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Citrus BMP Implementation in Florida's Gulf Citrus Production Area: Water, Sediment, and Aquatic Weeds[1]

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Introduction

Citrus groves in the five-county Gulf region (Charlotte, Collier, Glades, Hendry, and Lee) occupy 178,000 acres, which represent approximately 25% of Florida's total citrus acreage and production volume. Commercial citrus production in the Gulf Citrus Production Area (GCPA) intensified in the mid 1980s and early 1990s due to warmer climate, sufficient water supply, and less expensive land compared with traditional production on the central Florida ridge. Most Gulf citrus acreage expansion during this period occurred due to freezes that severely damaged or killed numerous central Florida citrus groves.

Profitable citrus production requires a consistent and reliable water supply for supplementary irrigation. In the past 3 years 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 increased water demand due mostly to urban population growth near the coast. By 2020, the South Florida Water Management District (SFWMD) expects water demand to increase 27% over 1995 levels. Water supply issues must be addressed for present needs as well as for future planning.

In addition to water supply, the region is also experiencing nutrient-loading-related water quality issues. Nutrient loading is the mass of nutrients (such as phosphorus (P)) from a watershed (or a land area) that enters into a receiving waterbody. Usually nutrient loadings are expressed in terms of mass of nutrient per unit of time (e.g., lb/day). One of the sources of nutrient loadings to the waterbodies is the nitrogen (N) and P fertilizer from agricultural and urban areas. Excessive nutrient loadings have degraded the waterbodies and have impacted the ecosystem. A Total Maximum Daily Load (TMDL) program for all major surface waterbodies in the region including the Caloosahatchee River is scheduled to be completed in 2007. The C139 basin in southeast Hendry County, which is hydrologically linked to Florida's Everglades through a stormwater treatment area (STA), is already regulated to limit P discharges with required Best Management Practices (BMPs) implementation. The SFWMD has set a limit

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on P discharge (adjusted for rainfall) from the C139 basin. For 2005, the target load was 30 short tons (U.S.), while the actual load was 44 tons.

State agencies are promoting the development and implementation of BMPs to address water quality issues. The Gulf citrus industry in association with UF/IFAS, the Florida Department of Agriculture and Consumer Services (FDACS), SFWMD, and the Florida Department of Environmental Protection (FDEP) has developed a citrus BMP manual that was released in February 2006. The objective of the manual is 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. Presumption of compliance with the state's water quality standards also provides a release from any government agency to proceed against the owner of the source of pollution for the recovery and damage costs associated with the contamination of surface or groundwater caused by the pollutants listed by FDACS.

Several of the identified BMPs have already been implemented in the GCPA region. Since most of the groves in the GCPA have been developed in the last 20 years, they contain many water quantity/quality features that are lacking in older groves. For example, most GCPA groves contain one or more stormwater impoundments (reservoirs) integrated with the drainage systems that reduce off-site nutrient and sediment loads. For groves developed since the mid-1980s, SFWMD required reservoir installation before issuing a water use permit. Additional BMPs have been implemented, but data on their extent within the GCPA has not been available. Therefore, in 2005 we conducted a survey in cooperation with the 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. This publication describes the survey and discusses the findings regarding water, sediment, and aquatic weed BMPs.

BMP Survey

The survey questionnaire included five major water quality BMP categories: water volume, sediment control, aquatic plant control, pesticide use, and nutrients. This publication discusses the first three of these categories. Results for other BMPs will be presented in other EDIS documents in the future.

The survey captured grove-specific BMP adoption data by asking general questions descriptive of grove management and importance of BMPs with regard to water quality benefits and grove profits. To determine if a particular practice was in use, growers were asked if they implemented it consistently or not. The remaining choice of "*sometimes"* indicated that this 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*." To determine whether a grower would be willing to implement a practice in the future, two additional choices, "*plan to use"* and "*would if cost-shared*," were also included. The latter 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 the farm manager (Table 1). The surveyed acreage was distributed between large (>1,000 acres), medium (250-1,000 acres), and small groves (<250 acres). From a water quality standpoint, the percentage of grove land area affected by a specific BMP is more important than the percentage of total grove number. Therefore, almost all of the *large* groves in the region (104,170 acres) were included in the survey. In addition, 75% of *medium*-size groves (9,982 acres) in GCPA were included in the survey. The area occupied by the surveyed *small* groves was 1,639 acres. The grove name and location were kept confidential. For data analysis convenience, survey questions were coded for different categories indexed with the initial of that survey category name. For example, the water survey questions were coded as W1, W2, ...

