Vegetation Management in Row Middles in Florida Citrus

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Because Florida’s climate allows year-round weed germination and growth, control of weeds is a major economic factor in Florida citrus production. Weeds compete with citrus trees for water and nutrients, and during winter months, weeds can increase fire hazards and the chance of cold damage from radiation freezes. Vegetation management between the rows of trees in Florida citrus utilizes various methods to establish or suppress vegetation growth to minimize impacts on citrus production and harvesting practices as well as tree growth. The optimum row middle vegetation will minimize soil erosion and will be low growing, non-invasive into herbicide treated areas, and easy to control either mechanically or chemically, thereby minimizing competition with the citrus tree for water and nutrients. Middles vegetation should not harbor pests which can potentially interfere with the orchard production systems. Methods of vegetation management in row middles include mechanical (cultivation and mechanical mowing), chemical, and chemical mowing/wiping.

Cultivation controls weeds efficiently and economically, but damage to the limited root system of the citrus tree may occur particularly for HLB infected trees and especially in bedded orchard systems.

Chemical weed control kills emerging weed seedlings with preemergence herbicides or emerged weeds with postemergence herbicides. Chemical mowing, when used in combination with mechanical mowing, utilizes low rates of glyphosate herbicide to suppress vegetative growth for 45 to 90 days in the row middles, whereas wiping technology applies concentrated glyphosate to tall growing species, leaving lower-growing species unaffected.

Middles management programs in Florida citrus involve various methods to establish or suppress vegetation in areas between tree rows. Optimum row middle vegetation minimizes soil erosion from rain and wind, is low growing, non-invasive into herbicide treated areas, is easy to control mechanically or chemically, and does not compete with the citrus tree for water or nutrients. Methods to control vegetation includes mechanical, chemical, and chemical mowing/wiping.

Local climate greatly affects vegetation growth because areas of relatively high rainfall and heavier soils having greater vegetation pressure. Soil types, especially poor sandy soil, affect vegetation species present and the extent to which vegetation competes with citrus trees. Heavy soils have a greater nutrient and moisture holding potential, which can be shared between grove floor vegetation and citrus trees.

Vegetation species’ ability to compete with citrus varies greatly. In general, grass species, especially sod-forming ones, are more aggressive competitors than broadleaf weeds (Tucker and Singh 1999). Mowed grasses can be more competitive than unmowed because mowed grasses demand nutrients and moisture for regrowth. Chemically
mowed areas retain higher soil moisture levels than areas under other treatments (Tucker et al. 1997). Under Florida conditions, it is not economically feasible nor desirable to remove all vegetation from row middles.

This document addresses vegetation management in row middles as opposed to weed management in tree rows. Depending on the width of the herbicide treated area under the tree canopy, the area remaining will be mechanically and/or chemically mowed or, to a lesser extent, mechanically tilled. Approximately 44 to 68% of the total grove acreage is under a middles management program for mature and young orchards, respectively, with the remaining acreage generally chemically treated to keep the area under the tree canopy free of vegetation. In Florida, the cost for managing vegetation in the row middles ranges from approximately $53.06 per acre per year or around 3% of the annual production costs (Muraro 2000). Actual costs will vary depending on middles width, climate, soil conditions, orchard layout (bedded vs. non-bedded) and vegetation species.

The middles management programs can influence vegetation species present (Monsanto 1996), soil moisture (Tucker et al. 1997), nutrient status (Rouse and Mullahey 1992), soil erosion from wind and water (Jackson and Davies 1999), climatic conditions (Krezdorn and Martsolf 1984; Tucker et al. 1980; Tucker and Singh 1993) and various biological factors (Knapp et al. 1982).

Grove Cover Crop Programs
Prior to establishing a new orchard, soil stabilization programs should be initiated to prevent soil erosion by wind or rain and sand blasting of newly planted trees. In many cases, temporary grass or broadleaf species are planted in the row middles as a cover crop to minimize soil erosion.

