# Plastic Isolation Chambers For Sugerbeet Seed Production[1]

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Contamination of sugarbeet (*Beta vulgaris* L.) breeding strains by stray pollen is not a new problem. This problem is particularly acute with type-O (nonrestorer) lines and their cytoplasmic male-sterile equivalents, since even a trace of contamination may lead to partial fertility in male sterile lines. Compartmented glass greenhouses ventilated with filtered air are widely used in Europe and the United States (3,4)[3] for producing small quantities of sugarbeet seed. This report describes a relatively inexpensive isolation chamber, consisting of polyethylene sheeting and a special air filter system, which is suitable for use either in a greenhouse or outside.

## Filter Experiments

In two preliminary greenhouse experiments, several green hypocotyl (rryy) male-sterile sugarbeet plants were held during flowering in small polyethylene chambers ventilated continuously with blowers. The air entering each blower was liberally contaminated with pollen from sugarbeet plants that were homozygous for the dominant character, red root (RRYY). Except for the control chamber, air was passed through a filter before being discharged into the chamber containing the male-sterile plants. The seed produced in each chamber was planted, and the viability of the seed and the color of the seedlings were used to appraise the effectiveness of the filters used.

Results of the first experiment showed conclusively that an ordinary commercial 1-in. Owens-Corning Dust Stop Fiberglas[4] filter permitted the passage of a substantial amount of pollen. A combination filter consisting of a 1-in. Dust Stop filter and a ½-in. layer of Owens-Corning PF-105 Fiberglas filter resulted in no viable seed, which indicated effective removal of pollen. Viable seed was produced in the unfiltered control chamber. In the second experiment of similar design, viable hybrid seed was harvested where nonfiltered air was used, and again no viable seed was obtained when the combination 1 in. Dust Stop and PF-105 filter were used.

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The next spring, a larger polyethlene chamber with ventilation and filter system was constructed outside and used for production of seed of a type-O, rryy, sugarbeet inbred line and its cytoplasmic male-sterile equivalent. The filter was ½ in. Owens-Corning Fiberglas High Efficiency Filtration Media, FM-004 (identical to PF-105). Pollen of the RRYY cultivar was introduced liberally into the air stream at the blower intake daily throughout the flowering period. The plants grew well, and seed set on the type-O group was satisfactory. Seed set on the male-sterile group was sparce, probably because of inadequate movement of pollen within the chamber. Some of the seed from each group was planted to evaluate the effectiveness of the filter. Twelve grams of seed from the type-O group produced 920 seedlings, and 9 grams from the male-sterile group produced 666 seedlings. None of the seed produced red-root plants, indicating satisfactory removal of pollen by the filter.

## Outside Chambers

Satisfied with the adequacy of the filter system, a set of 5 chambers was built outside, as illustrated in Figure 1. Each chamber consisted of a portable wooden frame covered with 6-mil-thick polyethylene sheeting with a pull-gate type of opening at one corner for use in inspections, weeding, insecticide applications, etc. Each chamber covered a 6-ft. × 6-ft. soil area and was 6 ft. high at the peak. The filter unit for each chamber consisted of a basic filter element with ½-in. FM-004 filter (Figure 2), surrounded by a polyethylene jacket (Figure 1). A separate blower, operated continuously, was used for each filter unit. The blowers delivered 350 cfm at zero static pressure and operated at 1585 rpm with a 1/12-hp motor. Air was discharged from each chamber

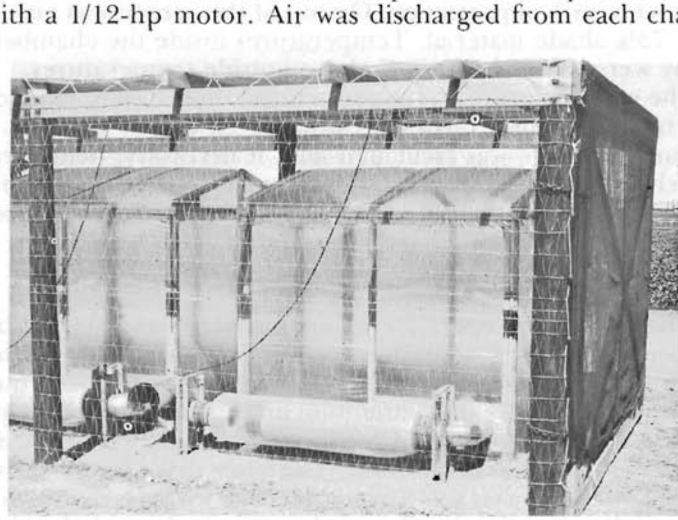

**Figure 1.—View of isolation chamber with blower and complete filter unit. Note bulging of chamber from internal air pressure.**

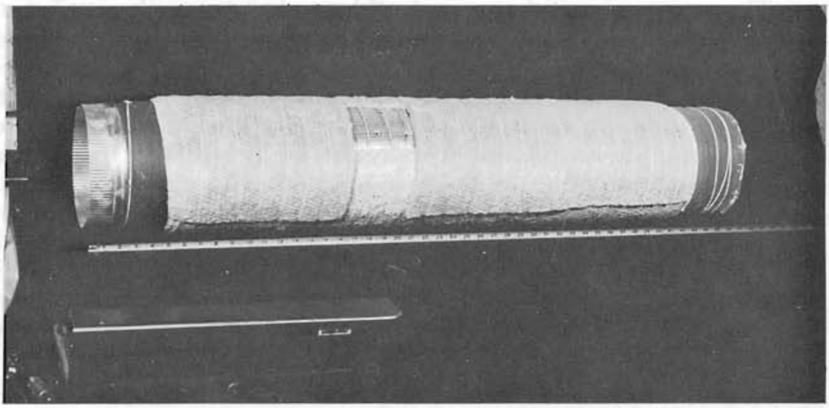

**Figure 2.—Basic filter element of perforated, 9-in. sheetmetal pipe covered with ¼-in. mesh wire screen and a ½-in. layer of filter material. A section of the latter has been removed to show the perforations in the pipe and the wire screen. The discharge end of the pipe is at the left. The right end is completely closed. The effective part of the filter is about 37 in. long.**

through a 4-in. flutter valve located near the chamber top. The rate of discharge was equivalent to about one-third of the total volume of the chamber per minute. A small fan operating continuously in each chamber aided in pollen distribution—a feature not included in the outside experimental chamber. The plants were furrow irrigated by means of valves outside the chambers.

