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WEED MANAGEMENT

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General Goals of Weed Management

If asked what we do, most of us would answer - grow grapes. It is easy to forget that, in terms of biological complexity, our vineyards are no less complex than any "natural" ecosystem. In addition to grapevines, growers manage (or are being managed by) populations of fungi, insects, nematodes, bacteria, mammals and, not least of all, other plants than grapevines, some of which are weeds. Weeds, by the usual horticultural definition, are plants growing where they are not wanted. In our vineyards even grapevines can be weeds (if they are the wrong variety or feral). However, some plants other than grapevines, especially cover crops, are tolerated or even encouraged.

To attempt to manage rationally we need to understand the management goals, and to realize that we will never be able to exert absolute control over weeds any more than we can ultimately control the rest of the vineyard ecosystem. Instead we should attempt to use techniques which encourage a beneficial, rather than a detrimental, mix of plant growth in the vineyard.

Plants growing in the vineyard do many things. They compete with grapevines for water, nutrients and sunlight. They can directly add nutrients (legumes) or, by adding organic matter, they can indirectly supply nutrients. They can harbor pests or diseases or they can sustain predators of the same pests and diseases. They can harm workers (I'm very sensitive to poison ivy, and view it as some people do snakes or spiders - the only good poison ivy is dead poison ivy), or they can feed workers (I also like a spring burdock feed). Most importantly, they maintain soil quality by preventing erosion, by providing support to heavy equipment moving through the vineyard and by adding organic matter. Although changing markets often are cited as the reason for reduced acreage in the Finger Lakes, 100 years of deep and continuous cultivation produced so much erosion that many formerly profitable vineyard soils are no longer able to sustain competitive production.

What are the goals? The first goal should be, but not always is, sustainability. Erosion needs to be prevented. Soil organic matter should be maintained or enhanced. Support for equipment should be provided so that timely sprays and

Table 1. Comparison of Conventional and Organic Weed Control In-The-Row Post Harvest Weed Assessment October 20, 1993

		Percent Ground Cover	
Variety	Method	Average	Standard Error
Concord	Organic	56.2	3.50
	Conventional	5.6	1.37
Elvira	Organic	47.5	4.14
	Conventional	0.3	0.30
Seyval	Organic	55.5	6.02
	Conventional	0.3	0.26

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harvest can be made without causing rutting and soil compaction. The best way to accomplish these tasks is to have live or dead plants established in the vineyard. Mulches can be useful, but they are expensive, and often restrict rather than enable equipment access to vineyards.

Secondly, plants should not excessively compete with the vines for water, nutrients or sunlight. This is accomplished by managing where, when and what kind of other plants grow in the vineyard.

Thirdly, vineyard floor management should reduce the environmental impact of grape growing. This is accomplished by preventing erosion (a major source of phosphorus build-up in water supplies; by serving as a reservoir for nutrients during periods when grapes are not taking them up; and by avoiding export of herbicides or other chemicals outside the vineyard. Non-grape plants should harbor predators, not pests, and they should not become contaminates of the grapes delivered to processors.

Because grapevines are planted in rows, their roots and leaf canopies are not distributed uniformly in the vineyard. Thus we recognize two different management zones, the in-row zone under the leaf canopy and the between-the-row zone between the canopies. The management needs and options of these two areas differ, so they will be discussed separately.

In-the-row weed management is more difficult. This is the area of maximum grapevine root function, so it is the area where vines least tolerate competition for water or nutrients. Plants which can grow in this shaded part of the vineyard tend to be very vigorous and competitive. Tall weeds will compete for light, reduce spray coverage, increase humidity and drying time and can directly contaminate machine harvested grape loads. Management options are also reduced in this area. Herbicide labels often do not permit contact with grape foliage, and impact of cultivation on grape roots is greatest where grape root density is greatest. The primary goal then is to prevent any non-grapevine plants from growing in this area. A problem with this approach is the high erosion potential. A way to reduce erosion hazard, especially in winter and spring, without increasing grapevine competition is needed.

Between-the-rows weed management is much different. In this region there is a different balance between negative aspects of non-grape plant growth (competition) and their positive impacts (erosion control, soil quality enhancement, pest management and equipment floatation). The historic practice of deep cultivation is thankfully just that, historic. Present standard commercial practice in New York uses a no-till approach where glyphosate (round-up) replaces cultivation to suppress weed growth during periods when the grapevine is most sensitive to competition from other plants. We also have considerable research and commercial experience with continuous “natural” sods (primarily covers of mixed orchardgrass and broad leaf weeds such as dandelion and plantains). In the typical New York vineyard situation these provide excessive competition, but where soils are very deep and vine vigor much above average, sods offers many advantages and few problems (primarily harboring cut worms and plants which serve as reservoirs of the soil nematode transmitted ringspot virus disease complex).

