UF UNIVERSITY of FLORIDA
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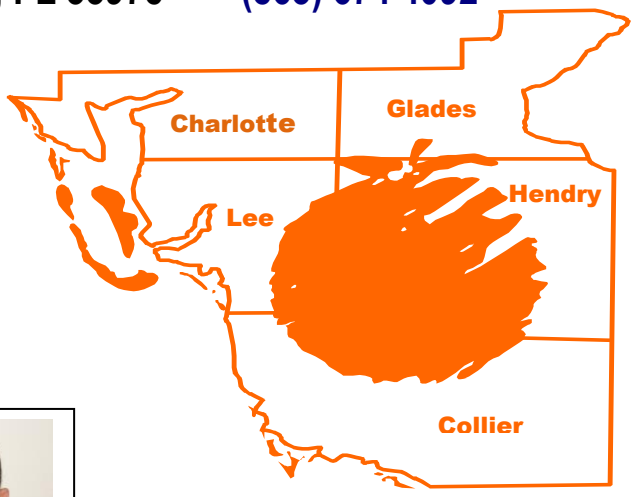
EXTENSION

Institute of Food and Agricultural Sciences

Hendry County Extension, P.O. Box 68, LaBelle, FL 33975 (863) 674 4092

Flatwoods Citrus



Vol. 23, No. 10 October 2020

Dr. Mongi Zekri
Multi-County Citrus Agent, SW Florida

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November ZOOM Seminar

Thursday, November 19, 2020
10:00 AM to 11:00 AM

1 CEU for certified crop advisors

10:00 AM – 10:30 AM
"Effect of various irrigation rates on growth of high-density plantings of young trees"
Dr. Said Hamido and Dr. Kelly Morgan, UF-IFAS
In November 2017, eight-month-old citrus trees were transplanted at different densities with four irrigation treatments (very low, low, medium, and high) of recommended rates for young citrus trees. Between 2017 and 2020, tree height, trunk diameter, leaf area, canopy volume, root growth, nutrient concentrations, stem water potential, and water use were evaluated. Results concluded that the highest irrigation rate increased the tree's height, trunk diameter, canopy volume, root growth, root lifespan, stem water potential, and nutrients uptake.

10:30 AM – 11:00 AM
"Manual pruning for high quality citrus: not all varieties are pruned equal"
Dr. Fernando Alferez, UF-IFAS
Modern manual pruning is a mix of science and art, and is the result of centuries of accumulating knowledge. In this talk, I will address the basics of citrus hand pruning. How, why, and when to prune by hand, and types of pruning. I will also make emphasis on varietal differences that will dictate the way we prune each variety for better yield and quality, as pruning principles are totally different depending on the variety. I will show two case studies to illustrate those differences: Satsuma mandarins and Navel oranges, as they behave differently and require radically different manual pruning.

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EL NIÑO/SOUTHERN OSCILLATION (ENSO) DIAGNOSTIC DISCUSSION

issued by

CLIMATE PREDICTION CENTER/NCEP/NWS
and the International Research Institute for Climate and Society

8 October 2020

ENSO Alert System Status: La Niña Advisory

Synopsis: La Niña is likely to continue through the Northern Hemisphere winter 2020-21 (~85% chance) and into spring 2021 (~60% chance during February-April).

La Niña continued during September, as evidenced by below-average sea surface temperatures (SSTs) extending from the Date Line to the eastern Pacific Ocean (Fig. 1). The SST indices in the two westernmost Niño regions, Niño-4 and Niño-3.4, cooled throughout the month, and the Niño-3.4 index was -1.1ºC in the past week (Fig. 2). The equatorial subsurface temperature anomalies (averaged from 180°-100°W) remained substantially unchanged (Fig. 3), and continued to reflect below-average temperatures from the surface to 200m depth in the eastern Pacific Ocean (Fig. 4). The atmospheric circulation anomalies over the tropical Pacific Ocean remained consistent with La Niña. Low-level wind anomalies were easterly across most of the tropical Pacific, and upper-level wind anomalies were westerly over the east-central Pacific. Tropical convection continued to be suppressed from the western Pacific to the Date Line, and a slight enhancement of convection emerged over Indonesia (Fig. 5). Also, both the Southern Oscillation and Equatorial Southern Oscillation indices remained positive. Overall, the coupled ocean-atmosphere system indicates the continuation of La Niña.

