Volume I Number 5
GRAPE FACTS

Managing Weeds in New York Vineyards

V. Managing Vineyard Floors Using No-tillage

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Introduction: Reasons for avoiding vineyard tillage

Productive vineyards have large vines which contain sufficient reserves to ensure that both a substantial crop of grapes and new vegetative growth can be produced. An important management practice traditionally used to enhance vine growth is the elimination of competing vegetation from the vineyard by cultivating the soil under and between the rows. In the short run, cultivation stimulates vine growth by eliminating competition, but long term yield declines have been attributed to the practice. Long term cultivation can result in damage to the soil structure and reduced organic matter, nitrogen supply, and water permeability. It also directly injures vines by pruning roots and, for vineyards planted on slopes, cultivation increases loss of top soil through erosion.

To reduce these negative effects of cultivation a modified between-the-row cultivation technique, called **trashy cultivation**, was developed. With trashy cultivation, deep disking is avoided (usually by adding spacers which restrict the depth to which disks can penetrate the soil). Instead, a shallow cultivation is used which eliminates only 70-80 per cent of the ground cover. With trashy cultivation competition from weeds is reduced, but the retained plants stabilize the soil and aid water penetration. While trashy cultivation generally reduces the negative impact of cultivation it does not completely eliminate it.

Using mown sods

The negative effects of cultivation on soil structure and erosion can be eliminated by not cultivating between-the-rows and letting a permanent or semi-permanent cover become established. These permanently growing plants effectively prevent erosion, maintain or increase soil organic matter concentration, and help maintain desirable soil structure. They also help to prevent compaction and rutting caused by heavy equipment such as the grape harvesters used in the vineyard.

The problem with this approach is that the ground cover plants compete with the vine for water and nutrients (especially nitrogen). Sites with deep or rich soils may be able to supply sufficient resources to meet the needs of both the vine and the ground cover plants, but many New York vineyard soils cannot supply adequate resources to meet the needs of both vines and cover crops plants during dry periods. The use of irrigation and supplemental nitrogen can help vines thrive on less-than-perfect sites, but most New York vineyards are not irrigated. It has been speculated that specific ground cover plants might be selected to reduce the degree of vine competition caused by the between-the-row living ground cover, but there is almost no data describing how specific plant species differ regarding competition with grapevines.

Using killed sod (no-tillage)

No-tillage has been developed as an alternative to cultivation for many crop. With no-tillage, competing plant growth is suppressed or controlled using herbicides. Eliminating plant growth with herbicides offers several potential advantages over conventional tillage, including reduced erosion and soil compaction, improved moisture status due to reduced evaporation, increased percolation rates, and reduced energy costs and equipment requirements. Soils managed with no-tillage systems for extended periods of time generally have higher soil organic matter content than tilled soils.

Vineyard no-tillage has been studied in South Africa and Europe where it was found that vines growing under no-tillage had better vine size, yield, and fruit quality than those growing under clean cultivation or sod. In these studies, no-tillage treatments utilized pre-emergence herbicides with residual activity that results in season-long weed control.

These results from areas without summer rainfall suggest that no-tillage might be a useful alternative to trashy cultivation for 'Concord' vineyards growing under the summer rainfall conditions of New York state. Because between-the-row plant covers during harvest and winter are desirable in that they reduce compaction by harvesters and supply organic matter to the soil, a non-persistent herbicide, gylphosate (Roundup®), was chosen for our New York studies. Glyphosate allows weed re-growth to occur by late summer. In order to test the utility of no-tillage for New York vineyards, two, four-year studies were conducted from 1984-1987 in Chautauqua County, New York. They compared the impact of no-tillage using non-persistent herbicides with that of traditional vineyard floor management practices. One experiment compared three herbicide treatments with two cultivation methods, permanent sod, and mulching in a typical eroded, hillside vineyard where soil depth restricts root growth. A second experiment compared three herbicide treatments with clean cultivation in a vineyard where the potential for deep (> 6m) root growth is possible.

