GLYPHOSATE: A PROMISING NEW HERBICIDE FOR CITRUS

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Abstract. Glyphosate is under development as a systemic herbicide for use in citrus and an experimental label is expected within 1 year. Extensive testing has shown glyphosate to be effective against a wide spectrum of weed species, including many of those problem weeds not satisfactorily controlled by presently recommended herbicides. Glyphosate is active as a foliar applied material with excellent properties of translocation and has essentially no soil residual action. Thorough coverage of the weed foliage is essential for optimum results, and a period of 6 hr is suggested between the time of application and the advent of rainfall or irrigation. Contact with the citrus foliage and trunks (with green bark) of recently planted trees should be avoided.

Herbicides presently recommended for use in Florida citrus (1, 2, 3) provide a satisfactory degree of weed control under a wide range of grove conditions. However, a number of species, some having a serious economic impact on the industry, are either totally or partially resistant to these materials. The purpose of this paper is to review the information available on this herbicide so that growers will be able to utilize it to their best advantage when it is registered for use in citrus.

Roundup herbicide is a water-soluble formulation of the isopropylamine salt of glyphosate which is the common name assigned to N-phosphonomethyl glycine, the parent acid. The formulated product contains 4 lb. per U.S. gal of the isopropylamine salt of glyphosate. It is a non-selective, broad spectrum translocated herbicide which controls a wide spectrum of annual and perennial grasses, broadleaf weeds and vines. Soil persistence of the herbicide is negligible.

Mode of Action.

Glyphosate is a systemic herbicide, actively translocated from leaf and stem tissue to the underground roots of rhizomes of perennial weeds. It kills by disrupting the basic metabolic processes of the plant. Its initial activity is fairly slow after application depending on the weed species, and obvious responses may not be visible...
for 2 to 4 days for annual weeds and up to 10 days or longer for perennial species. Visible effects appear as a gradual wilting and yellowing with eventual browning of the foliage followed by the decomposition of the underground root or rhizome system of perennial species. Shallow-rooted annual species are completely destroyed. Regrowth occurring from perennial vines and woody shrubs sprayed with glyphosate often will be malformed and yellow in color. Such plants seldom recover their original vigor.

Usage and Herbicidal Activity

Application rates for glyphosate vary widely depending on weed species and stage of development. Postemergence applications of 1 to 2 quarts per acre will control most annual species satisfactorily, while perennial species will require 2 to 4 quarts per acre. For the control of woody shrubs and perennial vines, rates of 3 to 4 quarts per acre are required. Specific application rates recommended for commonly found weed species will be given on the product label when it is approved for use. As glyphosate is inactivated rapidly upon contact with the soil, additional timely treatments at lower rates will be required to control germinating annual species which may reinfest the treated area after the original perennial or first flush of annuals has been destroyed.

It is probable that tank mixes with soil sterilant herbicides like bromacil or simazine will be desirable in Florida citrus weed control programs. However, in some situations where such tank mixes have been used, the degree of foliage activity of glyphosate has been suppressed. In many cases, but not all, where suppression was observed, weed control was comparable to where glyphosate was used alone in approximately 30 days after treatment. Applications in combination with soil residual herbicides need further evaluation to determine whether specific mixes are feasible. Unless the product label states specifically, glyphosate should not be used in combination with other materials.

Stage of Maturity

For best response with glyphosate, the stage of maturity of the weed species should be considered. Very early treatment of perennial species is usually less effective than when they approach maturity and have sufficient foliage to receive adequate amounts of the herbicide. Thus, it is essential to permit absorption and translocation of the compound into the plant tissue and root system. Annual species on the other hand are more effectively controlled at very early growth stages. As they mature, higher rates are required for their control.

Application Methods

Close attention to application techniques is essential to achieve best results with glyphosate. Being a non-selective, broad spectrum herbicide, it will destroy both desirable and undesirable species. Tree crops, such as citrus, are tolerant to trunk-directed sprays which must be kept off the foliage. However, when spraying in a newly planted grove, spray contact with green bark should be avoided as some injury may occur. The product label may stipulate tree age limitations with regard to usage.

