Electrifying the vineyard

Benchmarking the effect on productivity of using Electronic Secateurs in vineyard pruning.

An Ancient River research program carried out in June 2005

Introduction

Worker productivity is an issue that has been thrown into sharp relief in recent times due to an apparently increasing lack of available skilled people. This lack of personnel has prompted calls for, amongst other things, government consideration of an international Guest Worker scheme whereby skilled seasonal workers might be brought in for picking and pruning seasons.

While such schemes may be of assistance, it is suggested that consideration should also be given to exploring ways and means of increasing the productivity of existing workers.

The growth in the range of electronically powered secateurs available and the improvements which have been made in recent times to such things as power to weight ratios, flexibility of operation and length of operating time has lead to the grape-growing industry becoming more interested in considering this type of equipment.

Given there has been a paucity of independent, objective analysis of the likely impact on productivity of the new generation of electronic secateurs, a trial was arranged at the Ancient River vineyard.

The trial consisted of introducing six units of electronic secateurs to a gang of nine pruners experienced in pruning vineyards using manual tools with the objective of measuring the effect on productivity. The marketers of Electrocoup, Felco and Pellenc loaned two units each of electronic secateurs.

Methodology

Providers of the electronic secateurs each advised that it was "usual" for users to require 2-4 days before becoming used to working with an electronic tool. It was therefore determined that each pruner in the trial should have at least one day using this equipment before any measurements were taken.

To avoid, as much as possible, creating an artificial work pattern through constant, visible measurement, vine counts were not undertaken every day. Counts were made on days one, three and four to establish a manual benchmark. No counts were then made for the next three days while the workers were introduced to the electronic secateurs. Full day counts were then made for two days.

The gang was introduced to the vineyard and began by spending a day using manual tools (generally, loppers) to prune vines in rows that had not been mechanically pre-pruned. The vines pruned for the day (a short day of seven hours) by each person were counted. No counts were made the following day. Over the next three days, the gang moved on to rows that had been pre-pruned, once again using manual tools. The numbers of vines pruned before lunch on day three was counted with the fourth day measured in two parts – pre- and post-lunch.

On the fifth day, four units of electronic secateurs (two each of two brands/models) were introduced with four members of the gang (including the supervisor) each using the equipment for a full day. On the sixth day, three other members of the gang used the equipment with one member (the supervisor) using the brand/model he had not used the day before. On the seventh day the remaining two members of the gang who had not previously worked with any of the electronic secateurs, used the two units of the third brand/model with four of the other members using the model/brand they had not used before. No data was recorded for these days.

On the eighth and ninth days, vines pruned per worker were counted pre- and post-lunch. One member of the gang did not work on the morning of the third day nor the entire eighth day.

The gang then pruned for a further three and a half days with numbers of workers fluctuating between seven and eleven. No data was recorded for these days. The workers were then asked for their comments on the equipment at the end of the trial.

Manual Benchmarks

Although experienced in pruning wine grape vineyards, the gang had not worked in this particular vineyard before. This being the case, and taking into account mechanical pre-pruning of the vineyard was starting on the same day as the gang, it was decided to take a measurement of the gang's first day of production more as an introduction to the process that was to be employed in marking and recording individual progress than as a dependable benchmark of productivity.

It was also considered that, as this would be the only day the gang would be working on vines that had not been pre-pruned, the data collected might be of interest in a comparison with that which was collected on a day when the vines had been pre-pruned. This data is contained in Table 1 below

The result showed an overall lift of 52.1% in average hourly production where workers did not have to remove canes from wires. However, this result is not a reliable guide to likely productivity increases as day one was also the first day one of the gang had ever pruned. Removing that worker's data, the overall result showed an increase of 47.3%. This is still not considered to be a reliable guide but may be of some interest to vineyard managers considering the merits of mechanical pre-pruning.

Table 1 - Productivity increase of pre-pruned over unpruned

Worker	Day 1**	v/h	Day 4	v/h	%inc 4/1 v/h
1	124.0	17.7	220.0	24.4	38.0
2	128.0	18.3	219.0	24.3	33.1
3	103.0	14.7	219.0	24.3	65.4
4	114.0	16.3	217.0	24.1	48.1
5	118.0	16.9	255.0	28.3	68.1
6	129.0	18.4	242.0	26.9	45.9
7	129.0	18.4	222.0	24.7	33.9
8	111.0	15.9	216.0	24.0	51.4
*9	82.0	11.7	220.0	24.4	108.7
Total	1038.0	148.3	2030.0	225.6	52.1

* Worker 9 had no previous pruning experience
** Day 1 was a seven-hour day compared with a usual (Day 4) nine-hour day

The data for Day 4 shows the gang had reached an operating level of some uniformity with two workers achieving above average results. This pattern of relative productivity is a fair reflection of what the gang was observed achieving for the rest of the trial.

