ADAPTATION OF SUBSURFACE DRIP IRRIGATION TO ALFALFA SEED PRODUCTION

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Introduction

Past work at the Malheur Experiment Station (MES) in the 1980's demonstrated that considerable water stress was associated with high alfalfa seed yields. It is very difficult to irrigate alfalfa for optimal seed yield with a gravity irrigation system. Uniform levels of water stress are nearly impossible to maintain across the length of most furrow irrigated fields.

Some of the most advanced irrigation technology is subsurface drip irrigation (SDI). SDI allows highly productive crop production without negative environmental impacts associated with leaching or runoff. Only the amount of water consumed by the crop needs to be diverted from a stream or reservoir, helping to protect stream water quality in a large number of ways. Anecdotal evidence from alfalfa seed fields in northern Nevada and the Snake River plain of Idaho and eastern Oregon suggests that SDI may be beneficial to alfalfa seed yield and possibly to seed quality.

There are many opportunities for SDI in the Pacific Northwest, but the technology has not been adapted to most potential uses. For Oregon's irrigated crop acreage (1,833,000 acres) in 1998, gravity irrigation was used on 46.6 percent, sprinkler irrigation systems of all types were used on 52.4 percent, and low-flow systems (all types of drip and micro sprinkler systems) accounted for only 1 percent! For Idaho's irrigated crop acreage (4,104,600 acres) in 1998, gravity irrigation was utilized on 38.3 percent, sprinkler irrigation was used on 61.5 percent, and low flow systems (all types of drip and micro sprinkler systems) accounted for only 0.2 percent! (Anon. 1999[a]). The 1997 Census of Agriculture reports lower total irrigated acres with similarly low proportions of drip-irrigated crops (Anon. 1998).

The work begun at the Malheur Experiment Station in 2000 builds on previous drip irrigation research and demonstrations done by the Harvest Farm Co. (Nampa, ID), Bel Air Farms (Nyssa, OR), and the Nevada Nile Ranch (Lovelock, NV).

Objectives

a. Determine the ideal amount of water to apply through subsurface drip irrigation (SDI) for alfalfa seed production.

b. Determine the ideal soil water content for alfalfa seed yield when using a SDI irrigation system.

c. Future objectives will be kept in mind to help the practical application and management guidelines for SDI including crop rotations, rodent control, filtering, flushing of lines, and the use of long-life products.

Procedures

Alfalfa is being grown for seed on 30-inch spacing at the Malheur Experiment Station on a Nyssa silt loam of modest fertility and productivity. The site has been chosen to be representative of fields used for alfalfa seed production. Two varieties of alfalfa were planted on April 6, 2000 at 2 lb/acre in 30-inch rows. Two lb/acre Balan DF was applied preplant and incorporated with harrows. 'Tango', with a dormancy rating of six was planted in the upper half of the field and 'Accord', with a dormancy of four was planted in the lower half of the field (Anon. 1999[b]). The alfalfa was planted so that each irrigation plot would be planted to two varieties of alfalfa, one with greater and one with lesser dormancy. Two additional plots were established with the tape buried at 15- to 18-inch depth to evaluate the comparative feasibility of tape at that depth.

This year was spent establishing the crop. Solid set sprinklers were set up to assist with even emergence. First emergence was observed on April 17, 2000. Because of the complexity of the irrigation equipment set up, the first irrigation by drip was started on August 10. The last drip irrigation was on August 24. The alfalfa will be drip irrigated at four criteria in 2001.

Alfalfa will be irrigated uniformly in the 2001 season with SDI until bud formation, then at four different levels of alfalfa crop evapotranspiration (ET_c) demand (20, 40, 60, and 80 percent) with five replicates of each treatment (Table 1). Each treatment would be irrigated every 4-5 days to replace the fraction of evapotranspiration used in the last 3 to 4 days. It is anticipated that optimal seed production will occur with irrigation at around 40 percent ET_c. The reference crop water use of alfalfa will be determined by the AgriMet weather station at MES.

Table 1. Irrigation treatments.

Treatment #	Irrigation intensity	Interval, every	Tape depth
1	80% ET_c	4-5 days	12 inches
2	60% ET_c	4-5 days	12 inches
3	40% ET_c	4-5 days	12 inches
4	20% ET_c	4-5 days	12 inches
5	80% ET_c	4-5 days	15-18 inches

One pound of Treflan was applied through the sprinklers on June 14 and 15. One mechanical cultivation was done on June 6. Hand weeding was done on June 9 and July 6.

When alfalfa had grown to a height of approximately 6 inches, T-Tape No. 515-16-340 (T-Systems Int., Kennewick, WA) drip tape was shanked in at a depth of 12 inches. Tape is 5/8 inch diameter, 15-mil thickness, 16-inch emitter spacing and delivers 0.34 gal/100 ft/min. Tape is at 60-inch spacing and each run is 486 ft. Maximum water application is calculated to be 1.57 inches/24 hours. Each eight-row plot has four drip tapes, each supplying water needs of two rows, and is controlled separately by its own pressure regulator, electronic solenoid valve, and water meter. Ditch water for the entire system is filtered by automatic Fresno FR324 (Fresno Valves & Castings, Inc. Kennewick, WA), 24-inch sand media filters. The electronic solenoid valves for each plot and the sand media filters are controlled by an Ag Tech Irrigation Controller (Clearwater Supply, Inc. Ontario, OR). Drip tapes are automatically drained after each irrigation set. Periodic manual flushing of the tape is required.

Two pounds of Gramoxone Extra was sprayed on September 8 and alfalfa seed was harvested on September 20, 2000. No yield data was taken since all the plots were managed the same.

Soil water will be measured with capacitance probes and other soil moisture sensors. During the 1999 season TDR and capacitance probes were used successfully to measure soil water in an alfalfa seed crop.

Literature Cited

Anon. 1999[a]. 1998 annual irrigation survey. Irrigation Journal. http://www.greenindustry.com/ij/1999/0299/299

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