small amount of contact between the two cambiums will suffice, more is better. Because of this fact, cutting the scion with smooth, straight cuts and then fitting them together with extreme care adds up to more takes.

Wrapping and Nailing the Graft

Once the scion and stock are fitted together, they must be held in contact position until they knit. Nailing is by far the most common method of maintaining contact in horticultural grafts. There are some grafters, however, who insert veneer graft scions without either nailing or binding the grafts. They do this with surprising success when the bark of the stock is thick. To me it seems that with evergreens, wrapping works better than nailing.

When the scion is very small in diameter, driving a thin nail through it sometimes seriously damages it. In such instances, wrapping the graft is preferable to nailing it. Commonly, used wrapping materials are paper grafting tape, electricians' tape, masking tape and gummed cloth tape. Wrapping provides very satisfactory contact and does not injure the scion. For most of the evergreen grafting I did I used masking tape. When wrapping certain types of grafts—whip grafts, for example—care must be made not to move the scion out of position. This is a fairly common error.

Waxing the Graft

Once the graft is fitted together and wrapped or nailed, it is ready for waxing. Without waxing, cut surfaces are susceptible to drying air and decaying organisms. To preserve the delicate and exposed surfaces until scion and stock can knit, the graft must be covered with a complete seal. There are numerous sealing compounds. If they are to weather satisfactorily, they must neither crack nor wash off. In the evergreen grafting I did, I used a tree healing material. Because it gets very hard I prefer one of the regular grafting compounds.

One of the most common mistakes in waxing is to fail to see that all cut surfaces are well covered. As a rule it is well to check the grafting the following day and cover any cracks that may have opened. In general, it is not economical to be scotch with the wax. Personally, I like to use cold brush wax, but many grafters prefer and get excellent results with hand wax.

AERATED STEAM TREATMENT OF SOIL — ITS PRINCIPLES AND APPLICATION

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Aerated steam treatment of soil is basically a transfer of heat from the boiler fuel to the soil. Variables such as soil moisture, compaction, and volume, affect the penetration and volume of steam required to heat the soil.

Steam moves through the soil in an advancing front. If it is introduced beneath the surface of the soil, an egg-shaped heated area will be produced around the point of injection. The temperature in the center will be that of the incoming steam and will be progressively less with increasing distance from the input. The temperature gradient or front may be as narrow as ¼ inch. Aerated steam moves through the soil as a water vapor-saturated air mixture and condenses on the nearest cold soil particle releasing its heat to that soil particle.

When pure steam and a particular quantity of air are mixed, a temperature less than that of pure steam (212°F) will result. For instance, if 12.3 lb. of air are mixed with 1 lb. of steam, a temperature of 120°F will result; 6.5:1 yields 140°F, 3.4:1 yields 160°F, and 1.5:1 yields 180°F.

The advantages of aerated-steam soil treatments at 140°/30 min. are many. The four main advantages are:

1. All pathogens are killed by treatments of 140°/30 min.
2. The recontamination hazard is greatly reduced. Treatment at 140-160°/30 min. does not kill all the soil microorganisms, but does kill the pathogens. The great numbers of saprophytes that remain luxuriate in growth and act antagonistically against any organisms accidentally introduced after treatment. If this introduced organism is a pathogen, as is very likely in areas of intensive culture such as nurseries, the resulting disease will be restricted to only a few plants. In contrast, steam treatments at 212° will kill nearly all microorganisms, resulting in a 'biological vacuum'. The introduced pathogen will then grow rampant, resulting in a high incidence of disease.
3. Plant growth is better in soils treated at this temperature than at 212°F, due to reduced phytotoxicity. Most soils produce phytotoxic materials when treated at 212° with pure steam, and these result in reduced plant growth.
4. Only half the quantity of steam is required at 140° than at 212°, since the soil is heated only half as high.

Several ways of obtaining aerated steam have been devised. A steam venturi is suitable for use with a steam vault containing soil in flats, pots, etc. It consists of a large, carefully designed tube fitted with a steam nozzle at the closed end. The steam expands rapidly after passing through the nozzle and entrains a given amount of air from a side opening due to the partial vacuum created. Aerated steam is released through the open end of the tube and into the vault chamber. In normal operation, pure steam is introduced into the vault and mixes with the air normally present inside, producing a richer and richer mixture and resulting in a temperature rise. After soil temperatures of about 130° are attained, a second steam line fitted with one or more venturis is turned on. The temperature inside the vault continues to rise, but will not exceed that of the incoming aerated steam. Venturis are suitable for use only where static pressure will be constant and not exceed ⅛ lb.