A majority of the models in the IRI/CPC plume predict La Niña (Niño-3.4 index less than -0.5°C) to persist through the Northern Hemisphere winter 2020-21 and to weaken during the spring (Fig. 6). The latest forecasts from several models, including the NCEP CFSv2, suggest the likelihood of a moderate or even strong La Niña (Niño-3.4 index values < -1.0ºC) during the peak November-January season. The forecaster consensus supports that view in light of significant atmosphere-ocean coupling already in place. In summary, La Niña is likely to continue through the Northern Hemisphere winter 2020-21 (~85% chance) and into spring 2021 (~60% chance during February-April; click CPC/IRI consensus forecast for the chances in each 3-month period).

La Niña is anticipated to affect temperature and precipitation across the United States during the upcoming months (the 3-month seasonal temperature and precipitation outlooks will be updated on Thurs. October 15th).

This discussion is a consolidated effort of the National Oceanic and Atmospheric Administration (NOAA), NOAA's National Weather Service, and their funded institutions. Oceanic and atmospheric conditions are updated weekly on the Climate Prediction Center web site (El Niño/La Niña Current Conditions and Expert Discussions). Forecasts are also updated monthly in the Forecast Forum of CPC's Climate Diagnostics Bulletin. Additional perspectives and analysis are also available in an ENSO blog. The next ENSO Diagnostics Discussion is scheduled for 12 November 2020. To receive an e-mail notification when the monthly ENSO Diagnostic Discussions are released, please send an e-mail message to: ncep.list.enso-update@noaa.gov.

Climate Prediction Center
National Centers for Environmental Prediction
NOAA/National Weather Service
College Park, MD 20740

RESETTING IN CITRUS GROVES

For maximum efficiency of a production unit or grove, it is essential that every tree space is occupied by a healthy and productive tree. The average annual tree loss across the Florida citrus industry is currently around 6%. However, the extent of tree loss among individual groves can vary from 2 to 12% or more. Prompt replacement of unproductive trees means higher average long-term returns from the grove. If the declining trees remain in the grove, they keep getting weaker and yield less fruit each year and therefore the potential production capacity for the grove keeps declining even though production costs remain the same or even increase. It is very important to remove and replace such trees once it is clear that they are declining and they are no longer economically profitable. However, the reason for the decline should be determined and the condition should be corrected so that the replacement tree does not suffer the same fate.

Resetting should be considered if the tree is affected by an incurable disease such as blight, tristeza, or citrus greening. The resetting program should be conducted regularly rather than being delayed until serious losses in production have occurred. Resets should be planted with the same cultivar already in the block. Usually, it is more economical to keep resetting and not to push the entire block unless the cultivar and/or the tree spacing between rows is an undesirable one. Replanting in a mature grove seems justified only when a minimum of 8 ft between canopy driplines, (not from trunk-to-trunk), is available for canopy development of the new trees.

Replacement of dead, diseased, and declining trees in Florida citrus groves should always be an important part of the total production program. Today, tree replacement is more important than ever since overhead and production costs are dramatically increasing and a full stand of productive trees

is essential to maximize production and profits. Freezes, blight, tristeza, Phytophthora, Diaprepes, and other pests and diseases have been particularly troublesome to Florida citrus growers for the last two decades. Citrus canker and greening have been devastating citrus groves since their introduction to Florida. Extensive tree losses coupled with the economic necessity of regular resetting have caused many growers to investigate ways to achieve new efficiencies in reset management.

NOT AN EASY TASK

Caring for young citrus trees is always troublesome because they require far more attention than larger, established trees. Florida's sandy soils, high summer temperatures, possible low winter temperatures, and scattered rainfall patterns complicate young tree care by forcing growers to protect, fertilize, and weed young trees regularly or face extensive losses. Young trees are more sensitive and more attractive to pests than mature trees due to high levels of vegetative growth. Therefore, special care is needed to insure pests are adequately controlled. Resets often present an even greater problem because trees are usually scattered throughout a block of larger trees, where they compete with large, full-grown trees for limited supplies of water, nutrients, and sometimes sunlight. Scattered resets frequently have serious weed problems since removal of the previous tree allows the area to receive more sunlight and provides more favorable conditions for weed growth. Since resets are usually scattered throughout a block of much larger trees, they are often difficult to locate and may be accidentally overlooked, resulting in inadequate care. Researchers, growers, and production managers are continually developing and improving methods of dealing with reset care.

PLANNING THE RESET PROGRAM

Grove managers should include tree removal and resetting as a routine part of the production program and assign special crews to deal specifically with young tree care. Planning ahead is very important because there is often a lag period between the time when replacement trees are ordered and when they are received. The wait time for the most desired rootstock and scion combination may be as great as 1 to 2 years, so replacement tree needs should be anticipated (when possible) and orders placed so they can be obtained when needed.

PURCHASING TREES

High quality reset trees are essential for maximum young tree growth. These young trees will be placed in an intensely competitive situation and may sometimes receive less than ideal care, so there is no room for compromising tree quality. Only healthy and properly sized trees from registered sources should be purchased since the initial cost is only a small fraction of the total cost of bringing such a tree into production.

SITE PREPARATION

The planting site should be well prepared. Weeds should be removed before planting. At a minimum, a non-residual herbicide should be applied to the reset area to get weeds under control before the young tree is planted.

Planting sites should be prepared well in advance of receipt of the trees. Ideally, trees should be planted on the same day they are received. Under no circumstances should trees be allowed to dry out. To minimize root desiccation and damage, they should be kept cool and moist until they are planted.

PLANTING THE TREES

Trees should be removed from the container and inspected for evidence of pot-binding. Make several vertical slashes about one inch deep through the root ball to encourage root branching. These slashes also allow the potting soil and roots to interface more closely with the soil in the planting site. It may be easier to cut some of the roots with pruning shears and pull them so they protrude from the ball.

A common problem with nursery trees is that the potting mixture is often highly organic. Such materials form areas, which are difficult to permeate with water after the young tree is planted in

sandy soils and irrigated. The outer third of the organic ball should be removed so that the outer roots are exposed and can extend into the soil in which the tree is planted. Otherwise, the tree may not grow off quickly and satisfactorily.

WEED CONTROL

Keeping weeds under control during the establishment period of the reset is very important. Weeds compete with young citrus trees for water, nutrients, soil applied pesticides, and sunlight and they must be properly controlled. Weed control around a reset site should be considered at pre-plant, early post-plant, and after the tree is established. Control of weeds prior to planting should be provided. If residual herbicides are used, they should be used at proper rates and at least 30 days in advance of planting so that residues do not impact reset growth. Prior to planting, contact or growth regulating herbicides may be preferred since they do not leave residual effects in the soil.

Weed control during the establishment period or approximately the first year is frequently quite difficult. Hand labor is scarce and expensive. Trunk damage by hoes or other cultivation equipment further compounds the problem. Chemical weed control provides at least a partial solution to the problem during this establishment period. There is now a fairly wide selection of residual herbicides available, which can be used around young trees. These materials should be applied at reduced rates. Be sure to read labels carefully for restrictions on the use of herbicidal materials around young trees.

After the reset has been planted for a year or more, modifications of the weed control program can be considered. Labels of materials under consideration should be checked carefully for restrictions prior to use. Some herbicides require reduced rates around young trees to minimize potential damage to resets planted among older trees. Specially modified herbicide applicators are available which enable the equipment operator to deliver reduced rates or a different herbicide mix around young trees.

To minimize herbicide contact to young trees, many growers apply a wrap or guard around the lower 12 to 16 inches of the tree trunk. When using these wraps be sure to monitor the protective structure for ants or other pests that may damage the tree trunk.

SPROUTING

Resets require periodic sprout removal. The use of tree wraps usually reduces the need for sprout control. Wraps often stay in place for up to 3 years. They should, however, be checked periodically for the presence of ants or fungal diseases. Reduced sprouting may be enough to justify their use. There are no simple answers to the use of wraps. Each situation is different and requires careful horticultural and economic consideration to arrive at the best procedure of maintenance, inspection, and management.

IRRIGATION & DRAINAGE

Young citrus trees require frequent but moderate water application for survival and proper growth. Competition for water is accentuated by nearby older trees or if weeds are allowed to grow close to the young trees. Anything that can be done to discourage competition for available water should be beneficial to the young tree. Irrigation systems should be in place before planting trees. Special modifications to the irrigation pattern by inverting the micro-sprinkler so that the surface wetting area is reduced or by increasing irrigation frequency can be good strategies to supply water for resets. However, the irrigation frequency necessary to sustain a mature grove is rarely adequate for good growth of newly-set trees, and young trees should be checked frequently to be certain they are receiving sufficient water. Drainage is as important as irrigation. Excess water must be removed from the rootzone. The concept of total water management must be practiced. If either system -irrigation or drainage- is not designed, operated, and maintained properly, then the maximum profit potential of a grove cannot be achieved. In Florida, both surface and subsoil drainage is necessary to obtain adequate root systems for the trees.

