L. H. LAMOURIA · H. E. STUDER · H. L. BREWER

Improving the productivity of PRUNING LABOR *in the vineyard*

The productivity of pruning labor in the vineyard can be greatly improved by methods reported here for eliminating non-productive tasks, reducing pruner decision time, increasing the work rate and reducing pruner fatigue.

PRUNING GRAPE vines requires 20 to 30 man-hours per acre each year, depending on the variety and planting. These high labor requirements, costs and labor-management problems involved in pruning California's 500,000 acres of vines during the three-month period available, place further emphasis on the need for increased pruning efficiency.

Pruner efficiency (PE) can be expressed as the ratio of actual output (AO) to maximum output, (MO), or:

$$PE\% = \frac{AO}{MO} \times 100.$$

Laboratory tests were conducted in which pruners, using either vine pruners, Rieser shears or pneumatically powered tools, made cuts as rapidly as possible on Thompson Seedless canes which had been collected from the vineyard at pruning time. The number of cuts made by each pruner was recorded at one-minute intervals for a period of five minutes. This established a maximum cutting rate for a man using vine pruners at about 100 cuts per minute.

By comparing the actual number of cuts made per minute in the field pruning operation with this maximum value, it was possible to estimate pruner efficiency and possible room for improvement. One man observed pruning Thompson Seedless vines with vine pruners during field experiments averaged about 15 cuts per minute giving an efficiency of 15%. This man was not considered a slow pruner by the grower, however, and his actual cutting rate was slightly better than other pruners.

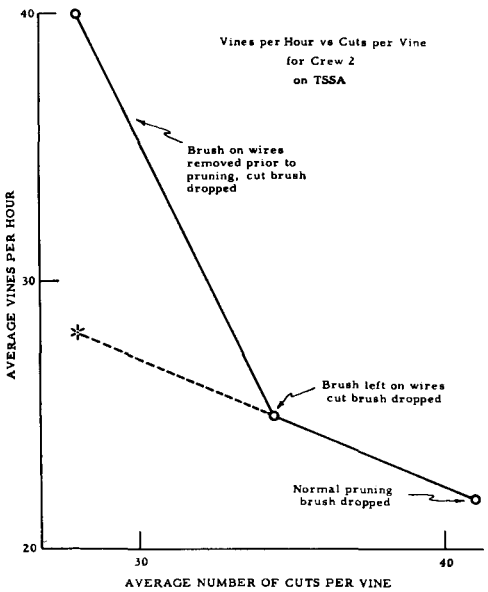
Pruner efficiency

Some of the factors affecting pruner efficiency are intangible and involve the pruner's emotions and attitudes toward his job, his employer and fellow workers. Other factors, such as weather conditions and pruner fatigue, also may affect his efficiency. Most of the above factors are not under the control of the grower. There are other factors, however, over which the grower has some control.

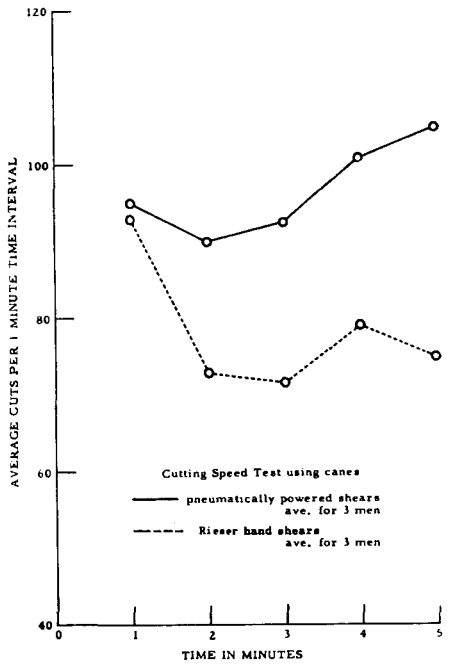
Pruning tasks

A typical pruning operation on Thompson Seedless vines trained on slant-arm trellises includes: (1) selection of canes to be left; (2) making the necessary pruning cuts; (3) removing old canes from the trellis wires; and (4) moving the brush into the center of the row for shredding. Only the first two tasks are really important for achieving vine vigor and production. Because the last two do not require special skills and have no effect on vine production, they should be eliminated as pruner tasks.