The Appendix contains the question codes and associated questions. The acreage for a specific practice was summed based on grower responses to quantify BMP implementation.

Table 1. Distribution of total surveyed acreage 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	1.4
Total	115,791	60	100

* Percent of total grove acreage (115,791 acres) surveyed within the five-county area covered by the Gulf Coast Citrus Growers Association (Total GCPA grove acreage = 178,000 acres).

Extent of Water Volume BMP Implementation in GCPA

One of the most important factors that determines water use and water quality is the type of irrigation used. Micro-sprinkler and drip irrigation systems use water more efficiently compared with seepage irrigation. Thus, micro-sprinkler or drip systems are preferred for citrus irrigation to reduce nutrient losses from the root zone. Table 2 shows the acreage using each irrigation system and the percentage of the surveyed area covered by each system.

Table 2. Irrigation systems used on surveyed groves.

Irrigation System	Area (Acres)	%
Microsprinkler **Drip** **Microsprinkler or Drip***	72,288 7,991 27,197	62 7
Total Area Under Microirrigation**	107,476	93 24
Seepage	8,333	7

* Represents groves that had a combination of the two irrigation systems within a grove; ** microsprinkler plus drip acreage from groves that had a combination of the two irrigation types.

In addition to efficiently delivering irrigation water, microirrigation systems also provide the opportunity to deliver fertilizer in small doses through fertigation.

Microsprinkler irrigation was used on 62% of the total surveyed citrus grove area.

Fertigation enables multiple applications of liquid fertilizer without increasing added cost compared with dry fertilizer, which requires additional labor and machinery input for each application. Delivery of nutrients in split applications throughout the year reduces the amount of fertilizer available to leach below the root zone at any given time.

Drip irrigation is another form of microirrigation and was used on approximately 7% of the surveyed area. In approximately 24% of groves, some combination of microsprinkler and drip were used. Overall, microirrigation systems were installed on approximately 93% of the acreages. Only 7% of the acreage was irrigated by seepage method.

Seepage irrigation delivers water through surface furrows to raise the water table close to the root zone, which then provides moisture to citrus trees through upward capillary movement (upflux). Seepage systems are less efficient because water evaporates from furrows and the soil surface outside the tree canopy. Furthermore, seepage irrigation requires that fertilizer be applied throughout the grove in dry form, in larger doses usually three to four times per year. These applications increase the amount of fertilizer that can be leached below the root zone after excessive rainfall. Table 3 presents the survey results for individual water BMPs for the three survey choices: *no*, *yes*, and *would if cost-shared*.

More than 60% of all water volume BMPs (W1 to W4, W7, and W8),were implemented on more than 60% (69,474 acres) of the area.

Implementation of water management strategies before initiation of the BMP program indicates a proactive approach by the Gulf citrus industry to use water more efficiently. Efficient irrigation requires a methodical water management approach using a variety of tools to decide on when, how much, and how often to irrigate. The amount of rainfall should be used to adjust the timing and amount of irrigation.

Survey question W1, "Do you use a rain gauge for irrigation management?" was a practice that was implemented on 99% of the surveyed acreage (114,641 acres).

consistently to schedule irrigation. This practice was not utilized on 29,409 acres (25.4%) of the surveyed grove area.

An important element of sound irrigation water management is regular monitoring and measurement of soil water. Soil water must be maintained between specific high and low limits of plant available water. Accurate soil water measurement is required to avoid both under-irrigation and over-irrigation. Soil moisture-based irrigation scheduling is superior to ET-based scheduling because it is more accurate. Soil water status can be either measured directly using moisture-sensing instruments (e.g. tensiometer or capacitance probes), or can be assessed using the depth to the water table when seepage irrigating. Water table depth can be measured using inexpensive groundwater monitoring wells. Soil moisture measurement and/or water table depth-based

Table 3. Summary of survey responses to eight questions involving water BMPs. See Appendix for actual questions.

