PLANT POPULATION FOR DRIP-IRRIGATED ONIONS

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Summary

Onions were grown with subsurface drip irrigation with narrow row spacings on wide beds at 8 plant populations. Plant populations varied from 75,000 to 250,000 plants per acre. A plant population of 125,000 plants/ac maximized onion yield and economic return.

Introduction

The improved water application efficiency with subsurface drip irrigation allows for narrower onion row spacings and higher per acre yields. Onion production on narrow row spacings (8 inches apart) on wide beds (88 inches between centers) with subsurface drip irrigation has been tested at the Malheur Experiment Station since 1993. The optimum plant populations for drip irrigated onions was not known. The objective of this trial was to determine the optimum plant population for wide bed, drip-irrigated onions to maximize onion yield and quality and economic return to the grower.

Procedures

The trial was conducted on a Owyhee silt loam previously planted to wheat at the Malheur Experiment Station. The experimental site had reduced topsoil due to leveling several decades ago. The site has received little chemical fertilizer during the last decade. A soil sample taken from the top foot on March 8, 1995 showed a pH of 7.6, 1.3 percent organic matter, 18 meq per 100 g of soil of cation exchange capacity, 6 ppm nitrate-N, 5 ppm ammonium-N, 23 ppm phosphorus, 432 ppm potassium, 6344 ppm calcium, 436 ppm magnesium, 418 ppm sodium, 1 ppm zinc, 2.3 ppm iron, 10.7 ppm manganese, 0.9 ppm copper, and 0.5 ppm sulfate-S. On April 5, the field was groundhogged following the broadcast application of 200 lb of phosphorus as 0-46-0 and 15 lb of zinc as zinc sulfate.

The field was made into 64-inch beds (88-inch centers) and 8 mm black polyethylene drip tapes were laid on April 6. In each bed three drip tapes were spaced 24 inches apart and buried 4 inches deep. Each drip tape serviced 3 onion rows. The beds were remade on April 12 using a bed harrow and roller. Onions (cv. Vision) were planted on 9 single rows spaced 8 inches apart in each bed on April 13. Onions were planted with

nine Beck Precision Planters (Mel Beck Precision Planters, Nyssa, OR) mounted 8 inches apart on a tool bar.

Onions were planted at 8 seeding rates in order to achieve the 8 plant populations (Table 1). The 8 plant populations were arranged in a randomized complete block design with 5 replicates. Plots were 3 beds wide and 40 feet long.

The trial was drip irrigated for 12 hours on April 19, 8 hours on April 22, and 11 hours on April 27 in order to assure uniform emergence. At each pre-emergence irrigation, the wetting front reached just beyond the 2 onion rows that were 8 inches to each side of each drip tape. Onions started emerging on May 1. Onions were irrigated by the same method as described in the preceeding report "Nitrogen fertilization for drip-irrigated onions," but with an independent set of controls.

Uran nitrogen fertilizer was applied at 25 lb N/ac on May 11, May 22, June 9, July 3, July 14, and July 19 (total of 150 lb N/ac). Fertilizer solutions were applied through the drip tape via venturi injectors (Mazzei injector Model 1078). Plants were sampled from the field for nutrient analyses on June 28, July 18, August 2, and August 23. The plants were washed, the roots were analyzed for nitrate-N, phosphate-P, K, sulfate-S, and the most recently developed nearly fully expanded leaves were analyzed for micronutrients by Tremblay Consulting of Jerome, Idaho. Phosphoric acid at 3 lb P/ac was applied on August 11, August 16, and August 30 after plants became marginally P deficient.

Weeds were controlled and onions were harvested and graded as in the nitrogen rate trial for drip irrigated onions above. Bulb counts for each plot were made during grading. Gross economic returns were calculated by crediting medium onions with $2.50/cwt, jumbo onions with $5.00/cwt, and colossal onions with $10.00/cwt.

Results and Discussion

Onion emergence in the irrigation trial was excellent. Onion growth and development continued until irrigation was cut off in early September. The crop suffered hail damage on June 16, June 19, and July 29. Environmental conditions were poor for onion bulb curing; there were several small rainfall events followed with very slow drying. Storage conditions were warmer and more humid than the ideal, especially in November.