Present Organic Weed Management Options

In-the-row organic weed management options are limited and include cultivation, the use of a “natural” contact herbicide - sharpshooter, and the propane weed burner. Other options such as mulches or less competitive cover crops might be feasible, but their utility has not been proven. For this project we primarily relied upon mechanical cultivation (grape hoe) or a combination of mechanical cultivation and

Table 2. Effectiveness of propane weed control and paraquat treatment in controlling different weed species.

Weed Common Name	Genus species	Plant Height (cm)	% Mortality 8 days after treatment: Propane Weed Control	Paraquat
Quackgrass	*Agropyron repens*	10	0	99
Plantain Buckhorn	*Plantago lanceolata*	5	80	99
Leafy Spurge	*Euphorbia esula*	25	100	99
Horsetail	*Equisetum arvense*	7.5	>10	25
Lambsquarter	*Chenopodium album*	10	99	99
Grape Seedlings	*Vitis sp.*	6.3	100	99
Velvetleaf	*Abutilon theophrasti*	7.5	100	99
Virginia Creeper	*Quinquifolia parthenocissus*	5	80	99
Morning-glory Bigroot	*Ipomoea pandura*	7.5	90	90

propane weed burning to manage in-the-row weeds. None of these proved to be wholly satisfactory.

Cultivation was effective in removing weed competition (Figure 1, Table 1), but it is a very expensive operation which must be done several times per season, and it has the detrimental effects of causing root pruning and encouraging erosion. We are experimenting with the use of special plants and mulches for in-row weed management, but to date no satisfactory organic alternative has been identified.

Sharpshooter appears to be as effective as paraquat in controlling emerged weeds. However, in spite of being a "natural" herbicide, its use does not really fit in with the spirit of organic weed management and eradication. Its cost is also prohibitive.

The propane weed burner produced mixed success. We spent much time trying to apply this technique to the vineyard situation as a non-chemical method of weed control. First results were partially satisfactory, but the equipment

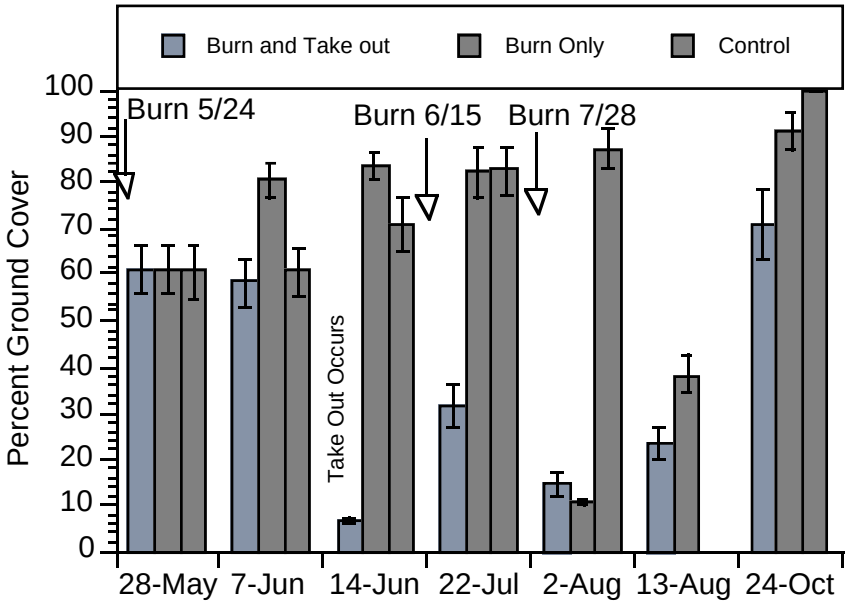

Figure 1 In the row percent weed cover response to liquid propane weedburner applications at various times during the 1993 growing season in the Concord organic block at Taylor Wines, Dresden, N.Y.

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was inadequate. Later with improved equipment we were able to achieve sufficient weed control relative to paraquat (Table 2), but there were still problems which are illustrated in Figure 1. Our basic strategy was to use the weed burner in combination with cultivation. We were concerned that weed burning alone would lead to a build-up of perennial and biennial weeds, so we planned on at least one take-out and hill-up each season.

