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Citrus BMP Implementation in Florida's Gulf Citrus Production Area: Nutrients[1]

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Citrus groves in the five-county Gulf region (Charlotte, Collier, Glades, Hendry, and Lee) occupied approximately 178,000 acres in 2005, which includes actual cropped acreage as well as impoundments and other water control features. This area represents 25% of both Florida's total citrus acreage as well as total production volume. Favorable citrus growing conditions in the Gulf Citrus Production Area (GCPA) were influential in creating the commercial citrus production boom in the region. Warmer climate, sufficient water supply, and less expensive land compared to the traditional production area on the central Florida ridge caused a large part of the citrus industry to move into southwest Florida. The majority of Gulf citrus acreage planting was done after periods of freeze that seriously damaged or destroyed numerous central Florida citrus groves.

Profitable citrus production relies on a consistent and reliable water supply for supplementary irrigation. Recently, Florida's lower west coast, a five-county area covering most of the GCPA, has faced both water quantity and quality concerns. The region is experiencing an increase in water demand, mainly due to urban population growth near the coast. The South Florida Water Management District (SFWMD) expects water demand to increase 27% by 2020 (compared with 1995). Water supply issues must be addressed for present needs and future planning.

In addition to water supply, the region also faces nutrients impacting the ecosystem. A Total Maximum Daily Load (TMDL) program for the Caloosahatchee River, C139, and the Big Cypress Basins is scheduled to be completed between 2009 and 2011. The C139 basin (area 170,000 acres) in southeast Hendry County, which is hydrologically linked to Florida's Everglades through a stormwater treatment area (STA), is already regulated to limit phosphorus (P) discharges with required implementation of Best Management Practices (BMPs). The SFWMD has set a limit on P discharge (adjusted for rainfall) from the C139 basin. For 2006, the target load was 38 short tons (U.S.), while the actual load was 118 tons. To address water quality/quantity and nutrient issues, both water and nutrient management strategies must be linked. To achieve successful commercial citrus

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yields, and use both water and nutrients effectively, these components must be managed together.

State agencies are promoting the development and implementation of BMPs to address water quality issues. The Gulf citrus industry in association with UF/IFAS, Florida Department of Agriculture and Consumer Services (FDACS), SFWMD, and Florida Department of Environmental Protection (FDEP) has developed a citrus BMP manual that was released in February 2006. The objective of the manual was to identify and promote BMP implementation within the GCPA to reduce environmental impacts. Through a legislative process, FDACS can provide growers a presumption of compliance with water quality standards associated with the TMDL process if growers agree to implement a set of practices from the BMP manual. The purpose of presumption of compliance is to effectively reduce pollution through non-regulatory programs and incentives. An additional benefit to the grower is that any government agency is restrained from pursuing recovery of damages due to pollution from contamination of surface water or groundwater caused by the pollutants listed by FDEP. In effect, the presumption of compliance assumes that a grower has or will implement a selected set of BMPs and that the grower has done what is necessary to comply with the intent of the TMDL goals.

Most groves in the GCPA have been developed in the last 25 years and have environmentally desirable features. For instance, training fertilizer applicators and applying fertilizers to avoid leaching and runoff losses have already been implemented in the GCPA region. However, data on the extent to which BMPs have been implemented within the GCPA have not been available. Therefore, in 2005 we conducted a survey in cooperation with Gulf Citrus Growers Association (GCGA) and FDACS to quantify the current level of BMP implementation and to identify BMPs that might be adopted if a cost-share program was available. The survey questionnaire included five major BMP categories: water volume, sediment control, aquatic plant control, pesticide use, and nutrients. This publication describes the survey and discusses the findings regarding nutrient BMPs. Results for other categories of BMPs are presented elsewhere (see *Citrus BMP Implementation in Florida's Gulf Citrus Production Area: Water, Sediment, and Aquatic Weeds* at http://edis.ifas.ufl.edu/ae405). The target audience for this publication is citrus growers; allied industry, local, state, and federal agencies; and parties interested in nutrients and water quality in the southwest Florida region.

