Proc. Fla. State Hort. Soc. 118:184-186. 2005.

ON-FARM DEMONSTRATION OF SOIL WATER MOVEMENT IN VEGETABLES GROWN WITH PLASTICULTURE

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Additional index words. drip irrigation, nutrient management, best management practices, irrigation scheduling, blue dye, soil wetting pattern

Abstract. **The long-term sustainability of commercial vegetable production requires increased fertilizer and irrigation efficiency. Vegetables growers recognized as leaders in fertilizer and drip irrigation management in North Florida were selected to demonstrate how irrigation and fertilizer management are linked together and how management may prevent water movement below the root zone of several vegetable crops, all grown with plasticulture. Colored dye was injected into the irrigation water in existing drip irrigation systems periodically during the growing season. Subsequently, cross sections of the beds were excavated to observe the soil profile to determine the depth of dye penetration. Similar results were found at all locations: water movement was greater early in the season (1 to 5 weeks after establishment) and the dye moved below the root zone (20 to 30 inches deep). The vertical movement of the dye was less on a loamy soil with an impermeable layer than on the deep sandy soils. The uniformity of water movement decreased as depth increased. Overall, these data show that some leaching is likely to occur on light-textured soils, even when UF/IFAS recommended practices are followed. Educational efforts should focus on fertigation management during the 2-3 weeks after crop establishment. Based on their involvement with this project, the cooperators refined their current fertigation practices as well as considered other future changes to improve their management of water and nutrients. This project shows that vegetables growers are more likely to try and adopt sustainable practices when they actively participate in the educational process than when production changes are mandated through legislation.**

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Irrigation and nutrient management are directly linked to each other and both affect the yield and economic value of vegetable crops in Florida. In addition, these two management areas are becoming much more important to the long-term sustainability and environmental impact on the Florida vegetable industry. This is especially true in the Suwannee River Basin of Florida due to ground water quality issues, particularly excess N. University of Florida IFAS Extension Specialists and County Extension Agents in North Florida have been involved with several major on-farm demonstration efforts over the past 15 years to help farmers adopt new technologies and practices. The efforts have included the introduction of plastic mulch and drip irrigation technologies, refinement of irrigation scheduling by using various soil moisture sensors, and teaching the use of plant petiole-sap testing to improve fertigation programs (Simonne et al., 2001).

The most recent on-farm demonstration program has involved injecting a soluble blue dye in the irrigation water as a way for farmers to visualize the wetting pattern of their drip irrigation system (Simonne et al., 2003). These dye tests were done on several farms from 2003-2005 by injecting blue dye into a small portion of the existing drip irrigation system on the cooperating farms (Simonne et al., 2005). After the dye was injected, the farmers irrigated using their normal schedule and recorded time and duration for each irrigation event. Extension personnel returned to the farm after approximately one week and dug into the bedded area under the drip tape to determine the movement of the dye. The width and depth of the wetted area were measured to determine how the irrigation program during the previous week affected the water/nutrient/dye distribution within the soil profile. This is an important teaching method because the soluble fertilizer and irrigation water front are known to move together (Simonne et al., 2004). Because water is the vehicle for moving soluble nutrients (such as nitrate nitrogen) in the soil, it may be possible to improve nutrient management. If water stays in the root zone, smaller amounts of nutrients are likely to be leached.

The goals of this project were to demonstrate to everyone how irrigation and fertilizer management are linked together and how management may prevent water movement below the root zone. More specifically, the objectives of this project were to (1) establish a partnership with key growers and discuss fertilizer and irrigation management, (2) determine the position of the water front throughout the growing season, (3) diagnose crop nutritional status, and (4) determine nitrate distribution in the soil profile at the end of the growing season. From a producer's standpoint, this information will be used to increase sustainability by reducing water and fertilizer inputs, and reduce the environmental impact of vegetable production. From a regulatory stand point, this information will contribute to demonstrate the efficacy of possible nutrient/water Best Management Practices (BMP) and provide a measure of the increased water and nutrient efficiencies that may be achieved by adopting these BMPs.

