

College of Agriculture & Life Sciences
Department of Horticultural Science

WEED MANAGEMENT FOR SOUTHEAST VINEYARDS

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The objective of this leaflet is to discuss, briefly, weed-control considerations and herbicide options for grape vineyards in the Southeastern United States. It should be used as a guide for growers making vineyard floor management decisions. It should not be used as an alternative to a pesticide label.

Introduction

The primary goal of weed management is to optimize yield by minimizing weed competition. Weeds reduce yields by competing with crops for water, light, and nutrients. Weeds reduce harvest efficiency, as well. Maintaining a bare soil surface under grape vines can minimize losses associated with frost/freezing events in the spring. This is commonly referred to as the *radiant heat benefit*. Soil surfaces, free of weeds or plant residue, are capable of absorbing heat during the day. The release of the absorbed heat at night can increase vineyard temperatures by a few degrees. Although temperature changes are not large, they can be enough to prevent fruit loss during spring freeze events.

Timely weed removal, wise use of herbicides, and prevention of weed seed production are an integral part of a good weed management system. Many weeds found in vineyards are difficult-to-control perennials, not typically found in annual crops. Weeds commonly found include goldenrod, johnsongrass,

bermudagrass, dallisgrass, dandelion, plantain, and white clover.

The vineyard-floor management system of choice consists of a perennial grass strip between the grape rows. In the grape rows herbicides are directed under vines to maintain a relatively weed-free strip. The herbicide strip is 3- to 4-ft wide. Some vineyards use specialty tillage equipment to eliminate weeds in the vine row. The perennial grass strip minimizes competition and supports equipment movement through the vineyards during periods of wet weather.

Herbicide Considerations

A number of good herbicides are registered for use in vineyards. Herbicides are generally grouped by two categories, preemergence (PRE) or postemergence (POST).

Prior to using an herbicide, or any pesticide, carefully read the manufacturer's label. Labels are legally binding documents and all statements on labels take precedence over any recommendation in this publication.

It is important that equipment be calibrated prior to any pesticide application. Calibration insures that herbicides are applied at the correct rate. Over-application as well as under-application can cost you money. For herbicide calibration information refer to Appendix 1. If you have further questions,

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Spray volume is not regularly discussed but it can have an impact on postemergence herbicide performance. Systemic herbicides (Fusilade, Poast, Select, and glyphosate) should not be applied in spray volumes greater than 25 or 30 gal/acre. High spray volume reduces concentration of the herbicide which can result in less than optimum herbicide performance. Contact herbicides (Gramoxone Max, Rely) should not be applied in spray volumes less than 20 gal/acre. Spray coverage is critical when applying contact herbicides. Volumes less than 20 gal/acre do not give the kind of coverage for optimum herbicide performance. A spray volume of 20 gal/acre is a good volume to use. It is acceptable for applying contact and systemic postemergence herbicides as well as most preemergence herbicides.

Herbicides should be applied as directed sprays to each side of the grape row. The most commonly used and recommended spray tip for herbicide application is the flat fan. They provide excellent spray coverage and come in sizes capable of applying a range of volumes. Some nozzle manufacturers make lat fan nozzles that minimize spray drift. Investing in such spray nozzles decreases the likelihood of off-target herbicide movement.

PRE herbicides control germinating weed seeds but do not usually give acceptable control of emerged weeds. However, some herbicides (e.g. diuron and oxyfluorfen) provide PRE and POST weed control. Rainfall is needed to activate PRE herbicides. Best control results when activation, from rainfall or overhead irrigation, occurs within a few days of application. The desired interval between application and activation varies from one herbicide to another. Refer to the manufacturer's label for specific information.

POST herbicides control emerged weeds and perform best when applied to actively growing weeds. Weeds stressed from drought or mowing may not be adequately controlled by POST herbicides. If weeds are stressed from drought, herbicide application should be delayed until one or two days after adequate rainfall when weeds are no longer wilted. If weeds have been mowed, wait several days to allow re-growth before applying herbicides. Application timing, relative to weed size or growth stage, has an impact on postemergence herbicide performance.