Water Question Codes*	**Total area (acre) and percent of acreage for the three survey responses (*no*, *yes*, *will if cost-shared*, and *sometimes*)**							
	No		Yes		Will if cost-shared		Sometimes	
	Area	%	Area	%	Area	%	Area	%
W1 (Rain Gauge)	620	0.5	114,641	99	0	0	530	0.5
W2 (Water Budget)	29,409	25.4	62,179	53.7	240	0.2	12,450	10.8
W3 (Soil Water/Groundwater Measurement	30,817	26.6	57,400	49.6	404	0.4	27,170	23.5
W4 (Retention/Detention)	10,478	9.1	86,608	74.8	7,033	6.1	11,672	10.1
W5 (Permit for Reuse)	67,065	57.9	18,724	16.2	0	0	16,347	14.1
W6 (Reservoir Water Reuse)	53,211	46	13,493	11.7	21,158	18.3	17,656	15.2
W7 (Drainage Retention)	28,133	24.3	63,316	54.7	0	0	22,622	19.5
W8 (Emitter Clogging Prevention)	34,073	29.4	38,736	33.5	164	0.1	38,338	33.1

* Actual questions are shown in Appendix.

Commonly-used techniques to decide on when and how much to irrigate fall into two categories: 1) Evapotranspiration (ET)-based (water budget); and 2) soil moisture-based. The ET-based approach uses weather data to estimate potential evapotranspiration (ET_0), and calculates plant available water in the soil profile. Knowing rainfall, ET_0, and the previous day's irrigation, the irrigation amount for the next day can be estimated.

On 54% (62,179 acres) of the surveyed citrus acreage, a water-budget technique (W2) was used irrigation scheduling not only conserves water and nutrients and reduces water quality impacts but reduces production cost by reducing fuel and fertilizer inputs.

On approximately 50% of the total surveyed area (57,400 acres), soil moisture measurement and/or water table depth-based irrigation scheduling was used consistently (W3).

Reservoirs control storm water volume and reduce water quality impacts by retaining both dissolved and sediment-bound nutrients and other chemicals. Because most groves in the GCPA were established since the mid 1980s, by regulation these groves have reservoirs to detain runoff/drainage after rainfall.

Reservoirs were used (W4) on 75% (86,608 acres) of the surveyed area. Survey results indicated that if cost-shared, reservoirs could be used on an additional 6% (7,033 acres) of the surveyed area.

This large fraction of citrus acreage with reservoirs suggests that most of the sediment and nutrients originating from the grove are retained on site. Although the primary purpose of reservoirs is to reduce the rate at which water leaves the grove, water stored in them is also a potential source of supply. Recycling stormwater for irrigation can also reduce off-site nutrient movement due to subsequent crop uptake. Jaber and Shukla (2004) showed that water stored in these reservoirs can be an alternative supply, providing more than 10 weeks of irrigation water for the grove. Discharges from reservoirs are regulated by the SFWMD, which requires that the grower obtain a permit to use reservoir water for irrigation.

Of the acreage with reservoirs, 16% (18,724 acres) had permits allowing reservoir water use for irrigation (W5). However, use of stormwater for irrigation was only practiced on 12% (13,493) of the area with reservoirs (W6). For 21,158 acres (18% of the total surveyed acres), a cost-share program could facilitate increased implementation of this practice.

Retaining water in the ditches and use of reservoir water for irrigation can conserve water and potentially retain nutrients on site. Increasing the water retention time in ditches in a ranch operation can reduce P loadings from 15% to 50% (Shukla et al., 2005). A similar reduction in P discharge can also be expected if water is held in grove ditches.

Use of canals and ditches to hold runoff/drainage water in the groves (W7) was practiced on 55% (63,316 acres) of the area.

Keeping microirrigation emitters clean is crucial for high irrigation uniformity and efficiency, so regular flushing of microirrigation lines is necessary. Chemicals are sometimes used to prevent or remediate emitter plugging due to microbial growth. Chlorination is a prevalent method that effectively reduces microbial activity. Acid injection is sometimes required to eliminate scale and mineral deposits, as well as to control microbes.

On at least 33% (38,736 acres) of the total surveyed area, line cleaning chemicals were used to prevent microirrigation emitter clogging (W8). On approximately an equal percentage of the area, growers used line cleaning chemicals sometimes, whereas on 29% of the area, chemicals were not utilized to prevent emitter clogging.

