Excessive moisture in this type of facility can lead to seed rot. A final system mentioned was sealing dried seeds in a polyethylene bag and freezing at -3 to -4°C.

4) Mycorrhizal Inoculants. Inoculating seed trays with mycorrhizae can increase the germination and growth of cuttings of native plants. Mycorrhizae show some specificity to the type of plant they will infect. Mycorrhizae can be on seed collected in the wild (e.g., oaks) and thereby naturally inoculate the growing media during the germination period. There is no benefit from using mycorrhizae inoculants on transplants that are going into soil with good biological activity (i.e., not sterilized with methyl bromide). After treatment with methyl bromide, it can be beneficial to treat soil with mycorrhizae. For *Betula papyrifera*, mixing humus collected from underneath a stand of trees into the potting media increased plant growth by 30%. The loss of beneficial microbes from fumigated soils was suggested to be the cause of severe replant losses in some crops. This can be overcome by adding nontreated soil to the site to re-establish the population of soil microbes. Typically, disease-causing organisms are first to re-colonize soil after being fumigated.

5) Mice Control. What control options, other than poison baits, are available to deal with mice problems in the greenhouse? One option is to make the habitat around the greenhouse less attractive to mice. Mice do not like crossing areas where they are exposed, therefore frequent cultivation or mowing and the application of a groundcover apron around the greenhouse can retard mice from entering the structure. Cats and/or live traps were also suggested, although it was noted that small mice can get out of some live traps.

Discussion Group: Budding and Grafting Made Better

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The following is a summary of the questions, answers, and general commentary from the two "Budding and Grafting Made Better" discussion sessions at the I.P.P.S. Western Region meeting on 14 Oct. 1999.

A walnut grower from California reported that the cold spring weather adversely affected their field-grafted walnuts so that graft survival could not be determined until May. This was unacceptable and he asked if anyone in the group had tried using a pipe to provide heat to the graft union in a field setting so that the rootstock could remain in the ground. No one in the group had knowledge of this being done in the field.

Mr. Frank Byles, a grower of Japanese and related maples in Olympia, Washington, described a pipe and shelf system that he developed for hot callusing the graft unions of containerized *Acer palmatum*. Mr. Byles reported observing more than eight hot-callus operations before designing his system. None of the systems he studied were alike, they varied by factors like: (1) provision of heat by different configurations of electrical heating cables or hot water systems; (2) type and size of pipe used; and (3) space utilization of ground and or shelf systems. He found that every hot-pipe-callus system was different and that the designs were