Electronic v. manual productivity increases

As is to be expected with a production process involving manual workers in an outdoors work environment, day-to-day production levels may vary depending on a number of factors including weather, individual worker physical capacity/wellbeing and worker attendance. This variability acknowledged, a marked increase in productivity of 40.1% (see Table 2 below) was recorded for the entire gang using electronic secateurs compared with their individual performance using manual tools.

Table 2 - Productivity increase of Electronic over manual

Worker	Electronic*	v/h	Manual**	v/h	% Inc E/M
1	279.0	31.0	220.0	24.4	26.8
2	309.0	34.3	219.0	24.3	41.1
3	310.0	34.4	219.0	24.3	41.6
4	326.0	36.2	217.0	24.1	50.2
5	383.0	42.6	255.0	28.3	50.2
6	357.0	39.7	242.0	26.9	47.5
***7	247.0	27.4	222.0	24.7	11.3
8	323.0	35.9	216.0	24.0	49.5
9	310.0	34.4	220.0	24.4	40.9
Total	2844.0	316.0	2030.0	225.6	40.1

* Lowest of Day 8 or 9
** Day 4
*** Electronic separate measurement day 12

Although this was the case, a couple of other factors of interest also emerged.

Firstly, two of the workers (1 and 7) had markedly smaller increases in productivity than the rest of the gang. In fact, if the data for these two workers is removed, the average increase in productivity was 46.0%. Whilst a number of possible reasons for their markedly lower than average increase in productivity can be suggested (eg. aversion to new technology, speed of production being restricted more by decision-making than physical limitations) the fact of a less than universal improvement in productivity suggests sociological conditions might also be an important consideration when contemplating likely productivity increases through the introduction of this type of technology.

Secondly, on any given day, no more than six units of electronic secateurs were available to the gang. This meant that two or three workers in the gang were using manual tools at the same time as the rest were using the electronic tools. Of particular interest is that the workers using manual tools on those days all achieved an increase in productivity of at least 20% compared with that recorded for them on Day 4 when all workers were using manual tools. In the case of Worker 7, the degree of increased productivity through the use of electronic secateurs was actually lower compared with that achieved using a manual tool as part of a gang using predominantly electronic equipment (see Table 3).

Table 3 – Productivity using manual tools as part of "electrified" gang

Worker	Day 4 Tot	v/h	Elec Day Tot	v/h	% Inc E/4
1	220	24.4	264	29.3	20.0
4	217	24.1	270	30.0	24.4
*7	222	24.7	274	30.4	23.4
8	216	24.0	270	30.0	25.0

* Elec Day result is lowest of two days recorded

Considerations

While increasing the productivity of workers in terms of vines pruned within a given time frame is an important objective, it is probably best framed within an economic context. After all, if productivity is increased by 40% but at a cost of, say, 60%, it is unlikely that such increased productivity would be welcomed by growers. It is therefore important that the financial cost of acquiring and maintaining electronic tools should be thoroughly considered.

As suggested through interpretation of productivity results for individual workers using electronic tools or using manual tools as part of an "electrified" gang, there are also important sociological considerations to be made. Not only is the productivity of individuals affected by the introduction of technology, but there would appear to be a group dynamic at work as well.

Another important factor for consideration is the culture of the workforce as it relates to the care and maintenance of tools. Where gangs normally use manual tools, there is likely to be a culture that might be described as "disposable". That is, if a tool becomes damaged or worn out, it is replaced at no cost to the worker. In the case of a manual tool, this might be an individual cost in the order of $100. However, given the extra work that an electronic tool will do in the same time frame as a manual tool, electronic tools will require a higher frequency of maintenance by users (blade sharpening, oiling, tension checking, etc.) as well as requiring users to be alert to other issues such as error messages, battery charge level, etc. The cost of poor user maintenance may extend beyond a simple reduction in productivity to include damage to vines through cuts that are less than clean and, at $2,500-3,000 per tool, a substantial repair bill should warranties be voided through breach of conditions.

Bearing the above in mind, it is therefore probably best to take into account not only the listed specifications and costs of alternative makes and models but, also, the human element of the work force who will be using the tools.

Is it imperative to provide all members of a gang with an electronic tool or are there some members who will not generate a sufficient increase in productivity to economically justify supplying them?

Will allocating a specific tool to an individual worker and holding that person responsible for its proper maintenance result in higher productivity and contained maintenance costs or is it better to allocate a specific person to check all tools each day to ensure they are correctly maintained and have a limited number of tools made available only to those workers who demonstrate a minimum level of increased productivity over their use of manual tools?

Given electronic tools require less physical effort than manual tools with a probable consequent decrease in the likelihood of repetitive strain injuries, will productivity be increased over time? If this decrease in RSI's is proven over time, will the use of these types of tools become mandated under OH&S regulations or affect Work Cover premiums?

