apical dominance. *Nature*. 201:939-940.
12. Williams, M.W., and Stahly, E.A. 1968. Effects of cytokinin in apple shoot development from axillary buds. *HortScience*. 3(2):68-69.

TOPWORKING ESTABLISHED VINIFERA GRAPEVINES

C.J. ALLEY

Department of Viticulture and Enology
University of California
Davis, California 95616

In California there are approximately 645,000 acres of *Vitis vinifera* grapevines. Of these, 325,000 acres are wine cultivars, 85,000 table cultivars and 235,000 raisin cultivars. The trend in the wine industry has been for an increased demand for white table wines because more people are beginning to consume these with their meals. Table wines are considered to supplement food with the meals.

Most persons beginning to drink wine will choose a sweet to slightly sweet white table wine because it more clearly resembles non-alcoholic beverages to which they are accustomed. Red table wines are more harsh than white wines and the dessert wines, which are higher in alcoholic content, are more difficult to drink. Because of the increased demand for white table wines a shortage in this type of wine is now present along with somewhat of a surplus of many common red wines. Consequently there is a higher premium paid for fruit of the white table wine cultivars than for the reds. In some of the newer grape areas in California, such as Monterey County, temperature data was not accurate when the vines were planted; as a result some wrong cultivars were planted there, Some of these are now being changed over to the more suitable white ones.

Some vineyard managers having red fruited cultivars in their planting are desirous to convert over to whites. In the past the quickest way to accomplish this had been to graft over the vines in the spring at ground level to the desirable white table wine cultivar using the cleft graft (9). This type of grafting requires considerable skill and high percentages of successful takes have been rare. If the grower was to remove the entire vineyard and replant, the expense would be much greater than that of grafting, plus the loss of 3 to 5 years of crops.

Wedge or saw kerf grafting was another method used to change cultivars (2). These methods enabled the grower to change only the head of the vine and save the established trunk. These methods, too, require considerable skill as well as

the use of black grafting compounds and the use of white latex paint over the grafting compounds to prevent sunburning of plant tissues. The successful take varied from 50 to 90 percent.

T-Budding. More recently T-budding has been used and has given very good success (80 to 95 percent take) (1,3). This method was used by Mr. A. Gargiulo, an Argentine grape breeder, to obtain earlier fruiting of his seedling vines (8). Growers in Mexico saw Mr. Gargiulo's technique and adapted it to change over their own established cultivars at high levels on the vines. They were successful and this method was much easier to perform than any grafting method. Only the head of the vine was changed.

Actually T-budding of grapes was first described in 1901 by Professor Drouhault of Lot, France under the term of Vouzou graft (7). He stated it was one of the easiest and most successful above-ground methods. Mr. Vouzou was a vineyard laborer at Chateau d'Crozes (Lot) who tried this method in 1891 using dormant instead of green budwood, followed by tying with raffia. This method gave him the highest take, over a period of several years (1891 to 1893), including one year of a severe drought which caused failure for all other methods used.

T-budding was tried at Davis and Parlier, California in 1974 with very good results (above 94 percent take). The Greenfield area of Monterey County, which is noted for its severe winds, and where the usual methods of grafting had met with failure was selected for a trial in 1975. A 95 percent take was obtained (5).

Since then many growers have used T-budding to change the cultivar of mature vines. When care and attention to details are observed the success has been high. The method consists in cutting off the tops of the vine just before budding. Starting about one to two inches below the cut-off top, which is 14 to 17 inches below the lower wire of a two-wire vertical trellis, a vertical slit is made about 1″ to 1½″ (Figure 1A) in the bark where the trunk is smooth. The second cut is made at a right angle (90 degrees) to the first cut (forming a T) at the top (Figure 1B). During the second cut the knife blade is inserted at about a 40° angle so that as it goes around the trunk it tends to pull away one of the flaps of the bark. Then, using the quill of the knife or blade, the other flap of bark is opened (Figure 1C). The trunk is now ready for the insertion of the bud. Cutting the bud is done by starting ¾″ to 1″ above the bud, entering at a slight downward angle to about ¾″ below the bud. The bud should be about ⅛″ thick. Starting about ¾″ below the bud the second cut is made at about 25° angle into the budstick until it intersects the first cut and frees the bud from the stick (Figure 1 E,F). The