In Figure 1 three treatments are shown. A control treatment with no weed control, a weed burning only treatment and a cultivation (take-out) treatment combined with weed burning. The first weed burn in 1993 was on May 24. The day was foggy, and unknown to us, a film of water on the plants prevented the attainment of lethal temperatures. The first take out was on June 14, and weeds were re-burned on June 15. Again, thermal weed control was inadequate. After much work, we found that the propane nozzles were not delivering sufficient pressure. The burning of July 28 was more successful, and produced results comparable to cultivation. However, at that time we found that, although foliage damage had not been a problem previously, treatment at a time when the vines were under water stress and the leaves were not transpiring freely, resulted in some grape foliage injury. Our later experience working with large Concord vines with closed canopies also resulted in excessive grape foliage injury.

In summary, the weed burner offers some prospects to supplement mechanical or chemical means of weed control. However, only when the vines are not under water stress and have relatively open canopies. Propane weed burning did an excellent job of sucker control relative to paraquat. At optimum operation and when substantial quantities of propane were purchased, the cost of propane treatment was not greater than treatment with paraquat

Between-the-row weed management was no-till round-up for conventional management and continuous sod for the organic blocks. Sub-plots were established in the organic blocks comparing clover and natural sod covers. All of these options are desirable in terms of sustainability, but the permanent covers were more competitive than the conventional not-till approach. The excessive competition was the primary reason that yields in the organic treatments were lower than conventional vine yields, especially following years of inadequate rainfall (see table 4).

Because cultivation is very undesirable, we were not able to identify practices which were both sustainable and acceptable for organic grape growers. As a result, we initiated work with alternative systems. We have made good progress with these approaches and will present data below. Future application of these techniques will depend upon future funding to pursue the research.

Table 3. Floor management treatments being evaluated at the Vineyard Laboratory, Fredonia, New York.

1. Mulch. with oat straw at ~5 tons/acre
2. Herbicide. Glyphosate applied at grape bloom with 1.5 qt. Roundup.
3. Cultivate. Goal is to eliminate competing weed growth from bud break (~May 1) till early August with 4-5 cultivations.
4. Orchardgrass, *Dactylis glomerata* L. (unmowed permanent sod).
5. Orchardgrass. Mowed 5-6 times per year when grass reaches height of 12-15".
6. Kentucky bluegrass, *Poa pratensis* L. (permanent cover).
7. Crown vetch, *Coronilla varia* L. (permanent cover).
8. White (alsike) clover, *Trifolium hybridum* L. (permanent cover).
9. Annual rye grass, *Lolium multiflorum* Lam. Annual seeding in early August.
10. Killed annual rye. Annual seeding in August, killed with glyphosate at about grape bloom.

Table 4. Effects of between-the-row floor management on 1993 vegetative growth (cane pruning weight) and 1994 yield and quality of balance pruned Concord grapevines growing at Fredonia, NY.

Floor cover	Cane Pruning Wt. (lb)		Clusters/ Vine		Tons/ Acre		Juice Soluble Solids (%)	
Mulch	3.2	abc	150.4	abc	9.2	ab	15.4	de
Round-up	2.5	bc	121.0	bcd	7.7	bc	15.8	cd
Cultivate	2.8	abc	137.5	abc	7.4	bcd	16.1	bcd
Orchard Grass	1.4	d	68.8	d	4.7	e	16.7	ab
Mowed Orchgrass	1.5	d	68.8	d	4.5	e	16.8	ab
Blue Grass	1.9	cd	84.3	d	5.1	e	17.0	a
Annual Rye	2.4	bc	129.5	abc	8.0	abc	15.6	de
Killed Rye	3.3	a	166.1	a	9.8	a	14.9	e
Crown Vetch	1.9	cd	88.8	cd	5.6	de	16.8	ab
Red Clover	1.9	cd	92.5	cd	6.2	cde	16.6	abc

Ten systems are being evaluated in the research block. The treatments are listed in Table 3. This research is being conducted on mature, balance pruned (20 nodes/ lb of prunings) Concord grapevines growing at the Vineyard Laboratory in Fredonia, New York. Several aspects of floor cover management are being considered. Mulching insures minimum cover competition and is included as a reference. Similarly, treatments 2 and 3 represent the best current commercially recommended herbicide and cultivation treatments respectively. Effect of mowing standard orchardgrass and replacing it with supposedly more drought intolerant blue grass is also being evaluated. The contribution and competitiveness of two legumes, clover and crown vetch, are evaluated because of their potential to enhance the nitrogen status of the

