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SOME GIRDLING TOOLS

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Avocado production can be increased in a number of ways (Bergh, 1967):

1) Choice of optimum location, including climate and soil
2) Choice of the best cultivar (variety)
3) Choice of the best available strain within that cultivar
4) Provision for optimum care, especially irrigation and fertilization
5) Provision for cross-pollination
6) Provision for additional bees at the right time.
7) *Plus:* Girdling.

Girdling was tested on a moderate scale decades ago in California (Hodgson and Cameron, 1937 and earlier). They obtained some quite striking yield increases, although other results were erratic. Prior to that, and also since, girdling has been little practised in California; there have been no further published reports of experimental studies of it.

But in Israel, girdling has proven to be a commercially very useful practice. Ticho (1971) estimated that of the 1970-71 Israeli crop of 15 million pounds, 2½ million was a result of girdling. For example, in one grove, check 'Fuerte' trees averaged only 600 pounds per acre, while 'Fuertes' girdled in late October averaged 9,000 pounds per acre. Results with other cultivars have sometimes been equally striking in Israel. Lahav et al. (1971) from several groves calculated "an increase in yield of 2.0-5.2 tons/acre due to girdling."

In the case of 'Hass', fruit size often became too small because of the very heavy fruit set following girdling (Lahav et al., 1972). Might this be a good way to bring 'Reed' size down to optimum, while getting even heavier yield from it?

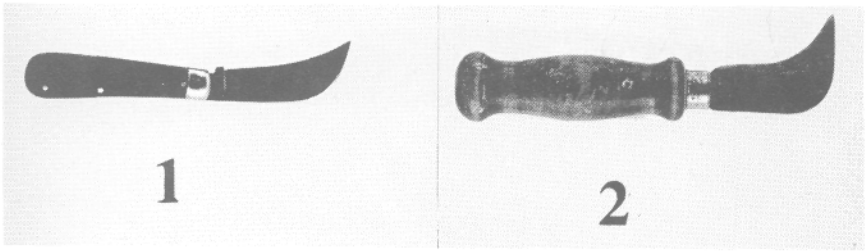
Materials and Methods

1. THE TREE. Seedling avocado trees growing in several fields at the South Coast Field Station south-east of Santa Ana, California, were used. They included self-pollinated progeny of the following cultivars: 'Fuerte', 'Hass', 'Irving', 'Jalna', 'Linda', 'Lyon', 'MacArthur', 'Queen', 'Stewart', Thille', 'Topa Topa', ‘Yama', and some small miscellaneous groups. Altogether, 2,614 trees were girdled. Random check groups of trees were left ungirdled.

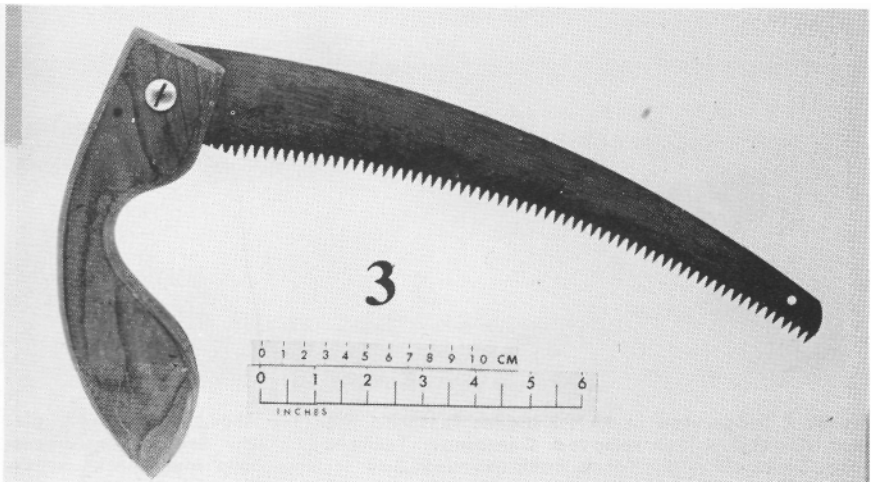
2. THE TOOLS. Three basic types of implements were tried:

1) Knives
2) Saws
3) Bark peeling tools.

