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Vegetable Growers' Water Use and Conservation Practices in Miami-Dade County[1]

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Introduction and background

The Miami-Dade County vegetable crops industry employs over 6,000 people, and has a $491 million impact on the state economy (Degner et al., 2002a; Degner et al., 2002b). There are about 40,411 acres of vegetable production and an estimated 80 to 100 commercial vegetable producers depending upon the criteria and sources used to estimate it (Degner et al., 2002b; T. Olczyk and H. Bryan, personal communication). The reported vegetable acreage is somewhat misleading as some acreage is annually double and triple cropped (Degner et al., 2002a). The major vegetable crops grown include bush and pole beans, tomatoes, yellow and zucchini squash, potatoes, sweet corn, bell peppers, boniato, and malanga. Others include cucumbers, eggplant, strawberries, cabbage, hot peppers, okra, calabaza, basil, winter melon, bitter melon, lemongrass, yuca, Thai/Chinese eggplant, long beans and others. Overall 82% of the farms in Miami-Dade County have irrigation systems, representing about 85% of the agricultural land in production (Degner et al., 2002b).

The major issues facing the vegetable crop industry in Florida include marketing and foreign competition, land use planning, water and fertilizer management, natural disaster avoidance and mitigation, pest and disease pressure, loss of methyl bromide for soil fumigation, and sustainable cultural practices. Due to the on-going Everglades and Biscayne National Park restoration projects and Florida Bay, water and fertilizer management practices for the vegetable crop industry have become critical components of its sustainability.

Water use, management, and quality are major issues in Florida's Miami-Dade County where periods of excessive rainfall (flooding) and extended dry spells (drought) are experienced occasionally. Agricultural practices (e.g., irrigation and fertilizer management) potentially affect the water quality of the Biscayne Aquifer and Biscayne Bay. However, water conservation practices by the Miami-Dade County vegetable crops industry are largely undocumented.

This fact sheet reports water conservation trends for vegetable producers based on a recent extensive survey carried out in Miami-Dade County.

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Survey and analysis methodology

The survey involved a random sample of 69 commercial vegetable producers that were selected from the mailing lists obtained from the Miami-Dade County/IFAS Cooperative Extension Service and other growers' organizations in Miami-Dade County. The survey recipients were selected according to the size of their operation to obtain a maximum of 53 surveys which roughly represented 69% to 86% of the commercial vegetable producers (depending on the source used for the total number of growers).

The survey instrument contained questions concerning current water consumption and irrigation practices, motivations for their adoption by growers, issues affecting water use, drought and flooding experience, and water management. Questions related to when the grower first started farming, and the size of the farm were added to gain a perspective of changes in the area with time.

The survey procedures were tailored to maximize growers' participation (Dillman, 2000). Each potential respondent received a letter informing him or her of the purpose of the survey. Two weeks later the surveys were sent out, and telephone follow up was done 4 and 8 weeks later. The survey protocol adopted was designed to collect enough responses for statistical analysis of the influence of the economic, technical, and sociological factors on water conservation practices in the area. The survey data were analyzed using SAS software FREQ and MEANS statistical procedures (SAS, 1999).

Survey results

Background

Although an initial random sample of 69 surveys was sent out, some could not be contacted or were no longer in business. Of the 53 growers who were in the reachable sample, 6 returned usable surveys. The survey response was 11%, representing 21% of the vegetable acreage, and less than a tenth of the estimated 80 to 100 commercial vegetable producers. Mail-back survey response rates of 10 to 50% are common, and typically may be as low as 20% (Donan et al., 2000; Nachmias and Nachmias, 1976; Neuman, 1997). The mean time producers were in vegetable farming was 21 years.

The average vegetable land area for respondents was 1,050 acres, much greater than the average of 54 acres reported previously (Degner et al., 2002a). This is because a disproportionate number of vegetable survey respondents had large operations, and many small producers did not return their survey. Sixty-one percent of the vegetable producers responding owned their own land, and 39% leased land.

