DRIP IRRIGATION ON COMMERCIAL SEED CARROTS IN CENTRAL OREGON, 2004

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Abstract

Drip irrigation used on commercial seed carrot fields was a two part study in 2004. The first part was to monitor and compare soil moisture levels, yield and water usage in drip versus non drip-irrigated fields. The second part was to investigate the occurrence of *Xanthomonas campestris pv carotae* in drip-irrigated compared to sprinkled-irrigated and flood-irrigated fields. Drip irrigation was imposed May and June 2004 on portions of seven existing sprinkler-irrigated carrot seed fields that were established from seed in 2003. Soil moisture in both the drip-irrigated and sprinkler-irrigated non-replicated plots was monitored with Watermark Soil Moisture Sensors. The sensor readings were used for irrigation scheduling in the drip-irrigated plots. Plots were farmed and harvested by the grower cooperators with commercial equipment following standard practices. Harvested seed was kept separate throughout the cleaning process. Carrot seed yields were increased 18.5 percent on average under drip irrigation. Water savings were less than in previous years. Disease results are reported in "Incidence of *Xanthomonas campestris* pv *carotae* on Carrot Seed Irrigated by Drip or Sprinkler in Central Oregon, 2004."

Introduction

In 2000 and 2001, research was conducted at the Central Oregon Agricultural Research Center (COARC) to evaluate drip irrigation on seed carrots. Benefits were shown to include a significant reduction in water usage, increased seed yields, and a decrease in disease. As a result of this research, drip irrigation was placed in three commercial fields in 2002. While disease results were inconclusive, yields increased by an average of 60 percent and water usage was generally half of that used under sprinkler irrigation.

Given these promising results under commercial conditions, the experiment expanded to four carrot fields in 2003. While yield results were less definitive than 2002, it was shown that drip irrigation allowed growers to plant seed carrots on otherwise unsuitable terrain. Water usage results again showed that water could be reduced by 50 percent or more under drip irrigation. When compared to furrow irrigation, water usage was reduced by almost 75 percent. Disease results were more conclusive in 2003, showing a lower incidence of *Xanthamonas* in the drip-irrigated fields compared to sprinkler-irrigated fields.

Nine commercial carrot fields were drip-irrigated in 2004. However, only seven fields were included in the project. The new growers purchased their systems with the aid of the Natural Resource Conservation Service EQIP (Environmental Quality Incentive Program) Cost-Share program. The disease portion of the research was funded by The

California Fresh Carrot Advisory Board, Central Oregon Seeds, Inc, and several major seed companies. The Agricultural Research Foundation funded soil moisture monitoring.

Methods and Materials

Four commercial carrot seed fields were evaluated for yield, and water usage. The fields ranged in size from 23 acres to 76 acres. Sprinkler-irrigated comparison plots were located side by side with the drip-irrigated plots. The drip-irrigated plot size averaged 62 percent of each field.

Disease was monitored in seven drip-irrigated fields. Nearby fields were used as comparisons because of concern about movement of *Xanthamonos* when the sprinkler and drip are side by side. Each set of comparisons included the same carrot variety, seed source, soil types and microclimates. Although farmed by different growers, each crop was managed similarly. Disease results are reported in "Incidence of *Xanthomonas campestris* pv *carotae* on Carrot Seed Irrigated by Drip or Sprinkler in Central Oregon, 2004."

The carrot fields were planted according to the seed contractor's specifications in mid August 2003. Drip-irrigation systems designed specifically for each field were assembled and installed by grower cooperators, under the direction of Jim Klauzer of Clearwater Supply during May and June. All the drip-irrigated fields were sprinkle-irrigated the previous fall, only one was sprinkle-irrigated in the spring prior to the imposition of drip-irrigation. Fertilizer and pesticide treatments were applied the same on both the drip-irrigated and sprinkler-irrigated plots.

