Current Status of Drip Irrigation for Vegetables in the Southeastern and Mid-Atlantic United States

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Summary. Responses to a 1993 survey showed that drip irrigation was used on 36,400 ha of commercial vegetables in the southeastern and mid-Atlantic United States. Florida led with 44% of total drip-irrigated vegetable area, followed by Georgia, North Carolina, and Pennsylvania, with about 10% each. Drip irrigation was used most commonly on tomato, pepper, and watermelon crops. The most-important benefits of drip irrigation were improved water and fertilizer delivery efficiencies compared to other irrigation systems, such as overhead sprinklers and subirrigation. Challenges with drip irrigation included high installation cost, emitter clogging problems, need for filtration, overirrigation problems, disposal of tubing, and lack of readily available expertise. Most drip irrigation was used with polyethylene mulch and most tubing was thin-wall disposable rather than thick-wall reusable. Eighty-one percent of the drip-irrigated vegetable acreage was fertilized with N and K. Survey responses indicated that drip irrigation use for vegetables is increasing.

Extension personnel often are asked to supply statistics on use levels of certain production technologies. These statistics often are gathered by surveys of commercial grower organizations, or extension colleagues. State vegetable extension specialists in 14 states were asked to respond to 10 questions concerning the status of drip irrigation use for vegetables in their state. The survey results are summarized here. Relevant literature citations are included in the discussion of each topic to provide supporting documentation and to provide assistance for readers desiring additional information.

The term "drip irrigation" used here refers to the application of small volumes of water under low pressure from small-orifice emitters in a tube (usually polyethylene) placed on or just below the soil surface near the plant (Hochmuth et al., 1993). The first installation of a combined drip irrigation–polyethylene mulch system in the southeast/mid-Atlantic United States was made by NORM Smith, Professor, at Rutgers University, in a demonstration plot on Long Island in 1964 (Amer. Veg. Grower, 1993). The demonstration was conducted with the early drip irrigation tubing developed by Richard Chapin, and this tubing was used in several early research studies (Chapin and Chapin, 1971; H all, 1977; O ebker and Kuykendall, 1971; Paterson and Smith, 1973; Voth, 1977). From these studies and demonstrations evolved wide adoption of drip irrigation for vegetable production in the southeastern and mid-Atlantic United States. This paper summarizes results of a 1993 survey of drip irrigation use on commercial vegetables in the southeastern and mid-Atlantic United States.

The survey covered 14 southeastern and mid-Atlantic states (Table 1). Drip irrigation was used on 36,400 ha, with Florida leading in usage with 16,230 ha (44%) (Table 1). North Carolina, Georgia, and Pennsylvania each had about 10% of the drip-irrigated vegetable area. New Jersey, Virginia, and South Carolina each had about 5% of the area, with 2230, 1840, and 1740 ha, respectively. Remaining states each had <1000 ha of drip-irrigated vegetables. The survey did not request the percentage of total vegetable area employing drip irrigation; however, for Florida, that figure would be 10% of total vegetable area or 30% of polyethylene-mulched vegetables.

Drip irrigation was used most extensively for tomatoes (50%), followed by peppers, watermelons, muskmelons, and cucumbers (Fig. 1). Strawberries, grown with production practices similar to vegetables, ranked in the top six crops for which drip irrigation was used.

Drip irrigation was combined with polyethylene mulch in 97% of the drip-irrigated area. Polyethylene mulch has been shown to improve early and total yields (Abdul-Baki et al., 1992; Bonanno and Lamont, 1987; Bryan, 1966; EMMET, 1957; H Armon and Worley, 1964; KNAVEL, 1966; LOCASIO and Thompson, 1960; MAIER et al., 1987; McEachern and Hawthorne, 1973; Schales, 1968), increase water and nutrient efficiency (Halsey, 1985; HAYSLIP and Iley, 1966; JONES et al., 1977; LOCASIO, 1961; LOCASIO et al., 1985; SWEENEY et al., 1987), and improve vegetable quality (JONES, 1961; Menn, 1960). Black polyethylene mulch also controls weeds in the row (Courter and Oebker, 1964; Halsey, 1985; THOMPSON, 1959), providing a substantial benefit for drip-irrigated crops with mulch compared to use of drip irrigation without mulch. Other advantages for mulch were summarized by Lamont (1993).