There are three major irrigation methods employed in vegetable production in Miami-Dade County, high volume, mobile irrigation units called big guns or water cannons, mobile linear water irrigation systems (called linear systems), and drip systems. High volume overhead irrigation is occasionally used, and high volume solid-set irrigation is commonly used on some crops (e.g., tomato). High volume overhead systems consist of high impact sprinkler heads on 5 ft to 20 ft risers spaced 40 ft to 60 ft apart. High volume solid set irrigation systems are primarily used for freeze protection, and are composed of lightweight detachable aluminum tubes with high impact sprinkler heads that can be taken apart and moved and reassembled easily. Sixty-two percent of the vegetable land was reported to be irrigated, although actual irrigated land may be much higher due to the extensive use of mobile high volume big gun irrigation systems.

Changes in irrigation technology

There have been dramatic changes in irrigation system technology, and soil water content monitoring during the past 21 years, which corresponds to the average time survey respondents have been in the agricultural business. Generally, irrigation efficiencies have improved in vegetable crop operations by more direct water delivery systems that limit the application rate and land surface area irrigated (e.g., drip), and by the use of soil water content monitoring devices (e.g., tensiometers) that enable producers to reduce leaching, and apply water based solely on crop needs.

The use of high volume over head irrigation has declined to zero; however, the use of high volume solid set systems has not changed, and remains at 18% (Fig. 1). The disappearance of high volume overhead irrigation systems is mostly due to establishment of fruit orchards on land used temporarily for vegetable crops during the last 3 years (J. Crane, personal communication). The use of high volume big gun irrigation has not changed (66.7%). This is due to the fact much of the vegetable land is leased on an annual basis, making installation of permanent irrigation systems uneconomical. Secondly, this is a reflection of the sharp increase in snap bean acreage where the cost of establishing drip and non-mobile irrigation systems is usually not economical. In contrast, the use of drip irrigation has increased by 50%. This reflects its utility in bedded vegetable production systems with such crops as tomato, peppers, and eggplant.

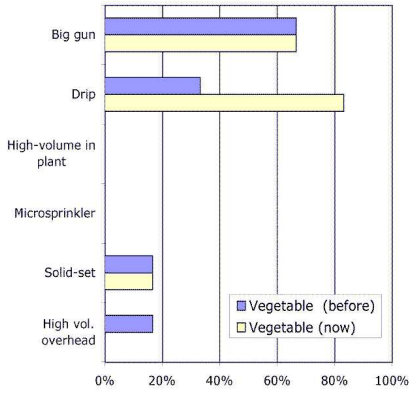

Figure 1. Changes in irrigation systems used by vegetable producers with time. The term "before" denotes the irrigation system used when the grower first started farming and "after" denotes the current irrigation system used.

Water resources

The use of open, uncased wells has declined by 16.7% for vegetable crop operations (Fig. 2). The percentage of capped, cased wells utilized in the vegetable industry for the past 21 years has remained about the same (about 33%). This is probably due to the annual change in the location of most farmed vegetable land and that changes in production practices for different crops on the same land makes establishment of permanent wells uneconomical and often impractical.

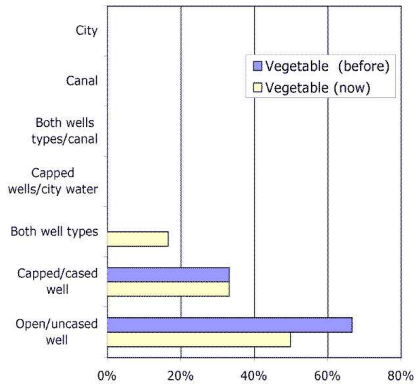

Figure 2. Changes in water sources used by vegetable producers with time. The term "before" denotes the source of water used when the grower first started farming and the "after" denotes the current water source used for irrigation.

Flooding and drought frequency

Thirty-five percent of the vegetable operations experienced flooding within the last five years and of those operations reporting flooding, nearly 67% reported a yield and/or a reduction in commodity quality as a result of flooding. Drought was reported by about 33% of the responding vegetable producers, and they sustained about a 50% reduction in yield and commodity quality.

Water conservation practices, and the motivations for adopting them

The survey included questions on the adoption of water conservation practices and motivations for adopting them. Over 83% of the responding vegetable producers utilized drip irrigation or some other highly efficient irrigation system (e.g., microsprinkler) in at least part of their operations. One third of the producers used the linear irrigation systems. This is somewhat confusing in that many producers farm multiple crops some of which are irrigated by low volume irrigation systems (e.g., tomato, eggplant), and others by big guns or linear irrigation systems (e.g., bush beans). In addition, most vegetable growers farm several separate parcels of land simultaneously (i.e., they use different irrigation systems for different crops and land areas).

