TREATMENT OF ONION BULBS WITH "SURROUND" TO REDUCE TEMPERATURE AND BULB SUNSCALD

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Introduction

Onion prices generally decrease starting in September when harvest intensifies. Harvesting earlier could increase profits, but mechanized early harvest runs the risk of increased losses to sunscald. The 58-year average maximum air temperatures at the Malheur Experiment Station for July, August, and September are 91°F, 90°F, and 81°F, respectively. "Surround WP" (Engelhard Corp., Iselin, NJ) is a product made from kaolinite clay and works by forming a white coating on surfaces, thus reflecting solar radiation. "Surround" is a wettable powder that is labeled for reduction of sunscald in fruits and vegetables. Application of "Surround" after onions are lifted could reduce sunscald and make early mechanized harvests more feasible. This preliminary trial tested "Surround" for reduction of onion bulb temperature and sunscald in September because we did not learn of this product until late in the summer.

Methods

The trial was conducted in two fields.

Procedures for Growing Onions in Field 1

The onions were grown at the Malheur Experiment Station, Ontario, Oregon on an Owyhee silt loam previously planted to wheat. Onion (cv. 'Vaquero', Sunseeds, Morgan Hill, CA) was planted in two double rows, spaced 22 inches apart on 44-inch beds on April 4, 2002. Onion was planted at 150,000 seeds/acre. Drip tape (T-tape, T-systems International, San Diego, CA) was laid simultaneously with planting at 6-inch depth between the two double onion rows. The drip tape had emitters spaced 12 inches apart and a flow rate of 0.22 gal/minute/100 ft.

Immediately after planting the onion rows received 3.7 oz of Lorsban 15G per 1,000 ft of row (0.82 lb ai/acre), and the soil surface was rolled. The trial was irrigated on April 8, April 20, April 24, April 27, and April 30 with a minisprinkler system (R10 Turbo Rotator, Nelson Irrigation Corp., Walla Walla, WA) for even stand establishment. Risers were spaced 25 ft apart along the flexible polyethylene hose laterals that were spaced 30 ft apart. Onions started emerging on April 18.

Fertilizer was applied through the drip tape as ammonium phosphate at 50 lb N/acre and 96 lb P/acre on June 12. On June 19 and June 27, ammonium phosphate at 25 lb N/acre and 48 lb P/acre was applied through the drip tape. On June 13, zinc chelate at

0.25 lb Zn/acre, copper chelate at 0.2 lb Cu/acre, and boric acid at 0.1 lb B/acre were injected through the drip tape. On June 20, magnesium sulfate at 5 lb Mg/acre was injected through the drip tape. On July 3, magnesium sulfate at 5 lb Mg/acre and copper chelate at 0.2 lb Cu/acre were injected through the drip tape.

The soil water potential at 8-inch depth was maintained nearly constant at -20 kPa by applying 0.06 acre-inch/acre of water up to eight times a day as needed based on automated soil water potential readings every 3 hours (Shock et al. 2000). The automated drip irrigation system was started on May 22.

Postemergence weed control was obtained by an application of Prowl (1.7 lb ai/acre) and Poast (0.2 lb ai/acre) on May 2 and an application of Goal (0.12 lb ai/acre), Buctril (0.12 lb ai/acre), and Poast (0.28 lb ai/acre) on May 23. Approximately 0.3 inch of water was applied through the minisprinkler system on May 2 to incorporate the Prowl. Thrips were controlled with four aerial applications of Warrior and Lannate (June 19, July 2, July 18, and August 6) and one aerial application of Warrior on June 10. Warrior was applied at 0.03 lb ai/acre and Lannate was applied at 0.26 lb ai/acre.

Procedures for Growing Onions in Field 2

The onions were grown at the Malheur Experiment Station, Ontario, Oregon on an Owyhee silt loam previously planted to wheat. In the fall of 2001, the wheat stubble was shredded, and the field was disked, irrigated, ripped, moldboard-plowed, roller-harrowed, fumigated with Telone C-17 at 20 gal/acre, and bedded. Before plowing, 100 lb P_2O_5/acre, 100 lb K /acre, 50 lb Mg/acre, 10 lb Zn/acre, 3 lb Cu/acre, and 1 lb B/acre were broadcast.