FERTILIZATION

Reset fertilization requires an extra effort beyond the needs of the bearing grove. Frequent application of water-soluble fertilizers with irrigation water (fertigation) can increase overall fertilizer use efficiency. If the grove is under a fertigation program, there is no need for special care in terms of nutrition for resets. Great care must be taken to ensure that proper rates of fertilizer materials are dispensed to prevent nutritional deficiencies or toxicities. Frequent light applications usually produce best results and lessen the danger of leaching but these practices need to be evaluated for cost effectiveness. The use of controlled-release fertilizers for resets is a better option than making multiple trips throughout the year to scattered resets throughout large blocks.

PEST CONTROL

Because young trees have more frequent flushing cycles than mature trees, they are more attractive and sensitive to pests. Therefore, special care is needed to keep the citrus psyllid and leafminer under control to reduce their damage to new leaves and to reduce the severity of citrus canker and the spread of citrus greening. Relying solely on foliar contact insecticides for resets is not a good strategy. Soil-applied systemic insecticides (neonicotinoids) which provide 6-8 weeks of control are the most effective tool for managing psyllids and leafminers on resets. Currently, three neonicotinoid products are registered for use in citrus: imidacloprid (Admire, Alias, Couraze, Nuprid), thiamethoxam (Platinum), and clothianidin (Belay). Various generic formulations are also available. Resets should also benefit from foliar contact pesticides and from foliar nutrition used on mature trees.

GROVE PLAT

Since resets are usually scattered throughout a block of much larger trees, they are often difficult to locate and may be accidentally overlooked, resulting in inadequate care. An annually updated grove plat is probably the best method for assessing general grove condition and productivity. Plats can be prepared by hand or with the assistance of a computer. This can help determine the number of trees which will be needed and where they should be placed. Reset plats can be prepared to later help equipment operators locate newly-planted trees for periodic care.

Scattered resets in a citrus grove.

United States Department of Agriculture
National Agricultural Statistics Service

CITRUS

OCTOBER FORECAST
MATURITY TEST RESULTS AND FRUIT SIZE

Cooperating with the Florida Department of Agriculture and Consumer Services
851 Trafalgar Ct. Suite 310E, Maitland, FL 32751-4132
(407) 648-6013 · (855) 271-9801 FAX · www.nass.usda.gov/fl

October 9, 2020

Florida All Orange Production Down 15 Percent from Last Season
Florida Non-Valencia Orange Production Down 22 Percent
Florida Valencia Orange Production Down 10 Percent
Florida All Grapefruit Production Down 7 Percent
Florida All Tangerine and Tangelo Production Up 8 Percent

FORECAST DATES – 2020-2021 SEASON
November 10, 2020 (Maturity only)
December 10, 2020

Citrus Production by Type – States and United States

Crop and State	Production [1]			Forecasted Production [1]
	2017-2018	2018-2019	2019-2020	2020-2021
	(1,000 boxes)	(1,000 boxes)	(1,000 boxes)	(1,000 boxes)
Non-Valencia Oranges [2]				
Florida	**18,950**	**30,400**	**29,650**	**23,000**
California	35,900	42,000	44,300	42,000
Texas	1,530	2,210	1,150	1,300
United States	56,380	74,610	75,100	66,300
Valencia Oranges				
Florida	**26,100**	**41,450**	**37,650**	**34,000**
California	8,300	10,200	9,000	8,500
Texas	350	290	190	200
United States	34,750	51,940	46,840	42,700
All Oranges				
Florida	**45,050**	**71,850**	**67,300**	**57,000**
California	44,200	52,200	53,300	50,500
Texas	1,880	2,500	1,340	1,500
United States	91,130	126,550	121,940	109,000
Grapefruit				
Florida-All	**3,880**	**4,510**	**4,850**	**4,500**
Red	**3,180**	**3,740**	**4,060**	**3,800**
White	**700**	**770**	**790**	**700**
California [3]	3,800	4,200	3,800	3,800
Texas	4,800	6,100	4,400	4,900
United States	12,480	14,810	13,050	13,200
Lemons				
Arizona	1,000	1,350	1,800	1,300
California	21,200	23,700	25,700	22,000
United States	22,200	25,050	27,500	23,300
Tangerines and Tangelos				
Florida	**750**	**990**	**1,020**	**1,100**
California	19,200	26,500	22,000	23,000
United States	19,950	27,490	23,020	24,100

[1] Net pounds per box: oranges in California-80, Florida-90, Texas-85; grapefruit in California and Texas-80, Florida-85; lemons-80; tangerines and mandarins in California-80, Florida-95.
[2] Early non-Valencia (including Navel) and midseason non-Valencia varieties in Florida; Navel and miscellaneous varieties in California; Early and mid-season varieties in Texas.
[3] Includes pummelos in California.