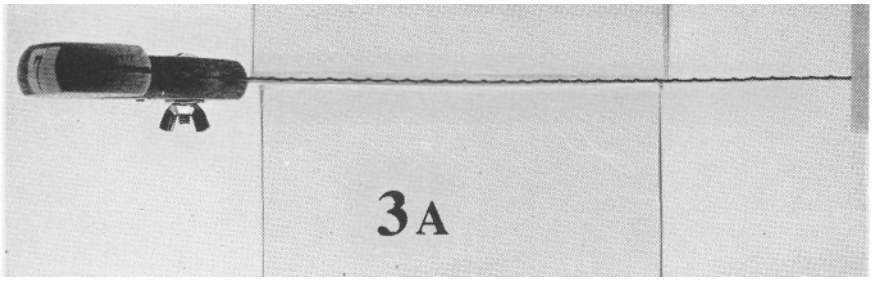
They are illustrated in Figures 1 to 21. The width of bark removed therefore ranged from none (knives) through the variable but relatively narrow strips cut away by the saws, to the also variable but usually wider strippings of the special tools.

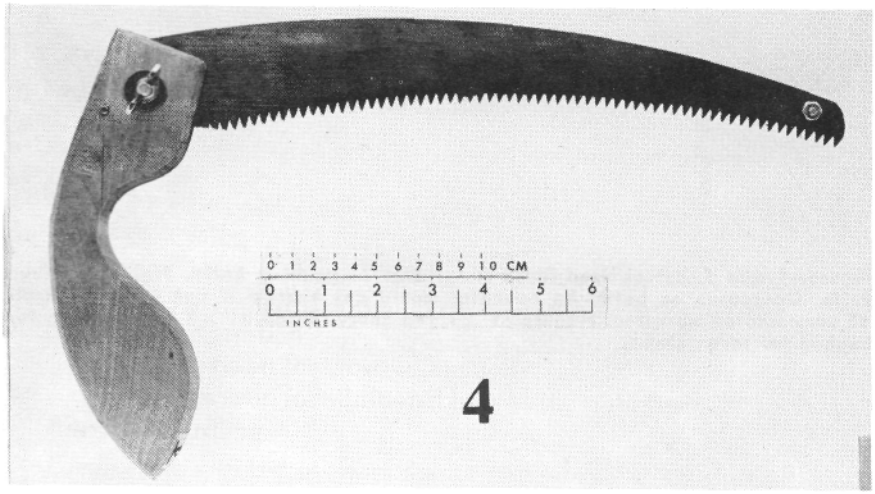


Figures 1 and 2, knives used in girdling. Fig. 1, pruning knife. Fig. 2, linoleum knife. Conseusus on both: An operator could cut himself if not careful. Girdle of very limited duration. Handle of #1 too short. Blade of #2 too flexible, too hooked for large stems.



Figures 3 to 5, saws used in girdling. Fig. 3 (edge view in 3A), single blade. Handle turned to fit in picture. About 1/16 inch of bark removed. Consensus: A light, very fast tool. Girdle may last too short a time for maximum set effect.





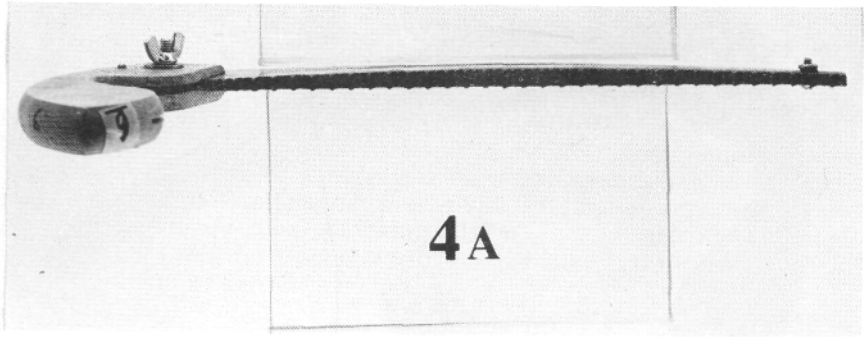


Figure 4 (edge view in 4A), 3 blades fastened together. Handle turned for picture. About 1/4 inch removed. *Consensus:* Tendency to saw deeper than necessary. Some clogging. Takes much exertion. Saw is heavy and longer than necessary. (See Fig. 16.)