On March 22, onion seed (cv. 'Vaquero', Sunseeds, Morgan Hill, CA) was planted in two double rows, spaced 22 inches apart on 44-inch beds. Onion seed was planted at 150,000 seeds per acre. The onion rows received 3.7 oz of Lorsban 15G per 1,000 ft of row (0.82 lb ai/acre), and the soil surface was rolled on March 25. The field was sidedressed with urea at 90 lb N/acre on May 15 and on June 11.

The trial was managed to avoid yield reductions from weeds, pests, and diseases. Weeds were controlled with a cultivation on April 18 and with an application of Goal at 0.12 lb ai/acre, Buctril at 0.37 lb ai/acre, Poast at 0.74 lb ai/acre, and Prowl at 1 lb ai/acre on May 31. After lay-by the field was hand weeded as necessary. Aerial applications of Poast at 0.74 lb ai/acre were made on July 31 and August 8. Thrips were controlled with four aerial applications of Warrior and Lannate (June 19, July 2, July 18, and August 6) and one aerial application of Warrior on June 10. Warrior was applied at 0.03 lb ai/acre and Lannate was applied at 0.26 lb ai/acre.

The trial was furrow irrigated when the soil water potential at 8-inch depth reached -20 kPa. Soil water potential was monitored by six granular matrix sensors (GMS, Watermark Soil Moisture Sensors Model 200SS, Irrometer Co., Riverside, CA) installed in mid-June below the onion row at 8-inch depth. Sensors were automatically read

three times a day with an AM-400 meter (MK Hansen Co., East Wenatchee, WA). The last irrigation was on August 29.

Procedures for Surround Treatments

Four rows of onions in each field were lifted on September 9. The lifted onions were divided into plots 25 ft long. The experimental designs were randomized complete blocks with four replicates in each field. There were four treatments: treatment 1 received one "Surround" application after lifting, treatment 2 received a "Surround" application after lifting and after windrowing, treatment 3 was untreated, and treatment 4 was treated after windrowing (Table 1). The "Surround" was applied with a ground sprayer with a 9.2-ft-long boom with nozzles every 10 inches. The "Surround" was applied at 50 lb/acre in 112 gal of water per acre with 8004 nozzles at 40 psi. Prior to the "Surround" application temperature probes were installed in bulbs at 0.5-cm depth. The temperature probes in the monitored bulbs were positioned so that they faced to the south-southeast and placed in a position receiving direct sun. One replicate in each field had bulbs monitored for temperature. Each monitored plot had one temperature probe. The temperature probes were read hourly by a datalogger (Hobo datalogger, Onset Computer Corp., Bourne, MA).

On September 13 the temperature probes were removed and the onions were topped and windrowed by hand. After windrowing the temperature probes were reinserted as before. The onion windrow was sprayed with "Surround" using a ground sprayer with a 30-inch boom with nozzles spaced 10 inches apart. Application rates and specifications were the same as for the initial "Surround" application. Since only the windrow was sprayed, only 25 lb of "Surround" were used per acre of onions. The treatments receiving the second "Surround" application were modified so that only one treatment received two total applications.

The onions were bagged on September 19 and placed into storage. On December 11 the onions were graded. Bulbs were separated according to quality: bulbs without blemishes (No. 1s), bulbs with sunscald damage, double bulbs (No. 2s), neck rot (bulbs infected with the fungus *Botrytis allii* in the neck or side), plate rot (bulbs infected with the fungus *Fusarium oxysporum*), and black mold (bulbs infected with the fungus *Aspergillus niger*). The No. 1 bulbs were graded according to diameter: small (<2¼ inch), medium (2¼-3 inch), jumbo (3-4 inch), colossal (4-4¼ inch), and supercolossal (>4¼ inch). Bulb counts per 50 lb of supercolossal onions were determined for each plot of every variety by weighing and counting all supercolossal bulbs during grading.

Results and Discussion

The highest air temperature reached during the trial was 94°F. Application of "Surround" resulted in significant reductions in maximum bulb temperatures (Table 2). Following the first application, average maximum bulb temperatures were reduced by 1 to 7°F compared to the untreated bulbs. Following the second application, average maximum bulb temperatures were reduced by 2 to 4°F. During the whole trial period,

average maximum bulb temperatures were reduced by 4°F for the bulbs that received two applications compared to the untreated bulbs.

Application of "Surround" did not result in any significant difference in bulb yield, grade, or quality (Table 3). The rates of sunscald were very low in both of these trials, as could be expected during a normal September harvest. Field 2 (furrow irrigated) had significantly higher total yield, marketable yield, supercolossal yield, and colossal yield than field 1 (drip irrigated). Field 2 also had significantly higher yield of bulbs with sunscald than field 1, probably because the onions were more mature at lifting and had less foliage left to protect against sunscald.