Symptoms of herbicide activity may not be noticeable for up to 14 days after application when using glyphosate, sethoxydim, clethodim, or fluazifop (Roundup, Poast, Select, Fusilade, respectively). Effects of glufosinate, and paraquat (Rely and Gramoxone, respectively) are noticeable within 1 to 3 days. Some POST herbicides require the addition of a surfactant or crop oil concentrate to improve herbicide activity. Remember, surfactants and crop oil concentrate differ from one another and may not be interchangeable.

Weed Management/Herbicide Systems

Establishment and First Year -- In many cases, vineyards are planted into an established, perennial sod. After grape rows have been marked off, and prior to planting, glyphosate can be used to kill vegetation. Usually 1.5 to 2 qt/acre of Roundup WeatherMax or 2 to 3 qt/acre of a generic glyphosate formulation applied 4 weeks prior to planting will control cool-season grasses and perennial weeds common to wine grape production areas. In coastal plain regions or areas where warm-season perennial grasses are common ground covers, a late summer or fall application to marked rows would be more appropriate. In order to control most warm-season perennial grasses apply Roundup WeatherMax or generic glyphosate product at 3 qt/acre or 4 qt/acre, respectively.

Prior to planting, sub-soiling or other tillage operations can be performed. At planting, the use of grow tubes are recommended to protect young vines from herbicide injury. Some herbicide labels require shielding of young vines. Once soil has settled around grape roots after planting, a PRE herbicide should be applied. Chateau (vines must be shielded), Oryzalin, Prowl, Casoron, Goal (if trellis system is used), and Devrinol can be applied to newly planted grapes.

POST herbicides will need to be applied to control escaped weeds throughout the summer. However, young grape vines must be shielded from paraquat or injury will occur. Grow tubes offer excellent herbicide protection along with increased growth during the first year. Perennial grasses can be very competitive. Poast, Fusilade, and Select are registered for use in newly established vineyards. They are safe, effective options for POST grass control.

Established Vineyards -- In established vineyards, growers have a broader range of herbicide options to

choose. There are three programs growers can consider. They include a spring PRE program, which is a traditional approach; the delayed PRE option; and the fall/spring split option.

Program 1. Traditionally, a vineyard herbicide program has consisted of a spring PRE herbicide applied with a non-selective POST herbicide like glyphosate or Gramoxone Max followed by POST applications of Gramoxone Max or Rely as needed.

Program 2. The delayed PRE herbicide program requires a spring glyphosate application. The spring application should be made prior to bud break. Mid to late March is a good application time. Later, when emerging summer annual weeds reach 2 to 4 in tall, glyphosate plus a PRE herbicide should be applied. The second application is generally applied the second week of May in western North Carolina. Delaying the PRE herbicide for 6 to 8 weeks extends Pre weed control for 6 to 8 weeks in the summer. The March glyphosate application provides control into early May. Therefore, there is no benefit to applying a PRE herbicide prior to that time.

Program 3. The fall/spring split is the third option that growers should consider. Grape growers located in the coastal plain or areas where weeds germinate throughout the winter and summer annual weeds germinate in early spring should consider this program. This program begins with a fall PRE application in combination with non-selective burn down herbicide like Gramoxone Max or Rely applied after harvest. In late spring, a PRE herbicide with glyphosate should be applied for residual summer annual weed control. The fall PRE herbicide maintains a bare soil surface under grape vines through the spring insuring minimal competition from winter annual weeds once vines break dormancy in the spring. Bare soil surface in the spring maximizes the radiant heat benefit. Summer weed control benefits because the fall PRE herbicide delays spring PRE herbicide application several weeks, extending residual weed control into summer. When a fall PRE herbicide is applied post-harvest, the spring PRE herbicide is applied in late May in western North Carolina.

Program 4. The spring/summer split is the fourth program option. This program consists of an early spring application of glyphosate with Chateau. This

application would be applied in late March in western North Carolina. Another application of glyphosate with Chateau should be applied when control from the initial application begins to fail and emerging weeds are 2 in to 4 in tall. The second application is generally applied in early to mid June in western North Carolina. Program 4 can only be implemented with Chateau since other products' labels (like simazine and diuron) do not allow for sequential applications within the same year.

