Factors Affecting Cost of Weed Management in Trees and Vines

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Managing weeds in orchard and vineyard settings is no easy task. No single weed control program will work for all growers or in all situations. In some cases, multiple strategies may need to be used over the life of the crop as weed types and populations change. Numerous factors can affect management decisions and costs for controlling weeds. Some important ones include, types of weeds, stage of weed growth, degree and length of control, availability of herbicides, equipment, labor, and cost. Cost of implementing various tools is often a driving factor behind the type of strategy employed. Growers and managers must weigh the risks associated with chemical and non-chemical options with the costs of using those techniques. In economic hardships, market value of a commodity may, in part, be a driving force behind the options used.

Regardless of the type of strategy employed, there are several steps that can be taken to help reduce overall costs associated with the selection and use of chemical and non-chemical tools. These steps include routine weed monitoring, proper sprayer calibration, accurate and timely applications, adjust the herbicide rate as needed, and eradicating perennial weeds before they become established.

Routinely monitoring fields for weeds will help you to determine the success of the current program strategy. It is inexpensive and does not add to the overall cost of control, but rather reduces it, allowing one to make adjustments to the program before problems arise. Weed surveys can easily show if current weed control measures need to be modified. The procedure is rather easy, requiring five steps: 1) walk several locations of the field every three months and identify any weed problems, 2) rate the weed infestation and record the findings, 3) note any new weeds, weed escapes, or a shift in the types of weeds, 4) map out areas of the field that are of particular concern, and 5) maintain the records in a file where they can be easily retrieved and updated.

It cannot be overemphasized how important it is to have a properly calibrated sprayer. Applying herbicides through spray equipment that is in proper working function and has been accurately calibrated will help insure the proper doses of herbicides are applied. This maximizes control and reduces unnecessary waste of product and resources, potential crop injury, down time, and contamination of the environment. Some herbicides, like halosulfuron methyl, require a low use rate (2/3 to 1 1/3 oz/acre), so it is critical that the proper dose of this and other herbicides be made. Replace or repair worn or damaged nozzles, hoses, pumps, and other parts that may contribute to poor or erratic spray discharge.

Herbicides should be applied uniformly and timely. Pre-emergence herbicides are applied before weed seeds germinate. Some weeds have prolonged or multiple germination periods and may require higher doses or split-applications for adequate residual control. Since winter and summer annual weeds germinate at different times of the year, it is important to understand the life cycle of weeds to better time pre-emergence sprays. Adjusting the timing of application to best meet the periods of weed seed germination will help maximize the effectiveness of control. It is equally important to apply the spray to the soil in a manner that insures proper pattern overlap. This will help reduce overlapping or weedy streaks in the field.

Post-emergence herbicides must also be applied properly and in a timely manner. The weeds should be small (less than 4" tall), and the foliage should be thoroughly wetted for adequate control. This is especially true when using contact-type herbicides, like paraquat, diquat, and glufosinate. Consider adding a spray surfactant to the tank to control hairy weeds like hairy fleabane or cudweed. As weeds increase in size, it becomes more difficult to control them, even with higher rates of herbicides, so spray them when they are young and actively growing. For example, research by Tim Prather in 1999 showed that the hairy fleabane control was affected by growth stage and amount of glyphosate was applied (see table 1).

Table 1. Influence of growth stage of hairy fleabane on control with glyphosate

Hairy fleabane stage	Glyphosate (Lb ai/A)	Herbicide cost/A ($)
3 – 6 leaf	0.5	1.25
7 – 12 leaf	1.0	2.50
13 – 19 leaf	1.5	3.75
20 – 21 leaf	2.0	5.00
> 25 leaf	no control	NA

Timothy Prather, 1999

"Smart spray" applicators can be used to significantly reduce amount of herbicide needed and cost, by only applying post-emergence sprays where weeds are growing and not the bare soil. For example, using the Patchen Weed Seeker® to treat an orchard or vineyard berm that has a weed cover rating of 100%, would require 64 oz/acre of product (like glyphosate) if mixed at a rate of 2% by volume (25 gpa) and sprayed broadcast. A 20% and 5% weed cover rating would use 12.8 and 3.2oz/acre, respectively. Under this scenario, the herbicide cost (currently $40/gal) for the three treatments would be $5/A (64 oz), $1/A (12.8 oz), and $0.25/A (3.2 oz).

