

# Northeast SARE Final Report

## Developing an Efficient Mechanical Pruner

### Project # FNE01-356

The goal of this grant was to develop a method of mechanically pruning grape vineyards that was productive, economical and sustainable. We feel that the improvements to the mechanical pruning unit have helped keep more productive wood on the vines. The hand follow-up behind the machine is faster and results in a cost savings to the farmer.

As stated in our application, the pruning process must be able to retain the good quality fruiting wood, while discarding the unproductive wood on the lower side of the canopy. The fingers that we added to the machine (we call them 'the spinners') actually lift some of this longer ripe wood and hold them up in the air allowing the machine to cut the undesirable wood. We placed the spinners on the front cutter bars and have the ability to raise or lower them depending on the vigor of the vineyard. The mechanical pruning unit requires adjustment (moving the spinners, cutter bars and/or the direction of the fingers) at least once a day or in each new vineyard. By making these adjustments we can reduce the amount of hand follow-up that is needed by allowing the machine to make precise cuts for that vineyard. Hand follow-up, cleaning the trunks and making at least one main cut to a two-year or older cane on each side of the cordon, is still a must. This hand follow-up is done at a rate of about 80 to 100 vines per hour, instead of an average hand trimmer pruning about 24 vines per hour.

The Betts' form of pruning, in the comparisons done by Dr. Terry Bates has shown that we can sustain bud counts and quality. Starting this year, we will have the opportunity to leave better buds and/or longer canes because of the spinners. We also have been able to show with this experiment on our farm that we have a hidden savings on sprays. Having only applied two fungicides in the last three years, we feel this is due to our maintaining the quality scouting, bud selection and not over cropping.

We held a demonstration on our farm, see Post-Journal article, showing the difference between our mechanical pruning unit with spinners and an original machine. All farmers attending had their own opinions, some liked our way of pruning and others still don't feel the need to change. Many farmers still are nervous about letting a machine do most of the work, or they may not think it looks as good as hand pruned. Dr. Terry Bates' articles and report shows how all comparisons work out technically and

economically. The articles were handed out at our demonstration and showed these same farmers that had many concerns, we were maintaining quality and tonnage. In cooperation with National Grape and Cornell Cooperative Extension we spoke and showed how we do our hand follow-up at four other demonstrations, see Co-Op and Observer article. We traveled from Michigan to the Finger Lakes in New York interacting with farmers and learning as much as we taught.

We have seen a great difference in farmers thinking within this last year. Money hasn't been as good as in the past, expenses have only rose and the future only has questions. We have been out in the lead with everyone watching our every move, not only in the vineyard but by our cost surveys. We feel we must move forward and keep looking for better ways to improve this machine. We are very pleased with the results of the spinners and of this project, but feel the mechanical pruning unit can be improved greatly. Speeding up the hand follow-up techniques, cutting costs and improve working standards (technology in our area is very primitive compared to other areas) are all things that still need to be addressed for us. We will always be looking, dreaming and hopefully finding new ways to improve the most costly part of grape farming.

# Northeast SARE 2001 Farmer/Grower Grant Technical Report

Project Title: Developing an Efficient Mechanical Pruner for Northeast Vineyards

Project Leaders: Bob and Dawn Betts

## Comparison of mechanized pruning systems

by

**Dr. Terry Bates, Technical Advisor to Bob and Dawn Betts on this project**

An experiment was initiated in 1999 in the Betts' vineyard to compare mechanical production systems on single-wire cordon trained vines.

### Treatments:

- 1) Hand prune to the best 100 nodes
- 2) Betts' system (Machine pruning with hand pruning follow-up)
- 3) Arkansas system (Machine Pruning without hand follow-up)
- 4) Minimal prune (undercut only)

