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

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Ontario, OR, 2003

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 result in 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

The trial was conducted in two fields.

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', Sunseeds, Morgan Hill, CA) was planted on March 17, 2003. The procedures can be found in the article "Effect of Short Duration Water Stress on Onion Single Centeredness and Translucent Scale" found in this report (Shock et al. 2004a).

Procedures for Growing Onions in Field 2

The onions were grown with furrow irrigation on a Greenleaf silt loam previously planted to wheat. Onion seed ('Vaquero' Sunseeds, Parma, ID) was planted on March 17, 2003. The procedures can be found in the article "2003 Onion Variety Trials" found in this report (Shock et al. 2004b).

Procedures for Surround Treatments

Four rows of onions in each field were lifted on August 11. 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 seven treatments: treatment 1 was untreated, treatment 2 received one "Surround" application after lifting, treatment 3 received a "Surround" application after lifting and windrowing, and treatment 4 was treated after windrowing (Table 1). Treatments 5-7 were the same as treatments 2-4, except that a different formulation of "Surround" was used. The "Surround" formulation (type 2) used for treatments 5-7 was made to be more light reflecting than type 1. The "Surround" was applied after lifting on August 11 with a ground sprayer and a boom with 9 nozzles spaced 10 inches apart. The "Surround" was applied at 50 lb/acre in 112 gallons 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. 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 14 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), only 17 lb of "Surround" were actually used per acre of onions.

The onions were bagged on August 21 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 inches), medium (2¼-3 inches), jumbo (3-4 inches), colossal (4-4¼ inches), and supercolossal (>4¼ 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 93°F (Table 2). The highest bulb temperature reached after lifting of the onions and before topping and windrowing was 123°F. Following the application of "Surround" after lifting, average maximum bulb temperatures were reduced 4-5°F compared to the untreated bulbs. There was no difference in maximum bulb temperature between "Surround" types, except on August 11, when only "Surround" type 2 reduced maximum bulb temperature.

The highest air temperature reached after topping and windrowing was 99°F (Table 3). The highest bulb temperature reached after topping and windrowing was 121°F. For the onions treated with "Surround" after topping and windrowing, average maximum bulb temperatures were reduced by 2-4°F compared to the untreated check. There was a trend for "Surround" type 2 to reduce bulb temperatures more than "Surround" type 1, but the difference was only significant on August 15, when "Surround" type 1 did not reduce bulb temperatures compared to the check.

The furrow-irrigated field (field 2) had higher marketable yield, and yield of onions with sunscald and rot than the drip-irrigated field (field 1, Table 4). In the furrow-irrigated field, one or two applications of "Surround" type 1 and application of "Surround" type 2 before and after windrowing or only after windrowing, resulted in significantly higher marketable onion yield (Table 4). Averaged over the two fields, one or two applications of "Surround" type 1 and application of "Surround" type 2 before and after windrowing or only after windrowing resulted in significantly higher marketable onion yield. In the furrow-irrigated field, one or two applications of either type of "Surround" resulted in lower bulb rot. Averaged over the two fields, one or two applications of "Surround" type 1 and application of "Surround" type 2 before and after windrowing or only before windrowing resulted in lower yield of onions with sunscald. Averaged over the two fields, two applications of "Surround" type 1 or type 2, and application of "Surround" type 2 after windrowing resulted in lower bulb rot.

References

Shock, C.C., E.B.G. Feibert, and L.D. Saunders. 2004a. Effects of short-duration water stress on onion single centeredness and translucent scale. Malheur Experiment Station Annual Report, Oregon State University Agricultural Experiment Station Special Report 1055:53-56.

Shock, C.C., E.B.G. Feibert, and L.D. Saunders. 2004b. 2003 onion variety trials. Malheur Experiment Station Annual Report, Oregon State University Agricultural Experiment Station Special Report 1055:36-44.

Table 1. Treatments applied to onions to evaluate two types of "Surround". "Surround" type 2 is a new formulation designed to be more reflective of sunlight. Malheur Experiment Station, Oregon State University, Ontario, OR, 2003.

Treatment	Surround type	Post lifting Surround application	Post topping and windrowing Surround application
1	none	No	No
2	1	Yes	No
3	1	Yes	Yes
4	1	No	Yes
5	2	Yes	No
6	2	Yes	Yes
7	2	No	Yes

Table 2. Maximum daily air temperature and maximum bulb temperature (°F) at 0.5-cm depth for onions treated with two types of "Surround" after lifting. "Surround" type 2 is a new formulation designed to be more reflective of sunlight. Malheur Experiment Station, Oregon State University, Ontario, OR, 2003.