Regardless of the PRE herbicide program, perennial weeds like bermudagrass, johnsongrass, brambles, etc. will be troublesome. Poast, Fusilade, and Select provide excellent bermudagrass and johnsongrass control without concern for crop injury. Woody perennials can be very difficult to manage, however appropriately timed glyphosate application provides good to excellent woody perennial control. Woody perennial weeds are most sensitive to glyphosate when they flower or in late summer through early fall. Labels provide application time information relative to the species. ***One concern growers must be aware of is increased grape sensitivity to glyphosate in midsummer through early fall.*** Glyphosate spray solution contact with grape vines after early summer (June) may cause injury. Therefore, glyphosate should be applied only as a spot treatment until grapes are dormant.

Tillage/Herbicide Program

Specialty tillage equipment can be used in conjunction with herbicides to provide excellent weed control in the herbicide strip. One system consists of a fall (post-harvest) tillage operation that ridges soil in the vine row. The ridge is knocked down with a "Weed Badger" in the spring after vines break dormancy. The freshly tilled, flat surface is then treated with a PRE herbicide for residual weed control. The combined tillage operations (fall and spring) delay the need for a spring PRE herbicide several weeks. The delay extends residual weed control into the summer. Topography and vineyard size limits the utility of this method. Tillage disrupts soil and in areas prone to erosion promotes washing. Specialty tillage equipment is expensive and due to economies of scale it may not be cost effective for small vineyards.

Tank Mixing and Herbicide Rotation

Tank mixing is commonly used to expand weed control spectrum. The most common use of tank mixing is combining a PRE with a non-selective POST herbicide to burn down

existing weeds and provide residual control of annual weeds. Combining more than one PRE herbicide in a tank mix with a non-selective POST herbicide can lengthen and expand residual control spectrum. An excellent example is increased residual grass control from combining Surflan with Simazine. Simazine alone provides residual grass control for 6 weeks. The addition of Surflan can result in season-long control.

Rotating herbicides is another good practice that should be followed. No matter how good or inexpensive a herbicide program might be, **DO NOT** use it continuously. Continuous use of the same herbicide year after year results in selection of weed species not controlled by that herbicide. Rotating herbicides yearly and tank mixing preemergence herbicides are ways to insure the effectiveness of your preferred program for a long time.

Another concern is herbicide-resistant weeds. Resistance occurs when a weed biotype is no longer controlled by a herbicide that is known to control that weed species. Resistance can be prevented by rotating herbicides, tank-mixing preemergence herbicides, and using non-selective POST herbicides to prevent seed production by poorly controlled weeds.

A list of herbicides and their recommended use is presented below. Consult the chart (Appendix 2) of relative susceptibility at the end of this leaflet for specific information on weeds controlled.

Preemergence Herbicides

Newly Planted Vineyards

Casoron 4G (dichlobenil), 100 to 150 lb/acre. Controls many annual and perennial weeds. Apply in January and February for best results. Apply to newly planted grapes once soil has settled and plants have recovered from transplanting.

Chateau 51 WDG (flumioxazin), 6 to 12 oz/acre. Chateau controls annual broadleaf and grass weeds. It is most effective when applied as a sequential application with the initial application in March followed by a second application when control from the initial one deteriorates. Grapes established less than 2 years must be shielded from contact with the herbicide and trellised 3 ft above the soil surface. **DO NOT** apply within 60 days of harvest and

allow a minimum of 30 days between sequential applications. Hooded or shielded application equipment must be used in established vineyards to prevent contact of spray solution with foliage or fruit. Tank mix with glyphosate, paraquat, or Rely for postemergence weed control.

Devrinol 50 DF (napropamide), 8 lb/acre. Controls most annual grasses and small seeded broadleaf weeds. Apply prior to weed emergence. Herbicide activation from rainfall or overhead irrigation is needed within 24 hours of application. **DO NOT** apply within 35 days of harvest. May be applied once soil has settled around plants after planting.