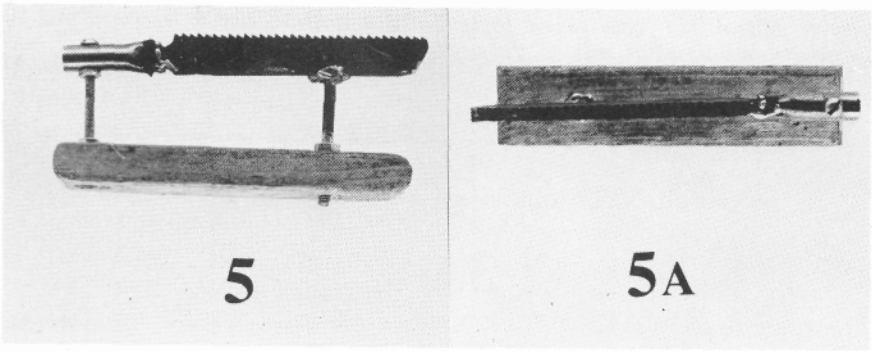


Figure 5 (edge view in 5A), short blades fastened together. About 1/4 inch removed. Consensus: Saw blade clogs with bark so a stiff-bristled brush should be carried. Requires even more exertion than the Fig. 4 saw. Needs curved saw blades, a longer handle, and perhaps a curved handle.

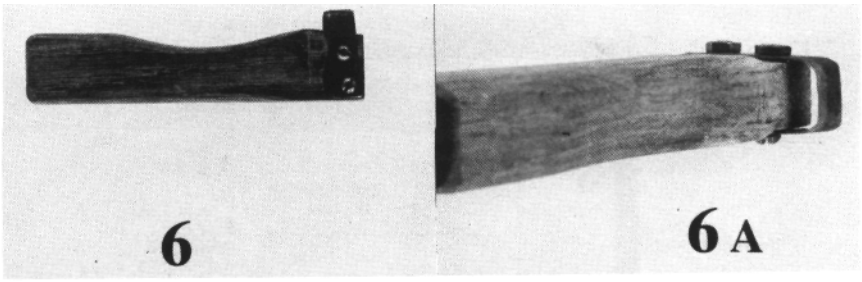


Figure 6 (angle view in 6A), simple peeler. About 3/4 inch removed. Consensus: Handle too short. Cutting tool requires much exertion to cut deep enough. Very light. Girdle wider than may be safe.

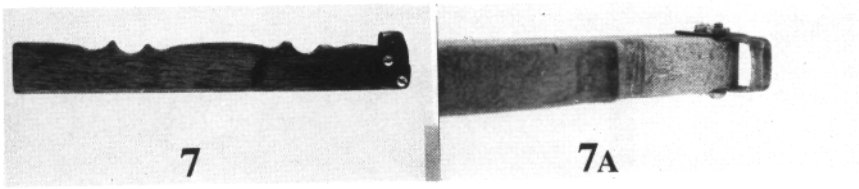
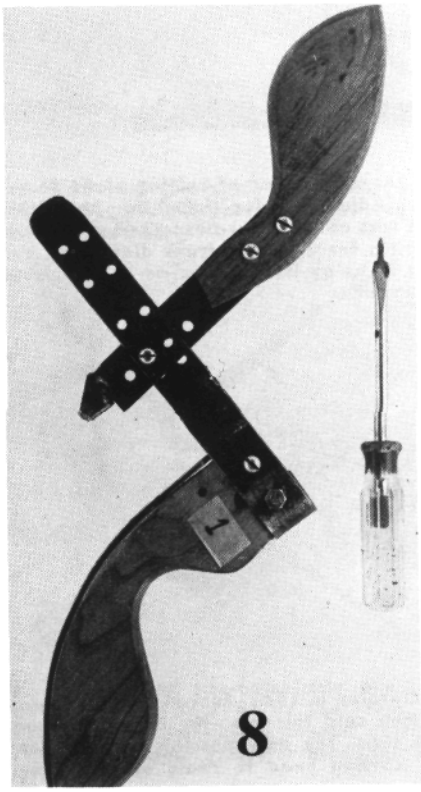


Figure 7 (angle view in 7A), 2-hand simple peeler. About 3/4 inch. Consensus: Cutting blade should be made to cut deeper. Leaves too much inner bark, due to blade being rounded. Light. Makes a riskily wide girdle.