BMP Survey

The survey was designed with descriptive questions about grove management practices, BMPs, and their importance with regard to water quality benefits and grove profits. To determine if a particular practice was in use, growers were asked if they implemented that practice consistently or not. Grove owners and grove managers were also given "*sometimes*" as a choice to indicate that a practice was not implemented on a regular basis. To understand whether or not a practice was acceptable to the growers, one of the choices was "*disagree with the practice*." Another choice, "*plan to use*," was helpful in determining whether a grower would be willing to implement a practice in the future. The "*would if cost-shared*" choice determined the potential for implementation of a specific BMP if federal and/or state cost-share funds were made available to offset a portion of the implementation cost.

Survey Procedure and Area

Sixty groves covering an area of 115,791 acres were surveyed by personally interviewing grove owners or managers. The surveyed acreage was distributed between large (> 1000 acres), medium (250 - 1000 acres), and small groves (< 250 acres). From a water quality standpoint, the percentage of land area affected by a specific BMP is more important than the percentage of total number of groves. Distribution of the surveyed area by grove size is provided in Table 1. The grove name and location were kept confidential. For convenient data analysis processing, survey questions were coded for different categories and indexed with the initial of that survey category name. Nutrient survey questions were coded as N1, N2, N3, etc. Question codes with associated descriptors are in Appendix 1. The acreage for a specific practice was summed based on grower responses to quantify BMP implementation.

Table 1. Distribution of surveyed area by grove size.

Grove Size	Area (Acres)	Number of Groves	Area (%)
Large	104,170	31	90
Medium	9,982	18	9
Small	1,639	11	1.0
Total	115,791	60	100

Extent of Nutrient BMP Implementation in the GCPA

Table 2 presents the coverage area as percentage of acreage for individual nutrient BMPs for the survey choices: *no, yes, would if cost-shared, and sometimes*.

UF/IFAS Fertilizer Recommendations Awareness (N1)

Growers representing 96% (111,011 acres) of the total surveyed area reported that they were aware of the fertilizer recommendations and standards documented in SL-253 [*] ***(N1) (*****http://edis.ifas.ufl.edu/ss478*****). Growers from a small percentage of area were not aware of UF/IFAS fertilizer recommendations. (*** [*] ***SL-253 replaced the older SP-169 in 2008. At the time of the survey, growers were asked about SP-169.)***

In 1954, a collaborative effort between the UF/IFAS Citrus Experiment Station and the USDA Horticulture Laboratory in Orlando produced the first fertilizer recommendations for Florida Citrus in Bulletin 536. Based on this document, UF/IFAS developed another document *Nutrition of Florida Citrus Trees*, SP-169 (1995) that superseded sections A through D of Bulletin 536. Since the time of the 2005 survey, the second version of *Nutrition of Florida Citrus Trees*, SL-253 has been published (2008). Research findings, including results from application of BMPs, have been added to this updated document.

Use of UF/IFAS Fertilizer Recommendations (N2)

On 46% (53,744 acres) of the surveyed area, UF/IFAS recommendations were utilized for fertilizer application (N2), while on 39% (45,347 acres) of the area, UF/IFAS recommendations were followed sometimes.

Florida citrus growers are advised to follow the recommendations provided in the second edition of *Nutrition of Florida Citrus Trees*, SL- 253, to take advantage of the most recent research for citrus production.

UF/IFAS fertilizer recommendations address nitrogen (N) rate and timing and irrigation for the growth of young nonbearing trees. Optimal growth results from proper application of N and irrigation. However, growth of young trees can be impeded if N and irrigation are not managed together for optimal nutrient-use efficiency and effective water use. Soil type, agricultural history of the land, fertilizer source and placement, crop load, citrus varieties, tree age, and irrigation type are some of the factors that should be considered before developing a fertilizer program for citrus trees. All of these factors and more are discussed in SL-253. By following these recommendations, growers can optimize tree growth and fruit production, thereby becoming more cost efficient, while avoiding over- or under-application of N or irrigation water.

Use of Soil Analyses for Fertilizer Application (N3)

On 90% (104,056 acres) of the area, soil analyses were performed to determine fertilizer or amendment rates (N3). On another 10% (11,735 acres) of the surveyed area, soil analyses were implemented sometimes.