Once cover crops reach maturity, they may be incorporated into the soil to add organic matter and nutrients. Nitrogen fixing leguminous crops such as hairy indigo (Indigofera hirsuta Harvey) and perennial peanut (Arachis glabrata Benth.) have been used to increase organic matter and add additional nitrogen to the soil (Jackson and Davies 1999).

Caution should be used in choosing cover crops since some harbor pests that can damage low volume irrigation systems in citrus orchards in central and southwest Florida (Childers et al. 1992). Cover crops, as well as native vegetation, will use additional water, and in areas where soil moisture is a limiting factor, careful consideration should be used in selecting cover crop species to minimize moisture competition.

In orchards planted on raised beds, permanent sod cover crops should be established to maintain bed configurations and to minimize soil erosion and movement of soil into drainage structures. Once the permanent sod cover is established, mechanical or chemical mowing will maintain vegetative plant growth height to an acceptable level. Perennial peanut (A. glabrata), a warm-season perennial legume grown on well-drained soils of Florida and other Gulf Coast states, has primarily been utilized as a forage legume.

The rhizomaeous peanut has good nitrogen-fixing ability, makes a low, dense cover crop, and does not require replanting once established. It develops a deep, extensive rhizome root system that enables it to survive in infertile, well-drained sands. The legume is native to South America and is being evaluated in Florida as citrus row middle vegetation. Nitrogen in excess of 180 kg ha per year could be produced from the dry matter and from the nitrogen fixing Rhizobium bacteria (Rouse and Mullahey 1992). Advantages include the nitrogen contribution and reduced mowing requirements, while disadvantages include the need for propagation from underground stems or rhizomes, the requirement of supplemental irrigation or rainfall for establishment, as well as weed control and fertilizer applications during establishment. The perennial peanut is easily damaged by plowing the soil. However, this is not frequently done in Florida except in major grove renovation.

Middles Management Programs
Mechanical Tillage
In the early years, extensive use of soil tillage was conducted with implements such as discs, choppers, mechanical hoes and hand hoes. Tillage is very economical and effective in severing stems and roots of vegetation species growing in the row middles, but it provides only temporary control of vegetation. When tillage was the main method of vegetation management, five to six such operations were conducted each year because each new crop of weeds emerges and eventually produces seeds. The timing of each tillage operation usually has greater flexibility than the application of soil-applied preemergence or postemergence herbicides. However, once seeds are produced and incorporated into the soil, they may remain viable for years with each tillage operation potentially exposing millions of additional seeds for subsequent germination. In some cases, control of deep-rooted perennial weeds may not be achieved with shallow cultivation and may create solid stands of very aggressive
species of bermudagrass (Cynodon dactylon (L.) Pers.),
torpedograss (Panicum ripens L.), bahiagrass (Paspalum
notatum Fluegge), or nutsedge (Cyperus spp.). The use of
tillage as a middles management method has decreased
significantly in the last 10 to 20 years.

In areas where citrus root systems are shallow and sus-
ceptible to damage from tillage equipment, it is estimated
that upwards of 75% of the root system may exist within
the upper 12 inches of the soil profile (Noling 1993). The
majority of citrus roots grow directly under the tree canopy
and decrease rapidly with distance from the trunk to
tree canopy edge and row middles, beyond which tillage
significantly reduces shallow feeder root abundance (Noling
and Duncan 1987). Tillage poses unacceptable levels of
root damage, especially where root systems are shallow on
raised beds on poorly drained soils. Tucker et al. (1980)
found that twice as many roots were found in 0 to 6 inch
soil samples where herbicides were applied as were found in
soil samples from tilled blocks. Damage to the tree trunks
by tillage equipment also provides easy entry sites for
soil-borne pathogens.

Where tillage is practiced, it has been noted that nighttime
minimum temperatures under calm conditions are 2–3.5°F
higher than in locations with dense, tall vegetation (Tucker
et al. 1980). Vegetation insulates the soil and reduces heat
loss from the soil surface by radiation. Freshly cultivated
soil will not release as much heat as will bare, compacted
soils. Thus, trees surrounded by little or no vegetation may
suffer less damage from marginal freezes than those with
other vegetation management systems.