Gallery 75 DF (isoxaben), 0.66 to 1.33 lb/acre. Controls broadleaf weeds like pigweed, lambsquarters, horseweed, ragweed, aster, smartweed, and chickweed. Apply once soil has settled after transplanting. Tank mix with Surflan, Gramoxone Max, glyphosate or Rely.

Goal 2 XL, Galligan, OxiFlo 2EC (oxyfluorfen), 2.0 to 8 pt/acre. **Oxyfluorfen** provides both PRE and POST broadleaf weed control. Use only on dormant plants. Direct the spray to the base of the plant. **DO NOT** apply after buds start to swell or when foliage or fruit are present. **DO NOT** apply to grapes established less than 3 years unless vines are on a trellis wire, 3 ft above the soil surface. Oxyfluorfen may be tank-mixed with Kerb, Devrinol, Simazine, Surflan, Gramoxone Max, glyphosate or Rely.

Prowl 3.3 EC or Prowl H2O (pendimethalin), 2.4 to 4.8 qt/acre or 2 to 4 qt/acre, respectively. Controls annual grasses and small seeded broadleaf weeds including chickweed, pigweed, purslane, carpetweed, and lambsquarters. Rate is soil texture dependent. Apply as a directed spray to dormant vines only. **DO NOT** apply within one year of harvest. Prowl can be tank mixed with Gramoxone Max, glyphosate, or Rely.

Surflan 4 AS FarmSaver (oryzalin), 2 to 4 qt/acre. Controls most annual grasses and annual sedge. It also controls small seeded broadleaf weeds like chickweed, prslane, carpetweed, lambsquarters, and pigweed. Rate is soil-texture dependent. May be used in newly planted vineyards once soil has settled around plants after transplanting. Surflan can be tank mixed with Goal 2 XL, simazine, glyphosate, Gramoxone Max, or Rely.

Established Vineyards

Karmex 80 DF (diuron), 2.0 to 3.0 lb/acre. Generic formulations of diuron are available. Diuron controls broadleaf weeds and some annual grass weeds. Broadleaf weeds include chickweed, dogfennel, jimsonweed, lambsquarters, pigweed, and purslane. **DO NOT** apply in vineyards established less than 3 years. **DO NOT** apply to soils with less than 1% organic matter. Rate is soil texture dependent. Karmex may be applied in the fall or spring. It can be tank mixed with Solicam, Gramoxone Max, glyphosate, and Rely.

Kerb (pronamide), 2 to 8 lb/acre. Provides early POST and PRE control of winter annual broadleaf weeds, cool-season perennial grasses, and other grass weeds. **DO NOT** apply to vines less than one year old. Kerb should be applied in late fall or early winter when temperatures do not exceed 55° F.

Princep Cal 90 or Princep 4 L (simazine), 2.2 to 4.4 lb/acre or 2 to 4 qt/acre, respectively. Generic formulations of simazine are available. Simazine controls some annual grasses, annual sedge, and many broadleaf weeds including ragweed and smartweed. It can be applied in fall or spring. **DO NOT** apply in vineyards less than 3 years old. **DO NOT** apply on gravelly, sand, or loamy sand soils or injury may result. Tank mix with Surflan or Solicam to improve preemergence grass control. May be applied in combination with Gramoxone Max, glyphosate, or Rely for control of emerged weeds.

Solicam 80 DF (norflurazon), 1.25 to 5 lb/acre. Controls annual grasses and some broadleaf weeds. Use only on vines established at least 2 years in the field. Whitening in leaf veins may occur if applied within 3 months of bud break to grapes grown in coarse-textured soils. Solicam may be tank mixed with simazine, Karmex, glyphosate, and Rely.