Although half of the surveyed area used a variety of water volume BMPs, cost-share combined with grower education has the potential to expand their use.

Overall, at least 44% of the growers representing 50% of the total acreage said that they use all of the eight water volume BMPs.

Extent of Sediment BMP Implementation in GCPA

A summary of responses to 12 sediment BMP questions are presented in Table 4. Survey results indicate that *yes* was the most prevalent choice for most of the sediment-related questions.

A variety of measures are available to reduce soil erosion and sediment transport from the grove to the waters of the state through the drainage system.

Soil erosion can be controlled in part by appropriate selection of herbicide band width. The width of the herbicide band also affects the amount of applied herbicide directly impacting the cost of weed control. While it is advisable to keep the herbicide bands narrower for young citrus trees, band width should increase as the trees grow larger. Restricting the herbicide band increases the width of grassed water furrow slopes that serve as filters, preventing sediment movement from the planted areas to the drainage system.

On more than 90% (104,552 acres) of the surveyed areas, herbicide band width was restricted to the tree canopy dripline (S2).

In addition to sediment input from the planted areas and furrow, erosion of the ditch banks is a significant sediment source. Wind, rainfall, or overland flow can erode the soil from the bank into the ditch. Banks with grass cover are more efficient in minimizing erosion compared with broadleaf weeds. Controlling broadleaf growth using herbicides or maintenance mowing of slopes and ditch banks increases grass cover and reduces erosion.

The entire surveyed area (100%) had a vegetative cover maintained near canals or ditch banks to stabilize soils (S6).

Another source of sediment is movement of runoff from the grove directly into a ditch without passing through grassed swales. This source of erosion can be avoided by constructing the ditch bank shoulders so they are sloped towards the grove.

On more than 96% of the acreage (111,439 acres), sloped bank shoulders were used to minimize overland flow of stormwater directly down the banks (S7).

Settling basins or sumps control erosion and sediment/nutrient loss by slowing surface water velocity, which allows solids to settle in the deeper sections of the ditch. Settling basins can be installed in front of the water furrow drainage inlet or in the main ditches. In the main ditches, settling basins can be installed at the field ditch/lateral ditch and lateral ditch/collector ditch junctions.

On more than 20% (24,149 acres) of the total surveyed groves, settling basins/sumps were used consistently (S1). On 34% (39,958 acres) of the surveyed area, establishment of settling basins/sumps could be achieved by cost-share.

It is important to inspect and maintain the settling basins and sumps to achieve optimum sediment retention.

*On 24.4% of the area with settling basin or sumps, maintenance and inspection was done regularly (S3) (*Table 4*).*

With time, sediment in the settling basins and ditches can change the cross-sectional area, reducing basin drainage capacity. Cleaning ditches by removing excess sediment is recommended to maintain the original construction design and flow rate. Removing sediment during the dry period and placing it away from the ditch bank prevents its re-entry into the ditch.

Sediment cleaning was implemented throughout the surveyed area with settling basins and ditches (S4).

In most groves, drainage control structures are installed in different sections of the ditch to regulate flow rate. Flow control structures include riser boards and screw gates. Riser-board structures create a low current zone near the bottom of the structure that enhances sediment deposition, reducing it in the discharge water. Sedimentation occurs because water is forced to flow over the top of the boards, decreasing turbulence with depth. Conversely, screw-gate structures do not create this dead-current zone. Since screw gates open from the bottom, considerable sediment (and sediment-bound agrichemicals) is transported with the discharge water.

The majority of the citrus acreage (63,063 acres; >50%) utilized riser boards rather than screw gates to minimize sediment release (S5). On an additional 31% (36,158 acres) of the area where screw-gates were used, growers were willing to convert to riser-board structures if cost share was provided.

On more than 96% of the acreage (112,971 acres), the following practices were consistently used:

Table 4. Summary of survey responses to 12 questions involving sediment BMPs. See Appendix for actual questions.