From the Florida Citrus Budwood Annual Report

Top 15 Rootstocks 2019-2020

	2019	# Budded	2018	2017	2016	2015
1	US-942	909,953	US-942	Swingle	Kuharske	Kuharske
2	Kuharske	651,926	Swingle	US-942	X-639	X-639
3	X-639	589,163	Kuharske	X-639	S/O	Swingle
4	Swingle	380,000	X-639	Kuharske	US-897	Sour Orange
5	US-897	285,459	Sour Orange	Sour Orange	SWG	Cleopatra
6	US-812	264,980	US-802	US-802	US-942	US-802
7	Sour Orange	181,615	Volkamer	US-897	US-802	US-897
8	US-802	127,110	US-812	UFR-04	US-812	US-942
9	Volkamer	105,575	US-897	US-812	Cleopatra	US-812
10	C-54	85,188	Rough Lemon	C-35	UFR-04	C-35 Citrange
11	Rough Lemon	77,149	C-35	Cleopatra	Volkamer	Carrizo
12	UFR-04	49,017	UFR-04	Volkamer	Kinkoji	Volkamer
13	C-35	44,850	UFR-17	UFR-03	UFR-03	Own Root
14	C-57	42,815	Poncirus trifoliata	C-22	Carrizo	UFR-04
15	US-1777	33,034	US-1516	Carizzo	Rough Lemon	Kinkoji

Seed	Tissue Culture	Rooted Cutting
42 different rootstocks used	25 different rootstocks used	18 different rootstocks used
2,924,868 propagations	772,391 propagations	224,346 propagations
Top Seed = Kuharske	Top Tissue Culture = US 942	Top Rooted Cutting = US-942

DROUGHT

Water stress is the physiological condition to which a plant is subjected whenever the rate of water loss from the leaves by transpiration exceeds the rate at which water is absorbed by the root system. Water stress can be the result of excessive transpiration due to hot weather or slow absorption from a dry soil, flooded soil or saline conditions. Any degree of water imbalance can produce a deleterious change in physiological activity of growth and reproduction. Short-term drought often reduces production and prolonged drought can cause total crop failure. Severe drought between February and June can reduce fruit set, fruit development and fruit growth. The number of fruit, fruit size, and tree canopy are reduced with water stress. Extension growth in shoots and roots, and leaf expansion are all negatively correlated with water stress. Trees subjected to water stress are generally reduced in size. Vegetative growth is particularly sensitive to water deficit. Growth is closely related to turgor and the loss of turgidity reduces photosynthesis, leaf and fruit enlargement, juice content and yield, and increases wilting and leaf and premature fruit drop. Growers cannot afford water stress or water restrictions during critical periods. Irrigation is not only essential during the springtime, but it is also important during dry falls to minimize premature fruit drop.

MICROSPRINKLER IRRIGATION & FERTIGATION

Microsprinkler irrigation is an important component of citrus production systems in Florida. Microirrigation is more desirable than other irrigation methods for several reasons. Three important advantages are: water conservation, the potential for significantly improving fertilizer management and for cold protection.

Research has shown that when properly managed (no overirrigation), water savings with microirrigation systems can amount to as much as 80% compared with subirrigation and 50% compared with overhead sprinkler irrigation.

Microirrigation provides for precise timing and application of fertilizer nutrients in citrus production. Fertilizer can be prescription-applied during the season in amounts that the tree needs and at particular times when those nutrients are needed. This capability helps growers increase the efficiency of fertilizer application and should result in reduced fertilizer applications for citrus production. Research has also shown the important advantage of microsprinklers for freeze protection of citrus.

Fertigation is the timely application of small amounts of fertilizer through irrigation systems directly to the root zone.

Some advantages of fertigation:

♦ Fertilizer is placed in the wetted area where feeder roots are extensive,

♦ Fertilizer may be applied more frequently in small amounts so that it is available when the tree needs it,

♦ Increased fertilizer application frequency can increase fertilizer efficiency and reduce leaching,

♦ Application cost is much lower than that of dry or foliar fertilizer application.

Through fertigation, comparable or better yields and quality can be produced with less fertilizer. Microirrigation systems must properly maintain to apply water and fertilizer uniformly. Growers must determine:

(1) which fertilizer formulations are most suitable for injection,

(2) the most appropriate fertilizer analysis for different age trees and specific stages of growth,

(3) the amount to apply during a given fertigation event, and

(4) the timing and frequency of applications.

Properly managed applications of plant nutrients through irrigation systems significantly enhance fertilizer efficiency while maintaining or increasing yield. On the other hand, poorly managed fertigation may result in substantial yield losses. Fertigation involves deciding which and how much nutrients to apply, selecting the most effective formulations and scheduling injections to ensure that essential nutrients are available as needed.