There are two types of drip irrigation tubing based on longevity of use—reusable (thick-wall) and disposable (thin-wall). Eighty-five percent of drip irrigation in the southeastern and mid-Atlantic United States involved disposable tubing, according to survey results. Disposable drip irrigation tubing, with a wall thickness of up to =0.30 mm, can be used for up to three crops (without intervening tillage) and then discarded.

Leading benefits of drip irrigation identified in the survey were water conservation and improved fertilizer management (Table 2), two topics that have been studied since the 1970s by researchers in the southeastern and mid-Atlantic United States. Research on water requirements of drip-irrigated vegetables in humid regions was summarized by LOCASIO et al. (1992).

Continued research is being conducted on water requirements of drip-irrigated vegetables, especially for Florida staked tomatoes and strawberries (Smajstrla et al., 1988). Crop water requirements for tomatoes ranged from =0.2 of pan evaporation (Class A Weather Bureau evaporation pan with appropriate pan coefficient) early in the season to =0.8 of pan evaporation during peak crop demand (Pitts and Clark, 1991). Water requirements av-
The exception to this occurs on medium- to fine-textured soils, where tomato yields with all fertilizer applied preplant were similar to yields of fertigated crops (Locascio et al., 1989; Cook and Sanders, 1991).

Improved nutrient delivery with drip irrigation probably results from nutrient applications timed more closely to crop demand. Schedules for N and K injection for crops such as watermelon (Table 3) have been presented for Florida (Hochmuth and Clark, 1991). Frequent daily or weekly nutrient injections were needed for sandy soils compared to more fine-textured soils (Cook and Sanders, 1991); however, when irrigation application was well-managed, weekly fertilizer injections were as effective as daily injections for yield enhancement (Cook and Sanders, 1991; Locascio and Smajstrla, 1989).

Survey respondents reported higher yields and better disease control with drip irrigation compared to other irrigation systems and production practices. Foliar diseases such as bacterial spot or early blight of tomatoes might be reduced with drip irrigation compared to overhead sprinkler irrigation.

Convenience was mentioned in the survey as a benefit of drip irrigation. Convenience results from the reduction in labor needed for moving pipe, and pumps required with sprinkler systems. Drip irrigation systems can be computerized to control application of water and nutrients to match crop requirements.

The most often-mentioned challenge with drip irrigation was the high cost of installation (Table 4). The annual total cost for drip irrigation is high, and similar to that for traveling gun and center pivot, but considerably more expensive than subirrigation (Prevatt et al., 1992). Annual cost per hectare was calculated to be $1200, $1045, $955, and $470 for traveling gun, center pivot, drip, and subirrigation, respectively (Prevatt et al., 1992).

Clogging problems were mentioned as challenges to successful drip irrigation by 45% of survey respondents (Table 4). Drip irrigation emit-
Drip irrigation has been widely adopted for vegetable crops in the southeastern and mid-Atlantic United States. Although costs and management expertise requirements are high, 86% of the survey respondents reported that drip irrigation was increasing in their state, and 14% reported that use was doubled. Drip irrigation tubing is popular due to reduced cost compared to tubing with other irrigation systems. Growers require training on proper irrigation system design and management. The most serious challenges for growers included high installation costs and a high level of expertise needed to properly operate drip irrigation systems. Emitter clogging is a common problem, and clogging control programs must be designed into the drip irrigation system. Benefits outweighed the potential problems leading to continued increase in drip irrigation use for vegetables.

Literature Cited