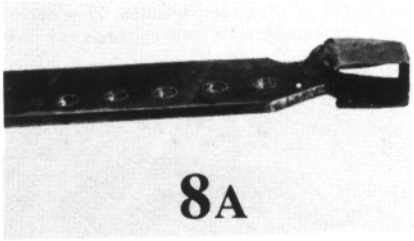


Figure 8 (close-up of cutting head in 8A), 2-hand reverse peeler. Adjustable for limb size. About 3/8 inch. The modified screwdriver shown was needed to occasionally remove jammed bark. Needs faster way to adjust to size of tree. Bark binds inside blade. (Further modification has since improved this tool in both respects.) A professional tool maker stated that this tool when properly modified could rank among our best.

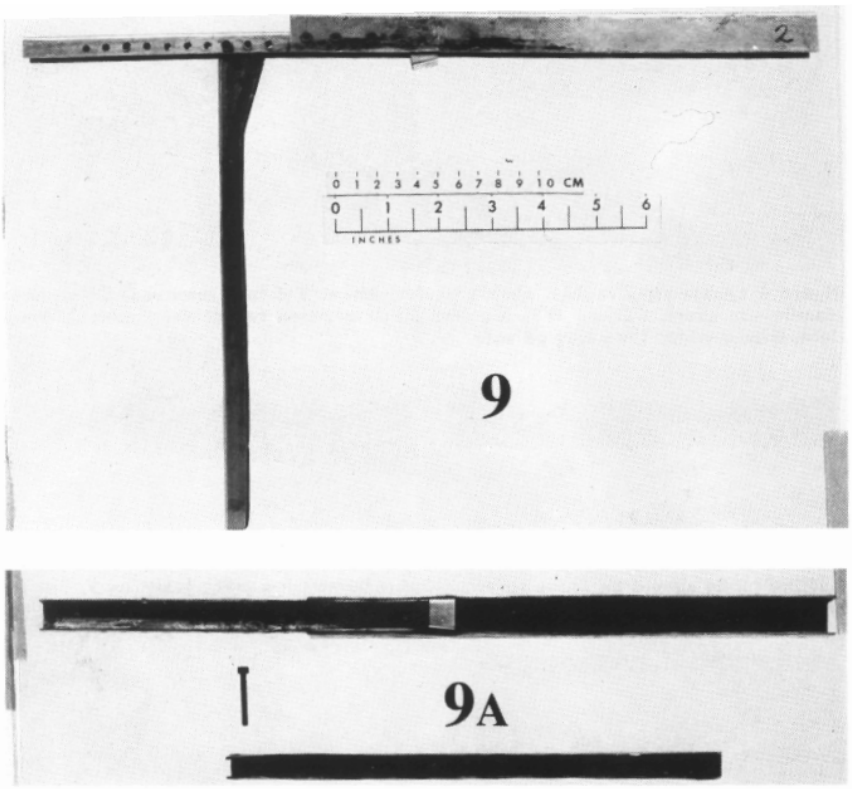


Figure 9 (disassembled with 'on' view in 9A; note taper of cutting blade to expedite bark removal), right-angle peeler. Adjustable for limb size. About 3/8 inch. Consensus: Opinions varied. One man was able to make excellent use of this tool. The others found an adjustment problem for different trunk diameters, and need for a stronger handle. It was loaned to us by its inventor as an unfinished tool for evaluation and subsequent improvement.

Figures 10 to 13, necked peelers. Fig. 10 (close-up in 10A), curved neck and hook handle. About 3/8 inch. Consensus: Two men said this was the best tool used, while the other man rated it with #9 as tops. The only possible improvement suggested was a "V" attachment on the cutting head to ream out remaining bark from limb depressions.

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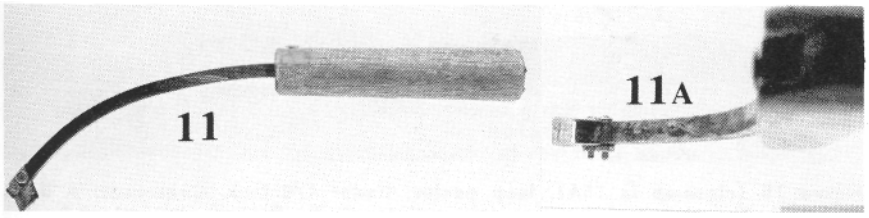

Figure 11 (close-up in 11A), curved neck and straight handle. About 3/8 inch. Needs pistol-grip handle. May need more curve in neck near cutting blade.