A successful nutrition program should be aimed at providing sufficient components necessary for tree growth and crop production. Excess application of nutrition raises environmental concerns. Soil and tissue analyses are two management tools that allow growers to make informed decisions about the fertilization of citrus trees. Soil testing can also provide soil pH and organic matter content, both useful for making amendment decisions. Soil testing works best for citrus when considering nutrients that are relatively immobile in the soil. Extractable values of phosphorus, potassium, calcium, magnesium, and copper are especially useful. Citrus tissue analyses work best for these same nutrients and nitrogen, zinc,

Table 2. Survey results for Nutrient BMPs.

Nutrient Question Codes	Total area (acre) and percentage of acreage for the three survey responses *no, yes, would if cost-shared* and *sometimes*							
	No		Yes		Would if cost-shared		Sometimes	
	Area	%	Area	%	Area	%	Area	%
N1 (know about fert. rec.)	3300	2.8	111011	95.9	0	0	0	0
N2 (follow fert. rec.)	6667	5.8	53744	46.4	0	0	45347	39.2
N3 (soil analyses)	0	0	104056	89.9	0	0	11735	10.1
N4 (tissue analyses)	0	0	92329	79.7	0	0	23462	20.3
N5 (fert. appl. training)	2575	2.2	113216	97.8	0	0	0	0
N6 (training document)	23682	20.5	72761	62.8	0	0	8955	7.7
N7 (liquid fert. on concrete slab)	24831	21.4	58782	50.8	164	0.1	17991	15.5
N8 (calibrate fert. spreaders)	0	0	115791	100	0	0	0	0
N9 (fert. application location)	620	0.5	115171	99.5	0	0	0	0
N10 (fert. application- high water table)	0	0	115791	100	0	0	0	0
N11 (weather forecasts)	7122	6.2	108669	93.8	0	0	0	0
N12 (loading fert.- use of tarp)	68090	58.8	5484	4.7	37737	32.6	0	0
N13 (loading fert.- near ditches, etc.)	1750	1.5	113421	98.0	0	0	620	0.5
N14 (vegetative filter strips)	15627	13.5	98972	85.5	0	0	1192	1.0
N15 (abandoned wells)	2820	2.4	110342	95.3	0	0	0	0
N16 (alternate loading sites)	3395	2.9	106866	92.3	0	0	5530	4.8
N17 (split dry- 3 times)	3376	2.9	88565	76.5	0	0	0	0
N18 (split dry- 4 times)	6100	5.3	42897	37	0	0	360	0.3
N19 (split dry- 5 times)	4792	4.1	126095	10.9	0	0	0	0
N20 (fertigation)	17167	14.8	73566	63.5	0	0	20374	17.6
N21 (combine fertigation)	16876	14.6	83793	72.4	0	0	11747	10.1
N22 (controlled release fert.)	10337	8.9	52492	45.3	5000	4.3	30587	26.4
N23 (controlled release fert.- resets)	1600	1.4	81219	70.1	5000	4.3	12687	11
N24 (controlled release fert.- mature trees)	29578	25.5	36500	31.5	21010	18.1	240	0.2
N25 (organic amendments)	14144	12.2	72837	62.9	4000	3.5	24810	21.4
N26 (adjust fert. rates)	62695	54.1	46774	40.4	0	0	3822	3.3
N27 (avoid fert. appl.- mid-June to mid-September)	8319	7.2	85264	73.6	0	0	12175	10.5

Note: Question codes and associated questions are presented in Appendix 1 manganese, iron, and boron (see SL-253 for more information).

Use of Tissue Analyses for Fertilizer Application (N4)

Growers representing 80% (92,329 acres) of the area used tissue analysis to estimate the fertilizer rate on their groves (N4). On 20% (23,462 acres) of the area, this tool was utilized sometimes.

Tissue analysis is particularly valuable in assessing nutritional status of a tree for macronutrients, particularly nitrogen and potassium, and micronutrients such as copper, manganese, zinc, iron, and boron. Deficiency or excess of nutrients assessed by tissue analyses can be adjusted through future adjustments to fertilizer application rates (see SL-253 for more information).

Training of Fertilizer Applicator(s) (N5)

Field operators using fertilizer application equipment were trained on 98% (113,216 acres) of the surveyed area (N5).