References

Shock, C.C., E.B.G. Feibert, and L.D. Saunders. 2000. Nitrogen fertilization and plant population for subsurface drip-irrigated onions. Oregon State University Agricultural Experiment Station, Special Report 1015:45-51.

Table 1. Treatments for "Surround" on onion trial. Malheur Experiment Station, Oregon State University, Ontario, OR, 2002.

Treatment	Post lifting "Surround" application	Post topping and windrowing "Surround" application
1	Yes	No
2	Yes	Yes
3	No	No
4	No	Yes

Table 2. Maximum daily air temperature and mean bulb temperature at 0.5-cm depth for "Surround" on onion trial. Rain occurred on Sept. 17 and 18 (total of 0.20 inch). Malheur Experiment Station, Oregon State University, Ontario, OR, 2002.

Post lifting "Surround" application	Maximum air temperature	"Surround" application				LSD (0.05)
		Yes	Yes	No	No	
	°F					
09 Sep	76	106.5	108.0	110.8	113.5	3.2
10 Sep	80	107.2	109.7	111.8	115.5	3.9
11 Sep	84	111.9	113.0	114.8	116.0	NS
12 Sep	90	114.2	114.6	117.4	117.9	NS
Average		107.8	111.4	112.7	114.7	3.0
Post topping and windrowing		No	Yes	No	Yes	
	°F					
13 Sep	91	120.2	115.8	122.2	117.4	3.4
14 Sep	94	116.0	111.9	116.9	111.5	2.9
15 Sep	90	106.7	103.0	108.2	103.4	3.1
16 Sep	90	108.4	105.9	108.9	105.5	2.5
17 Sep	83	73.8	73.7	73.8	73.8	NS
18 Sep	64	100.6	99.4	101.4	99.8	NS
Average		104.3	101.6	105.2	101.9	1.9
Average of whole trial		106.5	105.5	109.3	110.6	3.7

Table 3. Onion yield and grade response to "Surround" application. Malheur Experiment Station, Oregon State University, Ontario, OR, 2002.

Post lifting "Surround" application	Post topping and windrowing "Surround" application	Total yield	Marketable yield by grade					Small	Doubles	Scald	Rot
			Total	>4¼ in	4-4¼ in	3-4 in	2¼-3 in				
		cwt/acre									%
Field 1											
Yes	No	837.6	829.9	1.9	105.7	699.1	23.2	7.7	1.4	4.1	4.5
Yes	Yes	886.8	878.7	2.8	98.6	746.4	31.0	8.1	2.2	1.9	0.7
No	No	865.2	856.9	0.0	103.4	723.8	29.7	8.3	1.5	10.6	3.4
No	Yes	850.7	841.6	2.9	82.5	731.9	24.3	9.1	0.7	7.9	2.6
Average		860.1	851.8	1.9	97.6	725.3	27.0	8.3	1.4	6.1	2.8
Field 2											
Yes	No	1070.7	1066.9	35.0	387.8	626.9	17.1	3.8	1.0	19.9	2.5
Yes	Yes	1101.0	1096.6	48.2	389.4	643.6	15.4	4.4	1.8	16.5	2.0
No	No	1054.7	1051.2	34.3	365.2	640.6	11.2	3.5	3.1	20.6	4.3
No	Yes	1091.6	1088.3	35.6	392.3	646.6	13.8	3.3	0.5	19.2	2.8
Average		1079.5	1075.7	38.3	383.7	639.4	14.4	3.7	1.6	19.1	2.9
Field 1, Field 2 average											
Yes	No	937.5	931.5	16.1	226.6	668.2	20.6	6.0	1.3	10.9	3.6
Yes	Yes	993.9	987.7	25.5	244.0	695.0	23.2	6.2	2.0	9.2	1.4
No	No	946.4	940.2	14.7	215.6	688.1	21.8	6.2	2.2	14.9	3.8
No	Yes	971.1	964.9	19.2	237.4	689.3	19.1	6.2	0.6	13.6	2.7
LSD (0.05) Trt		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
LSD (0.05) Field		30.5	30.2	5.3	10.6	NS	NS	NS	NS	8.8	NS
LSD (0.05) Trt X Fld		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS