DRIP IRRIGATION ON COMMERCIAL SEED CARROTS AND ONIONS IN CENTRAL OREGON, 2002

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Abstract

Drip irrigation was imposed May, 2002 on portions of three existing sprinkler-irrigated carrot seed fields (3.5-10 acre) and one onion seed field (2.5 acre) that was established in 2001. Soil moisture in both the drip-irrigated and sprinkler-irrigated plots was monitored with Watermark sensors, which 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 by 15, 32 and 133 percent under drip irrigation, while onion seed yield was decreased by 5 percent. At 32 percent of carrot seed yield increase, the payback period to recover the cost of switching to drip irrigation is 2 years.

Introduction

In a cooperative effort with the vegetable seed industry, research was conducted to evaluate drip irrigation on seed carrots and onions at the Central Oregon Agricultural Research Center (COARC) during the 2000 and 2001 seasons. Results across the two seasons indicated a 100 percent increase in onion seed yield under drip irrigation compared to sprinkler irrigation, while carrots saw a 50 percent increase in seed yield under drip irrigation. During the 2001 season, when disease was present in the plots, incidence of *Botrytis* was reduced 5 fold in seed onions and *Xanthomonas* was reduced 2 fold in seed carrots.

This project at the COARC generated a significant amount of interest from growers and the vegetable seed industry. The objective of the current project is to take what was learned in these small plots and evaluate the potential for drip irrigation to increase seed yields, control disease, and reduce water consumption in seed carrots and onions in commercial-sized plots with grower cooperators.

Methods and Materials

This study was conducted on three commercial carrot seed fields and one onion seed field near Madras. The drip-irrigated carrot seed fields were 3.5 acres, 5.6 acres, and 10.0 acres, while the onion seed field under drip irrigation was 2.8 acres. The sprinkler-irrigated plots were of similar size and side by side with the drip-irrigated plots in the same field. Variables evaluated in this study include yield, water usage, and disease pressure.

The onion and carrot fields were planted according to the seed contractor's specifications in mid-July and early August 2001, respectively. The exception was the 10-acre carrot field, which was grown from spring-planted stecklings. Fields were sprinkler-irrigated in the fall and through the

end of April 2002. In May 2002 a drip-irrigation system designed specifically for each field was assembled and installed by grower cooperators, under the direction of Jim Klauzer of Clearwater Supply.

The drip tape delivered water at the rate of 0.22 gal/min/100 ft. The tape was installed 2-4 inches below the soil surface and offset 4-8 inches away from the carrot row to minimize disturbing the roots. After installation, the T-Tape was flushed and the ends rolled over and secured. The first irrigation with the drip tape was 24-30 hours in order to set the wetting pattern.

Watermark soil moisture sensors were installed 8 inches deep in groups of three in three locations in each of the drip-irrigated plots to track the soil moisture and determine irrigation scheduling. The target soil moisture level for carrot seed and onion seed from mid May to the end of June was -60 kPa to -70 kPa and -50 kPa to -60 kPa, respectively. After July 1 the target soil moisture was increased to -40 kPa and -50 kPa for carrot seed and -40 kPa to -45 kPa for onion seed.

Moisture readings were taken three to five times per week from mid-May to mid-August. Whenever the average of the readings reached the target levels, the grower was requested to irrigate the drip carrots or onions for 8-18 hours. The sprinkler-irrigated plots were managed by growers according to their standard practice. Six Watermark soil moisture sensors were randomly placed in the sprinkler irrigated plots to track the soil moisture and compare with the drip-irrigated plots.

Fertilizer and pesticide treatments for the onions and carrots were applied the same on both the drip-irrigated and sprinkler-irrigated plots. Disease monitoring was conducted during the growing season. In addition, seed from each plot was sampled and tested for surface contamination by *Xanthomonas*.

Plots were harvested by the grower cooperators using commercial equipment. Onion seed was harvested in mid-August while the carrot fields were harvested 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) to the specifications in the contract. Seed testing was conducted following Association of Official Seed Analysts (AOSA) standards.

Results and Discussion

Carrot seed yields were consistently increased under drip irrigation, compared to sprinkler irrigation (Table 1). Increases were 15, 32, and 133 percent for each of the three locations, for an average increase of 45 percent. Onion seed yields decreased by 5 percent under drip irrigation. The local conventional thinking is that the sprinkler irrigation may have helped to cool the crop during seed set, when temperatures were over 100^{o}F. Without this cooling effect, seed yield in the drip-irrigated plot may have been reduced.

Water use in the drip-irrigated vs. sprinkler-irrigated carrot seed plots at each location was 50, 60, and 85 percent. For onion seed, water use in the drip-irrigated plot was 43 percent of the sprinkler-irrigated plot.

The economic impact of using drip irrigation on carrot seed in the fields used in this study was an increase of $420.50/acre (29 lb at $14.50/lb), $744/acre (62 lb at $12/lb), and $2,480/acre (124 lb at $20/lb). Assuming a 20-acre field, the estimated cost of first-year setup for drip irrigation is $1,100/acre. The cost of tape replacement for each of the following years is estimated at $300. Using the increased income of $744/acre/year, the payback time to recover the cost of transferring to drip irrigation would be 2 years ($700/acre/year).

Additional benefits associated with using drip-irrigation compared to sprinkler irrigation include reduced water use (estimated at 25-50 percent less), and increased uniformity in soil moisture. Percent germination of seed was the same under both drip and sprinkler irrigation. Although one would expect reduced disease pressure under drip irrigation, results from this study were inconclusive. Other potential benefits include reduced fertilizer application when compared to broadcast application, and reduced area of active weed growth.

Table 1. Comparison of yield, water usage, and soil moisture in carrot seed and onion seed grown under drip-irrigation and sprinkler-irrigation regimes, near Madras, Oregon, 2002.

	Location A				Location B		Location C		Average	
	--Onion seed--		----------Carrot seed----------							
	Drip	Sprinkled	Drip	Sprinkled	Drip	Sprinkled	Drip	Sprinkled	Drip	Sprinkled
Yield (lb/acre)	306	322	224	195	257	195	217	93	233	161
% of Sprinkled	95	100	115	100	132	100	233	100	145	100
% Germination	----	----	89	86	88	87	95	91	91	88
% of Sprinkled	----	----	103	100	101	100	104	100	103	100
Water usage (acre feet/acrere)	0.5	1.1	0.9	1.5	1.7	2.0	0.7	1.6	1.1	1.7
% of Sprinkled	43	100	60	100	85	100	50	100	65	100
Soil moisture Low –kPa[1]	4.0	5.0	3.6	1.0	8.8	6.0	7.5	9.0	6.6	5.3
Soil moisture High -kPa	85	78	73	89	80	129	73	129	75	115
Soil moisture Average -kPa	31	32	37	32	33	45	33	47	34	41

[1]Kilopascal: when the soil is nearly saturated the reading is –15 kPa.