Year	Treatment	Retained Nodes	Yield (tons/acre)	<sup>o</sup> Brix	Ripe periderm	Clusters/ vine	Clusters/ node	Cluster weight (g)	Berry weight (g)	Berries/ cluster
1999	Hand	100 a	12.5 ab	15.8 bc	364 b	206 a	2.1 b	88.5 c	2.7 b	33.8 b
	Betts	122 b	11.9 a	16.2 c	339 b	192 a	1.6 a	82.0 c	2.6 b	31.7 b
	Arkansas	166 c	12.5 ab*	15.5 b	246 a	256 b	1.6 a	59.9 b	2.5 b	24.0 a
	Minimal	270 d	12.9 b*	14.6 a	235 a	373 c	1.4 a	50.0 a	2.2 a	22.4 a
2000	Hand	100 a	9.3 a	16.1 a	494 a	153 a	1.6 b	80.6 c	3.7 c	21.9 c
	Betts	111 a	8.5 a	16.1 a	488 a	156 a	1.4 ab	74.9 c	3.8 c	20.0 b
	Arkansas	143 b	9.8 a	16.0 a	434 a	191 b	1.3 a	64.0 b	3.5 b	18.2 b
	Minimal	157 b	8.6 a	16.4 a	445 a	202 b	1.3 a	54.1 a	3.3 a	16.1 a
2001	Hand	100 a	8.0 ab	16.1 b	455 a	154 a	1.6 a	63.5 c	3.6 b	17.8 c
	Betts	98 a	7.4 a	16.0 b	434 a	141 a	1.4 a	61.5 c	3.6 b	17.3 bc
	Arkansas	138 b	8.6 b	16.2 b	408 a	192 a	1.5 a	53.5 b	3.4 b	15.6 ab
	Minimal	234 c	11.5 c	15.4 a	413 a	316 b	1.4 a	45.8 a	3.2 a	14.7 a
99-01	Hand	100 a	9.9 ab	16.0 b	438 b	171 a	1.7 b	77.5 c	3.3 c	24.5 d
	Betts	110 a	9.3 a	16.1 b	420 b	163 a	1.5 a	72.8 c	3.3 c	23.0 c
	Arkansas	149 b	10.3 bc	15.9 b	363 a	213 b	1.5 a	59.1 b	3.2 b	19.3 b
	Minimal	220 c	11.0 c	15.4 a	364 a	297 c	1.4 a	50.0 a	2.9 a	17.7 a

**Table I:** The three year reproductive and vegetative data for the mechanical pruning experiment at the Betts' vineyard in Westfield, NY. Numbers with different letters indicate statistical difference at the 5% level.

### General Conclusions to date:

1. Betts' pruning (machine pruning with hand follow) has been identical to hand pruning in yield and brix. This conclusion is important because mechanical pruning systems, in the past, have led to lower quality grape production. The industry is searching for a mechanical pruning system that lowers the cost of production but does not decrease yield or juice quality. Since the Betts' and Hand treatments are the same in yield and quality,

the difference in the cost of production between the two systems translates into grower profits.

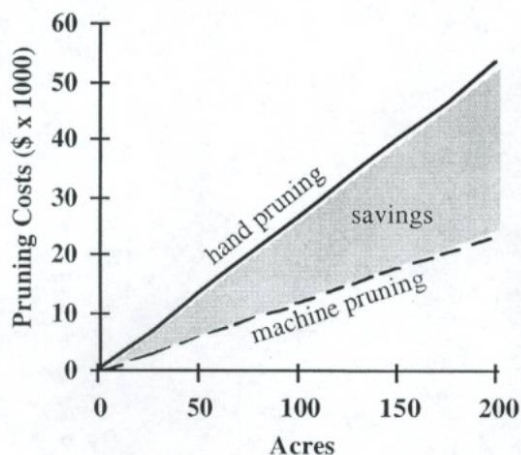
2. Bud selection with a machine is inferior to hand pruning, which leads to less fruitful buds (look at clusters/node). Therefore, growers must leave 10-20% more buds per vine to achieve the same yield. Quality bud selection when pruning is an important grape production issue. None of the machine pruning systems in this study can select buds as good as the human eye (although it has been argued that paid pruning crews in the field prune similar to machines). Therefore, a compromise is made with the Betts' system to retain slightly more buds of slightly lower quality to maintain similar yield and juice quality.

3. Machine pruning alone (Arkansas, without hand follow-up) retains more buds than Hand or Betts, which leads to a higher crop that may need to be adjusted by crop thinning 30 days after bloom. Vineyard balance or crop load management can be maintained through pruning alone, crop thinning alone, or a combination of pruning and crop thinning. The Arkansas treatment requires both pruning and thinning to maintain vineyard balance. As a rule, crop thinning has not been accepted in the New York Concord industry. Therefore, the Arkansas treatment has limited practical importance in New York until crop thinning is better understood and adopted by growers.