Controlling weeds mechanically (especially within the planted row) should also be done when weeds are less than four inches tall. Small-seeded broadleaves and grasses are fairly easy to dislodge from the soil when they are small, because they have not yet developed strong root systems. Most perennial weeds growing in the tree or vine row are not effectively controlled with in-row equipment. Johnsongrass, however, can be controlled in mature vineyards by using

a French plow to remove the large underground rhizome segments from the row and brought to the row middles. There they can be disked and chopped into small segments, making control easier with pre- and/or post-emergence herbicides. An operation like this may run $100 or more per acre, but can provide effective control. Always adjust and operate the equipment as recommended by the manufacturer to improve the efficiency and effectiveness of control.

Herbicide labels usually show various rates that can be applied, depending on the type and stage of weeds present, soil type, and other factors. Use the lowest rate possible to control the spectrum of weeds that best describes your field. In some cases, lower doses of herbicides will provide equally effective control as higher rates, which can save money. Tank-mixing certain herbicides can also be an effective method of providing effective control while using reduced rates. For example, combining low rates of diuron and simazine can be an effective method of controlling a broad spectrum of weeds at a reduced cost, compared to either alone used at higher rates. These materials are inexpensive by themselves, and can be added with other herbicides to broaden control, without significantly increasing costs.

It is possible to reduce the number of pre-emergence sprays needed, depending on how clean the field is. By reducing the weed population in a field over time to a point where the ground appears nearly bare, spot treating with post-emergence sprays may be all that is needed to maintain control. Here, a pre-emergence treatment could be applied every third or fourth year as part of a maintenance program to maintain a low seed bank level. For this to work, it is important to prevent new weed seed from entering the field. This isn't always possible, however, since many weed species disseminate their seed by air and can readily invade a field.

Studies have been conducted comparing the cost of pre- and post-emergence herbicide programs to mechanical programs. In trials conducted in almonds from 1995 to 1998, it was determined that overall program costs were similar between the different management strategies tested (see table 2). It was noted however, that programs involving pre- and post-emergence herbicides resulted in a reduction in the total number of applications needed plus trips through the field, compared to a mechanical mowing program. This led to a significant reduction in the amount of time and labor needed to achieve control, freeing up labor to perform other tasks.

Deciding on whether to use mechanical means, pre- or post-emergence herbicides, or a combination of tools should be based on local conditions and cost of treatment. Tables 3 and 4 show some of the typical mechanical equipment and common herbicide costs used in orchards and vineyards, although specific prices may vary within the state. Weed control program costs vary greatly, depending on the growing region, cost of equipment and herbicides, personal preference of methods used, soil and field conditions, weed spectrum, desired degree of control, availability of equipment and labor, crop market price, and other factors. In other words, there is no one right answer. You should select the program that meets your specific needs.

Table 2. Accumulated costs for orchard floor management; January 1995 through August 1998

Treatment	Chemical Cost ($)	Application Cost ($)	Mowing Cost ($)	Total Cost/A ($)
Mechanical Mowing + preharvest Roundup	84 (5)*	25 (5)	149 (28)	258 (33)
Chemical Mowing w/Roundup, mechanical mowing, and preharvest Roundup	136 (11)	55 (11)	91 (17)	281 (28)
Low Residual w/Surflan + Roundup, mechanical mowing, and preharvest Roundup spot treatment	144 (9)	45 (9)	75 (14)	264 (23)

* (x) = total number of times the application or operations were conducted

J.H. Connell et al. 1999. CWSS Proceedings. 51:66-70.