Sediment Question Codes*	**Total area (acre) and percent of acreage for the three survey responses (*no*, *yes*, *will if cost-shared*, and *sometimes*)**							
	No		Yes		Will if cost-shared		Sometimes	
	Area	%	Area	%	Area	%	Area	%
S1 (Erosion Control Measures)	51,154	44.1	24,149	20.9	39,958	34.5	530	0.5
S2 (Herbicide Restriction)	7,864	6.8	104,552	90.2	0	0	3,375	2.9
S3 (Erosion Control Maintenance)	16,042	13.9	28,213	24.4	0	0	0	0
S4 (Ditch Cleaning)	770	0.7	105,021	90.7	0	0	0	0
S5 (Riser Boards)	6,570	5.7	63,063	54.5	36,158	31.2	10,000	8.6
S6 (Vegetative Cover)	0	0	115,791	100	0	0	0	0
S7 (Sloped Shoulders)	0	0	111,439	96.2	0	0	4,352	3.8
S8 (Bank Protection)	4,160	3.6	83,202	71.9	4,000	3.5	24,429	21.1
S9 (Sediment Movement)	620	0.5	112,971	97.6	0	0	0	0
S10 (Reservoir Erosion)	5,497	4.8	94,306	81.5	3,395	3	360	0.3
S11 (Culvert Maintenance)	150	0.1	113,356	97.9	0	0	85	0.1
S12 (Erosion Control from Construction)	15,722	13.6	54,739	47.3	10,220	8.8	1,685	1.5

* Refer to Appendix for actual questions.

vegetative water furrows, drain tiles, and settling basins to ensure minimum movement of sediment (S9); and inspection and maintenance of culvert structures (S11).

At discharge points or at ditch intersections, water velocity can be high. Use of riprap, concrete, headwalls, sandbags, or wingwalls can shield ditch banks and reduce sediment transport.

On approximately 72% of the total surveyed area, riprap, concrete headwalls, sandbags, or wingwalls were used to protect ditch and canal banks from erosion (S8). Growers from 21% of the surveyed area implemented these erosion controls sometimes. On a small percentage of the acreage (3.6 %, 4,160 acres) where this practice was not used, almost all growers were willing to implement this practice, if it was cost shared.

Approximately 75% of the acreage had reservoirs that received pumped runoff/drainage from the grove. Once the reservoir reaches design capacity, accumulated water is discharged downstream, often through a passive weir system in the reservoir dike. Pumped flow into the reservoir strikes the bottom at high velocity, often causing severe erosion and sediment suspension. To dissipate the energy of the incoming water, flap gates (also prevent backflow) and concrete floors should be used at the inflow point. The practice to disperse and/or reduce the velocity of water entering the reservoir (S10) is relevant to only those groves that have reservoirs (W4). The percentage of area where reservoirs are present is quantified with W4, which is the area on which S10 should be implemented.

A cross-reference between the two practices reveals that this practice (S10) was implemented on all the groves that had reservoirs.

In addition to sediment loss from normal grove operation, activities like construction within a grove can also be another source of sediment due to soil disturbance.

In less than half (47%, 54,739 acres) of the surveyed area, measures were taken to prevent erosion during earth-moving construction or maintenance activities (S12). Growers representing 15,722 acres of the surveyed area reported that they did not use this practice.

Overall, most of the sediment BMPs (S2, S4, S6, S7, S9, and S11), were adopted on more than 90% of the surveyed acreage. This level of adoption within GCPA is encouraging with regard to sediment reduction and related sediment-bound chemical losses.

Extent of Aquatic Weed BMP Implementation in GCPA

A summary of the responses to five questions related to aquatic control BMPs is presented in Table 5.

Aquatic vegetation/weeds can reduce the cross-sectional area of the channel and the velocity of water flow. This restriction can result in a significant increase in aquatic vegetation in waterways and consequently increase the time required to drain when compared with clean ditches that permit free-flow of runoff/drainage water. Results from the survey indicated that the practice of cleaning and maintenance of ditches for aquatic weed control (A1) was implemented on almost all of the surveyed area.

On 99% (115,176 acres) of the total surveyed area, ditches were cleaned to keep aquatic weeds out of the waterways (A1).

Use of physical deterrents such as ribbon barriers, traps, or baffle boxes limit movement of aquatic weeds and debris from canals/ditches, trapping this material before it enters drainage pipeline.

Physical deterrents (A2) were used on 35% (40,865 acres) of the surveyed area. Growers from 30655 acres (27%) of the surveyed area reported a need for cost-share program to implement this practice.

Excavation and harvesting are two effective mechanical methods to remove aquatic weeds from ditches or canals. Often, both of these methods were used within a grove to achieve aquatic weed control.