Adequate training of the field operators engaged in the handling, loading, and operating of fertilizer spreaders can help maintain uniform placement of fertilizer, avoid wastage, and prevent contamination of nearby water resources. Accurate calibration of equipment is important to ensure that the proper amount of fertilizer is correctly placed.

Documentation of Fertilizer Applicator Training (N6)

Training records for fertilizer handlers were maintained (N6) for 63% (72,761 acres) of the surveyed grove area. Training was also offered on an additional 19% of the acreage; but no documentation was recorded. Growers representing 8% of the grove area disagreed with the training-records practice.

Documenting the training of the field operators can help in reinforcing critical operations. This record of training for field operators may also be useful for scheduling refresher training. Since growers from 98% of the area trained their field operators who were handling fertilizers, it was expected that they would be documenting the training provided. Documentation of training is one of the components of this review process and is required for cost-sharing purposes.

Liquid Fertilizer Containment (N7)

On 51% (58,782 acres) of the area, the practice of storing liquid fertilizer in containers on concrete slabs (N7) was followed consistently. On 21% (24,831 acres) of the area, this practice was not adopted. Growers from 15% of the area utilized this technique sometimes.

Liquid fertilizer containers should be stored on a concrete slab or other containment materials (see *Chemigation Equipment and Techniques for Citrus*). In the event of container leakage, nutrient fluids are retained on the slab and prevented from contaminating the soil or adjacent water bodies.

Calibration of Fertilizer Spreaders (N8)

Calibration of fertilizer spreaders before each application (N8) was consistently implemented in the entire surveyed area in the GCPA.

Proper calibration of fertilizer application equipment helps in preventing misapplication of nutrients. Calibration is recommended before each fertilizing event.

Fertilizer Application Position (N9)

On 99.5% (115,171 acres) of the surveyed area, fertilizer application was done within the root zones of trees, within drip lines, or on the high side of the bed from the bed top drive middle (N9).

Accurate placement of fertilizer facilitates nutrient uptake while reducing nutrient losses through leaching and runoff. Fertilizers should be placed over or near the root zone. Placement of fertilizer within the root zone, particularly in young trees that do not have a well-developed root system, aids in efficient nutrient uptake.

Fertilization during High Water Table and Flooded Conditions (N10)

One hundred percent (100%) of the surveyed groves avoided fertilization during high water table and flooded conditions (N10).

Water tables are typically high (at times < 3 ft from surface) throughout the GCPA and fluctuate widely particularly during rainy season due to rainfall, soil variability, and poor drainage. When rainfall exceeds the soil water storage, the root zone may become saturated for considerable time, often resulting in undesirable root pruning after more than 72 hours in a flooded condition. Fertilizers are utilized by trees in water soluble forms. Applying soluble fertilizers during extremely wet conditions exposes soluble nutrients to vertical movement with the falling water table and subsequently laterally to the drainage ditches. Nutrients lost in this manner are not available for crop use, increase costs of production, and pose adverse environmental concerns due to their movement to surface and ground waters. Fertilizer applications during wet or flooded conditions should be avoided or delayed until more favorable conditions are present.

Weather Forecast Consideration (N11)

Growers representing 94% (108,669 acres) of the surveyed area considered weather forecasts before applying fertilizer so that runoff and leaching losses could be controlled (N11).

Fertilizer application before an imminent rainfall event should be avoided, particularly when the water table approaches soil surface. Weather forecasts should be an integral part of an effective nutrient management plan.

Use of Tarps underneath Fertilizer Spreader (N12)

Use of impermeable surfaces, such as a tarp for a ground cover to catch any spilled fertilizer and reuse this spilled fertilizer, was followed on only 5% (5,484 acres) of the total surveyed area (N12). Growers from 59% (68,090 acres) reported that they did not follow this practice. Growers from 33% (37,737 acres) of the surveyed area who did not use tarps were interested in utilizing this practice if part of the cost was covered through government cost-share programs.

Use of tarps underneath spreaders during the transfer of fertilizer to the spreaders facilitates easy clean-up and reuse of spilled fertilizer. Capturing spilled fertilizers greatly reduces the risks of spilled fertilizer materials reaching adjacent water bodies.

Precautions while Loading Fertilizer near Waterways (N13)

On 98% (113,421 acres) of the surveyed area, precautions were taken when loading fertilizer near ditches, canals, and wells (N13).

