Chapter 3 Crops

Contents:

Chapter 3 Crops

FL652.0300 Purpose and objective

The purpose of this Florida amendment is to add crop information relative to Florida conditions including soils, climate, and production.

(a) General

The primary crops irrigated in Florida are citrus, corn, cotton, pastures, peanuts, small grains, sorghum, soybeans, strawberries, sugarcane, tobacco, tropical fruits and vegetables. Horticulture crops and turfgrasses are also irrigated.

Low fertility, low or high pH, and/or an imbalance of nutrients are often the limiting production factors on irrigated land. A well-fed plant uses water more efficiently than a plant deprived of nutrients.

The irrigator should monitor soil moisture, control weeds and pests, plant high quality seed of adapted varieties, and use timely operations. Weeds, insects, and diseases usually are a greater problem on irrigated land than on dry land.

(b) Crop adaptation to soils

Small grains are best suited to medium texture soils. Peanuts and most pasture plants are best suited to moderately coarse texture soils. Most vegetables do well on coarse textured soils. Alfalfa, tobacco, corn, cotton and soybeans will perform well on most deep, well drained, medium, and coarse textured soils when irrigated and fertilized properly.

(c) Cultural practices

On irrigated soils, crop residue or vegetative cover should be maintained on the surface to keep soil loss within the allowable limits.

On the outer portions of some center pivot irrigation systems, the application rate may exceed the soil water intake. Leaving crop residue on the surface can minimize this condition. Also minimum tillage will improve intake rates.

Cover crops (usually small grains) are essential to control wind and water erosion on most soils.

FL652.0301 Crop growth characteristics for selected Florida crops

(a) Critical growth periods

For optimum production and the most efficient use of water, plants must have ample moisture throughout the growing season. For most crops there are critical periods in the growing season when a high moisture level must be maintained for high yields. The critical period can best be defined as that time when soil moisture stress can most reduce yield in an otherwise healthy crop. This is not to say that it is the only time in the life of the crop that moisture stress reduces yield. It is the time when moisture stress has the greatest effect. If there is enough moisture for germination and for the development of an adequate stand, the critical moisture period is almost always in the latter part of the growing season during the reproductive growth stage. Although plants indicate moisture stress by various symptoms, yields will usually be reduced by the time the plant shows stress. Time and duration of irrigation should be determined by examination of the soil for moisture content. Critical moisture periods for Florida crops not listed in Table 3-1 are shown in Table FL3-1.

(b) Rooting Depth and Moisture Extraction

The rooting depth of the crop determines the volume of the soil moisture reservoir to be managed. The rooting depth depends on the crop being grown and soil conditions. Table FL3-2 gives the normal rooting depth of common crops grown in deep soils. Shallow soils due to shallow depths to bedrock, gravel, and soils with hardpans, high water tables and other restrictions to root development limit the rooting depth of crops. A minimum rooting depth as shown in Table FL3-2 should be available to support the crop.

In uniform soils with ample available moisture, plants use water rapidly from the upper part of the root zone and slowly from the lower part.

Most plants have similar moisture extraction patterns. The usual pattern for soils with a uniform texture is as follows: about 40% from the upper quarter of the root zone, 30% from the second quarter of the root zone, 20% from the third quarter, and 10% from the bottom quarter. See Figure 3-2. Because of this pattern of water extraction, if 50%of the available water capacity (AWC) has been used, the upper portion of the root zone is most affected by the lack of moisture.

(c) Limiting Irrigation

Many factors contribute to the need to limit irrigation. These factors include declining ground water supplies, increases in pumping cost and disease control. Profit may be maximized by limiting irrigations to the particular crop's critical moisture characteristics in lieu of trying for maximum yields by maintaining a high soil-moisture level throughout the growing season. Critical periods for plant moisture stress for Florida crops not listed in Table 3-1 are shown in Table FL3-1.

Alfalfa

Alfalfa needs adequate soil moisture for high production. The most critical need for moisture is at the start of flowering and after cutting. Irrigations should be scheduled 3 to 5 days after each cutting. The soil should be brought to field capacity 2 to 3 feet deep depending upon soil type. If less water is applied at each irrigation, then possibly the best times would be in the spring before cutting and in the fall. These are the most critical periods of growth in the maintenance of a highly productive stand. Fall growth should be sufficient to permit the production and storage of large quantities of reserve food in the crown and roots to reduce winter kill of plants.