4. Minimal pruning retains even more buds than the other treatments, which leads to high yield, low brix, low periderm, and low fruitfulness. It is important to note that Minimal pruned vines did not make minimum brix in 1999 even with crop thinning (\* indicates thinned vines).

### Economics

Since the Betts' and Hand treatments are identical in yield and juice quality, a 'pruning calculator' was created to compare the costs of the two pruning systems. The calculator includes mechanical pruner operation and maintenance as well as hand follow-up costs. The Betts' system is compared to hand pruning at 30 cents per vine with additional costs for tying and suckering (the current industry standard). The Betts have 189 acres and save nearly \$30,000/year in pruning costs (Figure 1).



**Figure 1:** The cost of machine pruning with hand follow-up (Betts' system) vs. hand pruning only at different vineyard sizes. For example, it costs a grower \$27,000 to pay a crew to prune 100 acres of Concord grapes (@ 30 cents a vine). It would cost the grower \$12,000 to hire one worker (@ \$12/hour) to mechanically prune and follow-up the same number of acres. The grower saves \$15,000 a year for the same yield and juice quality. At those savings, it would take the grower 2 years to pay for the \$25,000 mechanical pruner.

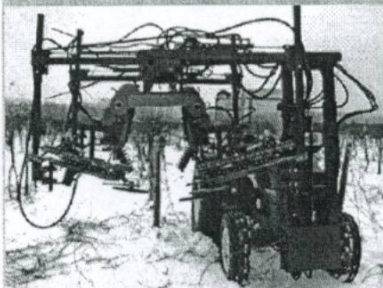
# Lake Erie Grape Research

Cornell University, New York State Agricultural Experiment Station  
Department of Horticultural Sciences, The Lake Erie Regional Grape Program



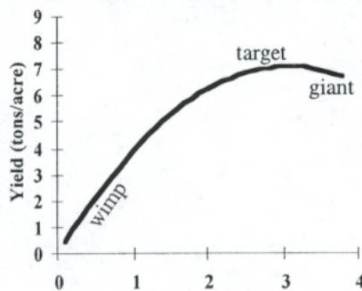
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Mike Vercant  
Paula Joy

## Mechanical Pruning Research



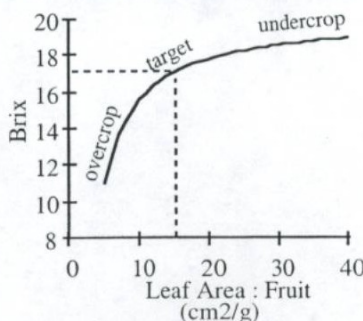
Machine Pruning is simply a pruning tool. It does NOT replace management for...

### Vine Size



or

### Crop Load!



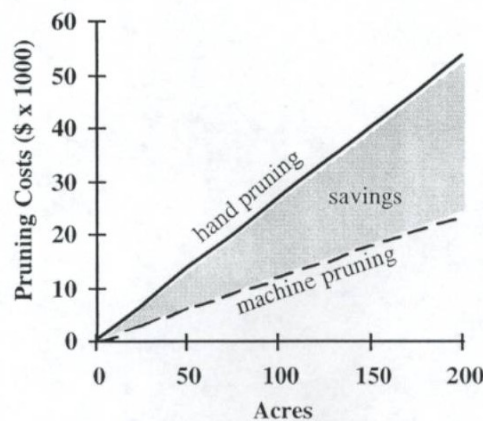
### Betts' Pruning Trial

12/3/01

Year	Treatment	Retained Nodes	Yield (tons/acre)	Brix	Ripe periderm	Clusters/vine	Clusters/node	Cluster weight (g)	Berry weight (g)	Berries/cluster
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	Minimal	270 d	12.9 b*	14.6 a	235 a	373 c	1.4 a	50.0 a	2.2 a	22.4 a
2000	Hand	100 a	9.3 a	16.1 a	494 a	153 a	1.6 b	80.6 c	3.7 c	21.9 c
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	Arkansas	149 b	10.3 bc	15.9 b	363 a	213 b	1.5 a	59.1 b	3.2 b	19.3 b
	Minimal	220 c	11.0 c	15.4 a	364 a	297 c	1.4 a	50.0 a	2.9 a	17.7 a