This possibility of increasing pruner productivity by reducing or eliminating non-productive pruner tasks was verified by pruning experiments conducted in the vineyards. When pruners, working with Thompson Seedless vines on slant-arm trellises, were instructed to allow all brush to drop as cut to the ground beneath the trellis, productivity measured in vines per hour increased by 20%. This eliminated the nonessential pruning operations of moving the brush to the center of the row for shredding. Another crew, instructed to leave in place all second-year growth wrapped on the wires, increased productivity by 40% as a result of the reduced number of cuts required on each vine—eliminating the other nonessential standard pruning operation.



GRAPH 1. EFFECT OF NON-PRODUCTIVE PRACTICES ON WORK RATE



GRAPH 2. MAXIMUM WORK RATE

Tractor-mounted vine hedging machine.

Pruner using pneumatic shears on Thompson Seedless vines.

Decision time

Possibilities considered for increasing pruner efficiency in the essential operations of selecting canes and making cuts included: (1) reducing decision time in cane selections, and (2) increasing the cutting rate of the pruner. When the pruner had to make one or two decisions, it resulted in a marked decrease in cutting speed in the laboratory tests.

Other experiments were conducted in the vineyards to show the effect on pruner output of easier decisions. In one experiment, the canes were stripped from the trellis wires prior to pruning and all other canes were positioned to lie beneath the trellis wires. The vines were now much more open to view. This increased the productivity of the pruners to nearly 130% of normal. Graph 1 shows the relationship between cuts required per vine and productivity per hour in vines. The increase in productivity, if based only on reduced number of cuts required, should have been as indicated by the asterisk on graph 1. However, productivity was much higher than this. The difference is explained by the increased ease with which the pruners were able to select their canes. Besides the increased pruner output, this improved facility of cane selection could result in better quality pruning, since mistakes in selection might be reduced.

Another experiment which demonstrated the effect on productivity of reducing the difficulty of decision making involved machine hedging of cordon-trained varieties such as Palomino and Carignane prior to pruning, as illustrated. The results were significant enough to point out the advantages of reducing the amount of brush by preclipping or hedging, with resulting improvement in the pruner's accessibility to, and view of, the vine.

Work rate

Other experiments showed that it is possible to increase the number of pruner cuts per unit of time. One such method, as illustrated, was the use of the pneumatic shear. Laboratory tests to determine maximum cutting rates with different tools indicated that, except for fatigue, there was essentially no difference in output for any of the three tools. However, as graph 2 indicates, the hand-shear cutting rate declined as the cutting time period increased; whereas the pneumatically powered shear cutting rate actually increased. This indicates that pruner fatigue can be reduced with the pneumatic shear, allowing more constant day-long productivity. The use of the pneumatic shear can also give the grower much better control over the pruners, since to some extent, they must pace themselves to the machine's travel speed. Crew interaction, such as talking, is thereby reduced and the crew spends more time in actual pruning.

Incentive payments

Incentive wage payments to pruners can also reduce crew interaction as well as provide a personal interest in improving productivity. Many growers have expressed objections to payment on a per vine basis due to the feeling that a reduction in pruning quality would result. However, there are methods of incentive wage payment which can be employed without losing management's control of the pruner.

One experiment was conducted with a crew pruning Thompson Seedless vines trained on a single wire trellis. The pruners were paid an hourly rate for their normal 16.8 vines per hour and a bonus of three cents per vine for additional production. The results indicate that an increase in productivity of 54% was achieved. The actual pruning cost per vine was reduced, and at the same time the pruner was able to increase his day's wages. Management control was still maintained because the incentive was not great enough to induce the pruner to do an unsatisfactory job.

Incentive wage payments, the use of power-operated pruning tools and mechanical hedging equipment (for cordon-trained varieties) can improve the productivity of pruning labor if used under adequate grower supervision. Machines for collecting brush and stripping wrapped canes from the trellis wires are not currently available, but they also represent possibilities for improvements in the future. Some of the methods for increasing pruner productivity require no investment and can mean immediate positive returns to the grower. Other methods may require capital investments, and growers must decide whether they are practical.

Lloyd H. Lamouria is Associate Professor of Agricultural Engineering; Henry E. Studer and Harold L. Brewer are Assistant Research Specialists, University of California, Davis.

Farm Advisors J. V. Lider, P. P. Baranek, J. J. Kissler, W. C. Micke, D. A. Luvisi, C. D. Lynn, P. D. LaVine, and F. L. Jensen assisted with this project. The Wine Advisory Board, Miller-Robinson Company, Oneto-Gotelli Company, Stowell Equipment Company and grower cooperators, also participated in this study.