

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

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Ontario, OR, 2004

Introduction

Onion prices generally decrease starting in September when harvest intensifies. Harvesting earlier from overwintered, transplanted, or normally planted full season onions could increase profits, but mechanized early harvest runs the risk of increased losses to sunscald. Sunscald occurs when the side of the bulb exposed to afternoon sun becomes excessively hot. Sunscald results in a flattened and shrunken area on the bulb surface. The 59-year-average maximum air temperature at the Malheur Experiment Station is 91, 90, and 80°F for July, August, and September, respectively. Maximum air temperatures in July and August often exceed 100°F, which can result in very high unprotected bulb temperatures and sunscald. Surround® (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.

Methods

Trials were conducted in two fields in 2004.

Procedures for Growing Onions in Field 1

The onions were grown with subsurface drip irrigation at the Malheur Experiment Station, Ontario, Oregon on an Owyhee silt loam previously planted to wheat. Onion (cv. 'Vaquero', Nunhems, Parma, ID) was planted on March 17, 2004. The procedures can be found in "Effect of Short-duration Water Stress on Onion Single Centeredness and Translucent Scale" by Shock et al. in this report.

Procedures for Growing Onions in Field 2

The onions were grown with furrow irrigation on an Owyhee silt loam previously planted to wheat. Onion seed ('Vaquero') was planted on March 19, 2004. The procedures can be found in "2004 Onion Variety Trials" by Shock et al. in this report.

Procedures for Surround Treatments

Onions in each field were lifted on August 9. The lifted onions were divided into plots 23 ft long. The experimental designs were randomized complete blocks with four replicates in each field. There were seven treatments: treatment 1 was untreated; 2 received one Surround application after lifting; 3 received one Surround application after lifting and one after windrowing; and 4 was treated after windrowing (Table 1). Treatments 2-4 had an application rate of 25 lb Surround/acre. Treatments 5-7 were the same as treatments 2-4, except that the application rate was 50 lb Surround/acre. The Surround was applied after lifting on August 9 with a ground sprayer and a boom with 9 nozzles spaced 10 inches apart. The Surround was applied in 102 gal water/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 placed so that they faced to the south-southeast in a position receiving direct sun. Three replicates in the drip-irrigated field and two replicates in the furrow-irrigated field each had one bulb monitored for temperature. The temperature probes were read hourly by a datalogger (Hobo datalogger, Onset Computer Corp., Bourne, MA).

On August 12 the temperature probes and probed onions were removed and the onions were topped and windrowed by hand. After windrowing the temperature probes were reinserted in different onions as before. The onion windrow was sprayed with Surround using a ground sprayer with 3 nozzles spaced 10 inches apart. Application rates and specifications were the same as the initial Surround application. Since only the windrow was sprayed (one-third of the field), the application rates were reduced to 8.3 lb Surround/acre for treatments 2-4 and to 17 lb Surround/acre for treatments 5-7.

The onions were bagged on August 16 and hauled to a shed. On August 19 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 (<2.25 inches), medium (2.25-3 inches), jumbo (3-4 inches), colossal (4-4.25 inches), and supercolossal (>4.25 inches). Bulb counts per 50 lb of supercolossal onions were determined for each plot by weighing and counting all supercolossal bulbs during grading.

To reduce the influence on the statistical analysis of the variability in onion yield and size between plots, the data for each field were normalized in relation to the average total yield for that field. Normalized data were subjected to analysis of variance.

Results and Discussion

The highest air temperature reached after lifting of the onions and before topping and windrowing was 100°F on August 11 (Table 2). The highest average bulb temperature reached after onions were lifted and before they were topped and windrowed was 129.5°F. Following the application of Surround after lifting on August 9, average maximum bulb temperatures were reduced 6-7°F compared to the untreated bulbs, but the temperature differences were statistically significant only on August 9 (Table 2, Fig. 1). Bulb temperatures for the 50-lb/acre Surround rate were slightly lower than for the 25 lb/acre rate, but the differences were not statistically significant.

The highest air temperature reached after topping and windrowing on August 12 was 99°F on August 13 (Table 3). The highest average bulb temperature reached after topping and windrowing was 129.2°F. For the onions treated with Surround after topping and windrowing, average maximum bulb temperatures were reduced by 5-6°F compared to the untreated check (Table 3, Fig. 1). After topping and windrowing, the bulb temperature differences between treatments were statistically significant for all days measured (August 12-15). After topping and windrowing, bulb temperatures for the 50-lb/acre Surround rate were slightly lower than for the 25-lb/acre rate and the differences were statistically significant on August 13, August 15, and on average.