Mixing and loading activities should be conducted away from groundwater, ditches, canals, and wells, so that spilled fertilizers have a reduced chance of entering surface water bodies.

Vegetative Filter Strips to Prevent Fertilizer Movement (N14)

Vegetative filter strips to prevent movement of fertilizers to environmentally sensitive areas (N14) were employed on 86% (98,972 acres) of the surveyed area.

Incorporating a vegetative buffer or filter strips into citrus groves increases residence time and nutrient uptake needed for preserving water quality.

Plugging of Abandoned Wells (N15)

On 95% (110,342 acres) of the surveyed area, abandoned wells in the groves were plugged (N15).

Unplugged wells can provide a rapid preferential pathway for nutrients and other agricultural chemicals to directly enter the groundwater. Plugging of abandoned or improperly constructed wells is crucial for preventing groundwater contamination.

Alternating Fertilizer Loading Sites (N16)

Growers representing 92% (106,866 acres) of the surveyed area alternated the fertilizer loading sites throughout their groves (N16). On 5% of the groves, this practice was used sometimes. The remaining groves did not utilize this technique.

Loading of nutrients on alternate loading sites prevents concentration of nutrients in one area. This practice is particularly effective when combined with the use of tarps to capture spilled fertilizer materials at the temporary loading site.

Split Fertilizer Applications (N17, N18, N19)

The survey results for use of dry fertilizer split applications were the following: 1) N17, 77% (88,565 acres) of the area practiced three split applications during the year; 2) N18, 37% (42,897 acres) of the area practiced four split applications; and 3) N19, 11% (12,605 acres) of the area practiced five or more split applications.

Split applications of fertilizers during the year can minimize leaching losses, particularly of N and K, during excessive rainfall events. It reduces the maximum amount of fertilizer N and K available for leaching at any given time. This process also helps to maintain the supply of nutrients throughout the growing season while avoiding particularly wet conditions.

Use of Fertigation (N20, N21)

Fertigation (N20) was consistently used on 64% (73,566 acres) of the surveyed area.

Fertigation was used in combination with other fertilizer application methods (N21), on approximately 72% (83,793 acres) of the surveyed area.

The advantage of fertigation is that it offers precise control of nutrients and water. Fertigation is better than conventional broadcast applications since both water and nutrients are distributed in precise quantities and placement for optimum nutrient uptake. Fertigation helps reduce the amount of leachable nutrients in the root zone at any given time.

Use of Controlled-Release Fertilizers (CRF) (N22)

Controlled-release fertilizer sources (N22) were consistently used on 45% (52,492 acres) of the total surveyed area.

Controlled-release fertilizers cover a variety of approaches to slow the release of soluble nutrient forms into the root zone. This gradual release of nutrient(s) extends the availability of nutrients (e.g., N and K) over a longer time period compared to the conventional soluble sources. At any one time, soluble nutrient concentrations are lower than with dry-soluble fertilizers since nutrients are slowly made available over time. The release of nutrients is affected by soil characteristics, especially soil temperature and water content. Although CRF are more expensive than standard fertilizers, the extra cost is compensated to some extent by the fact that they lose a relatively smaller portion of the nutrient to leaching, which reduces application amount and the need for multiple applications.

Use of CRF for Resets (N23)

Growers from 70% (81,219 acres) of surveyed acreage reported that they planned to use CRF for resets (N23).

Young citrus trees do not have the extensive root systems associated with mature trees, making fertilizer placement critical to encourage fast-growing resets. Additionally, young trees do not need the same rate of fertilizer as mature trees. To address the needs of the young, developing trees, CRF use is a likely choice to allow proper nutrition, reduce possible losses due to leaching, and avoid multiple small applications of soluble fertilizer to the young trees. By using CRF, the desired total amount of nutrients required during the year can be achieved.

Use of CRF for Mature Trees (N24)

Growers representing 32% (36,500 acres) of the surveyed areas planned to use CRF for mature trees (N24). On 26% (29,578 acres) of the area, growers did not have plans to use CRF for mature trees. However, if cost share was available, an additional 18% of the surveyed area would receive CRF, raising the total CRF acreage to 50%.