Avocado

According to University of Florida, Institute of Food and Agricultural Sciences, (IFAS), conclusive information on irrigation rates and frequencies for Florida avocado varieties is not currently available. However, observations suggest irrigation during dry periods may increase tree growth and development as well fruit set and production.

Banana

According to IFAS, bananas require large amounts of water are very sensitive to drought. Drought results in increased time to flowering and fruiting, reduced fruit size, fruit number, and crop yields. Bananas need about 4 to 6 inches (102-152mm) of water per month for normal growth and production. High volume sprinklers and low volume microsprinklers and drip systems may be used. Properly operated low volume systems are more efficient than high volume systems.

Since an adequate soil moisture is essential for good production, particularly during the dry months of the year, provision should be made for irrigation. However, caution should be exercised against over-irrigation. Bananas are extremely susceptible to damage by flooding, continuously wet soils, and soil with inadequate drainage.

Blueberries

Irrigation water should be applied according to the water needs of the blueberry. The root system on a blueberry plant will begin to grow before the top. Therefore, if the winter has been dry, it is important to irrigate thoroughly 3 to 4 weeks before the top starts to grow. From bloom until harvest is a critical moisture period for blueberries. After harvest the blueberry continues to make new growth to support the next season's crop. Water and adequate fertility are critical during this stage of growth.

Carambola

According to IFAS, irrigation is recommended for commercial carambola orchards. The most beneficial application rates and frequencies, however, have not been determined. The general recommendation is to apply one-half inch (1.3 cm) of water per acre twice a week during dry periods throughout the year.

High volume under or over tree-sprinkler irrigation has been observed to adequately protect carambola trees during freezing weather. The irrigation system should be designed to apply at least 0.21 inches (0.53 cm) of water per hour and proper coverage of the grove is critical in order to protect the trees. Sprinklers should be turned on when air temperatures are 3 to 4ºF

above freezing (35 to 36ºF; 1.7 to 2.2ºC) and continue to run until air temperatures exceed 32ºF (0ºC) or until ice has melted. **Caution**: irrigation during freezing weather that is accompanied by strong winds (greater than 5 mph) may not be advisable. For more information consult your county agricultural extension agent.

Citrus

A number of studies in Florida have shown that irrigation can significantly increase citrus fruit production. Such yield increases were obtained by maintaining adequate soil moisture in the root zone in the spring when the fruit is small. Specifically, the management allowed depletion (MAD) should not exceed 30 percent between fruit set (February - March) and until such time when young fruit has reached more than 1-inch in diameter (June - July). During the remaining months of the year MAD should not exceed 50 percent.

Corn

Corn is a shallow rooted plant until it nears tasseling. Water requirements for corn, whether from rain or irrigation are as follows:

(1) about 1 inch of water every 12 days for the first 40 days of growth,

(2) about 1 inch every 5 to 7 days between 40 days and tasseling, and

(3) 1 inch every 3 to 4 days from tasseling to maturity.

Total irrigation and/or rainfall requirement for corn during the first 60 days is about 7.7 inches. Demand for water from 60 days to maturity is high, totaling about 13.0 inches, and is especially high and important during the tasseling and grain filling period. The grain filling period is the 3 weeks following tasseling.

Corn should never be allowed to wilt since short season corn will mature in about 100 days under some environmental conditions. A drought period of a few days can significantly reduce yields. Under limited irrigation the critical period for irrigation is from the tassel stage through grain filling.

Cotton

Cotton is a drought tolerant plant. However, timely irrigation increases yields considerably. Quite often, preplant irrigation will supply adequate moisture up to the blooming period. The next irrigation should be at the early bloom stage. The first bloom through boll maturing stage is the most critical period for cotton. Adequate moisture is needed at this time to maintain high yields. An additional irrigation may be needed during the boll forming stage. High moisture levels after the boll forming stage will delay the crop and increase the amount of immature fibers.

Ferns

Leatherleaf and plumosus ferns are shallow-rooted plants. Ferns grow best in a moist but not saturated soil. Irrigation is necessary for both species for maximum production of quality foliage. Normally, irrigations should be scheduled with a MAD of more than 50 to 60 percent.

Guava

According to IFAS, guava has moderately high to high irrigation needs. An inch of water two times per week may be required in the absence of rain. Irrigate at a 10 to 20 centibar tensiometer reading.

Grapes

Adequate soil moisture is critical for grapes during the first year after planting. Many first-year plants have died in Florida vineyards from lack of soil moisture. The most critical moisture period is during the sizing of the fruit. Applications of 1 to 1.5 inches of water every week during April and May will be sufficient for both old and young vines when rains do not occur. Applications should not exceed soil water-holding capacity.