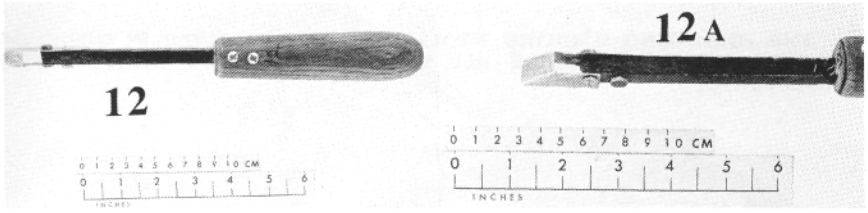

Figure 12 (close-up in 12A), long straight neck. About 3/8 inch. Possibly the second best tool used. A curved shaft with a pistol grip handle might make it more effective.

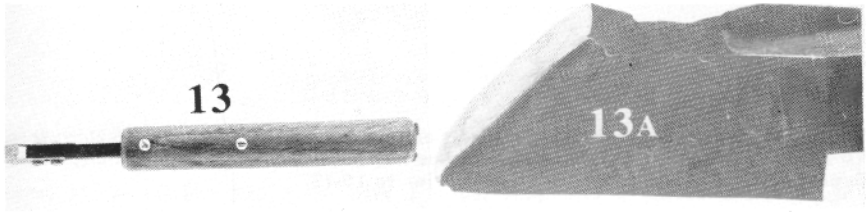

Figure 13 (extreme close-up in 13A), short straight neck. About 3/8 inch. Lip of cutting edge might protrude more for a deeper cut. One man considered it almost as good as #10.

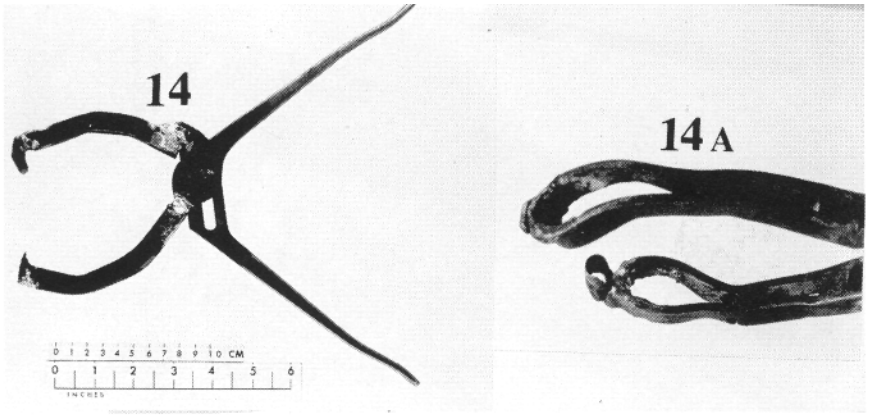

Fig. 14, modified size-adjustable pliers, with gripping point on one prong and peeler (close-up in 14A) on the other. About 1/4 inch. Consensus: Needs more work, including possibly a shorter cutting blade. Cutter and anchor point might be reversed. Angle of cutter blade might need to be more acute. Channels slip too easily.

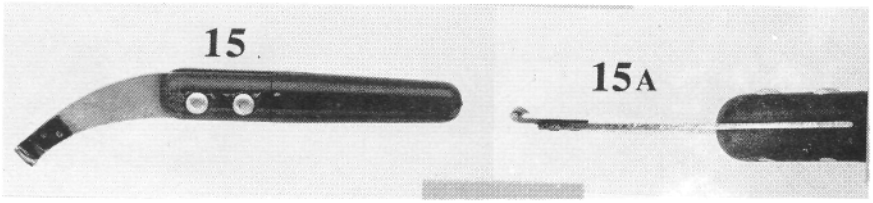

Figure 15 (close-up in 15A), loop peeler. Under 1/8 inch. Consensus: A light, fast tool. The narrow cut makes this a light girdle. Perhaps this might be the ideal tool for younger trees with thinner bark.

THE FOLLOWING GIRDLING TOOLS WERE NOT INVOLVED IN OUR COMPARATIVE EXPERIMENT, SINCE ALL WERE RECEIVED (OR CONSTRUCTED) SUBSEQUENTLY.