User observations

At the conclusion of the trial, workers were asked for their thoughts and preferences when it came to the tools they had used. As might be expected, most of them preferred to use the electronic tools. The exception to this rule was those workers whose productivity wasn't markedly improved through the use of electronic tools. In their case, though, they were ambivalent rather than negative.

The main issues or preferences that were mentioned by the users were as follows –

- The battery-pack harness should have the minimum of adjustable straps to avoid trailing straps being caught or cut. It should also ensure the weight of the unit is as evenly distributed as possible.
- The battery should hold its charge for at least the entire day.
- The On/Off switch should be easily accessible and preferably visible in front.
- The cutting head should have blades long enough to provide both the broadest possible diameter cut as well as the longest reach for accessing canes in awkward positions.

- Given battery charge-life and speed of cutting is enhanced by the blades only needing to open and close the minimum distance required, the ability to easily restrict the opening range to that sufficient for individual canes while providing the ability to open wider for cordons and thicker wood is highly desirable.
- Power cords should be easily managed to avoid them trailing into dangerous cutting-zones.
- Length of cords, etc. should be such that they don't make packing the unit away in its carry-case more difficult than it needs to be.

Buyer considerations

While this trial was not convened to generate a pecking order of brands (to do this, a much longer trial involving a larger number of workers and brands would be preferred), it is instructive to consider relative costs and the impact of downtime should units be out of action in-season.

With each of the three brands involved in this trial, the marketers recommend an annual service be carried out by the supplying organisation. In the case of one of the brands, this annual service is a condition required to activate the second year of a five-year warranty. Given such a service includes the checking, cleaning and, if necessary, overhauling of electronic componentry, it would seem sensible that it is budgeted for and carried out. It is also an opportunity to have a detailed diagnostic report produced as a readout from the unit to indicate how the machine has performed and indicate possible usage or maintenance issues that should be addressed with the user/s of the equipment.

Indicative prices (excluding GST) for each of the trialled brands are as follows –

	Electrocoup	Felco	Pellenc
Unit price	$2,785.00	$2,595.00	$2,680.00
Replacement cutting blade	$45.00	$51.29	$48.50
Annual service	$154.55	$170.00	$160.00*

*Approximate price assuming normal parts replacement

The costs of individual components of these units (especially the batteries) are substantial and so it would be advisable for buyers to explore guarantee/warranty coverage as well as the expected useful life of all components. One supplier suggested allowing a maintenance budget of $3-500 per year over a five-year period to cover the cost of annual servicing and replacement parts that are likely to be required in years three to five.

Apart from the direct costs associated with repairing non-operational equipment, there are also the costs to productivity of machine downtime. Buyers should therefore carefully consider the time it may take to analyse problems and have them rectified including the time it may take to transport the equipment to and from the service centre and the likely turn-around time of repairs in-season.

Conclusions

There is little doubt that electronic secateurs allow for a significant improvement in productivity over the use of manual tools in pruning vines. Whilst this productivity lift will depend on individual circumstances (Contract pruners or waged employees? Paid by the hour or vine? Workers happy to adopt new technology?) maximising productivity gains is also dependent on workers being adequately trained in the proper use and maintenance of the equipment and putting that training into daily use.

With a 40% lift in productivity within the bounds of probability, the cost of this technology is also within the bounds of sensible economics depending on the amount of use it will get.

Assuming a five-year life per unit with the purchase price amortised over that period and a $400 per year maintenance budget, the annual cost per unit would be in the order of $950 per year. Assuming an annual cost of $150 per year for manual tools, the difference would therefore be in the order of $800 per year. The productivity increase of 40% is equivalent to a decrease of 28.6% in the hourly rate paid to workers. Assuming a cost of $20 per hour per worker, this adjustment represents a saving of $5.72 per hour. It would therefore take approximately 140 hours a year for the equipment to pay for itself.

Naturally, the economics will depend on whether the unit is being purchased to supply a waged worker in the employ of a vineyard or a worker in the employ of a contractor. At 40 hours per week, the cost of the unit is equivalent to 3.5 weeks; at 60 hours per week it is around 2.3 weeks.

There is probably also an economic benefit in terms of OH&S, worker morale and employer/grower satisfaction but such considerations are outside the parameters of this trial.

What will be interesting to observe in the coming years is how the pruning service delivery model might change as a result of a wider adoption of electronic technology. Will growers be more likely to measure input costs on a per vine basis? Will contractors be more likely to charge on a per-vine or hectare rather than hourly basis? Will growers be more likely to employ vineyard workers or outsource vineyard work to contractors?

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Electrocoup F3005 – www.infaco.com
Felco 800 – www.felco800.com
Pellenc Lixion – www.lixion.com.au