Finally, it is advantageous to eradicate perennial weeds before their populations become "unmanageable". It is difficult, if not impossible, to put a price on the cost of eradicating tough perennial weeds (like purple or yellow nutsedge) once they become established throughout the field. The least expensive method of control is to keep them out in the first place. Don't allow them to produce seed or reproductive structures. Resources should be spent controlling them along field edges, roadsides, irrigation ditches and canals, and other locations, so that they don't get into your field. I believe the old adage goes "An ounce of prevention is worth a pound of cure". Once located within an orchard or vineyard, assign a person to stay on top of these areas and dedicate resources to eradicating it. It will take some time and resources, but far less compared to once they become established.

Simply comparing costs of the various chemical and non-chemical options available and making management decisions based solely on those costs does not lend itself to cost-effective weed management. The final strategy should be made based on taking into consideration all the information available and using that information for making smart, cost-effective decisions.

Table 3. Sample cost of different equipment used for weed control

Equipment	Tractor	Outlay Cost	Speed (MPH)	Operating Cost/Hr.	Labor Rate/Hr.*	Use in Hrs./A	Total Cost/A
Perfect In-row Mower	60 HP, 4WD	$8,500	1-2	$14.22	$12.70	1.38	$37.15
Kimco In-row Mower	60 HP, 4WD	9,000	1-2	14.22	12.70	1.38	37.15
Rears In-row Mower	60 HP, 4WD	2,500	1-2	14.22	12.70	1.38	37.15
Chris Grow Mower	60 HP, 4WD	8,000	3-4	31.22	12.70	0.80	35.14
Flail Mower	60 HP, 4WD	3,966	3-4	31.22	12.70	0.80	35.14
Hand-held Weed Eater	-----	225	---	6.75	12.70	9.00	175.05
Kimco In-row Tiller	60 HP, 4WD	11,000	1-2	22.53	12.70	1.38	48.62
L&H In-row Tiller	60 HP, 4WD	4,500	2.5	8.53	12.70	1.10	23.36
L&H In-row Hoe Plow	60 HP, 4WD	4,200	3-3.5	15.22	12.70	1.00	27.92
In-row Cultivator	60 HP, 4WD	4,222	2.5	14.22	12.70	1.10	29.61
Spader	60 HP 4WD	2,600	3	14.22	12.70	0.92	24.77
Disc, Offset 8’	60 HP, 4WD	9,410	3	11.97	12.70	0.92	22.70
Mulch Spreader	60 HP, 4WD	10,000	2-3	16.22	12.70	1.10	31.81
Propane Flamer	60 HP, 4WD	3,000	1-2	22.53	12.70	1.38	48.62
Steamer	60 HP, 4WD	4,000	1-2	22.53	12.70	1.38	48.62
Enviromist Sprayer	ATV	6,000	3	10.72	12.70	0.92	21.55
Patchen Weed Seeker	ATV	6,000	3	12.72	12.70	0.92	23.39
100-gal Weed Sprayer	60 HP, 4WD	3,404	3	19.22	12.70	0.92	29.37
50-gal Weed Sprayer	60 HP, 4WD	2,300	3-3.5	19.22	12.70	0.92	29.37

*Includes benefits, taxes, and miscellaneous expense paid by the grower

Table 4. Sample costs of various herbicides and combinations of herbicides

Pre-emergence Treatments	Lb a.i./A	Product/A	Cost ($)	Cost/A ($)*
Goal 2XL®	1.0	0.50 gal	96/gal	12.00
Goal 2XL® +	1.0	0.50 gal	96/gal	12.00
Surflan A.S. ®	4.0	1.00 gal	90/gal	22.50
				34.50
Princep Caliber 90® +	2.0	2.22 lb	3.20/lb	7.11
Surflan A.S. ®	2.0	0.50 gal	90/gal	11.25
				18.36
Post-emergence Treatments	**Lb a.i./A**	**Product/A**	**Cost($)**	**Cost/A ($)***
Rely®	1.0	1.00 gal	65/gal	16.25
Touchdown®	1.0	0.33 gal	48/gal	3.96
Roundup Ultra®	1.0	0.25 gal	40/gal	2.50
Gramoxone Extra®	0.5	0.20 gal	39/gal	1.95
Sprayable Ammonium Sulfate	---	0.16 lb	18/lb	0.72

*Assumes treating a 3’ berm on a row spacing of 12’ in a vineyard; figures do not include cost of application