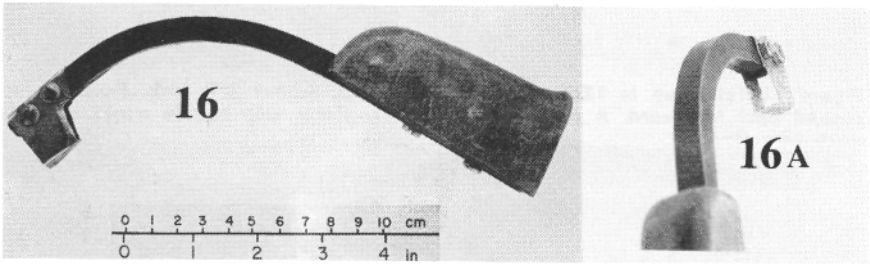

Figure 16 (angle view in 16A), modified curve-necked peeler, differing from 10 and 11 in having a short neck and handle, for use on stems with little room. Superior for its purposes, otherwise inferior to 10-13.

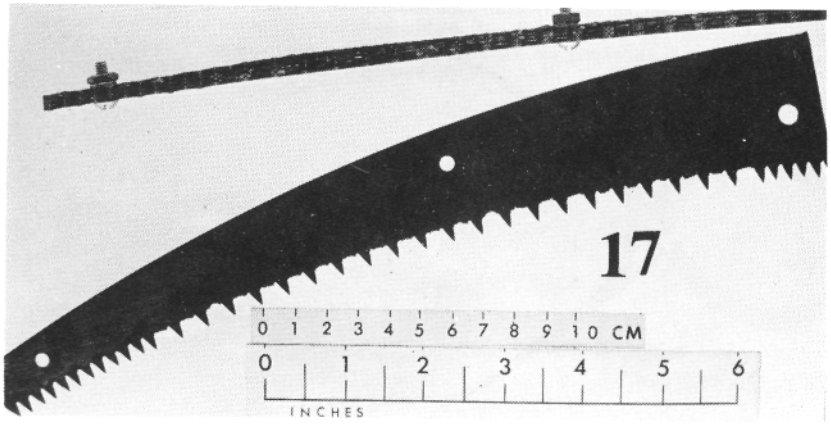

Figure 17, tool #4 improved by reducing the number of blades from 3 to 2 to make it lighter, adding a central binding bolt to reduce blade separation, and removing every other tooth for more rapid penetration and no bark clogging. Above is the tool in edge view and below is a single blade. This is a good choice where a safer, narrow girdle is desired, and a very fast tool of straightforward construction. About 1/8 inch.

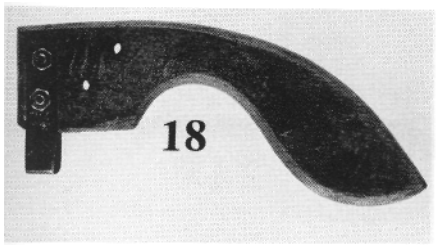

Figure 18, somewhat like #6 and 7, plus a pistol grip. In our limited testing, has not been as satisfactory as the best of the tools above.

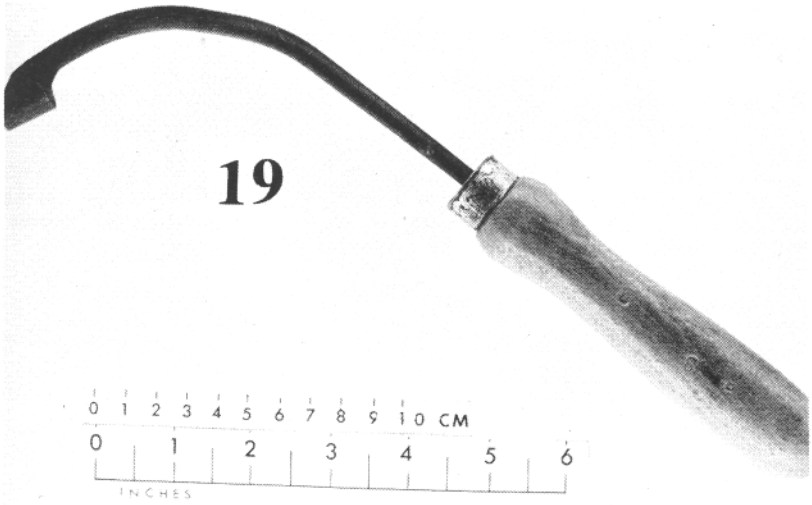

Figure 19, somewhat like #15, with a wider loop and a longer neck. In our limited testing, has not been as satisfactory as the best of the tools above.