On 104,964 acres (91%) of the surveyed area, mechanical methods to remove aquatic plants were used (A3).

Use of herbicides for aquatic-weed control (A4) was utilized on nearly 92% of the total acreage.

Table 5. Summary of survey responses to five questions involving aquatic weed BMPs. See appendix for actual questions.

Aquatic Weed Question Codes*	**Total area (acre) and percent of acreage for the three survey responses (*no*, *yes*, *will if cost-shared*, and *sometimes*)**							
	No		Yes		Will if cost-shared		Sometimes	
	Area	%	Area	%	Area	%	Area	%
A1 (Ditch Cleaning)	0	0	115,176	99.5	0	0	615	0.5
A2 (Physical Deterrents)	44,271	38.2	40,865	35.3	30,655	26.5	0	0.0
A3 (Mechanical Methods)	150	0.1	104,964	90.6	0	0	10,677	9.2
A4 (Herbicides)	0	0	106,269	91.8	0	0	9,522	8.2

Table 5. Summary of survey responses to five questions involving aquatic weed BMPs. See appendix for actual questions.

A5 (Biological Agents)	51,753	44.7	49,304	42.6	8,302	7.2	6,432	5.6
* Refer to Appendix for actual questions.								

Biological control agents for weed control are slowly becoming popular. For example, the alligator weed flea beetle has been effective in reducing alligator weed. Two species of water hyacinth weevil *Neochetina eichorniae* and *Neochetina bruchi* and the water hyacinth mite have also proved successful in controlling water hyacinth.

Biological controls were used for aquatic weeds (A5) on 43% of the surveyed area (49,304 acres), which was almost equal to the area (51,753 acres or 45% of the surveyed area) where they were not used.

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 implement selected BMPs. Survey information was analyzed to find BMPs in high need of cost-share programs to increase the acreage with implemented BMPs by encouraging grower adoption.

Water Volume BMPs

From both a water quality and citrus production standpoint, the use of soil moisture and/or water table measurements for irrigation scheduling is an important BMP. Appropriate irrigation scheduling can reduce nutrient leaching below the root zone, thereby reducing the chance that nutrients will reach ground or surface water. Given that only 50% of the growers currently use this practice and that 24% use it only occasionally, efforts should be directed to increase its use for achieving further water conservation and protecting water quality. Education efforts should be directed at growers who use this practice *sometimes* so they may be convinced to use it *consistently*.

Another practice that can potentially reduce nutrient loss and achieve water conservation is the use of reservoirs as an alternative source of water supply. Reservoirs have the potential to provide more than 10 weeks of irrigation water during the dry period. However, use of reservoir water for irrigation depends on reservoir presence and the required SFWMD permit to use stored water for irrigation. Data analyses revealed that 6% (7,033 acres) of the total surveyed area do not have reservoirs and that cost share was needed to construct reservoirs. Growers occupying 18% (21,158 acres) of the surveyed area specified need for a cost-share program before they would use reservoir water for irrigation.

Overall, use of soil moisture-based irrigation scheduling and use of reservoirs as an alternate source of water are the two BMPs that could be implemented on additional citrus growing areas within the GCPA to help protect water quality. If fully implemented, as much as 75% of the acreage would be positively affected by adoption of these two best management practices with partial support from government programs.

Sediment BMPs

By decreasing water velocity, settling basins or sumps allow sedimentation to occur before drainage water reaches the waters of the state. Basins or sumps are simple to install. Use of these sediment control measures could be more widely implemented with cost-share funds. At least 35% (39,958 acres) of additional grove area could install settling basins or sumps through cost-share programs.

Riser board structures force water to flow over the top of the structure, creating a low current area at the bottom that facilitates sediment deposition along with any sediment bound chemicals. Replacing screw gates with riser board structures can be expensive, ranging from a few hundred dollars to several thousand dollars, depending on materials and size. This practice was second in need for cost-share to improve participation by growers. Cost share could achieve implementation of this BMP on 36,158 acres, which accounts for 31% of the surveyed area.

Aquatic Weed BMPs

Growers representing almost the entire surveyed area (115,176 acres) practiced ditch cleaning and aquatic weed control by either mechanical methods or with herbicides. Physical deterrent and biological agent use was preferred by growers representing 35% and 43% of the total surveyed area, respectively. Use of physical deterrents was one practice for which growers were interested in seeking cost-sharing; growers representing 27% (30,655 acres) of the survey area indicated a need for cost-share.