The chambers were in a wire enclosure covered with ¼-in. mesh wire screen for hail protection. On top of this screen was one layer of plastic 75% shade material. Temperatures inside the chambers on a hot day were as much as 10° F above outside temperatures.

The wire enclosure was so constructed that all chambers could be easily removed and a farm tractor could be driven through. Thus, pre-planting tillage was facilitated and, if necessary, nematocides or other chemicals could be applied with tractor-mounted equipment.

The quality and quantity of seed produced in these chambers was satisfactory.

### Inside Chambers

After successful operation of the outside chambers, we built 16 chambers inside our evaporatively cooled greenhouses. Each chamber was separate and consisted of five plastic covered frames (four walls and a top) made of welded aluminum angle and redwood strips. The frames were bolted together. Chamber dimensions were 64 × 84 × 72 in. high, with a 24 × 72 in. door. The filter unit (Fig.3) was slightly modified, in that the air was forced into the 9 in. pipe, out through the filter, and then into the chamber, rather than in through the filter, into the 12 in. pipe, and then into the chamber, as in Figure 1. Both arrangements appeared to serve equally well. The plastic cover over the filter

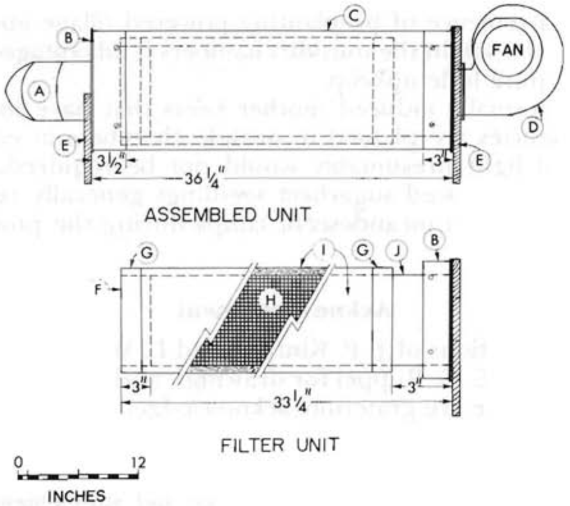


**Figure 3.—Air filter unit for inside chambers: A. 6-in. sheet metal elbow or pipe into chamber; B. 12-in. sheet metal caps; C. 12-in. sheet metal pipe; D. fan; E. wood stands and fan mount; F. 9-in. sheet metal cap; G. furnace tape to seal ends of filter material; H. ¼-in. mesh wire screen; I. filter material; J. 9-in. sheet metal perforated pipe.**

element was replaced with a 12-in. sheetmetal pipe for durability. The chambers were located on soil beds in the greenhouse, and the first seed crops were produced by transplanting mother roots or induced seedlings directly into the soil. From experience we found it more convenient to plant into pots. This necessitated more frequent watering, but allowed greater flexibility. Watering was done through the door or through a small closable port in the wall. Pollen was distributed daily within each chamber by blowing air through the door or port with a portable blower. Fog insecticides were introduced in the same manner. Chamber temperatures on hot days were as much as 8°F higher than outside. However, neither heat nor humidity was seriously detrimental to seed production in any season. The regular greenhouse incandescent lights, suspended directly above the chambers, were used to provide a 24-hr photoperiod. The quantity and quality of seed produced in these chambers was satisfactory.

## Conclusions

The fiberglass type filter elements described were highly effective in the removal of pollen from the ventilation air stream, but other filter material may be equally effective.

Maintenance of outside plastic chambers probably would be more expensive than maintenance of compartmented glass greenhouses of equal size. However, the relatively inexpensive construction of the former has advantages, especially if the need is temporary. Furthermore, the convenience of preplanting powered tillage and chemical treatment of the soil in the outside chambers is advantageous. Inside chambers require little upkeep.

When thermally induced mother beets that have intermediate bolting tendencies are planted in outside chambers in early spring, supplemental light presumably would not be required. However, photothermally induced sugarbeet seedlings generally require supplemental light from incandescent lamps during the post-induction period (1, 2).

### Acknowledgment

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### Literature Cited

(1) GASKILL, J. O. 1963. Influence of age and supplemental light on flowering of photothermally induced sugar beet seedlings. J. Am. Soc. Sugar Beet Technol. 12: 530-537.

(2) GASKILL, J. O. 1963. Comparison of fluorescent and incandescent lamps for promotion of flowering in sugar beet seedlings. J. Am. Soc. Sugar Beet Technol. 12: 623-634.

(3) MCFARLANE, J. S., and I. O. SKOYEN. 1963. Greenhouse chambers for small seed increases. J. Am. Soc. Sugar Beet Technol. 12: 323-325.

(4) WOOD, R. R., D. E. CONWELL, C. W. IMPEY, and P. B. SMITH. 1960. Development of air conditioned, compartmented greenhouse. J. Am. Soc. Sugar Beet Technol. 11: 44-48.