Results and Discussion

During the period from 2003-2005, this project was demonstrated on eight cooperating farms and included 14 field sites. All farmers used plastic mulch and drip irrigation practices, but individual farms used a wide variety of bed widths, drip tape flow rates, fertilizer programs, soil types, and crops. Vegetable crops included: watermelon [*Citrullus lanatus* (Thunb.)], cantaloupe [*Cucumis melo* (L.)], squash [*Cucurbita pepo* (L.)], calabaza [*Cucurbita moschata* (Duch. Ex. Poir)], pepper [*Capsicum annuum* (L.)], tomato [*Lycopersicon esculentum* (Mill.)], and eggplant [*Solanum melongena* (L.)].

The growers showed great interest in seeing the movement of the dye on the "digging" visits. It was very common for growers to make immediate changes in irrigation schedules, especially irrigation event durations early in the season based on what they observed. The greatest challenge in managing the leaching from over irrigation occurred in the early part of the season, weeks 1-5 after planting. Most growers apply a portion of the total fertilizer program to the soil prior to bedding and mulching. This fertilizer is especially vulnerable to being leached early in the season before the root system and crop become well developed. It was shown that single irrigation events of more than one hour in sandy soils can move the blue dye more than a foot deep. This can move fertilizer below the root zone in the early part of the season (Locascio, 2005; Locascio et al., 1997).

There have been several dye tests conducted on these farms and also at the University of Florida, IFAS, North Florida Research and Education Center—Suwannee Valley near Live Oak, Florida. These repeated injections and measurements have provided a very good estimate of movement of the dye in sandy soils (Fig. 1).

Each grower involved in these demonstrations made adjustments based on the visualization of the movement of the dye. This was an immediate but short term change to their management. The longer term changes are those made from one year to the next based on these educational experiences. These on-farm trials, in addition to other educational programs, such as the UF/IFAS Drip Irrigation School and various field days have resulted in significant changes on several farms. One grower has been involved with the dye demonstrations and other events for three years. Over that period, both water and nutrient management practices have changed. The main change has come in the fertilizer program by reducing the total nitrogen rate applied prior to bedding and mulching. This preplant N rate has been reduced from 151 to 77 pounds per acre in the last three years. The remaining N was applied via the drip system over the season. This part of the fertility program, where fertigation is used, has not change over that period of time. Therefore, a total reduction of 74 lb of N per acre per year for this grower has resulted directly from these demonstrations without affecting yield or quality. The final resulting N and water management programs on