Controlled-release fertilizers, often utilized for resets, are not very popular for mature trees. Although growers are accustomed to using water-soluble nitrogen sources such as ammonium nitrate, urea, and ammonium sulfate, recent studies have demonstrated that use of CRF is cost effective in the long-term. In a 5-year UF/IFAS trial comparing selected CRF products with standard water soluble fertilizer, one controlled-release, resin-coated, fertilizer-produced equivalent or higher pound-solids yield with less actual nitrogen than multiple applications of dry-soluble fertilizer at the higher standard rate. This pound-solids amount was produced with one application at 90 lbs N/acre of the CRF. Similar pound-solids were produced by the water soluble fertilizer using three split applications totaling 180 lbs N/acre.

Use of Organic Amendments (N25)

Organic amendments, such as yard waste, municipal waste, and animal manure, were used (N25) consistently on 63% (72,837 acres) of the surveyed area.

Adding organic amendments to the soil facilitates slow release of nutrients and improves water and nutrient holding of the soil. Use of organic amendments has other benefits such as recycling organic wastes and reducing energy needs for manufacturing synthetic fertilizers. A study conducted by UF/IFAS for vegetable crops has shown no adverse impact of compost use on groundwater quality or yield.

Accounting for Nutrients from Organic Amendments (N26)

Overall, 40% (46,744 acres) of the total surveyed area considered organic amendments as a nutrient source and adjusted their fertilizer rates accordingly (N26).

Use of organic amendments not only improves soil and environmental quality, it also supplies many nutrients in addition to the amount supplied by inorganic fertilizers. Nutrients added to soil through organic amendments should be used to adjust the application rate of synthetic fertilizer to avoid over-application of nutrients. Immature compost applications are not recommended because this source can induce temporary immobilization of inorganic N.

Fertilizer Application between June to mid-September (N27)

Fertilizer applications were avoided between mid-June and mid-September (N27) on 74% (85,264 acres) of the total surveyed area. On 11% of the total surveyed area, growers sometimes avoided fertilizer applications between June and mid-September. Growers from approximately 9% of the surveyed area did not agree with this practice.

The rainy season in Florida usually falls between mid-June and mid-September. Application of fertilizer before or during intense rainfall, especially on soils that have a high potential for erosion, is not advisable. There is an apparent conflict between the grower responses to N10 (avoiding fertilizer application during high water table and flood conditions) and N27.

Additional BMP Implementation Using Government Cost-Share Programs

Grower participation is crucial to the success of any BMP program. To promote participation, state and federal agencies have created several cost-share programs that provide partial cost relief to promote implementation of selected BMPs. Survey information was analyzed to find practices where cost-share programs could increase BMP implementation on additional acreage. Due to the nationwide recession, both state and federal funds for cost sharing are largely unavailable. However, implementation of BMPs using cost-share funding is accepted by a larger percentage of growers. For example, application for cost-share funds through the Southwest Florida Resource Conservation and Development Council (the local entity that has administered cost-share funds for the past several years) far exceeded state and federal funding. Thus, information from this survey indicates where cost-share funding should be focused to achieve improved BMP implementation and subsequent nutrient management improvements.

Survey results indicated that use of tarps to capture and reuse the spilled fertilizer was not used widely by the growers. However, if cost sharing was available, this BMP could be implemented on an additional 33% (37,737 acres) of surveyed area, raising the total area using this BMP to 38%.

There seems to be a mismatch between the training program and its actual implementation.

Fertilizer applicators on 98% of the surveyed areas were trained in handling and loading of fertilizers, yet use of tarps to catch and reuse spilled fertilizer was not practiced. One of the possible reasons for this discrepancy could be the material and personnel costs involved. This assumption is substantiated by the potential increase in use of tarps if cost sharing was available. Cost-share programs can help promote use of CRF for mature trees in 18% of the additional area to bring the total area using this BMP to 63%.

If cost sharing was available for CRF for mature trees, it is likely that growers who plan to use CRF for resets (70% of the surveyed acreage) in the future would implement that practice sooner.

Overall, use of both CRF and tarp use is likely to increase considerably with re-establishment of a cost-share program. Increased use of these two BMPs will reduce the potential losses of nutrients to surface and ground waters. It is much more cost effective to prevent nutrients from being introduced into the environment than to achieve water quality improvement through some form of treatment (e.g., stormwater treatment areas) after the fact.