Injection Duration

A minimum injection time of 45 to 60 minutes is recommended. This time is sufficient for uniform distribution of nutrients throughout the fertigation zone. Limit injection time to prevent the application of too much water, because excessive water leaches plant nutrients below the root zone.

Granular Controlled-Release Fertilizers

Most commonly used commercial fertilizers are water soluble, meaning they are readily available to plants when properly applied. Soluble fertilizers are applied to the soil dry in granular form, liquid through fertigation, or foliarly.

When applied in granular form to the soil, soluble fertilizers release nutrients relatively quickly, assuming the soil water content is at the appropriate level. Applying too much readily soluble fertilizer to crops at once can result in plant toxicity. In addition, heavy rainfall or irrigation can result in leaching of the nutrients. Therefore, it is suggested to split the soluble fertilizer into smaller doses.

Over many decades, the fertilizer industry has developed controlled-release fertilizers (CRFs). The Association of American Plant Food Control Officials defines CRFs as fertilizers that contain a plant nutrient in a form in which the plant uptake is delayed after application, or that provide a longer duration of nutrient availability compared with quick-release fertilizers. CRFs have become more popular in recent years.

CRFs are often called slow-release fertilizers (SRFs) or timed-release fertilizers. However, the terms CRF and SRF should not be used interchangeably. The main difference between CRFs and SRFs is that in CRFs, the factors affecting the rate, pattern, and duration of release are well known and controllable, whereas in SRFs, they are not well controlled. CRFs were initially developed for their horticultural benefits, but they have also attracted attention in the best management practices (BMPs) and citrus greening era.

CRFs have advantages in:
• inducing more growth and yield due to a continuous supply of nutrients.
• reducing rates and frequency of fertilizer applications.
• saving substantial labor and time.

CRFs are typically coated or encapsulated with inorganic or organic materials that control the rate, pattern, and duration of plant nutrient release. Soil moisture, temperature, and microbes have the greatest influence on nutrient release. CRFs have different N-P-K blends and may or may not include micronutrients. They can have different durations of release, expressed as months, which determine how long the CRF will persist.

Citrus fertilization research conducted in Florida within the past 30 years showed that tree growth and fruit yield where part or all of the fertilization program included CRF are similar or greater than growth and yield resulting from an all conventional water-soluble N fertilization program. CRFs are more efficient, have low plant toxicity hazard, and less leaching and volatilization potential than conventional soluble fertilizers. The improved efficiency of fertilizer use saves energy and reduces environmental pollution.

Applying Dry Fertilizers

Dry solid fertilizer spreaders should apply materials directly over the root zone. When applying fertilizers to young trees, managers should take advantage of manual or electronic spreader adaptations that deliver fertilizer rates accurately to small tree root zones while leaving out the area between trees where roots are not present. For economical and efficient fruit production, it is essential that spreaders be calibrated to apply accurate and appropriate amounts of fertilizers.

National Biosolids Partnership

FREQUENTLY ASKED QUESTIONS ABOUT BIOSOLIDS

1) What are Biosolids?
Biosolids are the nutrient-rich solid organic matter recovered from the treatment of domestic sewage in a wastewater treatment facility. Biosolids are a beneficial resource, containing essential plant nutrient and organic matter and are recycled as a fertilizer and soil amendment. When treated and processed, these residuals can be recycled and applied as fertilizer to improve and maintain productive soils and stimulate plant growth.

2) What is the difference between biosolids and sewage sludge?
Sludge is generally used before applicable beneficial recycling criteria have been achieved which normally occurs at the outlet of the stabilization process. It should be used in tandem with a specific process descriptor (e.g., *primary sludge*, *waste activated sludge*, *secondary sludge*, etc.)
Biosolids is generally used after applicable beneficial recycling criteria have been achieved, i.e., at the outlet of the stabilization process. Common stabilization processes include the following: aerobic digestion, autothermal thermophilic aerobic digestion (ATAD), anaerobic digestion, composting, alkaline stabilization, thermal drying, including flash, rotary, fluid bed, paddle, hollow-flight, disc, and infrared dryers, thermophilic pozzolanic fixation, acid oxidation/disinfection, and heat treatment/acid digestion.

3) Why do we have biosolids?
We have biosolids as a result of treating sewage sludge (i.e., the solids generated during the treatment of domestic sewage in a treatment plant) to meet the land application regulatory requirements). Wastewater treatment technology has made our water safer for recreation and seafood harvesting. Forty years ago, thousands of American cities dumped their raw sewage directly into the nation's rivers, lakes, and bays. Through regulation of this dumping, local government now required to treat domestic sewage and to make the decision whether to recycle the solids generated as fertilizer, incinerate them or bury them in a landfill. If the solids meet the regulatory requirements for land application and are recycled, they are biosolids.