Actual plant populations were close to the planned treatment levels (Table 1). Total yield increased with plant population up to 125,000 plants/ac (Table 2). The highest colossal onion yield was achieved with the lowest plant population of 75,000 plants/ac. The yield of Jumbo onions increased with plant population up to 125,000 plants/ac.

Plant populations higher than 125,000 plants/ac resulted in a significant increase in storage rot. Plant populations higher than 125,000 plants/ac resulted in an increase in the proportion of storage rot and in a decrease in the proportion of marketable onions (Table 3). When plant populations are high, water is retained between plants.

Evaporation of free water from leaf surfaces is hampered since air circulation is reduced between plants. Retention of water on the leaves and bulbs favors the development of disease organisms. Disease development is also favored with high plant populations because an excessive amount of tops covered the bulbs after lifting, hindering the curing process.

Gross returns increased with plant population up to 125,000 plants/ac then decreased with further increases in plant population (Table 2). It is difficult to determine the exact causes of high losses in storage in this trial. The 1995 crop was late maturing and had a late irrigation cut off date. The three hail occurrences hurt the crop and may have further delayed maturity. The warmer and more humid storage conditions in November also was a complicating factor in bulb decomposition.

Conclusions

A plant population of 125,000 plants/ac maximized total yield, jumbo onion yield, the proportion of marketable onions, and gross economic returns with subsurface drip irrigation. Plant populations higher than 125,000 plants/ac resulted in significant increases in storage rot.

Table 1. Planned and achieved onion plant populations. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1995.

Plant population	In-row seed spacing	Plant population counted
plants/ac	inches	plants/ac
75,000	8.55	76,547
100,000	6.40	101,020
125,000	5.13	133,072
150,000	4.28	143,649
175,000	3.67	180,147
200,000	3.21	204,138
225,000	2.85	222,626
250,000	2.57	261,063
LSD (0.05)		7,759

Table 2. Effect of plant population on onion yield. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1995.

Plant population	Yield by market grade							Marketable medium to colossal	Gross return
	#2	Small	Medium	Jumbo	Colossal	Total yield	Rot		
plants/ac	------ cwt/ac ------						---- cwt/ac ----		US. $/ac
75,000	73.3	1.1	3.6	462.0	211.1	751.0	223.6	476.9	4,430.00
100,000	52.5	3.7	16.4	632.9	138.6	844.1	309.8	499.9	4,591.50
125,000	23.0	5.7	37.3	743.1	158.5	967.6	320.0	628.9	5,393.75
150,000	48.3	7.9	55.7	767.8	87.9	967.6	514.0	430.4	4,857.25
175,000	28.7	15.3	103.5	820.9	39.2	1007.6	501.3	485.2	4,755.25
200,000	26.5	38.8	181.4	733.5	17.1	997.3	542.0	426.6	4,292.00
225,000	30.5	52.4	213.3	700.0	23.7	1019.8	576 .0	409.1	4,270.25
250,000	42.3	89.2	304.8	583.3	17.3	1036.9	567.3	410.9	3,851.50
LSD (0.05)	27.5	21.5	51.2	125.0	62.8	53.2	109.3	ns	

Table 3. Effect of plant population on onion market grade distribution. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1995.

Plant population	In-row seed spacing	Market grade distribution by weight					Rot	Marketable medium to colossal
		#2	Small	Medium	Jumbo	Colossal		
plants/ac	inches	——— % ———						
75,000	8.55	9.8	0.1	0.5	61.4	28.2	29.6	63.6
100,000	6.40	6.1	0.5	2.0	74.9	16.5	37.0	59.0
125,000	5.13	2.4	0.6	3.9	76.9	16.3	33.2	64.9
150,000	4.28	5.0	0.8	5.8	79.4	9.1	53.1	44.5
175,000	3.67	2.9	1.5	10.3	81.5	3.9	49.8	48.1
200,000	3.21	2.6	4.2	19.1	72.5	1.7	54.7	42.4
225,000	2.85	3.0	5.1	21.0	68.6	2.3	56.6	40.0
250,000	2.57	4.1	8.6	29.5	56.1	1.6	54.9	39.5
LSD (0.05)		3.1	2.5	6.4	12.1	7.9	11.3	11.7