The results were similar for both experiments and showed that a single

Table 1.—Impact of between-the-row vineyard floor management practices on growth and yield of Concord grapevines growing in a shallow, eroded soil.

Floor Management	Cane Pruning Weight/Vine (lbs) 1983 Grown	1987 Grown	Change 1983-87	Cumulative Tons/Acre
Mown Sod	1.6 ab	2.3 b	+0.7 b	17.7
Trashy Cultivation	1.6 ab	2.6 ab	+1.0 ab	18.7
Clean Cultivation	1.3 b	2.5 ab	+1.2 a	17.1
Mulch	1.7 a	3.0 a	+1.3 a	19.4
Bud Break Herbicide	1.4 ab	2.8 ab	+1.4 a	20.0
Bloom Herbicide	1.5 ab	2.8 ab	+1.2 a	19.2
Bud Break + Bloom Herbicide	1.3 b	2.5 ab	+1.2 a	18.7 NS

application of the non-persistent herbicide, glyphosate, would reduce competition from between-the-row weeds as effectively as either clean or trashy cultivation (Table 1). In addition, growers reported less rutting and better vineyard access for equipment during wet periods.

Chemicals available

To date we have only used gylphosate for vineyard no-tillage. (See Managing Weeds in New York Vineyards, Fact Sheets No's. 3 and 4 for information about herbicides which can be used by New York grape growers.) This herbicide has important advantages over other materials available to New York grape growers; it is systemic, non-persistent, and has low mammalian toxicity. Non-persistence ensures that plants can later become established in the row middles, providing support, organic matter, and stability to the soil. The other alternative is to use a non-systemic, non-persistent herbicide such as paraquat (Gramoxone®). However, when these materials are used, deeply rooted perennial weeds are often poorly controlled.

Timing of glyphosate application

Glyphosate will only control living plants, so late winter applications are ineffective in controlling warm season weed growth. Glyphosate may only be applied during the interval between natural leaf fall and the end of grape bloom. That establishes the window of opportunity for application; our data show that vine response to between-the-row glyphosate was similar whether it was applied soon after grape bud break or closer to the beginning of grape bloom. However, other considerations suggest that later applications are preferable. Usually there is little competition between the vine and cover crops during the early growth phase. This is because soils are usually at field water capacity following winter, and the small grapevine canopy requires little water. The presence of weeds in the row middles can provide desirable support for equipment during spring operations. If weed growth exceeds 18 inches, then mowing may be necessary prior to glyphosate application. Glyphosate application near bloom ensures that competition is minimized during the critical fruit-set and early berry growth periods. These are times in which competition for water is likely to result in substantial vine stress (Figure 1). We have obtained consistently acceptable results by using a single application of glyphosate applied about two weeks before grape bloom. That timing allows weed re-growth to occur by late season providing good footing for equipment during harvest and minimizing winter time erosion.

Ways to ensure effective application

General—Glyphosate is most effective when it is applied to actively growing weeds which are large enough that carbohydrates are being translocated to their root system. When weed height exceeds 18 inches, good coverage of low stature weeds in the canopy can be difficult to obtain. In such cases, the middles should be mowed and glyphosate application delayed for about two weeks.

Rates—Best results have been obtained when at least one quart/acre sprayed glyphosate is used. Sometimes areas of the vineyard are infested with weeds that are more difficult to control, such as burdock or curly dock. We suggest that these areas be separately treated with spot applications of higher (2-3 quart/acre sprayed) concentrations.