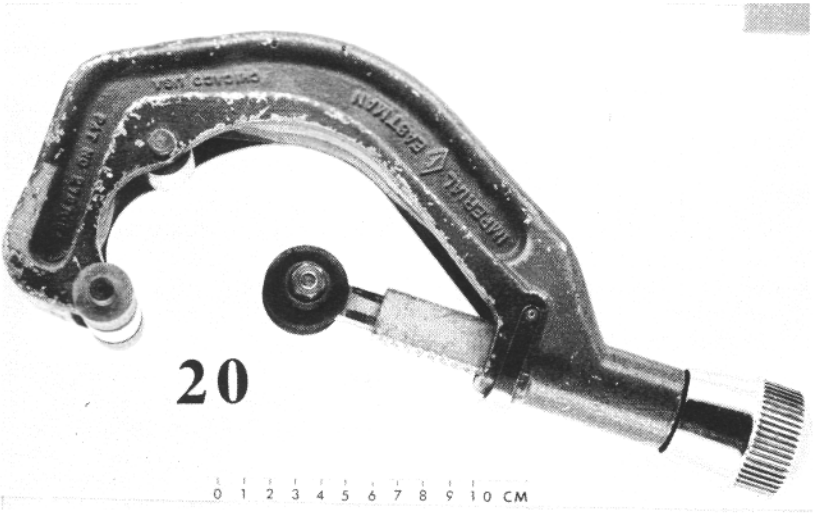

Figure 20, a pipe-cutter modified for girdling. Its fatal weakness is the lack of provision for rapid adjustment to variability in stem diameter, thus largely limiting its usefulness to (practically non-existent) perfectly round stems.

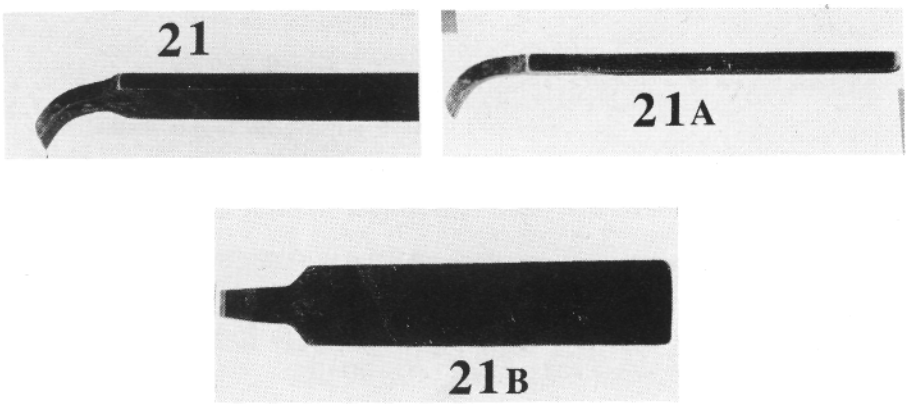

Figure 21 (edge view in 21A, flat view in 21B), file modified to ream out bark missed by the girdling tools, especially in depressions. Some such reamer is needed and this one proved superior to a (narrow-blade) chisel.

The girdling was carried out between December 28, 1970, and January 22, 1971. (Optimum time of girdling needs further experimental determination; periods from early fall to mid-bloom have given good yield responses, with early winter sometimes recommended; optimum timing has seemed to vary among different cultivars.)

Results

The most important consideration is of course the effect on yield. And our girdling frequently produced dramatic increases in the number of fruits set.

But for two reasons, statistical analyses were not very helpful. First, these were all seedling trees, which reacted to girdling in individual ways, none of which might be quite comparable to any commercial cultivar. Second, the subsequent blooming season proved to be a poor one for avocado fruit-set, and many trees, especially early bloomers, responded to the girdling by setting large numbers of "cukes". These seedless fruits are generally as useless for commercial return as they obviously are for breeding.

Apart from the increased set of normal fruit on many trees, the real value of the experiment was in its testing of different types of girdling tools. Most of the tools were rated independently by 3 girdlers. A consensus of their opinions is given with the Figures. Table 1 summarizes the rating by each man.