Lychee

According to IFAS, young trees should be irrigated regularly to facilitate tree establishment and growth. Once trees begin to bear (3 to 4 years after planting), trees should be irrigated regularly from flowering through harvest. Research from other regions has suggested that

mild drought stress during the late fall (September or October) and early winter enhances flowering in late winter or early spring.

Mango

According to IFAS, observations indicate irrigation of newly planted mango trees, especially during dry periods, improves tree establishment and early growth. Research also suggests that irrigation during the period of fruit development increases mango size, earliness, and yields.

Commercially, high volume overhead and under tree irrigation is used for cold protection during freezing weather. Irrigation should be started before freezing temperatures are reached and continued until temperatures are above freezing and ice has melted off the trees. Where electric motors are used, high volume irrigation should only be considered where power outages are not a problem during freezing weather conditions.

Papaya

According to IFAS, irrigation should be provided during dry spells because a fluctuating water supply may cause growth retardation, flower abortion, and dropping of young fruits.

Pasture Grasses

Inadequate soil moisture limits production of warm season grasses during the late spring and early summer. Where economically feasible apply 0.6 to 1 inch of irrigation water per week during this period.

Water control structures may be effectively used in South Central and South Florida to maintain the water table in the effective rooting depth of the plants for subirrigation.

Cool season grass in North and North Central Florida may fail to establish in some years due to poor soil moisture conditions in November and December. Where economically feasible, apply 0.6 inches of water per week, when rains do not occur. Cool season forages are not recommended in South Central or Central Florida without supplemental irrigation during the establishment period.

Peaches

The fruit growth pattern of peaches is referred to as a double sigmoid growth curve that brings fruit to maturity in 70 to 120 days. Depending upon the variety, there is an initial period of rather rapid fruit enlargement followed by a pit hardening period during which fruit enlargement is slight. Finally the flesh of the fruit thickens and total enlargement is very rapid immediately prior to maturity. It is during this final swell that moisture stress can reduce yield the most. During the last 30 days before harvest, about two-thirds of the final volume is attained.

Researchers have not agreed on the proper MAD to maintain for peaches, but data on cling peaches show that the growth rate is reduced when the MAD in the upper two feet root depth was less than 50%, especially during final swell.

Peanuts

Peanuts respond well to irrigation with the greatest increases in yields on light textured sandy soils. During the growing season, peanuts will require from four to eight inches of supplemental irrigation. Usually, irrigation commenced at no more than 50 percent MAD during the peak growing season will result in maximum yields. This will require an application every 4 to 5 days on light sandy soils and every 6 to 8 days on heavier soils. Do not exceed 1 inch per application for light sandy soils whereas 1.5 inches may be necessary for heavy soils.

If water supplies are limited or restricted, probably the most important irrigation is preplant if moisture is not adequate at planting time. One-half to three-fourths inch of water applied just before planting has proven to be very effective in producing good plant population. Growers should also irrigate during the main fruiting period.

Pecans

Irrigation is very important on newly planted pecan trees. A water ring should be maintained around the tree for at least a year and water applied every 7-10 days during the growing season in the absence of suitable rainfall. Microsprinklers work well for this application. Under no circumstance, should the young trees

be allowed to wilt. Critical moisture periods for older trees are during nut forming and nut filling.

Small Grains

Moderate to high small grain yields can be obtained with limited quantities of irrigation water. One method of achieving this goal is to delete the preplant irrigation when a good stand can be obtained without it. Spring irrigation can be delayed until the boot stage unless the small grains begin to show moderate soil moisture stress. Usually the most economical irrigations are at preplant and boot stage.

Sorghum

Grain sorghum is a drought tolerant plant that responds well to limited irrigation. Probably the most important irrigation is preplant if soil moisture is not adequate. In addition to preplant irrigation, be sure to irrigate at boot to early heading stage of growth.

Soybeans

Inadequate moisture during germination and early seedling growth can prevent establishment of a uniform stand. If there is not sufficient moisture in the surface layer to stimulate the germination of the seeds, it is desirable to apply a preplant or pre-emergence irrigation. Once a good stand is established soybeans can tolerate short droughts up until bloom with minimum adverse effects. The soybean uses water most in the reproductive phase. Particularly during pod growth and seed fill, lack of water will significantly reduce final soybean yields. Water stress in the early reproductive stage (flowering) may result in higher than normal levels of flower abortion, leading to reduced numbers of pods per plant. Moisture deficiencies during the seed filling stage will result in smaller than normal seeds, tending to lower overall yields. If irrigation is limited, then supplemental water at mid to late flowering will help produce the greatest increase in yield per unit of water applied.