Application Volume

The gal per acre of diluent used is also an important factor for consideration. Volumes as low as 20 GPA have been shown to be satisfactory. However, where high density vegetation is encountered, as is mostly the case in Florida, higher volumes will have to be used to ensure adequate distribution and coverage of spray material to all individual plants.

Surfactant Relationships

Adequate amounts of surfactant are contained in commercial formulations of glyphosate, and in most cases there is no need for more surfactant to be added to the spray solution. However, where high volumes are used (90 GPA or above) additional surfactant may be advantageous. Only those surfactants recommended for use with glyphosate should be used, otherwise the effectiveness of the compound may be reduced.

Climatic Conditions

Climatic conditions should be closely observed by those using glyphosate in their herbicide program. Rainfall or irrigation occurring within 6 hr after application may reduce its effectiveness depending on the intensity and duration of the precipitation. As is true with the more slowly absorbed foliar-applied herbicides, rainfall or irrigation may wash off varying amounts of the material. A slight drizzle, of course, will not be a serious problem, but spraying should be avoided.
when rain is imminent. Whereas treatments applied under cloudy or shaded conditions may initially be less effective on certain weed species, the ultimate results will usually be comparable to those made under sunlight.

**Toxicity Symptoms**

Citrus tree foliage sprayed with glyphosate will be severely damaged. Defoliation and twig dieback will result from applications, especially at higher rates. Leaf flushes emerging from sprayed branches and areas adjacent to those sprayed will exhibit characteristically malformed leaves which may be described as strap-shaped. There is evidence of some limited translocation into other areas of the tree, especially in smaller 1 to 2-year-old trees.

**Weed Species Controlled**

Whereas the list of weed species controlled by glyphosate is by no means complete, its spectrum of activity is known to be extremely broad. The following commonly occurring weeds in Florida citrus groves, including some of the most troublesome, are known to have been controlled at various locations by glyphosate. Only those weed species listed on the product label are the ones on which specific efficacy data has been collected and approved.

**Broadleaf Weeds**

- Black nightshade: *Solanum nigrum*
- Dogfennel: *Eupatorium capillofolium*
- Evening primrose: *Oenothera sp.*
- Florida pusley: *Richardia scabra*
- Goatweed: *Scoparia dulcis*
- Horseweed: *Erigeron canadensis*
- Jerusalem oak: *Chenopodium botrys*
- Lambsquarters: *Chenopodium album*
- Nutsedge: *Cyperus sp.*
- Pigweed: *Amaranthus sp.*

**Annual Grasses**

- Crabgrass: *Digitaria sp.*
- Goosegrass: *Eleusine indica*
- Natalgrass: *Rhynchospora rosea*
- Sandspur: *Cenchrus pauciflorus*
- Texas panicum: *Panicum tezcanum*

**Perennial Grasses**

- Bahia: *Paspalum notatum*
- Bermudagrass: *Cynodon dactylon*
- Guineagrass: *Panicum maximum*
- Maidencane: *Panicum hemitomon*
- Napiergrass: *Pennisetum purpureum*
- Paragrass: *Panicum purpurascens*
- Torpedograss: *Panicum repens*
- Vaseygrass: *Paspalum urvillei*

**Vines**

- Balsamapple: *Momordica charantia*
- Maypop: *Passiflora incarnata*
- Milkweed: *Morrenia odorata*
- Moonvine: *Calonyction aculeatum*
- Morningglory: *Ipomoea sp.*

As with any other pesticide, use glyphosate on citrus only after the product has been registered for use and after you have conscientiously read the label. No other information takes precedence over that on the label. Glyphosate promises to be an important addition to the overall herbicide program when used on its own, or in conjunction with other herbicides.

**Literature Cited**