Carrier—The label states that glyphosate can be applied in a maximum of 40 gallons water per acre sprayed. Effectiveness is enhanced when glyphosate concentration is increased by

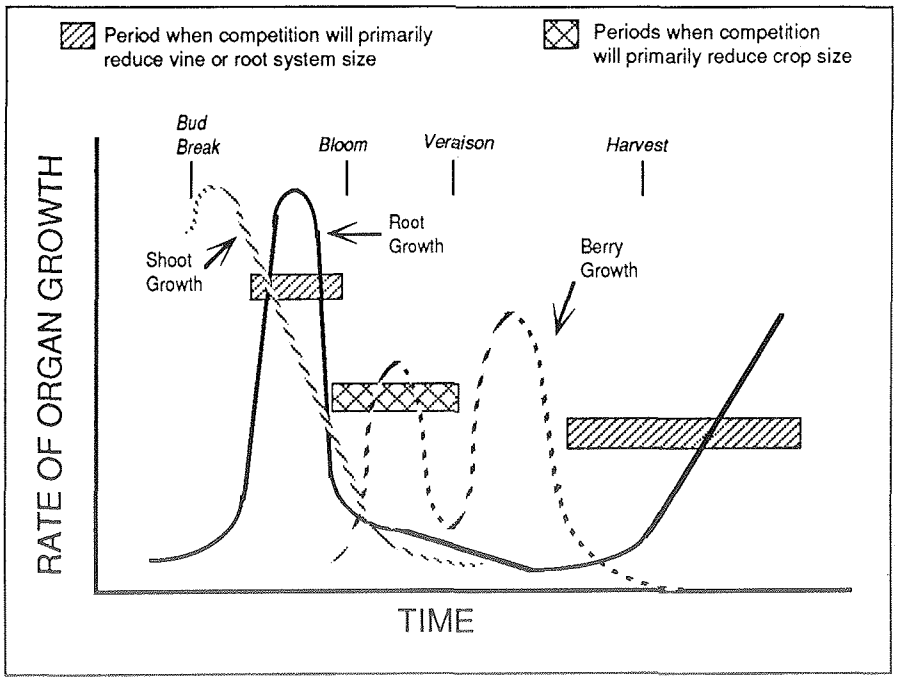

Figure 1. Seasonal change in growth rates of grapevine parts.

using less water in the spray solution. Literature from the manufacturer on low rate technology states that best results are obtained with 5-10 gallons of water per acre sprayed. With proper nozzle selection, most weed sprayers currently used in New York vineyards are capable of reliably delivering 10 gallons/acre. Accurate sprayer calibration is very important for low volume applications. Table 2 lists one method of calibrating vineyard sprayers.

Additions to the tank mix—Weed control with glyphosate is improved by the inclusion of a surfactant in the tank. The manufacturer recommends that two quarts of a surfactant containing at least 50 per cent active ingredient be added per 100 gallons of solution. When weeds are under temperature or moisture stress, effectiveness of glyphosate is reduced. At such times glyphosate performance may be enhanced by adding ammonium sulfate to the spray solutions at a rate of 2 per cent by weight (17 lbs per 100 gallons of water). Low quality ammonium sulfate may contain material that does not dissolve readily and may cause nozzle clogging. When using ammonium sulfate, ensure that the material is completely dissolved in the spray tank before adding glyphosate or surfactant. Thoroughly rinse the spray system after using this combination to prevent corrosion.

Equipment—Most growers make their own spray boom using PVC pipe. For this or any other glyphosate use, galvanized metal should be avoided because glyphosate corrodes it. Figure 2 illustrates a typical boom used for applying herbicides between-the-row. Flat fan or low pressure nozzles should be used and selected to deliver the proper amount of solution. Most commonly used nozzle sizes are in the range 8001 to 8002. As the figure shows, there should be a spray overlap of 30-50 per cent. Depending on nozzle selection, boom height should be from 17-23 inches above the weed surface, and as close to the ground as is possible so as to minimize the likelihood that grapevines will receive spray drift. As mentioned above, it may be necessary to mow the weeds two weeks before application to effectively lower weed height. Many growers mount a second bar about 6 to 12 inches ahead of the spray boom and 6 to 12 inches above ground level to reduce effective plant height. The bar pushes tall weeds down, allowing the entire spray boom to be lowered. That helps to ensure coverage of both tall weeds and any low stature weeds growing under the taller ones.