Strawberries

The strawberry plant is shallow-rooted with 80 to 90 percent of its roots in the top 12 inches of soil. In the plastic mulch cultural system, adequate moisture is necessary in the surface soil to permit transplants to set and make maximum growth. Irrigation is needed at transplanting, during fruit bud formation and fruit enlargement. Irrigation begun at a MAD of 50 percent or less appears to be adequate.

Tobacco

Irrigation of tobacco at transplanting will improve plant survival and early growth and enable weaker plants to initiate growth similar to the stronger plants. An analysis of moisture uptake by tobacco during the first three weeks after transplanting has shown the main moisture supply to be in the top 6 inches of soil and during the next two weeks it is in the top 12 inches. The top 18 inches of soil supplies most of the water for the plants for the remainder of the growing period. This being so, it is suggested that the soil be irrigated to a depth of 6 inches during the first three weeks, 12 inches during the next two weeks, and 18 inches during the remaining period of growth. Under limited irrigation, the critical time other than at transplanting is when the tobacco is from the knee-high stage until the top leaves are filled out.

Turfgrass

Many turfgrass species can be grown in Florida. Determining which one is best for a particular situation is based on several factors. Since most of Florida's soil is sandy in nature, a deep-rooted grass is desirable. If properly maintained, bahiagrass and St. Augustinegrass provide deep rooting and therefore increased drought resistance. Bahiagrass can survive on natural rainfall whereas St. Augustine requires supplemental irrigation even during the winter months.

If the purchaser is willing to allot more time, energy and economic resources to turf maintenance, a finer-texture species is suggested such as one of the bermudagrass or zoysiagrass cultivars. In addition, centipedegrass is available for those regions with heavier, acidic soils, such as the panhandle area and north Florida, and for those with less resources and time available for upkeep.

Supplemental irrigation is necessary to maintain a desirable turfgrass. For Florida's sandy soils, in the absence of rain, irrigation will be necessary a minimum of one to two times weekly during summer to prevent stress on the turf. In most Florida areas, 0.75 inch of water should be applied per irrigation. Irrigation with 0.75 inch will wet the entire root zone without leaching nutrients from the soil profile. Do not irrigate frequently (i.e. daily) with light rates of water as this encourages shallow turf rooting as well as increased pest activity. Irrigation with 0.75 inch should be applied when the turf shows signs of drought stress (i.e. wilting, bluish-grey color). Once applied, wait until drought symptoms reappear before watering again.

Irrigate in early spring when day temperatures are warm but night temperatures are still cool. Turfgrass crowns coming out of winter dormancy are especially susceptible to dehydration at time of 'green-up'. Higher mowing heights and adequate soil potassium will increase the drought tolerance of turfgrasses.

Irrigation is required for turfgrass to produce quality sod for resell. Ample water of good quality should be a priority during the planting stage.

Vegetables

Vegetables are 80 - 95 percent water. Since they contain so much water, their yield and quality suffer very quickly from drought. Thus for good yields and high quality, irrigation is essential to the production of most vegetables. If water shortages occur early in the crop's development, maturity may be delayed and yields are often reduced. If a moisture shortage occurs later in the growing season, quality is often reduced even though total yield is not affected. Most vegetables are rather shallow rooted and even short periods of two to three days of stress can hurt marketable yield.

Most vegetables have small seeds which are planted 0.75 inches deep or less. When seeds are planted shallow, the upper layer of soil can dry rapidly leaving the seed without sufficient moisture to complete germination. When this happens, no stand or at best a poor stand will result. An irrigation of 0.5 inch immediately after planting should be applied to settle the soil and to start germinating seeds. For larger seeded crops, irrigation a few days prior to seeding is desired. If seed is slow to emerge, then irrigations of 0.50 inch should be applied as needed. This should keep the area around the seed moist until seedlings emerge. Irrigation is a valuable tool in getting good, uniform stands which ensure high yields. Good uniform stands also mean uniform harvest dates and more efficient production.

Vegetable transplants also require irrigation and adequate water cannot be applied to dry soil with a transplanter. A light irrigation of 0.5 to 0.75 inch will help transplants get firmly set in the soil and will provide a ready supply of water to young broken roots in the small root system of the transplants.