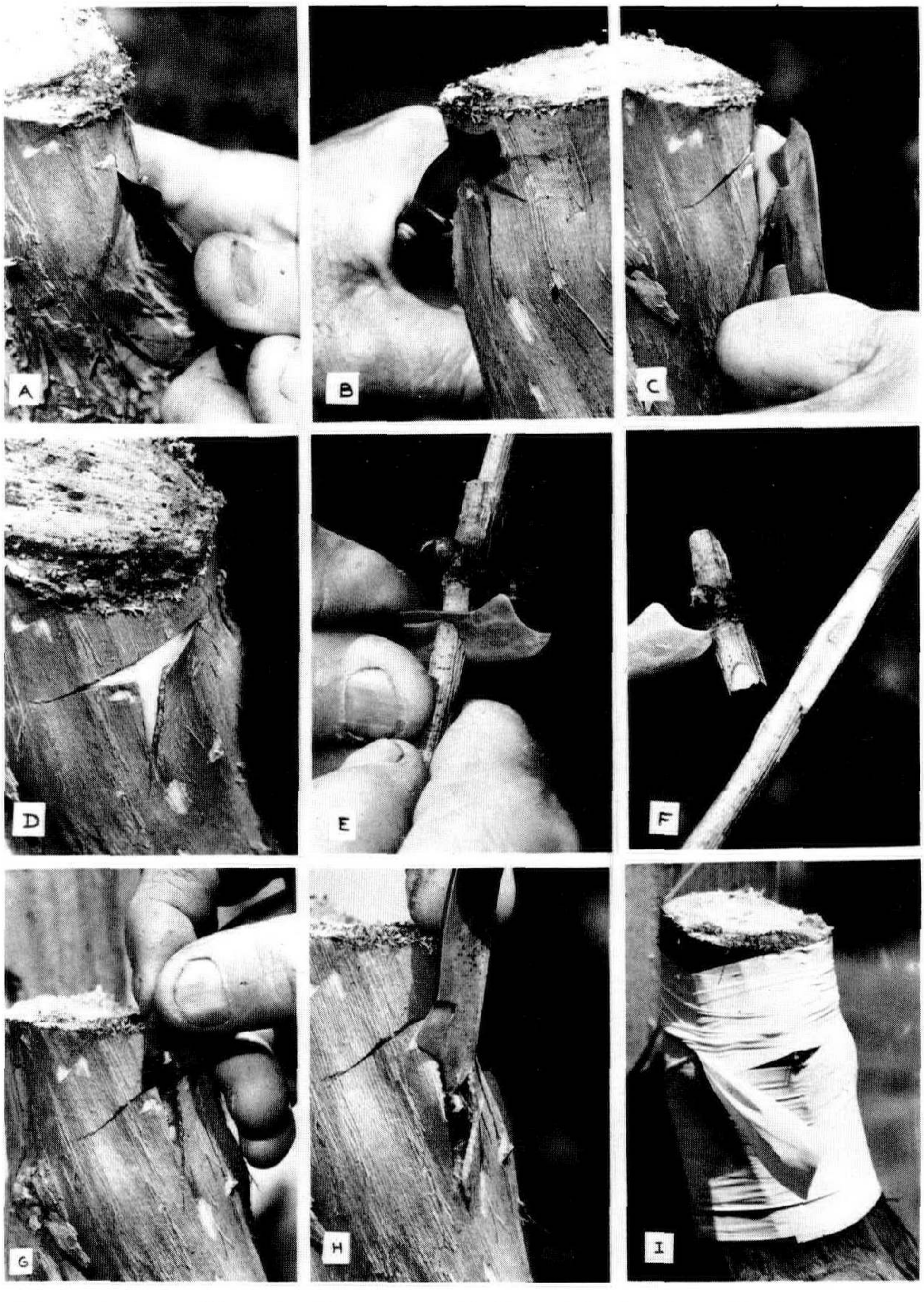

Figure 1. T-Budding. A. First cut-vertical 1-1½ inches long. B. Second cut — horizontal over top of first cut, knife blade pulls open left flap of bark. C. Other flap opened using quill on knife blade. D. Flaps opened ready for insertion of bud. E. Cutting bud — second cut ½ to ¾ inch below bud at 25-30° angle. F. Completed bud. G. Inserting bud under bark. H. Imbedding front of bud more deeply under undisturbed bark. I. Completely wrapped bud.

