MACHINE GRAFTING OF FRUIT TREES

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Dr. Lider and Plant Propagators: It was an honor to be asked to give my experiences in grafting fruit trees Dr Alley has asked me to relate some of my experiences in developing several types of grafting machines.

About 1951, we planned to graft some of our pear trees to the variety Red Bartlett. Since the wood was very scarce, we decided to make a bark graft using one bud, set in the stock. This would provide a better take.

We used a 5 kilowatt electric generator and an electric chain saw to remove the tree tops. A band saw was used to cut the scions, always leaving one or two buds on the top of the scion and making sure that one of the buds was facing the outside of the graft This method was successful in producing take as high as 98%. When this method was used on apple trees, the results were nowhere as satisfactory. The cambium seemed to be injured by the saw.

About 1953, we started growing Malling rootstock for dwarfing apple trees. We grafted apple root below Malling 7 and 9, using the circular saw machine as commonly used in California on grapevines. Our first saw speed was 750 rpm, but we found that the bark was torn and left a ragged edge. Increasing the saw speed to 3,500 rpm still produced a rather rough cut on the scion and stock. After joining stock and scion, the grafts were allowed to callus. Most of them remained without any callus development and eventually developed blue mold and died. "Just like the doctor who performed a successful operation, but the patient died"

Approximately 2,000 benchgrafts were made using this method Dr Higden examined them under the microscope and found that the cambium was damaged on the edge and failed to heal. In the process of grafting, the problem of sanitation is very important. The mechanics of grafting is only one step or phase in the operation to develop a grafted plant. Any step along the line can cause failure if not properly handled. Our most effective process is to clean the stock to be grafted and dip the entire plant in a solution of aerosan using 2 tablespoons per gallon of water Scions are also dipped in this same solution and allowed to dry before grafting. The saw blades are painted with a solution of 7½ grams of $HgCL_2$ (citric acid base), 7½ grams of $Hg(CN)_2$ in a pint of water. This is extremely poisonous and should be handled with great care. It is excellent for sterilizing knives and scions. Incidentally, this solution is also Prof. Reimer's "blight solution" for pear trees.

The first grafting machine that we used was the La Rapide built by A. Lozevis of Argen, France. This type machine makes a short whip-graft cut, but it is very hard to adapt to woody plants that have hard and brittle wood. Dr. Alley stated this machine is supposed to make two cuts at the same time, one to cut the scion and the other to cut the rootstock, but it is impossible to make both cuts at once. The writer

has tried this and all that he has succeeded in doing was to bite his tongue.

By setting the machine in a vertical position and using compressed air, 12 to 15 cuts a minute could be made. However; the cuts were never smooth, only on one side, and so short that we had trouble in tying them together About 10,000 benchgrafts of apple (using double benchgrafts) were made. The grafts callused well, but were difficult to put in the field without breaking. Even with all these hazards, we still obtained about a 50% take.

Our next machine was a chip budder which we developed ourselves. It makes a clean cut, beveled on both sides, so that the chip bud is held in place by the stock and is covered by wax or budding tape, and heals very quickly Again sanitation cannot be over-emphasized. The machine should be cleaned every 50 to 100 cuts with blight disinfectant solution. Do not forget to dip the stock and scions in aerosan $Hg(CN)_2$ solution

The chip budder makes a clean cut. However, the human element is the most troublesome. Upon sending benchgrafts to friends, they soon call back and report that the benchgrafts are smooth, but that about a third of the scions are upside down. This caused no end of headaches until two changes were made. Where the cut is beveled on both sides of the bud, we moved the bud from the center of the chip to the lowest point of the chip, leaving a long blank space above the bud Also we changed the shape of the chip bud by making the top cut vertical instead of beveled. This produces a chip bud having a bevel cut below the bud and a square cut above the bud. It is impossible to put in a chip bud upside down. When cutting scions for benchgrafting, the cut above the bud is made at an angle and below the bud is cut squarely across (or a bevel cut on the lower side of the scion and square across the top). The speed of the chip budder is between 30 to 60 cuts a minute The slow part of the operation is assembling the scion and the stock, placing the chip bud in the stock, and then wrapping or tying.

To make some of the dwarf combinations, such as a fast growing rootstock, a dwarfing inter-stock, and the scion variety would necessitate all to be accomplished at the same time; for example, with apples Malling #16 rootstock, a Clark Dwarf or Malling #9 inter-stock and the scion. This would require a machine of high flexibility. It should be able to make several different cuts. It should be powered by air and controlled by electric solenoid valves. By changing the various jigs, it should be possible to make the following cuts for grafting and chip budding: (1) Whip grafting (2) Side grafting (3) Scoop grafting (4) Chip budding (5) Saddle grafting and (6) Double side grafting. The machine should make clean smooth cuts at all times. We have developed such a machine and are able to make these cuts at the rate of 60 or more per minute — chip bud, whip graft, and side graft After this machine has had a few of the bugs worked out of it, as all new gadgets do, I will be glad to give an additional progress report. In addition, the machine makes cuts on stock and scion from the size of a matchstick to ¾″ in diameter.

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