TABLE 1. Evaluation of girdling tools.

Girdler:			
Tool	*1*	*2*	*3*
1	Good	Good	No comment
2	Good	Good	No comment
3	Good	Excellent	Good
4	Fair	Good	Poor
5	Fair	Good	No comment
6	Very poor	Poor	Very poor

7	Very good	Very good	Very good
8	Fair	Fair	Fair
9	Excellent	Poor	Fair
10	Excellent	Excellent	Excellent
11	Good	Good	No comment
12	Excellent	Good	Excellent
13	Good	Good	Excellent
14	Poor	Good	No comment
15	Very good	Good	Excellent

A further consideration is girdling speed. Average time per tree for the different tools ranged from about ½ minute to over 3 minutes. Relative speed classified the tools into four groups, listed in approximate order of decreasing speed:

Fast: 3, 15,1, 4, 2

Medium: 12, 11, 9,10, 13

Slow: 5, 8, 7

Very slow: 6

For several reasons, the above ratings are tentative. First, experimental requirements meant that each girdler switched tools several times during the day — some tools were much more tiring than others, and one might be able to maintain a good pace with them for only about the relatively short time of usage in this experiment. Second, it took much less time to become adept with some tools than with others — the above ratings reflect overall average times, although some tools permitted faster and faster girdling whereas others remained nearly constant. Third, the girdlers sometimes differed markedly in their relative rating of the tools; the above represents an averaging that obliterates some large differences in individual performances. Fourth, the nature of some tools means that the girdler requires more room to maneuver; so relative girdling speed will vary with such factors as cultivar (variety) and pruning history. Fifth, experience showed that many of the tools could be better designed, with hopefully marked improvement in girdling speed.

The second and especially the first preceding point means that the evaluations in Table 1 should carry more weight than rated tool speeds for choosing the best girdling tool.

It was not generally possible to obtain meaningful comparisons of the effectiveness of the different tools in terms of fruit set. Genetic differences between and within our progeny sets was aggravated by the necessity for many tool treatments and so there were fewer trees per treatment than would have been desirable. Any real differences in treatment effects were swamped by the erratic behavior of the individual, genetically unique tree.

However, there were evident differences associated with the extremes in girdle width. The narrowest, consisting of the two knives and, to a lesser extent, the single saw blade, produced too brief a girdle for any marked fruit-set benefits.

The widest, approximately ¾ inch, produced some striking yield increases with the girdle healing fine. But a few trees were killed outright when the trunk was thus girdled. On other trees, this girdle resulted in a huge fruit set, but the leaves above the girdle

became sparse and shabby, the fruits failed to size properly, and the girdle had not healed when the trees were removed two years later.

Our results indicate that girdle width should be from 1/8 to no more than 1/2 inch.

The various types of tools represented in our experiment do not, of course, begin to exhaust the possibilities. An example of a quite different approach would be a power-driven router or saw. Someone may have an idea for a relatively small modification of one of our experimental tools that would greatly improve it. Creative imagination plays a large role in the development of superior tools.

All readers are invited to share with us their own ideas on better avocado girdlers or ideas on improving ours. These can then be given a comparative test, for a future Yearbook article.

Summarizing Conclusions

1. For a relatively narrow girdle, on smaller branches or young trees, the very different tools #15 or 17 should prove best, or even #3 for a very narrow girdle.

2. For a wider and probably more usual girdle, #10 was highly preferred, followed by the rather similar #12, 13 and 11, and #16 where there is little room to maneuver. #9 was the least-finished as tested, and even so worked extremely well for one of the evaluators.

3. Most of these tools can be readily improved, on the basis of test experience or of further thought by us or by others. Entirely new and different designs may prove superior to anything yet envisioned.

4. Individuals differ strikingly in their reaction to different tools — do your own tool testing.

5. Some tools require longer experience for the user to become adept — do not reject a tool too quickly.

6. The best tool also varies with tree age and structure (so with cultivar, pruning, cultural history).

7. If a girdler has two or more tools of different type available for interchangeable use, he can girdle more trees per day with less weariness.

ACKNOWLEDGMENTS

Our appreciation to the following for use of their girdling tools: A. D. McBurney, Fallbrook, #9; Harry Turner, Fallbrook, #18; Farm Advisor Don Gustafson, San Diego, for the Israeli tools #6, 15, 19.

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