The furrow-irrigated field (field 2) had lower marketable yield and higher yield of onions with sunscald than the drip-irrigated field (field 1, Table 4). There were no significant differences in onion yield or grade between treatments. However, in Field 2 there was a small but significant reduction in rot with

increasing total amount of Surround applied (Fig. 2). In 2003, application of Surround resulted in statistically significant reductions in bulb sunscald and in increases in marketable yield (Shock et al. 2004). In 2003, the highest bulb temperature reached after lifting was 123°F and the highest bulb temperature after topping and windrowing was 121°F. These bulb temperatures were 6.5 and 8.2°F lower than the highest bulb temperatures in 2004. The higher bulb temperatures in 2004 could be related to the higher average bulb sunscald in 2004 (152 cwt/acre) compared to the average sunscald in 2003 (37 cwt/acre). The higher bulb temperatures in 2004 might also be related to the higher air temperatures reached during the 2004 trial (average of 97°F) than during the 2003 trial (average of 94°F).

References

Shock, C.C., E.B.G. Feibert, and L.D. Saunders. 2004. Treatment of onion bulbs with "Surround" to reduce temperature and bulb sunscald. Malheur Experiment Station Annual Report, Oregon State University Agricultural Experiment Station Special Report 1055:75-79.

Table 1. Treatments applied to onions to evaluate two application rates of Surround®, Malheur Experiment Station, Oregon State University, Ontario, OR, 2003.

Treatment	Surround rate lb/acre	Post lifting Surround application	Post topping and windrowing Surround application
1	none	No	No
2	25	Yes	No
3	25	Yes	Yes
4	25	No	Yes
5	50	Yes	No
6	50	Yes	Yes
7	50	No	Yes

Table 2. Maximum daily air temperature and maximum bulb temperature (°F) at 0.5-cm depth for onions treated with two rates of Surround® after lifting, Malheur Experiment Station, Oregon State University, Ontario, OR, 2004.

Date	Maximum air temperature	Solar radiation	Surround rate lb/acre			LSD
			none	25	50	
	°F	24-hr total watt hr/m ²	-----°F -----			(0.05)
9 Aug	92	7,531	123.6	116.2	114.2	5.4
10-Aug	97	7,340	127.4	122.6	120.7	NS
11-Aug	100	7,204	129.5	124.2	123.7	NS
Average			126.8	121	119.5	NS

Table 3. Maximum daily air temperature, solar radiation, and maximum bulb temperature (°F) at 0.5-cm depth for onions treated with two rates of Surround® after topping and windrowing, Malheur Experiment Station, Oregon State University, Ontario, OR, 2004.

Date	Maximum air temperature	Solar radiation	Surround rate lb/acre			LSD (0.05)
			none	25	50	
	°F	24-hr total watt hr/m ²	-----°F -----			
12 Aug	98	7,081	128.4	123	121.5	3.4
13-Aug	99	6,830	126.5	121.2	119.7	1.4
14-Aug	97	4,769	125.8	120.5	119.5	1.5
15-Aug	96	6,656	129.2	125.5	123.6	1.4
Average				122.5	121.1	1.2

Figure 1. Onion bulb temperature over time for untreated bulbs and bulbs treated with two rates of Surround, Malheur Experiment Station, Oregon State University, Ontario, OR, 2004.