4) How are biosolids generated and processed?
Biosolids are generated during the treatment of domestic sewage when treated further to meet regulatory requirements. The wastewater treatment can actually begin before the wastewater reaches the treatment plant. In many larger wastewater

treatment systems, pre-treatment regulations require that industrial facilities pre-treat their wastewater to remove many hazardous contaminants before it is sent to a wastewater treatment plant. Wastewater treatment facilities monitor incoming wastewater streams to ensure their recyclability and compatibility with the treatment plant process.

Sewage sludge is not generated until domestic sewage is treated in a treatment works, and biosolids are not produced until the sewage sludge meets the land application Part 503 requirements. For these reasons, the treatment of biosolids cannot occur before the domestic sewage reaches the wastewater treatment plant.

Once the wastewater reaches the plant, domestic sewage goes through physical, chemical and biological processes that clean the domestic sewage and remove the solids. If necessary, some of the solids are then treated with lime to raise the pH level to eliminate objectionable odors. Pathogen reduction (disease-causing organisms, such as bacteria, viruses and parasites) and other organisms capable of transporting disease for the solids usually occur in a different process (e.g., a digester).

5) How are biosolids used?

After treatment and processing, biosolids can be recycled and applied as fertilizer to improve and maintain productive soils and stimulate plant growth. The controlled land application of biosolids completes a natural cycle in the environment. By treating sewage sludge, it becomes biosolids that can be used as valuable fertilizer, instead of taking up space in a landfill or other disposal facility.

6) Are biosolids safe?

Decades of studies have demonstrated that biosolids can be safely used on food crops. The National Academy of Sciences has reviewed current practices, public health concerns and regulatory standards, and has concluded that "the use of these materials in the production of crops for human consumption when practiced in accordance with existing federal guidelines and regulations, presents negligible risk to the consumer, to crop production and to the environment." In addition, an epidemiological study of the health of farm families using biosolids showed that the use of biosolids was safe.

7) Do biosolids smell?

Biosolids may have their own distinctive odor depending on the type of treatment it has been through. Some biosolids may have only a slight musty, ammonia odor. Others have a stronger odor that may be offensive to some people. Compounds that contain sulfur and ammonia, which are both plant nutrients, cause most odors.

8) Are there regulations for the land application of biosolids?

The federal biosolids rule is contained in 40 CFR Part 503. Biosolids that are to be land applied must meet these strict regulations and quality standards. The Part 503 rule governing the use and disposal of biosolids contains general requirements, numerical limits for metals in biosolids, pathogen and vector attraction reduction standards, management practices and frequency of monitoring, record keeping and

reporting requirements for land applied biosolids as well as similar requirements for sewage sludge that is surface disposed or incinerated. Most recently, Part 503 requirements have been proposed to limit the concentration of dioxin and dioxin like compounds in biosolids to ensure safe land application. Biosolids are one of the most studied materials that have ever been regulated by EPA.

9) Where can I find out more about the regulations?

The biosolids rule is described in the EPA publication, A Plan English Guide to the EPA Part 503 Biosolids Rule. This guide states and interprets the Part 503 rule for the general reader. This guide is also available in hard copy. In addition to the Plain English Guide, EPA has prepare A Guide to the Biosolids Risk Assessments for the EPA Part 503 Rule which shows the many steps followed to develop the scientifically defensible, safe set of rules (also available from EPA in hard copy.)

The cited references provide valuable information about the Part 503 land application requirements. However, if the information in the references is different form the requirements in the Part 503 rule, the Part 503 rule requirements apply. A number of relevant biosolids publications are located on the National Biosolids Partnership's web page at: http://www.biosolids.org.

10) How are biosolids used for agriculture?

Biosolids are used to fertilize fields on which crops are grown. Agricultural uses of biosolids that meet strict quality criteria and application rates have been shown to produce significant improvements in crop growth and yield. Nutrients found in biosolids, such as nitrogen, phosphorus and potassium and trace elements such as calcium, copper, iron, magnesium, manganese, sulfur and zinc, are necessary for crop production and growth. The use of biosolids reduces the farmer's production costs and replenishes the organic matter that has been depleted over time. The organic matter improves soil structure by increasing the soil's ability to absorb and store moisture.

Crops use the organic nitrogen and phosphorous found in biosolids very efficiently because these plant nutrients are released slowly throughout the growing season. This enables the crop to absorb these nutrients as the crop grows. This efficiency lessens the likelihood of groundwater pollution of nitrogen and phosphorous.