PRE Tank Mix Options

Gallery + Surflan
Goal + Surflan
Karmex + Solicam
Simazine + Solicam
Simazine + Surflan

Postemergence Herbicides

Annual and Perennial Grass Weeds

Fusilade DX (fluazifop), 16 to 24 oz/acre. Provides excellent postemergence control of annual and some perennial grasses. Fusilade has no soil activity or activity on broadleaf weeds or sedges. For optimum results add 1 qt of a crop oil concentrate or 8 oz of nonionic surfactant for every 25 gal of spray mix. Spray solution contact with grape leaves during hot, humid conditions can cause foliar burn or injury. Sequential applications will be necessary for controlling perennial grass weeds like bermudagrass or johnsongrass. **DO NOT** apply to weeds stressed from drought. **DO NOT** apply within one year of harvest.

Poast (sethoxydim), 1.5 to 2.5 pt/acre. Provides excellent control of annual and some perennial grasses. Poast has no soil activity or activity on broadleaf weeds or sedges. The addition of crop oil concentrate at 1 qt/acre is recommended. Spray solution contact with grape leaves during hot, humid conditions can cause foliar burn or injury. Sequential applications will be necessary for controlling perennial grass weeds like bermudagrass or johnsongrass. **DO NOT** apply to weeds stressed from drought. **DO NOT** apply within 50 days of harvest.

Select 2EC or Arrow 2EC (clethodim), 6 to 8 oz/acre. Controls annual and most perennial grasses. Clethodim has no soil activity or activity on broadleaf weeds or sedges. The addition of non-ionic surfactant at 0.25% v/v (1 qt per 100 gal of spray solution) is necessary for optimum results. Spray solution contact with grape leaves during hot, humid conditions can cause foliar burn or injury. Sequential applications will be necessary for controlling perennial grass weeds like bermudagrass or johnsongrass. **DO NOT** apply to weeds stressed from drought. **DO NOT** apply within one year of harvest. Clethodim is for non-bearing grapes only. Apply in spray volumes of 15 to 20 gal per acre for best results.

Non-Selective Postemergence Herbicides

Gramoxone Max 3.0L (paraquat), 1.75 to 2.7 pt/acre. Provides POST control of annual weeds and suppresses perennial weeds. Apply when grass and weeds are 1 to 6 in high and succulent for best results. Green bark must be

shielded from contact with spray solution. Grow tubes provide excellent protection of newly planted vines from herbicides. The addition of a non-ionic surfactant at 0.25% v/v (1 qt per 100 gal of spray solution) is necessary. Apply in no less than 20 gal of spray solution per acre. Paraquat can be used to suppress or control suckers, however application must be when sucker length does not exceed 8 in. Tank mix paraquat with PRE herbicides for residual weed control.

Rely 1 L (glufosinate), 3 to 5 qt/acre. Controls emerged annual grasses and broadleaf weeds and a few perennials. Apply as a directed spray to the base of plants. **DO NOT** allow spray to contact desirable foliage or green bark or apply within 14 days of harvest. Rely can also be used for sucker control. Apply at 4 qt/acre when sucker length does not exceed 12 in. Two applications, 4 weeks apart are recommended — see label for directions. Tank mix with PRE herbicides for residual control.

Roundup WeatherMax (glyphosate), 1.4 to 2.75 pt/acre. **Various generic glyphosate formulations**, 1 to 2 qt/acre. Generic glyphosate formulations are available. Refer to labels for rate information. Glyphosate controls emerged annual and perennial weeds. The rates listed above provide adequate control of most weeds. Some species require higher rates for control; refer to label for details. Grapes exhibit excellent tolerance to glyphosate applied in winter, spring and early summer. However, grapes become sensitive to glyphosate applied after June through late fall when grapes become dormant. Applications made in late summer and fall may cause severe injury. **DO NOT** spray green bark or foliage. **DO NOT** apply on first-year plantings. Glyphosate may be used as a spot treatment for controlling perennial weeds like brambles, mugwort, Virginia creeper, poison ivy. Generic glyphosate formulations may require the addition of a surfactant. See label for details. Glyphosate is most effective when applied in spray volumes of 15 to 30 gal per acre. Tank mix with PRE herbicides for residual weed control.

Postemergence Broadleaf Weed and Yellow Nutsedge Control

Basagran (bentazon), 1.5 to 2 pt/acre. Basagran will control some emerged broadleaf weeds like cocklebur, common ragweed, smartweed, spreading dayflower, as well as, yellow nutsedge in **non-bearing** grape vineyards.

