

## CLEAN CULTURE OF BEDDING PLANTS

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Basically the production of bedding plants would fall into three categories:

1. The preparation of the soil or planting media.
2. The planting of the seed and production of the seedlings.
3. The transplanting and care of the seedling to the marketing stage.

Everything must start with the soil, as this phase of our operation is very important. We use the University of California system of growing, in which we utilize a mixture of fine sand and peat plus the necessary fertilizer elements. All the elements of our soil mixture are loaded into a permanently-mounted, ready-mixed cement mixer. We have found this does an excellent job of mixing the soil. We have contrived a lid for the mixer, through which we inject live steam directly into the mixer. As the soil is tumbling within the mixer it is exposed to the steam which, we feel, gives us a thorough and reliable sterilization process. All soil mixed in the nursery goes through this sterilization process, by being brought to a temperature of 180 degrees.

From the mixer the soil is run out onto a conveyor belt and brought into our flat filling machine, from which it is distributed into the containers in which we will be planting our seedlings. Of course, prior to placing the sterilized soil into containers, care must be taken to see that the containers themselves are properly sterilized. All of our flats or containers which might be contaminated in any way are placed in a steam chamber and subjected to steam sterilization for a period of approximately one hour.

The temperature within the steam chamber is raised to the vicinity of 200 degrees F. Subjecting the flats or containers to this temperature for a one hour period seems to be adequate to prevent the carry over of any diseases.

After the containers are filled with soil, they are then distributed to the various planting areas throughout the nursery. Care must be exercised to see that the soil is not recontaminated by placing it where dirt or other harmful organisms might be blown into it.

At this point I would now like to discuss step number two, which is the planting of the seed and the production of the seedlings.

Our seed soil is prepared in the same manner as we prepare the soil for our general planting throughout the nursery. The flats of soil in which the seed is to be planted are placed in the seed house, leveled, and prepared for the planting of the seed. Care is taken to see that the benches on which the flats are placed are kept clean, and free of all harmful organisms. We attempt to follow good growing practices by seeing that the seed itself is clean and free of disease.

Those varieties which we have found to be particularly bothered by seed-borne fungi are either subjected to dusting with Arasan,

drenched with Panogen, or subjected to hot water treatments. We have found these methods to be quite adequate in most situations. After the seed is sown it is watered again. It is important, of course, to see that no contamination takes place after the seed is planted. We try to limit the people who have access to the seed house and, like most growers, we leave the care of the seed flats in the hands of one capable person.

After the seed has germinated and the seedlings have reached the desired size, the flats of seedlings are moved to special areas out of the seed house where they are grown to the desired stage for transplanting. Care is taken here to see that the flats are not subjected to any contamination. Most seed flats are kept on raised benches. Less sensitive varieties may be placed on boards set on the ground, but in no case are seed flats ever placed directly on the open ground. Again care should be taken to see that seed flats are not placed in positions where there is a great deal of traffic or possibility of outside contaminants, such as dust, settling on them.

Periodically we make it a practice to treat all benches and boards on which seed flats may be placed with a solution of copper naphthenate to prevent any carry-over of fungi on the benches. I might add that we treat all of our greenhouse benches in this manner.

In the event that any fungus should appear in a seed flat we treat the affected flat with a drench of Panogen which we have found to be quite effective in controlling most cases. Flats of seedlings which are badly affected by fungi are discarded in most instances, as we have found the transplanting of seedlings from these flats to be very uneconomical. The cost of preparing soil and labor of transplanting are too costly to risk the planting of contaminated seedlings.

After we have prepared our soil and grown our seedlings we have arrived at step number three in the production of bedding plants. This step involves the actual transplanting and growing up to the marketing stage.

The flats of soil and the flats containing the seedlings are brought together to the various planting areas where the seedlings are to be grown. Again care is taken to see that no contamination takes place while these components are being moved about the nursery. The people who are doing the transplanting are indoctrinated so that they are familiar with the reasons why precautions must be taken to prevent possible contamination. Again care is taken with all tools to see that they are clean and free of disease. This, of course, is one of the more difficult aspects to control. If a person should drop one of their tools on the ground the temptation to pick it up and continue using it is great, and of course, this is one of the easiest ways to introduce disease to a flat of transplants.

After the seedlings are transplanted, good housekeeping practices are followed to prevent any contamination of the transplanted seedlings. Hoses are kept off the ground. No one is allowed to get up on the benches or walk over the flats. Animals are kept out, etc. All of the above are possible sources of disease to the seedlings.



When the transplants have reached the desired stage of growth, they are moved from the greenhouses to beds outside, where they are grown to the finished stage for marketing. We have covered most of the beds in the nursery with coarse gravel, upon which we set the flats of transplants. This seems to be adequate in most cases in preventing the transmission of disease from the soil, and allows good drainage through the flats. Naturally, after the plants have been moved from the greenhouse, the opportunities of becoming infected are greater. However, by this time, the plants have reached a stage of growth in which they are better able to ward off the effects of disease organisms. Should disease be prevalent, we have found that the application of Panogen as a soil drench is quite effective.

Now I do not want to give the impression that everything we do is absolutely aseptic. This simply is not practical in any volume production. However, just plain good housekeeping practices should be followed. You wouldn't eat from a dirty table with dirty utensils. The same degree of cleanliness your wife uses in the conduct of your household will usually be adequate for the conduct of your bedding plant nursery, in so far as the cleanliness of the plants you produce are concerned.

MODERATOR MAIRE: Thank you, Carl. Next we will hear from Henry and Fumio Satow, who will describe their methods of producing carnation plants by these clean culture practices.

### **CLEAN CULTURE OF CARNATIONS**

HENRY AND FUMIO SATOW

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The events that led us up to the system of clean cultural practices are as follows:

(a) In 1955, cuttings were taken in the usual manner from *flowering areas* where no sanitary procedures were practiced. These cuttings were misted in steam sterilized sand; rooted cuttings were planted in steam-sterilized *ground beds*. Analysis at the end of 18 months of the blooming period showed that out of an original 125,000 plants planted, only 50% of the plants survived. The other 50% was lost to *Fusarium stem rot*, *Fusarium wilt*, and *bacterial wilt of carnation*. *Reason for loss of plants:* uncultured cuttings were planted into steam sterilized soil. A mass inoculation of harmful carnation pathogens into a soil which has lost its bacterial balance due to sterilization. *Solution:* Use of cuttings entirely from cultured mother-block plants. This resulted in the construction of a double-range, fan-padded glass house, with completely asphalted floor and raised benches housing 6,000 cultured mother-block plants.

(b) In 1957, rooted cuttings from cultured mother-block plants were planted in sterilized ground beds. (Same area as in 1955.) Analysis at the end of 18 months blooming cycle again showed that