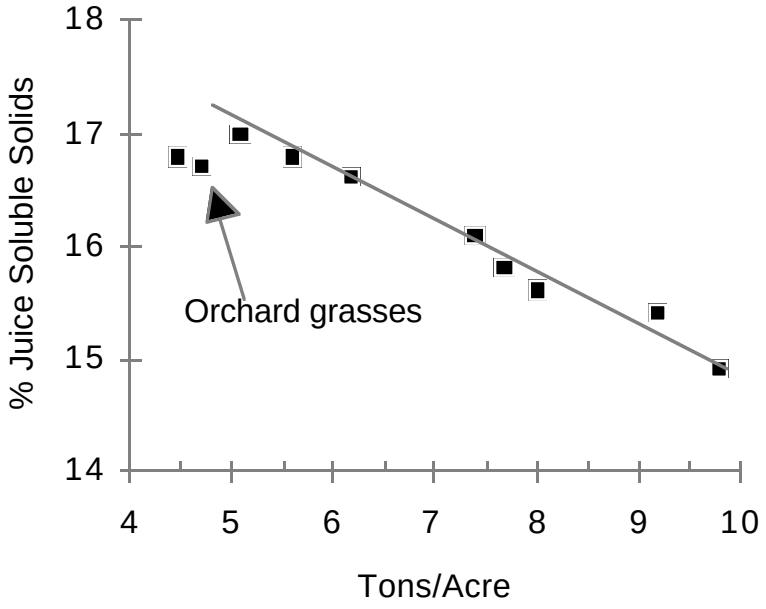

Figure 4. Concord fruit maturity in 1994 as related to 1994 vine yield for the 10 cover crop management systems at Fredonia. Note that orchard grass and mowed orchard grass covers had low maturity relative to other treatments indicating increased stress.

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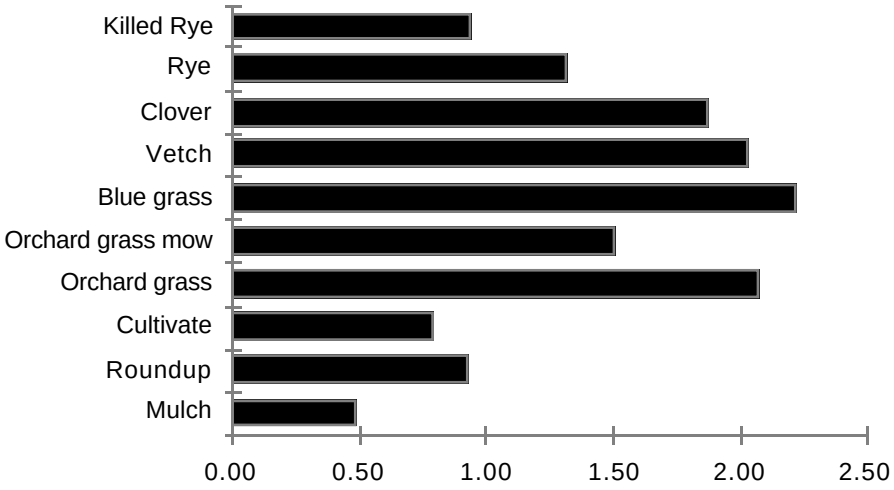

Figure 5. Relative water use by different cover crops during the period bloom to veraison.

soil. Finally, an allelopathic grass, rye, which potentially may replace herbicides in suppressing weed germination and growth is being tested.

Covers were planted in 1991 but did not become fully established until 1992. Data for 1994 thus reflect effect of covers on 1993 and 1994 growth. Because of a very dry late summer in both years, mulch treatments have the highest combination of vine size and yield (Table 4). Cultivated and no-till plots maintained good vine size and yield. The effect of competitive covers is seen with the grasses and legumes which reduced vine size and yield. Mowing orchardgrass did not substantially reduce its competitiveness. The rye covers did not induce maximum vine size, but were associated with high yields (Table 4), reduced competition (Figure 3), and reduced water consumption by the cover crop itself (Figure 5). In addition to evaluating the time when cover crop plants are active (Figure 4), water consumption of covers was monitored by placing double pots planted to the different cover crop systems in row middles and following water consumption gravimetrically (Figure 5). Figures 4 and 5 show the importance of water competition. Generally, covers which used less water resulted in higher yields and satisfactory fruit maturity. However, Figure 4 shows that competition affects more than just vine vigor. The high water consuming orchardgrass plots not only had small yields, but because late season water stress reduced grapevine photosynthesis, they also produced fruit of lower quality relative to the yield.