Date	Maximum air temperature	Solar radiation	Surround type			LSD (0.05)
			none	1	2	
11 Aug	93	7259	120.6	118.1	114.9	(3.3)*
12 Aug	92	7226	119.9	115.2	113.5	2.3
13 Aug	93	7245	123.0	118.5	118.2	2.6
Average			121.2	117.0	116.7	(2.8)*

*significant at the 0.10 level.

Table 3. Maximum daily air temperature, solar radiation, and maximum bulb temperature (°F) at 0.5-cm depth for onions treated with two types of "Surround" after topping and windrowing. "Surround" type 2 is a new formulation designed to be more reflective of sunlight. Malheur Experiment Station, Oregon State University, Ontario, OR, 2003.

Date	Maximum air temperature	Solar radiation	Surround type			LSD (0.05)
			none	1	2	
14 Aug	96	6446	119.1	116.9	116.8	1.5
15 Aug	99	5345	115.0	113.8	112.8	1.7
16 Aug	90	7262	112.6	113.5	109.8	NS
17 Aug	91	7114	117.2	118.2	112.7	NS
18 Aug	94	6898	118.6	na	116.2	NS
19 Aug	98	6593	121.1	na	118.7	NS
20 Aug	93	6969	118.5	na	112.8	3.2
Average			117.3	114.6	113.8	1.3

Table 4. Onion yield and grade response to application of two types of "Surround" in a drip-irrigated field (field 1) and in a furrow-irrigated field (field 2). "Surround" type 2 is a new formulation designed to be more reflective of sunlight. Malheur Experiment Station, Oregon State University, Ontario, OR, 2003.

Type	1st applic.	2nd applic.	Marketable yield		Non-marketable yield			
					Small	Doubles	Scald	Rot
			cwt/acre	%	cwt/acre			
Field 1								
none	No	No	580.6	94.8	4.1	0.9	12.6	13.9
Type 1	Yes	No	581.5	95.0	6.3	0.4	8.2	15.8
Type 1	Yes	Yes	587.9	96.0	4.7	0.9	6.4	12.3
Type 1	No	Yes	557.3	91.0	6.2	0.4	7.8	40.5
Type 2	Yes	No	564.2	92.2	5.7	0.6	14.9	26.8
Type 2	Yes	Yes	590.0	96.4	5.8	0.5	5.8	10.1
Type 2	No	Yes	580.0	94.7	6.3	1.0	5.4	19.5
average			577.4	94.3	5.6	0.7	8.7	19.8
Field 2								
none	No	No	540.4	74.4	2.8	2.9	89.7	90.8
Type 1	Yes	No	610.4	84.0	3.6	2.6	51.4	58.6
Type 1	Yes	Yes	628.5	86.5	2.6	1.3	58.4	32.8
Type 1	No	Yes	621.5	85.5	2.3	6.0	66.1	33.2
Type 2	Yes	No	584.0	80.4	4.0	0.6	88.4	49.6
Type 2	Yes	Yes	614.8	84.6	3.2	3.3	72.6	32.6
Type 2	No	Yes	614.5	84.6	2.9	1.4	67.6	40.2
average			602.0	82.9	3.0	2.6	70.6	48.3
Field 1, Field 2 average								
none	No	No	560.5	84.6	3.5	1.9	51.1	52.3
Type 1	Yes	No	596.0	89.5	4.9	1.5	29.8	37.2
Type 1	Yes	Yes	608.2	91.3	3.7	1.1	32.4	22.6
Type 1	No	Yes	589.4	88.3	4.2	3.2	37.0	36.9
Type 2	Yes	No	574.1	86.3	4.8	0.6	51.6	38.2
Type 2	Yes	Yes	602.4	90.5	4.5	1.9	39.2	21.4
Type 2	No	Yes	597.3	89.7	4.6	1.2	36.5	29.8
LSD (0.05) Trt			23.5	3.5	NS	NS	(14.2)*	(21.3)*
LSD (0.05) Field			12.8	1.9	1.5	1.7	(7.7)*	(10.8)*
LSD (0.05) Trt X Fld			33.9	5.1	NS	NS	NS	(28.5)*

*significant at the 0.10 level.