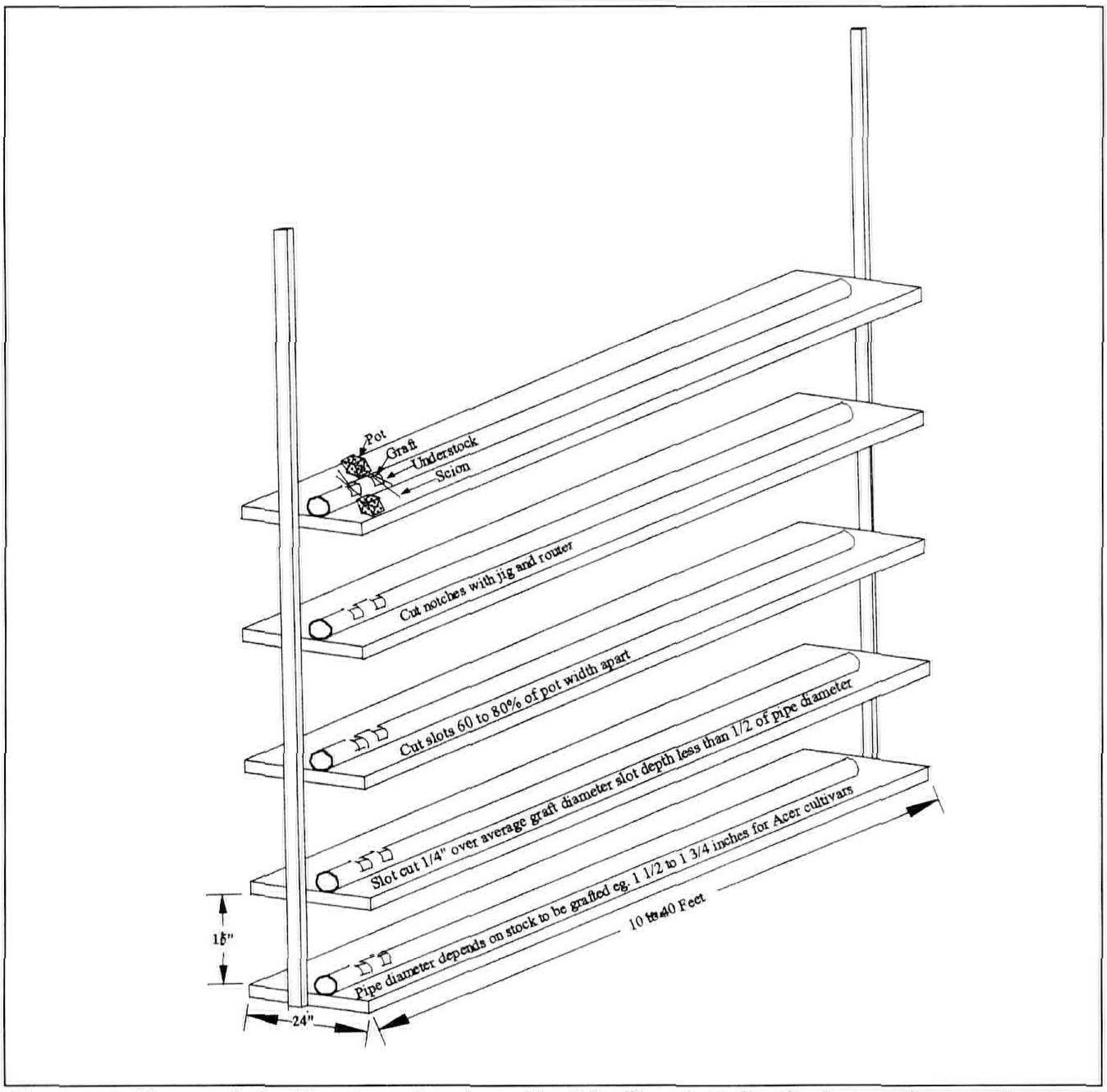

Figure 1. Pipe and shelf system developed by Mr. Frank Byles for hot-callusing the graft unions of containerized maples. The bottom shelf rests on the ground and the upright attaches to the roof. All dimensions of the system can be varied to suit the needs of the grower and/or the crop.

determined by the grower's available resources and the crop being produced. (Please refer to the articles by Dunn (1995) or Lagerstedt (1981) for detailed information on hot callusing.)

Mr. Byles veneer (side) grafts dormant scion using budding tape or budding bands on dormant rootstock grown in 2⅞-inch (7.3-cm) or 4-inch (10.2-cm) containers. The container is laid on its side on a shelf with the top of the plant horizontal and oriented so that the graft union is placed in a notch made in a thermostatically controlled 1½-inch (3.8-cm) PVC pipe. The roots and top portion of the scion are left cold while the graft union is heated between 68 and 72°F (20 and 22°C). A sponge plug placed in the notch insulates the graft union from the cold air. A diagram of Mr. Byles system for hot callusing maple grafts is shown in Fig. 1. The PVC pipe runs down the center of a 2-ft-wide shelf. Heat is delivered to the graft union by attaching a calibrated electrical heating cable to the bottom of the outside of the PVC pipe. The cable runs the length of the pipe and is enclosed with the pipe inside pipe insulation. Notches to accommodate the graft union are cut in both the pipe and the insulation. Mr. Byles believes that a better alternative to heat the graft unions may be to pump 68 to 72°F water through seven spaghetti (drip) tubes laid on the bottom of the inside of the notched pipe. A water source and return at both ends of the pipe would allow water to be pumped through three tubes from one end and through the other four tubes from the other end in a closed (self-contained) water system. This would prove satisfactory to equilibrate the temperature throughout the length of the pipe. Another system that also appears to work is to lay a hot-water pipe in sawdust on the ground outdoors and place graft unions on top of the pipe then lightly cover everything with a layer of sawdust. According to Mr. Byles there is no "one" right or perfect method for delivering heat to the graft union but improved success seemed to be coming from all methods he observed.

Mr. Byles indicated that he produces 3000 to 4000 trees per year on his system of five 20-ft shelves which has a maximum capacity of 645 plants per loading. The graft unions must be monitored during use because it can take up to 22 days in December and as few as 10 days in March to callus maple grafts. Mr. Byles hot-callus system is very energy efficient and produces winter grafting results that are comparable or better than in a heated greenhouse at a much lower cost.

A discussion of the materials used to tie-in buds ensued. A grower of filberts in Oregon indicated that he used black electric tape with better success than budding bands because the tape helped to heat the bud union. The tape is put on tightly but must be removed so that it does not girdle the stem. A California grower reported using white latex paint to keep the union of scion and rootstock cool. A large Oregon nursery reported that flagging tape (also called surveyors tape) was inexpensive, would stretch and worked well for them. They use 500 to 600 rolls per year and believe that the color blue gives the best results. The flagging tape is easily tied off by looping through itself and cinching-up. It must be cut off to prevent girdling, but is reported to come off easily.

Some growers reported timing their budding with the phases of the moon. In Oregon, budding during the new moon has been successful, while in California, walnuts have been successfully budded during the dark of the moon. Another participant considered timing of budding to the phases of the moon to be superstition. Growers from California and Israel cautioned against budding when the plant is wet. Growers from Oregon indicated weather conditions often did not give them a choice.

Placement of the bud was discussed. In Oregon, a large grower places the bud on the southwest face of the tree toward the prevailing wind and rain. This keeps the bud clean and works for all but those varieties that have poor take when the bud gets too hot. In those varieties, the bud is placed on the north side of the stem. In Modesto, California, sunburn can damage buds placed on the south side of the tree.

One of the participants asked if there was any chemical treatment that could be applied to a graft union to promote cambial tissue growth and callusing. None of the participants in either session knew of a treatment that could be successfully used for such a purpose.

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