The water use efficiency of the drip and other low volume systems along with their capability for delivering liquid fertilizers is attractive from a management and economic standpoint. They are also

recommended for the extremely coarse (gravelly-loam) "rock-plowed" soils in the area that have a limited water holding capacity and high permeability. However, use of drip irrigation for some crops (e.g., beans and corn) is not economic or practical. Nearly 17% and 25% of the vegetable producers indicated they utilize or plan to utilize water meters to monitor water use, respectively. Fifty percent of the growers employed some type of conservation tillage, and another 20% plan to do so in the future.

All of the respondents indicated that they monitor the local weather (i.e., National Weather Service, Florida Agricultural Weather Network) and keep track of rainfall (mostly with rain gauges at each major parcel of land). About 83% of the vegetable producers indicated they monitor soil water content. Roughly half utilize a soil inspection (visual appearance and feeling for moisture) method, and half utilize soil moisture monitoring devices (e.g., tensiometer). About 33% of those surveyed use the accounting method to schedule irrigation. Two-thirds (67%) of those surveyed irrigate at night, or early morning, or late evening to reduce evaporative losses and wind distortion of the high volume big gun irrigation pattern.

About 17% of the vegetable producers reported they utilize somewhat drought tolerant vegetable cultivars and another 12% indicate they plan to do so in the future. Two-thirds of the vegetable producers surveyed utilize black or white plastic mulch. Plastic mulch decreases soil evaporation, the need for herbicide applications, and increases water and nutrient efficiency.

At present none of the vegetable producers are utilizing urban recycled water for irrigation, however, 67% indicated an interest in doing so. For this to occur would require an extensive state and local government commitment to establish and maintain suitable water recycling facilities in the south Florida region.

Fifty percent of the vegetable producers reported keeping irrigation records and utilizing the Mobile Irrigation Lab (MIL). Another 20% plan on utilizing the MIL. This service is designed to assess the water and energy use efficiency of irrigation systems at no charge to producers. The MIL provides recommendations for repairs and/or upgrades in an effort to increase irrigation efficiency, and conserve water.

The three most common motivations for utilizing water conservation practices are water, time, and money savings. The primary motivation for vegetable producers varied with the conservation practice. For example, money savings was the primary reason given for utilizing plastic mulch, whereas time was the major motivation for conservation tillage practices. In contrast, equal weight was given to water conservation and money and time savings for irrigating during the night or evening or early morning, monitoring soil water content, measuring rainfall, and using a linear irrigation system. Time was given as the primary motivation for utilizing conservation tillage and keeping irrigation records. This makes sense since the acreage farmed tended to be large and in several parcels.

Conclusions and challenges ahead

Our results generally show an increase in the adoption of water conservation practices for these large vegetable operations in the last 21 years. The past and present status of smaller vegetable operations was not determined due to a lack of response by this group of growers. The 50% increase in the use of drip irrigation and nearly 17% drop in the use of open, uncased wells indicates a positive trend in water use efficiency and ground water protection by vegetable producers. Time was given as the main reason for adoption of water conservation practices by vegetable producers, with cost being a close second.

Thirty-five percent of the vegetable operations have experienced flooding within the last five years and a significant reduction (67%) in crop yield and quality resulted. Drought was reported by about 33% of the vegetable crops acreage surveyed and was associated with about a 50% reduction in yield and commodity quality.

In spite of these positive findings, there remain important educational challenges to optimize water use while protecting the environment

(Muñoz-Carpena et al., 2003). Improvements are needed in four major areas:

1. The possible reduction in the use of high volume big gun irrigation systems.

2. Improvements in water management practices including record keeping, equipment maintenance, use of soil water content monitoring devices, and periodic irrigation evaluation by the Mobile Irrigation Lab.

3. Protection of water sources by increased use of capped and cased wells.

4. Generalized adoption (and adaptation to the particular soils and climatic conditions of the area) of the new state “Vegetable BMP Manual” integrating improved water management with nutrient and IPM.

Realizing an improvement in water conservation practices for smaller producers may be more difficult because of more limited manpower and financial resources available to them.

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