DRIP IRRIGATION OF SEED ONIONS IN CENTRAL OREGON: EFFECT OF TAPE PLACEMENT ON DISEASE AND YIELD

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Abstract

A 2-year project was conducted from 1999 to 2001 at the Central Oregon Agricultural Research Center to evaluate drip irrigation on seed onions. Tape placement comparisons were between the surface and at 2-in, 4-in, and 8-in depths. These replicated plots were compared to a single large sprinkler irrigated plot. Irrigation scheduling was based on a soil moisture potential of –45 kPa during 2000 and –50 kPa for 2001, using granular matrix sensors placed in the row 6 in deep. There were no differences between drip tape placement for disease incidence of neck rot (*Botrytis allii*), bacterial soft rot, and scape blight (*Botrytis allii*). Although no statistical analysis could be made between the drip and sprinkler-irrigated plots, the trend was for decreased yields and the potential for increased soft rot under sprinkler irrigation. Water application to maintain similar soil moisture potentials was reduced by 26 percent under drip-irrigation.

Introduction

Scape blight and neck rot caused by the fungus *Botrytis allii*, along with bacterial soft rot, can be a serious problem in onion seed production, with the potential to cause a complete stand loss. By providing better control of water delivery, drip irrigation may decrease disease pressure while also decreasing water usage and increasing yields. The objective of this experiment is to observe the effect of tape placement depth on disease incidence and yield of onion grown for seed during 1999-2001.

Methods and Materials

Hybrid seed onions were planted in rows on 2.5-ft centers on July 30, 1999 and July 21, 2000 at the Central Oregon Agricultural Research Center (COARC). Two rows of female plants were alternated with two rows of male plants. Plots consisted of four rows, with the two inner rows being females. Treatments consisted of drip tape (Rainbird) delivering 0.25 gal/min/100 ft shanked in at depths of 2, 4, and 8 in before planting, along with a surface placement after planting. The trial was laid out as a randomized complete block design with four replications per treatment. A solid-set sprinkler system was used for plant establishment. After emergence, the irrigation pipe was removed from the drip-irrigated plots. Treatments were begun in the spring following stand establishment. All plots were irrigated whenever the soil moisture potential within a given replication was within 10 percent of -45 kPa for 2000 and -50 kPa in 2001. Soil moisture potential was tracked using granular matrix sensors (one per plot, placed in the row 6 in deep) measured three times weekly in 2000 and five times weekly in 2001. These readings were averaged across the plots for each replication to guide irrigation. During 2000, the plots were originally irrigated for 8 hours per application. However, in June the time was reduced to 4 hours per application when the plots were showing signs of over-watering. Plots were irrigated for 4 hours per application during the 2001 season. A single, large

sprinkler-irrigated plot adjacent to the drip-irrigated plots was used to compare the two application methods. Weeds were controlled using a combination of herbicides and hand weeding. Insect control measures were the same for all plots.

Prior to planting in 1999, 16-16-16 fertilizer at a rate of 290 lb/acre and 40 lb/acre S was broadcast on all plots. A spring application of 450 lb/acre of 30-10-0-7 was made on April 5, 2000. In July 2000, the drip-irrigated plots received an additional 48 lb/acre N and 41 lb/acre P and K through an injection system. Prior to planting the second year crop, 16-15-15-3 fertilizer at the rate of 400 lb/acre was broadcast on all plots in July 2000. The sprinkler-irrigated plot received a spring broadcast application of 30-10 at 300 lb/acre in March 2001, while the drip-irrigated plots received a total of 45 lb/acre N, P and K in three applications in May and June.

Disease evaluations were made on June 23, 2000, June 6, 2001, and August 17, 2001. A representative 3-ft section of female row was selected for the June evaluations. A count of bulbs with neck rot (*Botrytis allii*) and bacterial soft rot was made to determine the number of plants affected. The same 3-ft section was used for the August evaluation for neck rot, while entire female rows of the plots were used for bacterial soft rot and scape blight evaluations.

In 2000, a 20-ft section of female plants from each drip-irrigated plot was hand harvested on August 25. The 2001 harvest on August 21 and 22 included the entire female rows from each plot. Four subsamples taken from the single sprinkler-irrigated plot followed the same harvest procedure used for the drip-irrigated plots. The seed heads were placed in woven burlap sacks, hung to air dry, and then threshed in a stationary thresher. The seed was cleaned at COARC using a Clipper Cleaner M-2B. Germination testing followed Association of Official Seed Analysts (AOSA) protocols.

Since the sprinkler-irrigated treatment was applied to a single large plot from which 4 subsamples were taken a direct statistical comparison could not be made between the sprinkler-irrigated and drip-irrigated plots.

Results and Discussion

There was no statistical difference in disease levels between drip-irrigation treatments for any of the parameters evaluated (Tables 1 and 2). Saturating the bulbs with 8-hour sets of water early in the 2000 season is believed to have been responsible for differences seen in neck rot (*Botrytis allii*). When the length of irrigation was changed to 4-hour sets, the differences between drip- and sprinkler-irrigated plots seemed to disappear based on informal observations. During 2001 there was no difference in the amount of neck rot between the drip-irrigated plots and the sprinkler-irrigated plot.

Although bacterial soft rot in 2000 was low, the sprinkler-irrigated plot had three times the incidence of soft rot compared to the drip-irrigated plots. In 2001, there was a higher incidence of disease, some of which might be accounted for by plant damage from a hail storm on May 23, 2001. The amount of soft rot in the sprinkler-irrigated plot during 2001 was three times higher than in the drip plots. On August 17, 2001 a second visual

rating for disease incidence was taken and there were 4.5 times as many plants with soft rot symptoms in the sprinkler-irrigated plot than in the drip plots. Although not significantly different, the trend was for reduced soft rot under drip irrigation.

There was inadequate scape blight (*Botrytis allii*) for evaluation during 2000. In 2001 there was no difference in the number of plants affected with scape blight between the drip-irrigated plots and the sprinkler-irrigated plot. However, when the lower portion of the scape was evaluated separately, the trend indicated that incidence of scape blight was greater in the sprinkler-irrigated plot compared to the drip-irrigated plots.

Yield trends across the 2 years indicate greater yields (188-225 percent of sprinkled plot) with drip irrigation (Table 3). Statistical analysis of the effect of drip tape depth on yield showed no difference, but the trend was for the seed yield to be greatest at a tape depth of 4 in.

When keeping the soil moisture level within the same range, water usage decreased when using drip irrigation compared to sprinkler irrigation (Table 4). The drip-irrigated plots used 74 percent of the water used in the sprinkler-irrigated plot. Observations made by industry representatives suggest that the amount of water applied could be reduced further.

Table 1. Effect of drip irrigation on the incidence of bacterial soft rot, and neck rot (*Botrytis allii)* on onion seed evaluated on June 23, 2000, June 6, and August 17, 2001, at COARC near Madras, Oregon.

	Neck rot			Soft rot		
	2000	2001		2000	2001	
Tape depth	June 23	June 6	August 17	June 23	June 6	August 17
inches	---------plants/3 ft of row---------			---------plants/3 ft of row---------		
0	9	20	1.9	0.25	0.9	0.37
2	15	15	5.6	0.0	1.1	0.37
4	14	17	5.4	0.0	1.1	0.29
8	26	17	6.0	0.0	1.0	0.40
	NS[1]	NS	NS	NS	NS	NS
sprinkle	2	16	5.0	0.75	3.5	1.88

[1]Mean separation with Student-Newman-Kuels Test at P = 0.05; NS = not significant.

Table 2. Effect of drip irrigation on the incidence of scape blight evaluated visually August 17, 2001, at COARC near Madras, Oregon.

Tape depth	Lower scape affected	Upper scape affected	Entire scape affected	Total scapes affected
inches	plants/plot	plants/plot	plants/plot	plants/plot
0	9.5	10.0	9.7	29.3
2	9.7	11.8	6.1	27.6
4	7.4	12.3	11.2	30.9
8	8.3	6.6	12.6	27.5
	NS[1]	NS	NS	NS
sprinkled	18.5	7.4	11.0	36.9

[1]Mean separation with Student-Newman-Kuels Test at P = 0.05; NS = not significant.

Table 3. Effect of drip irrigation on yield,100-seed weight, and germination on onion seed at COARC near Madras, Oregon, 2000-2001.

Tape	Yield				100-seed weight		Germination	
depth	2000	2001	Average	% sprinkled	2000	2001	2000	2001
inches	----------lb/acre----------			--%--	---------g---------		-------%-----	
0	593	497	545	197	0.478	0.502	87	82
2	648	408	528	191	0.496	0.522	89	88
4	1094	485	789	285	0.499	0.502	91	84
8	610	454	521	188	0.492	0.509	88	90
	NS[1]	NS	NS	NS	NS	NS	NS	NS
sprinkled	274	279	277	100	0.478	0.527	90	75

[1]Mean separation with Student-Newman-Kuels Test at P = 0.05; NS = not significant.

Table 4. Amount of water applied to drip-irrigated and sprinkler-irrigated plots on seed onions, at COARC near Madras, Oregon, 2000-2001.

	Water applied			
Treatment	2000	2001	Average	% of sprinkled
	----------acre-ft/acre----------			--%--
Drip irrigated	0.96	0.87	0.92	74
Sprinkler irrigated	1.27	1.21	1.24	100