bud is then inserted under the open flaps on the trunk (Figure 1G) and pushed downward under the bark until the eye of the bud is pushed to the bottom of the cut slit or even lower, splitting more bark (Figure 1H). The top of the bud shield should be ½″ to ¾″ below the horizontal cut. On vine trunks under 1″ in diameter, ½″ wide tape is used. On larger stocks 1″ tape is preferable.

The first wrap is made at the top to hold the two flaps together. Then the tape is moved to below the bud and wrapped upwards overlapping the wraps. Whent he bud is encountered the budder may carefully wrap around the bud leaving only the eye exposed. Or the budder map wrap entirely over the bud being careful to center the eye in the tape. Wrapping is continued upward to about 1½ to 2″ above the horizontal cut (Figure 1I). The last wrap is placed under the next to last wrap pulling the tape tight to stretch it. If the budder wraps over the eye of the bud he must carefully make a vertical slit over the eye cutting only the tape. This method of wrapping is faster and uses less tape then going around the bud but extreme care must be used when slitting the tape so as not to damage the eye.

After the vines have been cut off they frequently bleed. Bleeding retards callusing and may delay bud push by one to three weeks (4). This can be avoided by slashing at the base of the trunk on two sides using a medium-tooth pruning saw to encourage the bleeding well below the bud. If, after slashing, the vine continues to bleed at the decapitated top the slashing cuts should be made deeper.

T-budding is the easiest and most successful way to change over cultivars in an established vineyard. This method works well in May, June, and part of July in the San Joaquin Valley of California. With late budding (even at the end of July) the bud will grow but often the shoot does not mature by the end of summer and may be killed in the winter.

Chip budding. A method is needed to start budding earlier in the spring. Research recently with chip budding indicates that this method is as successful as T-budding (6). However, it requires more skill in that the budder must match cambiums and the cut bud is not of uniform thickness as with T-budding but tapers so that the base is thicker than the top.

The advantage of chip budding is that the grower may start budding in March instead of having to wait until May, as with T-budding. The new head following budding attains a very large size by the end of the growing season (about ⅔ the size of the original head) and the wood becomes well matured to go