Summary

Present floor management options open to organic grape growers are cultivation or a continuous cover. Experience has shown that, in dry years, organically managed vines suffer increased drought stress when the “natural” cover (mixed orchard grass and broad leaf weeds) which develops when Finger Lakes row middles are only mown, are used instead of the conventional glyphosate no-till approach. Legume covers appear to be at least as competitive as the natural covers. Tests with alternate cover crops have generally not verified reported benefits from reportedly low competition covers such as bluegrass, but inclusion of rye grass appears to offer real benefit. Decaying rye grass debris inhibits weed seed germination and reduces vine competition during critical periods. The result has been enhanced vine growth, yield and quality. These approaches need to be more broadly applied; the potential for allelotrophic suppression of in-the-row weeds should be evaluated.

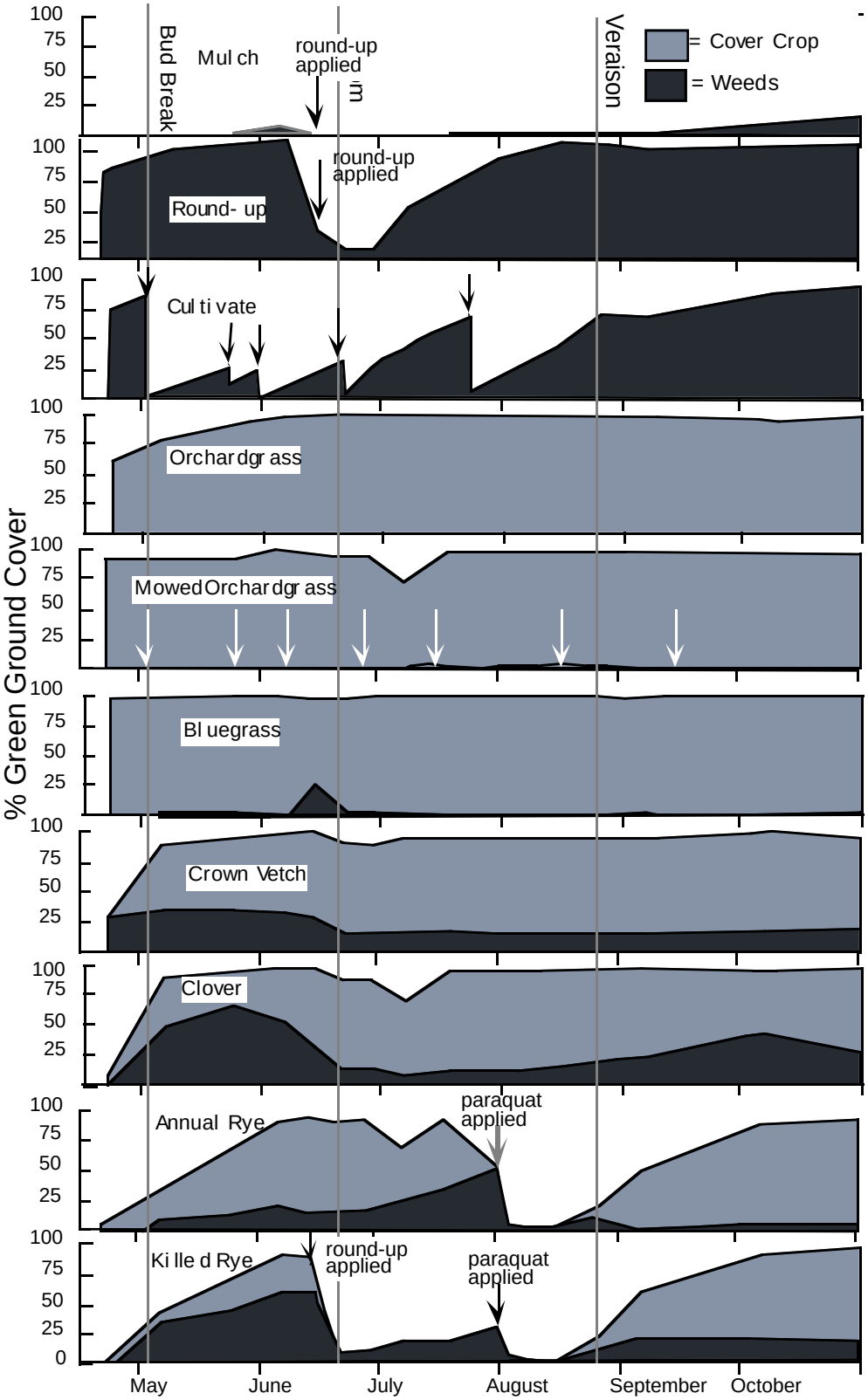

Figure 3. Season percentage cover for different floor management strategies during 1994 at the Fredonia Vineyard Laboratory cover crop experiment.

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