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2. Bud selection with a machine is inferior to hand pruning, which leads to less fruitful buds (look at clusters/node). Therefore, you must leave a few more buds per vine to achieve the same yield.
3. Machine pruning alone (Arkansas, without hand follow-up) retains more buds than Hand or Betts, which leads to a higher crop that may need to be adjusted by crop thinning 30 days after bloom.
4. Minimal pruning retains even more buds than the other treatments, which leads to high yield, low brix, low periderm, and low fruitfulness. It is important to note that Minimal pruned vines did not make minimum brix in 1999 even with thinning (\* indicates thinned vines).

### Economics: Hand vs. Machine with Hand Follow



acres	\$ Saved per Year
1	\$150
25	\$3,739
50	\$7,479
75	\$11,218
100	\$14,957
125	\$18,696
150	\$22,436
175	\$26,175
200	\$29,914

Refer to spreadsheet for number crunching.

## Machine Pruning with Hand Follow-up vs. Hand Pruning

	User Entered	Calculated
<b>Machine Pruning with Hand Follow-Up</b>		
Price of Pruner	25,000.00	
<b>Pruner Operation</b>		
Total vineyard acres?	50	50
Row and Vine spacing?	vine sp. 8 row sp. 9	
Vines per acre.		605
Acres covered by machine pruner in one hour?	1	
Hours per day the pruner is operated?	8	
Acres covered in one day.		8.0
Cost of fuel (per gallon)?	1	
Gallons used per hour?	1	
Daily Fuel Cost		8.00
Hourly pay rate of machine pruner operator?	12	
Labor cost of machine pruning per day.		96.00
Benefit Rate (SS, WC, Health, Ret.)%	35	
Paid benefits of machine pruning per day.		33.60
Total Machine Pruning Labor per Day		129.60
<b>Pruner Maintenance</b>		
Maintenance hours per day?	1	
Hourly pay rate for machine maintenance?	12	
Labor cost for maintenance per day		12.00
Benefit Rate (SS, WC, Health, Ret.)%	35	
Paid benefits of maintenance per day.		4.20
Total Maintenance Labor per Day		16.20
Fuel, Pruning, Maintenance cost per day		153.80
Daily cost per acre		19.23
Estimated days to prune total acres		6.3
Estimated cost to prune total acres		961.25
<b>Hand Follow-up (large pruning cuts, tying, suckering)</b>		
Vines covered in one hour?	100	
Hours to cover one acre.		6.05
Hourly pay rate for hand follow-up?	12	
Labor cost per acre.		72.60
Benefit Rate (SS, WC, Health, Ret.)%	35	
Paid benefits per acre.		25.41
Total labor cost per acre.		98.01
Estimated cost to follow-up total acres.		4,900.50
<b>Pruning with Hand Follow-Up</b>		
Total pruning with hand follow-up cost per acre.		117.24
<b>Total pruning with hand follow-up cost for total acres.</b>		<b>5,861.75</b>
<b>Hand Pruning</b>		
Dollar rate per vine? (30 cents = 0.30 dollars)	0.3	
Labor cost per acre.		181.50
Benefit Rate (SS, WC, Health, Ret.)%	35	
Paid benefits per acre.		63.53
Pruning labor cost per acre.		245.03
<b>Follow-up (tying and suckering)</b>		
Vines covered in one hour?	300	
Hours to cover one acre.		2.02
Hourly follow-up rate.	8	
Labor cost per acre.		16.13
Benefit Rate (SS, WC, Health, Ret.)%	35	
Paid benefits per acre.		5.65
Follow-up labor cost per acre.		21.78
Total Cost per Acre		266.81
<b>Total Cost to Hand Prune Vineyard</b>		<b>13,340.25</b>
<b>Savings per Year with Machine Pruning</b>		<b>7,478.50</b>
Years to pay for pruner with	50 acres	3.34