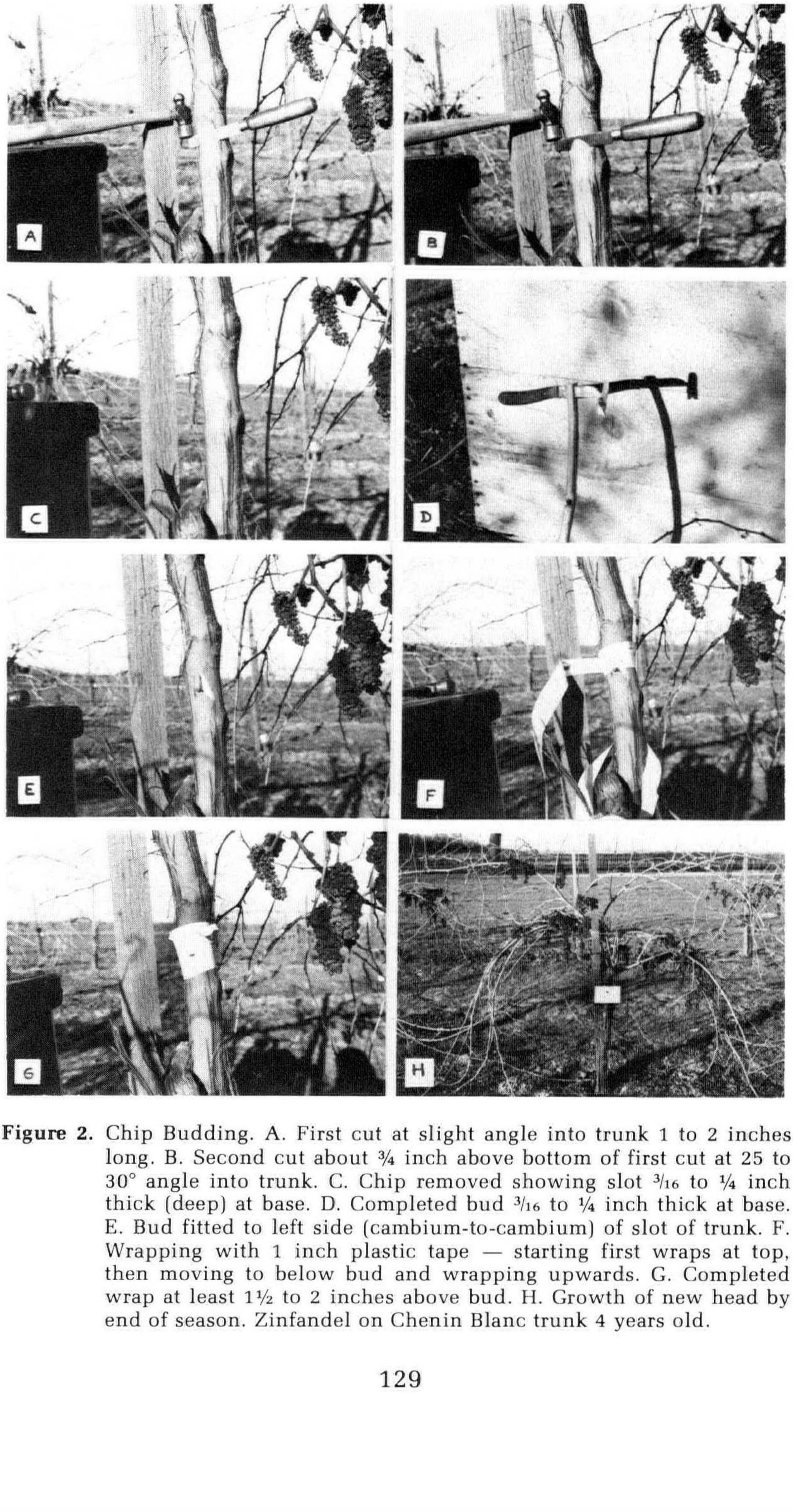

Figure 2. Chip Budding. A. First cut at slight angle into trunk 1 to 2 inches long. B. Second cut about ¾ inch above bottom of first cut at 25 to 30° angle into trunk. C. Chip removed showing slot 3/16 to ¼ inch thick (deep) at base. D. Completed bud 3/16 to ¼ inch thick at base. E. Bud fitted to left side (cambium-to-cambium) of slot of trunk. F. Wrapping with 1 inch plastic tape — starting first wraps at top, then moving to below bud and wrapping upwards. G. Completed wrap at least 1½ to 2 inches above bud. H. Growth of new head by end of season. Zinfandel on Chenin Blanc trunk 4 years old.

through the winter (Figure 2H).

Chip budding offers the advantage of having the inserted bud ready to begin growth shortly later than the time the buds normally push on the vine. By the time the bark slips the grower can rebud those buds that have failed to push using the T-bud method.