Summary

The citrus BMP survey was able to quantify the current level of water volume, sediment, and aquatic weed BMP implementation in the GCPA. Results indicated that a large fraction of the BMPs included in the survey have already been implemented within the GCPA. Such extensive adoption within the survey is a clear indication of the proactive approach taken by the citrus industry in reducing environmental impacts. Increasing implementation of BMPs like soil moisture-based irrigation scheduling and use of detention/retention reservoirs as an alternative irrigation water supply may minimize water quality impacts from citrus groves. Installation of settling basins, sumps, and riser boards could reduce the extent of sediment loss from groves. Most of the GCPA area employed some type of aquatic weed control practice. However, use of physical deterrents and biological methods could increase if cost-share programs were available to implement these practices.

A BMP manual has been developed for GCPA. Growers in the area are aware of environmental concerns and for the most part are taking educated measures to increase BMP implementation. Continuing to inform growers about BMP options and water quality regulations could help to achieve increased BMP implementation in the GCPA. Additionally, cost-share programs could provide an incentive to citrus growers to implement expensive BMPs.

With increased urban development in southwest Florida, water demand is increasing rapidly. The fact that 92% of the citrus acreage already uses microirrigation clearly indicates that growers within the GCPA are modern and efficient with regard to irrigation. Further use of this technology in conjunction with soil water-based irrigation scheduling will maximize water use efficiency and reduce nutrient loss. This survey has established the current adoption of BMP use in the GCPA. A repeat survey in the next 5 years will document both changes and coverage of BMP implementation. Results from this and future surveys will also provide much-needed feedback on the success of the BMP education and cost-share programs.

For More Information

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Appendix

What is your business (mark all that apply)?

__ Owner of grove(s)

__ Citrus production manage

__ Caretaker

__ Consultant

__ Chemical or equipment salesperson

__ Other (specify) ________________

How many acres do you manage and in which county or counties?

________________ _______________

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 is it 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 and Question Description

W1: Do you use a rain gauge for irrigation management?

W2: Do you use water budget (ET) data to schedule irrigation?

W3: Do you use water table monitoring wells/soil water measurement devices to schedule irrigation/drainage events?

W4: Do you have retention/detention areas (reservoirs) on site?

W5: Does your permit allow use of reservoir water for irrigation?

W6: Do you use water from reservoirs for irrigation?

W7: Do you use canals and ditches to hold runoff / drainage water in the grove?

W8: Do you regularly use line cleaning chemicals (e.g. chlorine) to prevent emitter clogging for microirrigation?

S1: Do you use erosion control measures (settling basins or sumps)?

S2: Do you restrict the herbicide band to the tree canopy dripline?

S3: Are settling basins inspected and maintained at an appropriate frequency to meet their intended function?

S4: Are removed sediments placed so that they do not re-enter cleaned ditches / canals?

S5: Do you have riser boards rather than screw gates to minimize sediment release?

S6: Is vegetative cover maintained near canal or ditch banks to stabilize soils?

S7: Are bank shoulders sloped to minimize overland flow of stormwater directly down banks?

S8: Do you use riprap, concrete headwalls, sandbags, or wingwalls to protect ditch and canal banks from erosion?

S9: Are vegetative water furrows, drain tiles, and settling basins used to ensure minimum movement of sediment?

S10: Do you use any measures to disperse and / or reduce the velocity of water entering reservoir (flap, concrete pad)?

S11: Are culvert structures routinely inspected and properly maintained to meet their intended function?

S12: Are measures taken to prevent erosion (sediment loss) during earth-moving construction / maintenance activities (i.e., hay bales, silt fence)?

A1: Are ditches cleaned and maintained to control aquatic plants?

A2: Are physical deterrents such as ribbon barriers, traps, or baffle boxes used to limit the movement of aquatic weeds and debris from canals and ditches?

A3: Are mechanical methods used to remove aquatic weeds from ditches or canals?

A4: Are herbicides used to control aquatic weeds within ditches/canals?

A5: Are biological control agents (flea beetles, hyacinth weevils, or grass carp) used to manage aquatic weeds?