Best management practices (BMPs) have been established
for the entire citrus production area in Florida (Pride
2012) to encourage vegetation within all water furrows
to prevent erosion and trap sediments that may enter the
drainage system.

**Mechanical Mowing**

Mowing operations are intended to remove all vegetative
growing portions of the plant, usually at a height of about 1
to 2 feet, and produce an aesthetically pleasing appearance.
Vegetative growth will resume quickly after mowing if
conditions are favorable for regrowth. Frequent mowing of
tall-growing species will allow for establishment of lower
growing species, which may create a solid sod culture.

Frequent mowing will not eliminate competitive demands
for moisture consumption by vegetation species. Moisture
availability should be considered when choosing mowing
as the vegetation control method, especially when orchards
are subjected to drought conditions.

Energy demand and equipment maintenance involved
in mechanical mowing is very high compared to other
vegetation control measures. Mowing vegetation prior to
seed head formation minimizes depositing seeds in the
herbicide-treated areas under the trees.

Plant stubble from large amounts of vegetative growth
may severely damage or kill vegetation, which would allow
other species to invade the area. Weed growth should be
mowed prior to vegetation regrowing above optimum height at about 75 to 90 days and then
retreated for another 75 to 90 days of growth suppression.

**Chemical Wiping**

Chemical wiping applies glyphosate through a solution-
permeable carpet wiper or solution-panel wiper to kill
tall-growing weed species and aid in establishing a desirable

**Chemical Mowing**

Chemical mowing applies low rates of postemergence
glyphosate herbicide to suppress vegetative regrowth of
grasses and broadleaf weeds in the row middles for 45 to
90 days. After 45 days, treated vegetation will resume slow
regrowth and should be mowed prior to vegetation regrow-
ing above optimum height at about 75 to 90 days and then
retreated for another 75 to 90 days of growth suppression.
To get the maximum suppression of vegetative regrowth,
the treated area should be mowed 1 to 2 weeks before
re-application of glyphosate to vegetation with a height of
15 to 20 cm. The rate of herbicide applied will vary depend-
ing on the weed species present. For control of bahiagrass
(Paspalum notatum) and bermudagrass (Cynodon dactylon)
apply 0.125 and 0.37 lb A.E. glyphosate, respectively, per
treated acre (Futch et al. 2015). Applications of 10 to 25 gpa
of solution are standard with rates as low as 7 to 10 gpa to
allow for larger areas to be covered in a shorter period of
time, thereby increasing efficiency. Higher product rates
may severely damage or kill vegetation, which would allow
other species to invade the area. Weed growth should be
in an active state of growth and not drought stressed at
the time of application. Rainfall within several hours may
diminish the effectiveness of chemical mowing control.

Proper boom design and application pressure can minimize
potential damage to low-hanging tree limbs and fruit. A
flexible carpet or belt cover on the back of the boom should
minimize drift of spray material.

**Chemical Wiping**

Chemical wiping applies glyphosate through a solution-permeable carpet wiper or solution-panel wiper to kill
tall-growing weed species and aid in establishing a desirable
sod. A carpet wiper utilizes a modified spray boom that is wrapped with a porous-backed carpet type material. The spray material is applied on the back of the carpet, soaks through the carpet, and then is wiped onto the target weed at 0.5 to 1 gpa as a 5–33% solution. The panel wiper utilizes a dispensing system to apply 0.5 to 1 gpa as a 50–80% solution. The spray solution is applied evenly to a panel that passes over the target weed at a specified height. The panel wiper recirculates excess material to minimize dripping from the panel.

Filtration is critical to maintain even application of spray solution to the carpet or panel. Both types of wipers utilize a timer connected to the pump to regulate the flow of spray solution. The regulated flow keeps the carpet or panel at an even wetness for thorough coverage while minimizing excessive application to avoid dripping from the wiper surface.

**Conclusions**

A single middles management method will not provide adequate control over a wide geographical area because numerous weed species, soil types, and environmental factors influence the vegetation present as well as its growth. Thus, growers must utilize a combination of methods to provide effective, environmentally sound, and economical vegetation control.

**Literature Cited**