Summary

The citrus BMP survey was able to quantify the current level of nutrient BMP implementation in the GCPA. Results indicated that a large percentage of the BMPs in this survey have already been implemented. Considerable grower involvement indicates clearly that growers in the area have been proactive in adopting new techniques for environmental benefits. In nutrient-related BMPs, use of tarps and controlled-release fertilizers for mature trees were the two practices that needed cost-share programs to stimulate implementation. Both practices are likely to reduce off-site nutrient movement.

A BMP manual for GCPA was published in 2006. Even though growers in the area are aware of environmental concerns and proactive in their approach toward BMP implementation, continuous information flow will achieve greater success and keep them in touch with the latest developments in environmental issues. Cost-share programs are useful and important in keeping the growers interested in measures that are good for the environment, will likely reduce operational and production costs, and will help avoid additional regulation.

This survey has established the current adoption of BMP use in the GCPA. A follow-up survey within the next two years will document both changes and coverage of BMP implementation. Results from this and future surveys will also provide the needed feedback to record the success of BMP implementation and related cost-share programs.

Appendix 1

What is your business (circle all that apply)?

(_) Owner of grove(s)

(_) Citrus production manager

(_) Caretaker

(_) Consultant

(_) Chemical or equipment salesperson

(_) Other (specify)________________________________

How many acres of citrus do you manage and which county (s)? ______________________________ _______________

When you decide to use a citrus BMP, please rate how important it is for the BMP to return a net profit on the investment:

(_) Very Important (_) Moderately Important
(_) Slightly Important (_) Not at all Important

When you decide to use a citrus BMP, how important it is for you to be certain that the BMP will prevent pollution:

(_) Very Important (_) Moderately Important
(_) Slightly Important (_) Not at all Important

What type of irrigation system do you use?

(_) Micro-jet (_) Drip
(_) Seepage (furrow) (_) Overhead

What is your current use of the following practices, NOTE that not all are BMPs (check all answers that apply to your use)?

Survey Question Code	Question description
N1	Are you aware of the UF/IFAS fertilizer recommendations (SP-169)?
N2	Do you follow UF/IFAS fertilizer recommendations (SP-169)?
N3	Do you use soil analyses to determine how much fertilizer and amendments to apply?
N4	Do you use tissue analyses to determine how much fertilizer and amendments to apply?
N5	Are the fertilizer applicator(s) properly trained in the handling and loading of spreaders?
N6	Has the training been documented?
N7	Are liquid fertilizer tanks stored on a concrete slab?
N8	Do you calibrate fertilizer spreaders before each application?
N9	Do you apply fertilizer within the root zone of trees, within drip line, on the high side of the bed and avoid application in furrow?
N10	Do you avoid fertilizer application to soils under high water table and flooded conditions?
N11	Do you consider weather forecasts before applying fertilizer to avoid run-off and leaching?
N12	Do you place a tarp underneath fertilizer spreaders while loading the fertilizer and reuse spilled fertilizer?
N13	Do you take precaution (e.g., berm between road and ditch / staging area) when loading fertilizer near ditches, canals, and wells?
N14	Do you have vegetative filter strips to prevent movement of fertilizers to environmentally sensitive areas (e.g. canals, ditches)?
N15	Are abandoned wells in your grove plugged?
N16	Do you alternate fertilizer loading sites throughout the grove?
N17	Do you split dry-soluble fertilizer applications? a) 3
N18	Do you split dry-soluble fertilizer applications? b) 4
N19	Do you split dry-soluble fertilizer applications? c) 5 or more
N20	Do you use fertigation?
N21	Do you combine your fertigation with other fertilizer applications (e.g., dry, liquid, suspension, controlled release)?
N22	Do you use controlled-release fertilizer?
N23	Do you plan to use controlled-release fertilizers in the future? a) for resets
N24	Do you plan to use controlled-release fertilizers in the future? b) For mature trees
N25	Do you use organic amendments (yard waste, municipal waste, animal manures, or combination)?
N26	Do you account for the nutrient (N and P) from organic amendments and adjust your fertilizer rates accordingly?
N27	Do you avoid fertilizer applications between mid-June through mid-September?

For More Information

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