Chip budding is accomplished by cutting a slot from the trunk into which the bud will be fitted (14 to 17 inches below the bottom wire) using a light mallet or hammer to tap the knife blade at a slight angle downward into the trunk for 1 to 2 inches depending upon trunk diameter (Figure 2A). The cut cannot be made by hand on vines over 1″ in diameter as the wood is too hard. The second cut is made about ¾″ above the bottom of the first cut into the trunk at about 20° angle intersecting the base of the first cut (Figure 2B). The chip is removed. This leaves an open slot (Figure 2C). It should be as narrow as possible in order that the bud shield will fill the slot completely, or as complete as possible. In order to obtain as narrow a slot as possible the side of the trunk having the greatest curvature should be used. For chip budding the largest budwood is most desirable as the bud shield will then most nearly fill the slot cut into the trunk. The bud is cut slightly different from that for T-budding. The budder starts 1″ to 1½″ above the bud, cutting at a slight angle to about ½″ to ¾″ below the bud. The thickness of the bud increases down to the base about 3/16 to ¼″. The second cut starts just under the bud through the leaf scar at about a 25° angle and meets the first cut at the base. The bud is removed from the stick (Figure 2D) and is fitted (not inserted) into the slot on the trunk making sure that the cambium of the trunk is aligned with the cambium of the bud shield. The bark of the trunk may be 1/16 to ⅛″ thick. A properly fitted bud may show some exposed cut bark surface just on the outside of the bud. Frequently the bud is not wide enough to fill the slot. In these cases the bud is fitted on only one side of the slot, with the cut surfaces of the wood and bark left exposed on the opposite side (Figure 2E). This does not matter although complete bud callusing will be slower. The bud is then wrapped with plastic tape as described above for T-budding (Figures 2F,G). The top of the vine is not cut off at the time of budding. This is not done until the danger of spring frosts are over. Early work on the effect of vine bleeding on chip budding indicates that slashing at the base of the trunk does not effect the bud take or push as it does with T-budding.

The vines will sucker very heavily after the tops are cut off. These must be removed otherwise they will grow while the inserted bud may remain dormant. Generally two buds are in-

serted on vine trunks from 1 to 3 inches in diameter. Over 3 inches in diameter 3 to 4 buds should be used. It is not recommended to bud over old vines which are more than 4″ in diameter.

A word of caution is made for persons starting to use these methods. They should try it on a small scale until they become familiar with what to expect, how the buds grow, how fast the shoots grow and the time that is needed to properly train the shoots during this first year.

LITERATURE CITED

1. Alley, C.J. Field budding of grapevines. *Calif. Agric.* 29:6-8 (1974).
2. Alley, C.J. Research Note: Grapevine propagation VII. The wedge graft — a modified notch graft. *Am. J. Enol. Vitic.* 26(2):105-8 (1975).
3. Alley, C.J. T-bud grafting of grapevines. *Calif. Agric.* 31(7):4-6 (1977).
4. Alley, C.J., and A.T. Koyama. Vine bleeding delays growth of T-budded grapevines. *Calif. Agric.* 32(8):6 (1978).
5. Alley, C.J., R.A. Neja, and T.A. West. Grapevine propagation X. Effects of tape color, wax type, bud covering and early vine topping on late spring chip and T-budded vines at Greenfield, Monterey County, Calif. *Am. J. Enol. Vitic.* 30(1):1-2 (1979).
6. Alley, C.J. Chip-budding mature grapevines. *Calif. Agric.* 33(9):14-6 (1979).
7. Dubois, R., and W.P. Wilkinson. Grafting and budding. Dept. of Agric. Vitic. Sta. Rutherglen, Victoria, Aust. (1901).
8. Gargiulo, A.A. Injerto en 'T' lenoso. Estac. Exper. Agropec. Rama Caida INTA Mendoza. Dec. (1976).
9. Winkler, A.J., J.A. Cook, W.M. Kliewer, and L.A. Lider. General Viticulture. Univ. of California Press, Berkeley, Calif. p. 225-35 (1974).

GERMINATION OF HARD-TO-START XEROPHYTE SEEDS

BART SCHUTZMAN[1]

Department of Environmental Horticulture
University of California
Davis, California 95616

Problems in germinating the seed of many species of xerophytic plants (representing the Cactaceae and other plant families) have been noted; possible explanations for these include initially low or rapidly declining viability, mechanical resistance of seed coats to imbibition or subsequent emergence of the seedling, or chemically caused dormancies, among which are inhibitors in seed coats or in embryos.

Seeds of 14 species of xerophytic, succulent plants representing the Cactaceae, Euphorbiaceae, Dioscoreaceae, Passif-

[1] Student in Environmental Horticulture.