In order to control yellow nutsedge sequential Basagran applications 7 to 10 days apart must be applied to 6-8 “ tall yellow nutsedge. In order to maximize herbicide effectiveness, crop oil concentrate must be included in the spray solution at a 1 qt/acre rate.

Appendix 1.

128th Acre Calibration Method.

1. Use nozzle spacing to determine driving distance. (Refer to chart below.)
2. Fill sprayer half full with water, select RPM and gear settings. Determine how many seconds it takes equipment to travel the determined distance. Record the times of three separate passes and average.
3. Park tractor, maintain engine RPM, and catch spray in container marked in oz for time noted in #2. Catch spray from one nozzle.
4. Ounces collected from an individual nozzle is equivalent to gal of spray solution applied per acre.
5. Collect output from each nozzle to assure uniform distribution. Replace any nozzle that varies > 10% from the average output.

Travel Distance to Allow Each Nozzle to Spray $\frac{1}{128}$ th of an Acre

Nozzle Spacing (in.)	Distance (ft.)
14	292
16	255
18	227
20	204
22	186
24	170
26	157
28	146
30	136

If you have questions or need assistance, contact the Agriculture Agent with the Cooperative Extension Service in your county.

Source: Calibration card developed by Wayne Buhler, Pesticide Education Specialist, Department of Horticultural Science, N. C. State University.

Weeds	Casoron	Chateau	Devrinol	Diuron	Kerb	Oryzalin	Oxy-fluorfen	Prowl	Simazine	Glypho-sate	Paraquat	Rely	Clethodim Poast Select
Barnyardgrass	E	G	G	G	E	G	E	G	E	E	E	E	E
Crabgrass	E	E	E	G	E	E	E	E	E	E	E	E	E
Crowfootgrass	E	G	E	G	E	E	F	E	G	E	E	E	E
Fall Panicum	N	G	G	F	E	E	F	G	E	E	E	E	E
Foxtails	E	G	E	G	E	E	F	E	G	E	E	E	E
Goosegrass	E	E	E	G	E	E	E	E	G	E	E	E	E
Johnsongrass (S)	E		P	P	P	G	F	G	P	E	E	E	E
Signalgrass	G	G	G	P	G	G	F	G	P	E	E	E	E
Texas Panicum	E	G	P	F	P	G	F	G	P	E	E	E	E
Carpet Weed	E	E	G		G	G	E	G	E	E	E	E	N
Chickweed	E	E	E	G	E	G	E	G	E	E	E	E	N
Common Cocklebur		G	P	F	P	P		P	F	E	E	E	N
Dogfennel	E			E		N			N	E	E		N
Galinsoga		G	E		F	P	F	P	G	E	G	E	N
Horseweed	E	G		F		N		N	N	E	F	G	N
Jimsonweed		G	P	G	P	P		P	E	E	E	E	N
Lambsquarter	E	E	G	E	E	G	E	G	E	E	E	E	N
Morningglory	G	E	P	F	G	P	P	P	G	G	E	E	N
Pigweed	E	E	G	E	E	G	E	G	E	E	E	G	N
Pickly Sida		E	P	F		P	E	P	G	E	E	G	N
Ragweed	E	E	G	G	E	P	E	P	E	E	E	G	N
Smartweed	E	E	G	F	G	F	E	P	E	G	E	G	N
Velvetleaf		G	P	F	P	F		E		E	E		N
Bermudagrass	P	N	P	P	P	P	P	P	N	E	F	F	E
Brambles	N	N	P	P	P	N	N	N	N	E	P	F	N
Greenbriar	P	N	P	P	P	N	N	N	N	G	P		N
Johnsongrass (R)	F	N	P	P	P	P	P	P	N	E	F	F	E
Yellow Nutsedge	E	N	P	P	P	P	P	P	N	G	F	F	N
Virginia Creeper	P	N	P	P	P	N	N	N		G	P		N

E = 90% or better control; G = 75 to 90% control; F= 50 to 75% control; P = 5 to 50% control; N= less than 5% control.