HS999

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What You Should Know Before Planning Your Citrus Weed Management Program[1]

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This publication provides an overview of the principles upon which a successful weed management program is built. In this publication the author distinguishes the important differences between weed management and weed control. Weed control is the specific act of eliminating weeds in the grove. Weed management, a part of integrated pest management, manages weeds through the combined efforts of cultural, mechanical, chemical, and biological methods to improve the long-term profitability of the grove. The anticipated returns, tree age, scion / rootstock combination, weed control options, weed species, density, insect and nematode populations, and cultural practices are recognized and measured. Once the most important factors that affect yield and cost effective control measures are identified, then an economic threshold can be formed for your weed management program. An economic threshold is the pest (a weed in this example) population levels that are expected to result in loss of profit that exceeds the cost of pest control. In this document, a typical decision process of planning a weed management program as well as some important factors that impact tree growth and yield are discussed. In Tables 1 and 2 below, examples of weed programs are compared to demonstrate the value of a weed management program.

Both the *Weed Control Program* and the *Weed Management Program* use 3 to 5 herbicide applications per year. The goals of the two progams are different, and these differences determine the types of herbicides used and the frequency of herbicide application. In the *Weed Control Program*, the goal is to minimize weed species in tree rows at "reasonable expenditures." Therefore, the control measures will be implemented throughout the year to consistently maintain low weed population levels. The goal of this program is to reduce the presence and cost of weed control, rather than to improve the economic value or benefit of killing weeds. Users of a weed control program don't know how much yield is gained from controlling weeds. Therefore, selecting the proper herbicide and rate is based on how much one wants to spend, and not how much one wishes to gain.

By contrast, the centerpiece of a citrus weed management program is the *tree*, not the weeds! A

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Weed Management Program starts with the ultimate goal: profitable fruit yield. Based on the expected yields/returns, an estimated economic damage from weed competition can be calculated. The difference between these programs is demonstrated in this example:

> We know from research on weed interference in California and Brazilian citrus that yield can be reduced from 0 to 77%. Citrus has been shown to be more susceptible to weed competition during spring growth (bloom and flush). Assuming an intermediate yield reduction of 37%, which occurs after bloom, the value of a weed management program is compared to a weed control program that strives to remove weeds from the grove.

In this example, the W*eed Control Program* achieves weed-free rows through: 3 applications of a tank mixture of pre-emergent plus post-emergent herbicides every 4 months, in addition to 2 post-emergent herbicide applications. In the W*eed Management Program*, the herbicides are applied when tree growth and yields will be benefited the most. Note that the pre- and post-emergent herbicide mixtures are applied from early March to late July.

Why are the most broad spectrum control measures applied in early March and late July? Each crop has a time when it is most susceptible to vegetative growth or yield reductions from weeds, otherwise known as the *critical period*. The critical period must be known to properly budget a weed management program. Therefore, as the critical period approaches, the most effective weed control options should be used. Citrus growing in the southern hemisphere was susceptible to competition from weeds after the bloom periods. Assuming citrus trees in Florida are susceptible to weed competition after bloom periods, the most effective weed control options should be implemented at this time. In this example, the annual herbicide costs are $166.03/acre in the *Weed Control Program* (Example 1a) versus $140.45/acre in the *Weed Management Program* (Example 1b) or $25.58/acre lower. The lower expenditures in the *Weed Management Program* should not reduce yield. Because the *Weed Management Program* ensures that the most effective herbicides are applied when competition is occurring, in the *Weed Management Program* the chance of realizing the projected 400 boxes per acre should be equal to or better than the same chance in the *Weed Control Program*.

Critical periods of weed control in Florida citrus have not yet been determined. Research to determine the critical periods in citrus is underway at the University of Florida, Citrus Research and Education Center. The estimations presented in this paper are drawn from published research on citrus outside of Florida. Each year the estimations of critical periods can be affected by several biological factors such as:

1. Weed species and populations.
2. The tree age.
3. The crop variety.
4. Location of the weed species.
5. Insect and Nematode populations.

The longer the critical period, the more likely the cost of the weed management program will increase. Therefore, it's important to have reliable scientific research to estimate the critical period and to accurately quantify the additional factors that alter the critical period.