A second common means of obtaining aerated steam is with a fan. Only vane-axial or compression (paddle wheel) fans are suitable. They must be engineered to operate against a static pressure of at least $\frac{1}{3}$-$\frac{1}{2}$ lb. A very successful application of the use of fans in aerated steam treatments involves forcing the mixture into a plenum chamber 4-6 in. high for distribution under a layer of soil. This design consists of a large rectangular box, 4-6 inches deep with an opening at one side, to which the fan housing can be coupled. A perforated plate or heavy mesh supported on vertical pipes or a grid comprises the top. A water drain is commonly provided to clear out condensate. On top of the plenum a soil bin can be constructed, or the plenum can be made to fit into the bottom of a truck or trailer body. Bulk soil is loaded into the treatment chamber onto the perforated plate or mesh. The steam line opening into the outlet at the fan housing, is turned on and the air temperature in the plenum will rise. When the bottom of the soil layer reaches about 140°, the fan is turned on and the steam volume adjusted to maintain the correct temperature or ratio of air and steam. The soil surface can then be covered with a plastic tarp or suitable lid, but it should not be air tight. At least one grower has the top of his plenum box fitted with a large pipe to recirculate the aerated steam back through the fan, and in this case the lid should be tight fitting. The life of the fan may be reduced due to corrosion, but this is offset by the greater uniformity in soil heating. A means of mechanical loading and unloading should be provided. Several of these plenum units can be set up that operate from one portable fan unit.

The Thomas method of steaming raised benches also lends itself to aerated steam treatment. The perforated pipe running the length of the bench should be large enough to handle the increased flow of aerated steam. Aluminum irrigation pipe has been used for this purpose with great success. The aerated steam can be supplied by a portable fan unit that can be wheeled into position at the end of each bench. As with successful steam treatments, cracks or holes in the bottom of the benches are essential. These allow the escape of air in the cold soil, rather than trap it in pockets in the soil which therefore heat slowly.

Aerated steam provides a means of treating soil so that all pathogens are killed, and it allows the antagonistic effects of residual microflora to operate. Better plant growth is evident in treatments at 140°/30 min. due to reduced plant toxicity of the soil, and the cost of treatment is reduced. Aerated steam treatments have proved to be a valuable commercial nursery practice. It should be pointed out that the 30 min. treatment period should not begin until the coldest soil has reached the treatment temperature.

A number of seeds have been treated experimentally for the eradication of seed-borne pathogens. Several advantages of these treatments over hot-water treatments have become evident: (1) often increased seed germination results, (2) there is less moisture uptake, and (3) rupture of the seed coat and mucilage production (stock seed) are reduced. The control of certain seed-borne pathogens has been very successful and this method warrants further use.

AUTOMATIC ONE-GALLON CONTAINER IRRIGATION

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Hand watering has been the oldest and most widely used method of irrigation of container plants in wholesale nurseries. Due to the ready availability and reliability of stoop labor in the past, it was possible to proceed this way in our irrigation practices from the time of the Babylonians four thousand years ago until recently.

Today, however, we find labor is pricing itself too high for this type of work, and is not constantly available. If you will notice by the slide (SLIDE) the girl is hand watering. She does not look like she is paying much attention to her work, so therefore we are going to have spotty watering of the containers. When this happens, we are sure to get spotty plant growth. (SLIDE) Here we see the some girl turning off the water faucet. She has had to drag a heavy hose throughout the area and back to the hydrant. Notice that while she is turning the water off she is also washing three or four plants out of the containers, due to the fact that she is not paying any attention to her water hose.

Why should we automate a sprinkler system? I feel that there are three main points which should be brought into any discussion on automated sprinkler systems: One, the reliability of labor; two, proper irrigation techniques; and three, the cost of labor.

In the discussion of reliability of labor we all know what problems have arisen during the past year in the unionization of nurseries. Suppose on a day when the temperature is 110°F and you are relying on manual labor for irrigating your plants, your workers decide to go out on strike. This would be the fastest way I know to bankruptcy. Relying wholly on manual labor for irrigating plants leaves any nurseryman in an extremely vulnerable position.

Another point which we should consider in the manual irrigation of plants is that if a person becomes ill, we must either replace him or have someone else do his job. If we have someone else try to fill in for him, we are faced with the problem of people hurrying over their own watering to do other worker's jobs... thus again, we have a condition whereby the plants are receiving inadequate irrigation. In this day and age, when everyone wants a forty hour week (and recently I heard of a company in Orange County going on a thirty-five hour week)