The drip-tape delivered water at the rate of 0.22-gal/min/100 ft. The tape was installed 2 to 4 inches below the soil surface and offset 3 to 5 inches from the carrot row to minimize disturbing the roots. After installation, the drip tape was flushed and the ends rolled over and secured. The first irrigation with the drip tape lasted for 24 to 48 hours in order to set the wetting pattern.

Watermark soil moisture sensors were placed in groups of three at multiple locations in each of the drip-irrigated plots to track soil moisture and determine irrigation scheduling. The sensors were installed 8 inches deep in the carrot row. The target soil moisture level was -40kPa throughout the season. Three Watermark soil moisture sensors were placed in the sprinkler and furrow-irrigated plots, including the comparison fields, to track the soil moisture. Moisture readings were taken two times per week from mid May to mid August. Additionally, growers had an AM400 (generally referred to as a Hansen). The Hansen allowed them to access their soil moisture readings at any time. Whenever the average of the readings reached the target level, growers were requested to irrigate the drip carrots. The length of the irrigation set varied from 4-12 hours. The sprinkler-irrigated plots were managed by growers according to their standard practices.

Plots were harvested by grower cooperators using commercial equipment in September. Seed from the drip and sprinkler-irrigated plots at each location were kept separate

throughout harvest, storage, and seed cleaning. Seed cleaning was conducted by Central Oregon Seed (COSI) according to the specifications in the contract. Seed testing was conducted following Association of Seed Analysts standards.

Results and Discussion

Yields were increased in the four drip-irrigated fields (Table 1). The north Culver field experienced the largest increase of 46 percent. The south Culver, Mud Springs, and Agency Plains fields had increased seed yields of 14, 15, and 3 percent, respectively. Seed from the four drip irrigated fields had increased germination rates compared to sprinkler-irrigation. The greatest gain was 5%, while the average germination increase was 3.6%.

Water savings were less than in previous years and varied widely from field to field (Table 1). The water usage of the Agency Plains field was 55.6 percent of the water used on the sprinkler-irrigated plots. The north Culver, south Culver, and Mud Springs fields used 83.6, 126.6, and 166.7 percent of the water put on the sprinkler-irrigated plots, respectively.

Potential benefits associated with drip-irrigation compared to sprinkler-irrigation include a reduction in weeding time since less area watered reduces the area of active weed growth. Additionally, labor associated with irrigation is used more intensively during May and June rather than in July and August when labor is at a premium. Lodging occurs less frequently when drip irrigation is used. Drip irrigation has made it possible for growers to plant carrots in fields where the terrain had made it prohibitive in the past. This allows growers to have more land available for rotation to grow high-valued seed crops. Another potential benefit of drip irrigation is reduced fertilizer application when compared to broadcast application. Given the average increase in seed yields over the past three years, it is estimated the system will pay for itself in two years.

Table 1. Comparison of yield, germination, and water usage in carrot seed grown under drip-irrigation and sprinkler-irrigation regimes, near Madras, Oregon, 2004.

	North Culver		South Culver		Mud Springs		Agency Plains		Average	
	Drip	Sprinkled	Drip	Sprinkled	Drip	Sprinkled	Drip	Sprinkled	Drip	Sprinkled
Acreage	20.4	5.3	17.75	5.25	39.9	36.0	20.3	14.6	24.6	15.3
Yield (pounds/acre)	668	456	220	193	1070	933	576	557	633.5	534.8
% of Sprinkled	146.5	100	114.0	100	114.7	100	103.4	100	118.5	100
% Germination	98	94	91	89	97	95	90	85	94.0	90.8
% of Sprinkled	104.3	100	102.2	100	102.1	100	105.9	100	103.6	100
Water usage (acre feet/acre)	1.27	1.52	1.15	0.69	0.81	0.64	0.89	1.6	1.0	1.1
% of Sprinkled	83.6	100	166.7	100	126.6	100	55.6	100	92.6	100