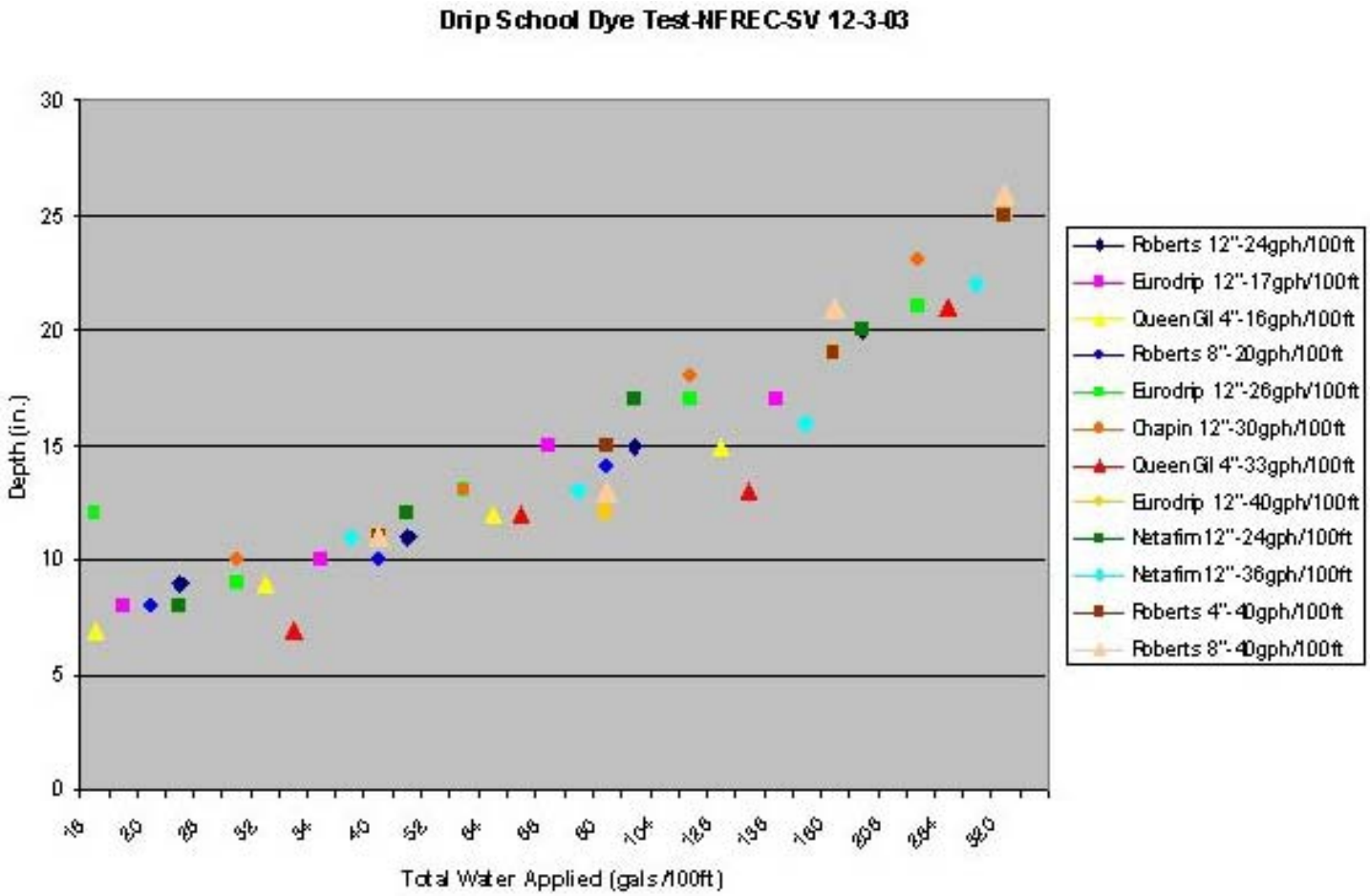

Fig. 1. Response of depth of the water front to irrigation water volume delivered via drip tape in a Lakeland fine sand at the North Florida Research and Education Center—Suwannee Valley near Live Oak, Florida.

this farm would be accepted Best Management Practices for growing watermelon using plasticulture.

Literature Cited

Locascio, S. J. 2005. Management of irrigation for vegetables: past, present, and future. HortTechnology 15(3):482-485.

Locascio, S. J., G. J. Hochmuth, F. M. Rhoads, S. M. Olson, A. G. Smajstrla, and E. A. Hanlon. 1997. Nitrogen and potassium application scheduling effects on drip-irrigated tomato yield and leaf tissue analysis. HortScience 32:230-235.

Simonne, E. H., D. W. Studstill, R. C. Hochmuth, J. T. Jones, and C. W. Starling. 2005. On-farm demonstration of soil water movement in vegetables grown with plasticulture. Fla Coop. Ext. Serv. Pub HS 1008 http://edis.ifas.ufl.edu/HS251

Simonne, E., D. Studstill, and R. Hochmuth. 2004. Understanding water movement in mulched beds on sandy soils: An approach to ecologically sound fertigation in vegetable production. Acta. Hort. (In press).

Simonne, E. H., D. W. Studstill, R. C. Hochmuth, G. McAvoy, M. D. Dukes, and S. M. Olson. 2003. Visualization of water movement in mulched beds with injections of dye with drip irrigation. Proc. Fla. State. Hort. Soc. 116:88-91.

Simonne, E., A. Andreasen, D. Dinkins, J. Fletcher, R. Hochmuth, J. Simmons, M. Sweat, and A. Tyree. 2001. On-farm irrigation scheduling for vegetables using the watermark soil moisture sensor. Proc. Fla. Agric. Conf. Trade Show. Oct 1-3. Lakeland, FL. pp. 17-22.