Irrigation at planting time can hasten seedling emergence. If 0.5 inch of irrigation is slowly applied, either with low rates or by turning the irrigation system off long enough to allow the water to soak in, crusting can be reduced and the stand will be improve.

Most vegetables that are fruits such as tomatoes and peppers are injured by wide fluctuations in soil moisture. These contain large amounts of water and depend on this water for expansion and growth. When soil moisture is allowed to drop below the proper level, the fruit does not expand to produce maximum size before it ripens, thus reducing yield. If moisture is allowed to fluctuate too much, blossom end rot can occur and fruit is no longer useable.

If moisture fluctuation occurs during the fruit expansion stage, fruit cracking will occur. Fruit cracking usually occurs when inadequate water has been applied and then heavy rains bring too much water. The best way to prevent fruit cracking is a steady moisture supply. Second growth or knobs in potatoes are also caused by soil moisture fluctuations.

Additional information regarding the affect of irrigation on specialty crops may be found on the internet at the website for Extension Digital Information Source (EDIS), edis.ifas.ufl.edu/

Table FL3-1 Critical periods for plant moisture stress

Crop	Critical Period	Comments
Avovado	From bloom until harvest	
Banana	All year (bloom until harvest)	multiple crops per year
Blueberries	From bloom until harvest	
Carambola	All year (bloom until harvest)	multiple crops per year
Ferns	Throughout growing season	maintain MAD < 50%
Guava	All year (bloom until harvest)	multiple crops per year
Langan	Flowering through harvest	
Lime	Bloom through harvest	multiple crops per year
Lychee	Flowering through harvest	
Mamey Sapote	Continuous	multiple crops per year
Mango	Flowering through harvest	
Papaya	All year (bloom until harvest)	multiple crops per year
Peanuts	First bloom through nut forming	maintain MAD < 50%
Pecans	During nut set (April-May) and nut fill (August-September)	
Turfgrass	Planting	
Vegetables		
Asparagus	Crown set and transplanting	
Beet	Root expansion	
Brussels Sprout	Sprout formation	
Calabuza	Prebloom through fruit fruit development	multiple crops per year
Carrot	Seed germination, root expansion	
Cantaloupe	Flowering & fruit development	
Celery	Continuous	
Chinese Cabbage	Continuous	
Collards	Continuous	
Cucumber	Flowering & fruiting	
Eggplant	Flowering & fruiting	
Greens	Continuous	
Leeks	Continuous	
Spinach	Continuous	
Okra	Flowering	
Parsnip	Root Expansion	
Potato Sweet	First & last 40 days	
Pumpkin	Fruiting	
Radish	Continuos	
Rhubarb	Leaf emergence	
Rutabagas	Root expansion	
Squash	Fruit sizing	

Table FL3-2 Root zone moisture extraction depths

Crop	Root Zone Moisture Extraction Depth in Unrestricted Soils Inches	Minimum Root Zone Moisture Extraction Depth Required Inches
Alfalfa	36	24
Avocados	60	30
Bananas	60	18
Blueberries	24	18
Carambola	60	18
Citrus	36-60	18-24
Corn, grain	36	24
Corn, silage	36	24
Corn, sweet	30	18
Cotton	36	24
Fern, leatherleaf	6	4
Fern, plumosus	10	6
Flowers, annual	6	6
Grain, small	24	18
Grapes	60	36
Guava	60	18
Lime	60	18
Lychee	60	18
Mango	96	18
Melons	36	24
Papaya	36	18
Pasture Grass	36	30
Peaches	60	36
Peanuts	24	18
Pecans	60	48
Sorghum, grain	36	24
Soybeans	30	24
Strawberries	12	10
Sugarcane	36	24
Tobacco	18	18
Turfgrass	6	6
Vegetables		
Group 1[1/]	24	18
Group 2[2/]	18	12

[1/] Group 1– Asparagus, Beans (Lima), Lettuce, Okra, Parsnip, Potato (Sweet), Pumpkin, Rhubarb, Tomatoes, Squash (Winter)

[2/] Group 2– Beans (Dry, Pole, Snap), Beet, Broccoli, Brussels Sprouts, Cabbage, Carrot, Cantaloupes, Peppers, Cauliflowers, Celery, Collards, Cucumber, Eggplant, Greens, Leak, Onion, Peas (Green, Southern), Potato (Irish), Rutabagas, Squash (Summer), Turnip