11) Can biosolids be used for composting?

Yes, biosolids may be composted and sold or distributed for use on lawns and home gardens. Biosolids composted with sawdust, wood chips, yard clippings, or crop residues make excellent mulches and topsoils for horticultural and landscaping purposes. Even after composting, the sewage sludge has to meet the appropriate Part 503 requirements for it to become biosolids that can be applied to lawns and home gardens. Many professional landscapers use composted biosolids for landscaping new homes and businesses. Home gardeners also find composted biosolids to be an excellent addition to planting beds and gardens. Most biosolids compost, are highly desirable products that are easy to store, transport and use.

12) Are there rules about where biosolids can be applied?

To determine whether biosolids can be applied to a particular farm site, a good management practice includes an evaluation of the site's suitability and is generally performed by the land applier. The evaluation examines water supplies, soil characteristics, slopes, vegetation, crop needs and the distances to surface and groundwater.

There are different rules for different classes of biosolids. Class A biosolids contain no detectible levels of pathogens and must meet strict vector attraction reduction requirements and low levels metals contents. The biosolids preparer usually applies for a permit and only have to apply for permits to ensure that these very tough standards have been met. However, the Part 503 requirements have to be met even if there is no permit. Class B biosolids are treated but still contain detectible levels of pathogens. There are buffer requirements, public access, and crop harvesting restrictions for Class B biosolids. (The land application site restrictions have to be met in all cases where Class B biosolids are land-applied.)

Nutrient management planning ensures that the appropriate quantity of biosolids is land-applied. The biosolids application is specifically calculated to match the nutrient uptake requirements of the particular crop. Nutrient management technicians work with the farm community to assure proper land application and nutrient control.

13) Is EPA pushing the use of biosolids as a fertilizer? Is the federal policy for biosolids driven by economics of disposal?

As a result of its decade-long assessment of biosolids, EPA concluded that recycling biosolids to land was an environmentally responsible solution, when used in accordance with the Part 503 rule. The Federal policies supporting and promoting the beneficial recycling of biosolids are based upon sound science that has demonstrated the benefits of such recycling. These policies are not driven by economics, and the choice of to recycle biosolids remains a local decision.

14) How do the risks associated with biosolids compare with other soil amendments used in agriculture?

A Water Environment Research Foundation (WERF) study completed

in 2002 finds that the risks associated with biosolids are no greater than risks associated with other soil amendments used in agriculture. The project, "Evaluate Risks and Benefits of Soil Amendments Used in Agriculture" (project no. 99-PUM-1), examined the risks and benefits, advantages and potential disadvantages associated with the use of a variety of soil amendments in comparison to chemical fertilizers. Project results indicate that the relative risk to the environment from amendments and fertilizers varies by parameter and shows that known risks from each of the materials studied can be managed. Moreover, these manageable risks must be carefully weighed against the considerable benefits provided by the land application of amendments and fertilizers.

15) Is recycling much cheaper than disposal?

In areas where disposal costs have increased due to shrinking landfill space and increased costs to maintain and monitor landfills, some cities and towns find that recycling biosolids is less expensive than land filling. However, in most cases, land filling is competitive or less expensive than land application. In such cases, many U.S. communities have made a positive environmental decision to commit to recycling biosolids despite the additional cost. This is especially true where communities have committed to the additional costs of composting or heat drying and pathogen reduction processes for biosolids prior to utilization.

16) Are Biosolids good for the environment?

Recycling biosolids is good for the environment. Organic matter has been recycled for centuries to improve soil fertility and productivity. When properly applied and managed, biosolids can: provide essential plant nutrients; improve soil structure and tilth; add organic matter; enhance moisture retention; and reduce soil erosion.

Biosolids recycling is regulated and encouraged by the United States Environmental Protection Agency and state and local authorities. Research and years of recycling experience have demonstrated that properly managed land application of biosolids is environmentally safe.

- Use of compost, animal manures, biosolids, organic fertilizers, and mulch in citriculture is useful and beneficial.
- Humus, which is the end product of broken down (decayed) organic matter, is an important component of healthy soils and has many great benefits.

Humus improves soil structure, has exceptionally high water-holding capacity and high nutrient storage capacity, supplies plant nutrients, allows more oxygen to enter the soil increasing root growth, increases water penetration into the soil and root development, increases and maintains healthy populations of beneficial micro-organisms and can be very effective at preventing and suppressing plant diseases.

Flatwoods Citrus

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__Black, non-Hispanic

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