1. Weed species and density: The critical period will vary with weed species and density. Therefore, scouting to determine the weed species and density present is essential to accurately estimate the critical period. The critical period of watermelon in the presence of spiny amaranth (*Amaranthus spinosus*) was 8 days longer than when large crabgrass (*Digitaria sanguinalis*) was present, and citrus may also respond similarly. Differential yield loss from varying weed species has been reported with citrus. Over an entire season of competition of citrus in California with Bermuda grass, Valencia yields were reduced 78% compared to 57% from other annual weeds. There are over 200 weeds commonly found in citrus groves, some of which can be easily misidentified. A guide with color photographs to aid in accurately identifying weeds is available from the following IFAS publications: HS896, "Identification

of Broadleaf Weeds in Citrus"; HS955, "Identification of Grass Weeds in Florida Citus"; HS926, "Identification of Vine Weeds in Florida Citrus"; and HS962, "Identification of Sedge and Sedge-Like Weeds in Florida Citrus."

Weed density can affect the vegetative growth and fruit yield of citrus. When density does affect critical periods, the effect is: increased length of critical periods as a result of increasing density. If the critical period is normally 100 days (April 1st to July 1st) with a consistent weed density, then in years when weed densities are abnormally low, the critical period may be less than 100 days. If the critical period is less than 100 days, 1 pre-emergent herbicide application may eclipse the critical period.

Under Florida growing conditions, recently planted citrus trees can tolerate up to 0.6 Spanish needle (*Bidens pilosa*) plants per square foot. However, densities greater than 0.6 per square foot can cause growth reductions of up to 10% (Figure 1). Eliminating weeds may be desirable even after the critical period has passed. Significant leaf flushes occur on citrus trees during the summer. If vegetative growth is desired (after a freeze, a hurricane, or a severe pruning) then weed control may be warranted.

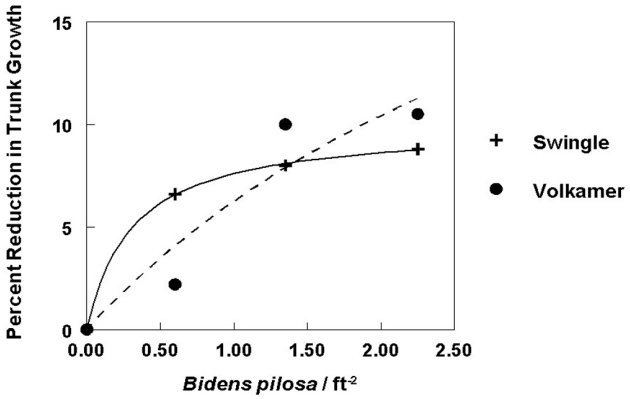

Figure 1. Trunk growth reduction of 'Hamlin' on Swingle or Volkamer lemon rootstocks in response to Spanish needles density in central Florida.

2. Tree age: As the age of an annual crop increases, the susceptibility of the crop to competition decreases (see the above discussion on critical periods). The same principle holds true for a citrus tree. As the age of the crop increases, the space the tree takes up typically increases. The shading by the citrus tree will reduce the effect of competition from most weeds.

3. Crop variety: The selection of citrus variety (scion and rootstock) may affect the critical period on growth and fruit yield. Young tree growth on vigorous rootstocks has been shown to be affected more by weeds than trees on slower growing rootstocks. The critical period for Valencia on Cleopatra mandarin may not be the same critical period for Valencia on Carrizo citrange. Therefore, rootstock may affect the yield response to competition from weeds.

4. Location of weed species: The location of the weed species in the tree row also impacts growth and yield. For example, weeds growing in the center of 25-foot row middles will not reduce growth or yield of recently planted citrus trees. Weeds that are within the tree root zone can have a greater impact than weeds outside the root zone. In a 3-year study at the Citrus Research and Education Center, rows in which perennial peanuts were allowed to grow up to the trunks of the tees were compared to rows in which 7- and 15-foot weed-free areas were maintained around the trunks of the trees. The trees with perennial peanuts growing up to their trunks were found to have reduced fruit numbers and growth as compared to the trees grown in the fifteen-foot weed-free areas. Noting weed location is more important when trees are younger and have non-adjacent canopies than after they've grown and the canopy has closed. When scouting for weed densities, those weeds within the growing area should be given priority in management decisions. However, one distance cannot be used for all weeds. The roots of iron weed (*Sida acuta*) are vertical, while the roots of balsam apple (*Momordica charantia* L.) grow horizontally. Therefore, iron weed may have to be closer to the tree to affect growth and yield compared to balsam apple.

5. Insect and nematode populations: The impacts of insect and nematode populations have not been adequately studied to provide definitive recommendations. However, evidence suggests rust mite populations are higher in groves with low weed populations. The effect of nematodes on water relations in citrus has been documented. High nematode populations may compound the effect of

weeds competing through soil moisture depletion, which may result in longer critical periods. In addition, the presence of weeds can increase the frequency and severity of nematode damage on citrus.