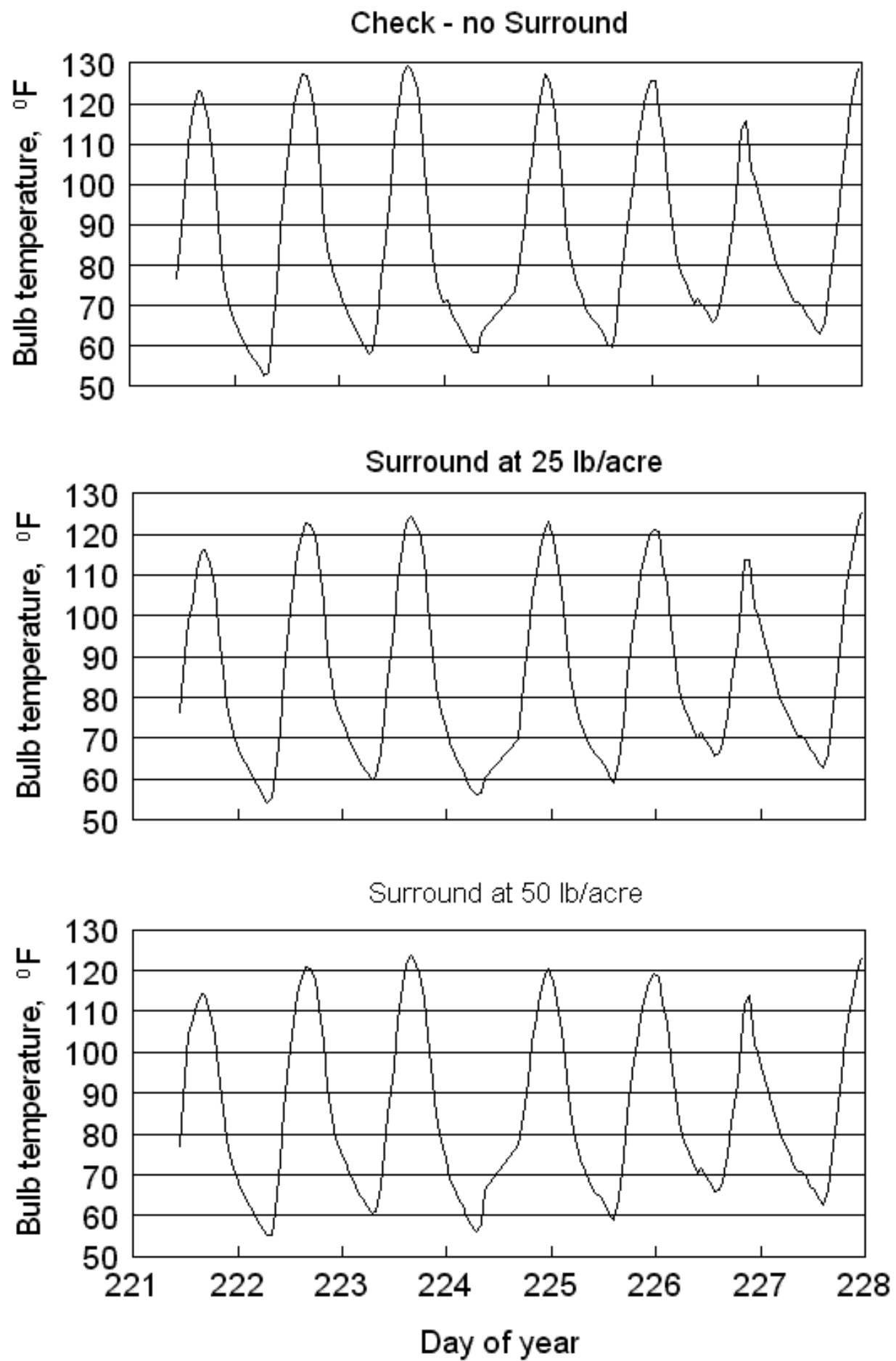


Table 4. Onion yield and grade response to application of two rates of Surround® in a drip-irrigated field (field 1) and in a furrow-irrigated field (field 2), Malheur Experiment Station, Oregon State University, Ontario, OR, 2004.

Surround rate	1st applic.	2nd applic.	Marketable yield		Non-marketable yield			
			lb/acre	% of total	Small	Doubles	Scald	Rot
Field 1			cwt/acre		----- cwt/acre -----			
none	No	No	674	79.2	7.9	0.4	165.3	3
25	Yes	No	697.8	82	8.1	2.8	140.2	1.6
25	Yes	Yes	718.7	84.5	6.7	0.8	121.8	2.6
25	No	Yes	703.5	82.7	8.8	1.7	132.5	4.2
50	Yes	No	667.2	78.4	9.4	0	172.2	1.8
50	Yes	Yes	712.7	83.8	8	0.4	126.2	3.2
50	No	Yes	712.9	83.8	9.5	0.6	125.2	2.4
average			698.1	82.1	8.3	1	140.5	2.7
Field 2								
none	No	No	641.3	76.4	3.8	0.7	189.1	4.6
25	Yes	No	664.7	79.2	4.4	0.7	168.6	1.2
25	Yes	Yes	672.5	80.1	5.1	0.8	159.1	2.1
25	No	Yes	676	80.5	3.8	2.2	155.5	2.1
50	Yes	No	673.3	80.2	2.7	1.5	161.1	1.1
50	Yes	Yes	679.9	81	4.6	2.3	150.9	1.8
50	No	Yes	651.5	77.6	3.2	3	179.7	2.2
average			665.6	79.3	3.9	1.6	166.3	2.1
Fields 1 and 2 average								
none	No	No	657.7	77.8	5.9	0.6	177.2	3.8
25	Yes	No	681.3	80.6	6.2	1.8	154.4	1.4
25	Yes	Yes	695.6	82.3	5.9	0.8	140.4	2.3
25	No	Yes	689.7	81.6	6.3	1.9	144	3.1
50	Yes	No	670.2	79.3	6	0.7	166.7	1.4
50	Yes	Yes	696.3	82.4	6.3	1.4	138.6	2.5
50	No	Yes	682.2	80.7	6.4	1.8	152.4	2.3
LSD (0.05) Trt		NS	NS	NS	NS	NS	NS	NS
LSD (0.05) Field		NS	NS	2.7	NS	NS	22.6	NS
LSD (0.05) Trt X Fld		NS	NS	NS	NS	NS	NS	NS

Figure 2. Effect of total amount of Surround® applied on onion decomposition in a furrow-irrigated field, Malheur Experiment Station, Oregon State University, Ontario, OR, 2004.

