cost, but deliver 25 percent more light with the same current draw.

Entire fixtures were purchased as the cost of the ballasts, if bought separately, would have been more. The sheet metal was discarded and the ballasts are mounted separately, 3 on the end of each shelf. This reduces heat around the seed flats, eliminates the need for insulation and decreases the distances between shelves. The sockets are mounted on the metal framework. The ballasts are shielded on the inside of the shelf with a 2 × 6 and on the outside with a strip of sheet metal salvaged from the discarded fixtures. This contains the radiant heat from the ballasts which then merely warm the air.

Figure 1. Seed germination units in growing room.

Two exhaust fans are mounted in the ceiling to remove heat. In the corner where the refrigeration unit hangs, two galvanized steel holding tanks raise the temperature of the water to approximately the ambient room temperature, providing tepid water to water the seedlings thus eliminating the need for a water heater.

Thermostats are strategically mounted in the room to provide automatic control of the exhaust fans in the ceiling, a louvered fan to provide fresh air from outside, a circulation fan in the refrigeration unit, and to control heat alarms. Extra outlets above each cart increase the options of the room by allowing the use of such devices as timers and fans, if desired. Individual switches for each shelf provide daylength control and, of course, mean that the lights may be turned off when not in use.

At Skagit Gardens we used standard 11″ × 22″ plastic flats run off on a flat filler using our regular potting soil. Most seed is broadcast over pressed moistened soil. A 5 ppm boron drench is applied which seats the seed in the soil and counteracts boron deficiencies that we have encountered in the past, particularly in the crucifer crops. Milled sphagnum moss is then sprinkled over the surface and moistened with a fine mist nozzle. This moss serves to hold moisture around the seed for best germination. It also lets some light through which enhances germination of many seeds and it also has a reputation for decreasing the incidence of damping-off. Very fine seed such as begonia is broadcast on the top of the premoistened moss. Sheets of glass are then placed over these flats for the duration of the germination process to ensure high moisture around the exposed seed.

Watering is done by hand with a hose coming from the holding tanks and feeding is done with a Hozon proportioner having a 5 gallon concentrate bucket using Peter's 20-20-20 at 200 ppm nitrogen.

Nearly all seedlings are raised under 24 hours of illumination. If day-length control is desired the lights can be turned off and a black plastic curtain hung around a shelf or a whole cart to block out light from adjacent carts. Seedlings are taken to the greenhouses when ready to transplant and arranged on the floor along the north end for easy access.

When the room is in use there is a distinct temperature gradient from ceiling to floor. The top shelf maintains a steady 80°F. soil and air temperature and the bottom shelf a steady 60°F. By proper shelf selection the ideal temperature for germination can be provided for all plants that we grow from seed. Plants thought of as requiring darkness for germination were often found to germinate quite well on a lighted shelf. If not, they were placed on a shelf with the lights turned off, or any appropriate dark place until germination, and then grown on under light.

Light readings on the shelves vary from about 1200 foot-candles in the center to about 750 foot-candles on the edge. Plant growth is a response to the intensity of the light times the duration of exposure. At a certain point light saturation sets in.

This condition is characterized by foliar chlorosis thought to be the result of photosynthate production exceeding the ability of the plant to metalbolize it. It is corrected by decreasing either the intensity or duration of exposure. Petunias, for example, light-saturate at 14 days from sowing under continuous lighting, tomatoes at 21 days, and lobelia at about 4 weeks. Some plants, such as peppers and celosia, were never observed to show any symptoms of saturation. Salvia germinated very well in the room, but developed poorly afterwards and subsequent sowings were removed to the greenhouse before being ready to transplant. Nearly all other items are raised to transplant size in the growing room. Marigolds are not done in the room as the long days delay flowering. Tuberous begonias in nurse flats from early sowings, which need supplemental illumination to develop properly, achieve rapid growth with a 16 hour light regime.

The most striking effect of the growing room is the extremely rapid growth that seedlings make. This necessitated many changes in sowing dates. Plants also show increased pigmentation and seeds sown as mixes stand out immediately after germination. An advantagous effect of using this room is the decreased stretching of seedlings. This can be a major factor in our often dark western Washington climate. Tomatoes are a prime example. They are germinated on the top shelf and at 14 days have 2-3 true leaves and are ready for transplant. If, for some reason, they can not be transplanted by 21 days they are moved from the top shelf to the bottom and put on 16 hour days. They can then be held without stretching for a period of several weeks. This could not be done if the seedlings were being raised in the greenhouse.

We expected that somewhat tender seedlings would emerge from the room and possibly need a hardening off period before transplanting. We found quite the opposite to be the case. The seedlings were stockier and more vigorous than those we were able to produce in the greenhouse.

There are some problems encountered with our growing room. The light intensity and sometimes soil temperature are too high in the center of the shelf for some plants, such as coleus. Possible solutions to this include the removal of the two center tubes, the re-spacing of the tubes, and the replacement of only the outer pairs of tubes when they begin to dim. This would only need to be done on a few shelves to accommodate low light plants. Rapid drying of the surface of the seed flats has occasionally hurt germination, but probably also inhibits damping-off which ony rarely occurs.

A major advantage of the growing room has been a radical decrease in the labor required to raise the seedlings. With occasional use of a helper during heavy sowing weeks I was able to easily produce all the seed flats for the season. The time saved in running around looking after seedlings was used to better supervise the cutting operation. The result was an increase in both quality and quantity of material with a decrease in the number of people required to get the job done.

Our growing room cost over $16,000 to build and will take years to pay for itself. It is difficult to place dollar values on improvements in quality and savings in time by a salaried grower. All plants, except salvia, grown in this room showed a distinct increase in quality so that use of this room has proven highly advantageous to our bedding plant operation. Its 400 sq. ft. are equivalent to 2,000 sq. ft. of greenhouse space. Its artificial environment is unaffected by the time of year or the weather so that the results are more predictable. With the high turnover rate due to rapid seedling development, the room can easily handle an operation twice our size. So as our needs increase the room will become even more valuable to us.

SEED BED PRODUCTION IN RHODE ISLAND

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Production requirements for any seed bed operation must be a determination by top management. This decision should be periodically reviewed and kept current with market demands and production costs. If a production facility can economically purchase seedlings to fill its market needs, it should not consider seedling propagation. Certain specific needs must be considered by each management staff in reaching its decision. Some of the relevant areas are: 1) Propagation needs of the firm; 2) Seasonal planting requirements; and 3) Reliability of delivery capabilities.

The Rhode Island Nurseries, Inc., Newport, Rhode Island has always maintained a seedling production capability to meet both its propagation and production requirements. This policy is reviewed annually to reflect current needs and market trends. Great importance is attached to the needs of the propagation division in having a ready supply of understocks for grafting and for lining out.

Production output of the seedbeds is not intended to produce salable seedlings. However, if surplus quantities are pro-