Controlling weeds is the costliest production practice in Florida citrus. The profitability of weed control is dependent on the tree producing more fruit as a result of your efforts. To ensure greater fruit production, knowledge of the trees' growing state and factors that change growth and yield is required. The principle of the critical period is intended to ensure profits from proper selection and timing of control. More detailed information on recommended herbicides for use in citrus can be found in the IFAS publication HS107 "Weeds." For more information on weed management or critical periods, contact your local county agent or Richard S. Buker III, Citrus Extension Specialist, Citrus Research and Education Center, 700 Experiment Station Road, Lake Alfred, FL 33850.

Literature Cited

Buker III, R.S. Initial Bidens interference with reset Hamlin, does it matter? 2004. Florida Weed Science Society.

Carvalho, J.E.B., R.A. Pitelli, A.E. Santana, R. Gravena, R.C. Caldas, and A.J.B. Galli. Effects of weedy periods on citrus productivity. 2003. Abstracts Weed Sci. Soc. America 43:9.

Dusky, J.A., C.W. Deren, and D.B. Jones. Competition between yellow nutsedge (Cyperus esculentus) and rice (Oryza sativa). 1997. Proc. Southern Weed Sci. Soc. p.152.

Futch, S.H. Horticulture and environmental aspects of weed control in Florida citrus. 1997. Ph.D. dissertation, University of Florida.

Jordan, L.S. Weeds affect citrus growth, physiology, yield, fruit quality. 1981. Proc. Int. Soc. Citriculture. Vol. 2: 481-483.

Monks D. and J.R. Schultheis. Critical weed free period for large crabgrass (Digitaria sanguinalis) in transplanted melon. 1998. Weed Sci. 46:530-532.

Muraro, R.P., F.M. Roka, and R.E. Rouse. Budget cost and returns for southwest Florida citrus. 2003. http://edis.ifas.ufl.edu/FE 434

Terry, E.R., W.M. Stall, and D.G. Shilling. Smooth amaranth (*Amaranthus hybridus* L.) interference with watermelon (*Citrullus lanatus* L.) and muskmelon (*Cucumis melo* L.) production. 1997. HortScience 32:630-632.

Table 1. An Example of a Weed Control Program

Progression of Tasks	Time of Action	Driving Factor
1. Program Budgeting	At the fiscal year end or after payment	Based on cost of materials and perceived value of clean tree rows
2. Weed Control	When weeds are anticipated (seasonally) or after weed emergence	Weed seed characteristics, frequency, and number of weeds emerged Availability of personnel and equipment
3. Program Evaluation	After control measures are enacted	Mortality of weeds

Table 2. An Example of a Weed Management Program

Progression of Tasks	Time of Action	Driving Factor
1. Program Budgeting	Should occur before trees bloom	Derived from differential cost between expected returns with and without control
2. Weed/Pest Scouting	Anticipated seasonally	Physiological state of the tree and environmental conditions
3. Weed Control	Controls occur if trees are susceptible to competition and weed populations can decrease growth and yield	Weed/pest levels that exceed the economic threshold
4. Program Evaluation	After harvest	Realization of projected yields and returns

Example 1a. Weed Control Program

Application Date	Feb 15	May 15	June 17	July 30	October 19
Expected Yield	400 boxes/acre				
Return $/Acre	$1200 (assuming an on tree value of $3.00/box)				
Estimated Yield Loss From Weeds	1%	15%	10%	4%	2%
Weed Control Cost/Acre	49.59[1]	14.09[2]	49.59[1]	14.09[2]	38.67[3]
Net Value	-$37.59	$165.91	$70.41	$33.91	$-14.67

[1]Solicam® 3 pounds, Karmex® 4 pounds, and Roundup Ultra® max 2 quarts.
[2]Roundup Ultra® max 2 quarts.
[3]Gramoxone® 2 pints and Solicam® 3 pounds.
All herbicide rates are represented as amount of product per treated acre.

Example 1b. Weed Management Program

Application Date	Feb 15	March 15	June 30	July 30	October 19
Expected Yield	400 boxes/acre				
Return $/Acre	$1200 (assuming an on tree value of $3.00/box)				
Estimated Yield Loss from Weeds	1%	15%	10%	4%	2%
Weed Control Cost/Acre	16.05[4]	49.59[1]	14.09[2]	38.67[3]	22.05[5]
Net Value	-$4.05	$130.41	$105.91	$9.33	$1.95

[1]Solicam® 3 pounds, Karmex® 4 pounds, and Roundup Ultra® max 2 quarts.
[2]Roundup Ultra® max 2 quarts.
[3]Gramoxone® 2 pints and Solicam® 3 pounds.
[4]Gramoxone® 2 pints.
[5]Gramoxone® 2 pints and Princep® 4 pounds.
All herbicide rates are represented as amount of product per treated acre.