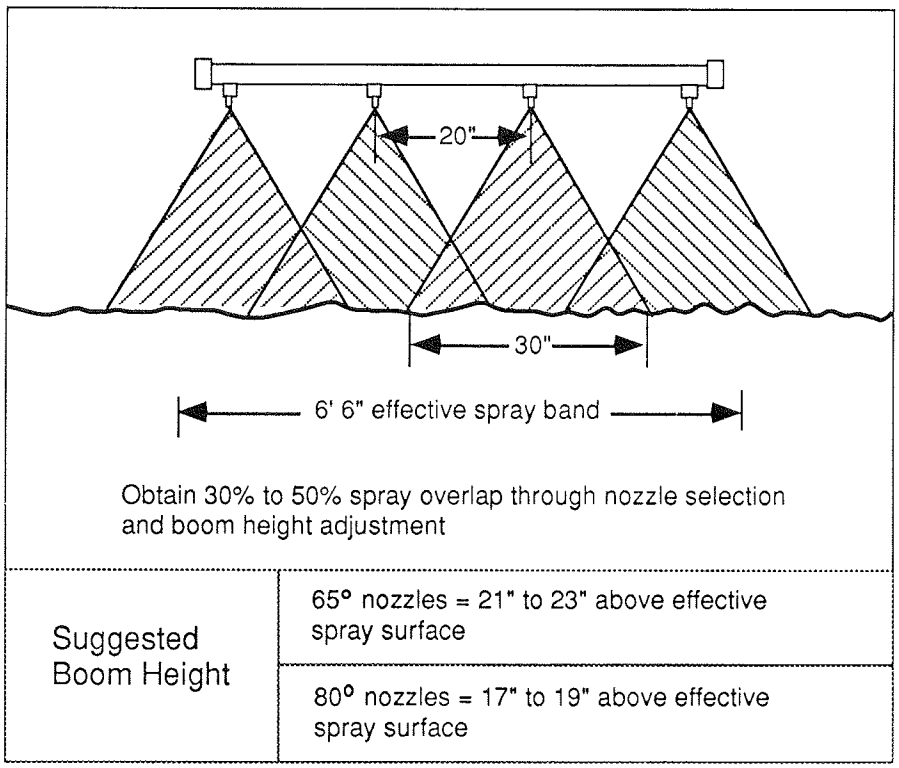

Figure 2. Typical spray boom for controlling between-the-row weeds for grapevines planted in 9 foot rows.

Table 2.—Steps to easy calibration of row middle vineyard weed sprayers.

1. Clean all nozzle tips, lines and spray tank and fill tank with clean water.
2. Select an operating ground speed that will allow for safe, efficient travel through the vineyard.
3. Set pump pressure between 25-35 psi for flat fan nozzles. LP nozzles perform well at pressures as low as 15 psi which minimizes spray drift.
4. Multiply number of nozzles by distance between nozzles to determine band width. (Suggested boom construction is four nozzles spaced 20 inches apart giving a 6' 6" spray band width that receives full rate of spray). For typical vineyard with 9-foot rows and a three foot under trellis spray band, this will treat a 6' 6" center with slight overlap onto the weed band.)
5. Mark off 100 feet and time how long it takes spray rig to travel that distance a the set ground speed.
6. Collect water from all nozzles in the same time it takes the spray rig to travel the 100 foot test distance.
7. Multiply ounces collected by 43,560 (square feet in an acre) and then divide by 660 (100' test run x 6.6' spray width). This calculation gives ounces applied per treated acre. Divide by 128 to get gallons per treated acre.

   Example - It takes spray rig 20 seconds to travel 100'. In 20 seconds all nozzles together put out 19 ounces of water.
   19 oz. x 43,560 ft^2 = 827,640
   827,640 ÷ 660 ft^2 = 1,254 oz. per treated acre
   1,254 ÷ 128 = 9.8 gals. per acre

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Grape Facts is a publication of the New York State Agricultural Experiment Station, Cornell University, Geneva, New York