prevented or reduced by storage at low temperature. Hence, it is clear that the sweetness of *su se* corn can be preserved by cold storage and that the high initial sucrose content is advantageous to retention of sugars when cold storage is not available.

Postharvest changes of sugars other than sucrose displayed a complex pattern. Fructose decreased significantly in all but 1 of the 7 inbreds during warm storage, while glucose decreased in only 1 case. Maltose increased significantly in most of the inbreds during storage at both low and high temperatures, possibly due to enhanced starch degradation. The higher maltose content of *su se* inbreds compared with *su Se* agrees with earlier results (2, 3), but the metabolic basis for this aspect of *se* gene action is not yet known.

The behavior of sorbitol differed from that of all 4 sugars. The level of this sugar alcohol declined significantly during warm storage in only 1 inbred, but it declined in 6 of the 7 inbreds during cool storage. This change during cool storage agrees with data of Rumpf et al. (7), and indicates that sorbitol can be transformed into other metabolites by maize kernels. Sorbitol utilization may also occur during warm storage, with conversion of sugar to sorbitol preventing depletion of the latter under warm conditions. No information is available as yet concerning the role of sorbitol in corn sugar interconversions.

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Effects of Antitranspirants on Water Use and Yield of Greenhouse and Field-grown Onions[1]

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***Abstract:* Plants of onion (*Allium cepa* L.) grown in the greenhouse and field were treated with antitranspirants during the bulb enlargement stage of growth. Daily water use in the greenhouse was significantly reduced by 1% Vapor Gard (di-1-*p*-menthene) and 3% Folicote (parafin wax) emulsions. The 3% Folicote treatment reduced bulb yield. In field studies, Folicote increased bulb size and total yield by 1.5–4.2 MT/ha. The increased yields resulted from larger bulb size, presumably due to reduction in the degree of moisture stress between irrigations. Neutron probe readings indicated a reduction in the rate of water removal from soils (30 cm depth) and an increase in bulb size and total yield in plots treated with the antitranspirants Folicote and tallow.**

Diminishing water supplies and increasing costs of pumping irrigation water necessitate increasing emphasis on water use efficiency studies on all crops, but especially on those that have high irrigation requirements. Onions are very shallow-rooted and require frequent irrigations to maintain adequate levels of available moisture in the surface 15–25 cm of soil. Adequate moisture is necessary in this zone for maximum yield (8). Antitranspirants have been shown to conserve irrigation water and extend the interval between irrigations or to reduce the extent of moisture stress on several crops (1, 2, 3, 4, 5, 6, 7, 9, 10). Treatment of potato plants with antitranspirants 3 and 5 weeks prior to vine-kill increased tuber size and total yield (4, 5, 6, 7). Treated potato plants conserved soil moisture, thus avoiding periods of moisture stress prior to succeeding irrigations (6, 7). In lysimeter studies on potatoes, water use was reduced by as much as 47% without significantly reducing plant growth (4, 5). The current research was initiated to determine if antitranspirants would affect the water use rate of onions as it had on potatoes and if it would increase bulb size and yield under field conditions.

Preliminary experiment 1978. Folicote emulsions of 0, 2, and 4% in 935–1400 liters/ha water were applied to plots in a field of 'Yellow Grano' (short day) and a field of 'Yellow Sweet Spanish' (long day) onions. Applications were June 29 for the 'Yellow Grano' and June 29 + July 21 (repeat applications) on the 'Yellow Sweet Spanish'. The 'Yellow Grano' onions were nearly mature on June 29, whereas the 'Yellow Sweet Spanish' were just initiating bulbs. 'Yellow Granos' were harvested on July 21 and 'Yellow Sweet Spanish' on August 3. Each plot consisted of 2 beds 102 cm wide × 6 m long. The experimental design was a randomized complete block with 5 replications. Due to proximity to other research plots, the 'Yellow Granos' were not irrigated after application of antitranspirant, and 'Yellow Sweet Spanish' were irrigated only once (July 1) after the first treatment. Harvested onions were graded into 3 size grades (< 5, 5–7.7 and > 7.7 cm diameter) and were weighed and counted.

No changes were observed in the 'Yellow Grano' onions as sprays were applied after bulbs were nearly mature (June 29). 'Yellow Sweet Spanish' onions, which mature about 30 days later, were affected by the antitranspirant sprays (Table 1). Overall yields were low due to moisture stress since the last irrigation was 4 weeks prior to harvest, but antitranspirant treatment increased bulb size and total yield. Significant increases in large bulbs (> 7.7 cm diameter) and trends toward lower percentage of small bulbs (< 5 cm) were caused by antitranspirant treatment. The increased bulb size was thought to be caused by reduced moisture stress through conservation of soil moisture in antitranspirant-treated plots as has been shown for potatoes (6, 7). Field observations 4 weeks after the last ir-

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Table 1. Effect of antitranspirant on yield and size grade of direct-seeded 'Yellow Sweet Spanish' onions, 1978.

Treatment	Size Grade: Small < 5 cm Yield (MT/ha)	(%)	Medium 5–7.7 cm Yield (MT/ha)	(%)	Large > 7.7 cm Yield (MT/ha)	(%)	Total yield (MT/ha)
Check	5.3a[z]	27	13.7a	70	0.4a	2	19.4a
2% Folicote	5.3a	24	15.4a	70	1.4b	6	22.1b
4% Folicote	4.6a	19	17.5a	74	1.4b	6	23.5b

[z]Mean separation within columns by Duncan's multiple range test, 5% level.

Table 2. Effect of antitranspirant spray on water use of lysimeter grown 'Ringmaster' onion plants, 1979.

Treatment	Water used per plant at each irrigation date (liter): July date of observation 1	3[z]	5	9	14	20	27	30	5–30
Check	1.5a[y]	1.5a	1.5a	1.2a	2.0a	1.3a	1.2a	1.1a	8.3a
1% Vapor Gard	1.6a	1.4a	1.0b	0.9b	1.8b	1.1b	1.1ab	0.1a	7.0b
3% Folicote	1.5a	1.4a	1.0b	1.1ab	1.9b	1.4a	1.0b	0.6b	6.9b

[z]Date of Folicote application.
[y]Mean separation within columns by Duncan's multiple range test, 5% level.

rigation indicated much greater wilting in check than in treated plots.

Lysimeter experiment, 1979. 'Ringmaster' onions were transplanted and grown in lysimeters in the greenhouse. Prior to and following treatment, water use was determined for the interval between each irrigation. Sprays (1% Vapor Gard and 3% Folicote) were applied in excess to runoff with a pressurized hand-sprayer on July 3, and plots were harvested August 17. Harvested plants were graded by weight, height, and bulb diameter. Each plot consisted of 6 plants replicated 10 times in a randomized complete block design.

Water uptake by 'Ringmaster' onions was reduced by 16% for the 27 days after treatment with antitranspirants (Table 2). Water savings were not as great as for potatoes (4, 5). The reduced water use was accompanied by a reduction in bulb weight for Folicote (Table 3). In earlier concentration studies with Folicote on potatoes (4, 5), some reductions in tuber yield were observed at the 4% Folicote treatment. Since space was limited in the present study, only 1 intermediate concentration of each antitranspirant was used. The 3% Folicote treatment was apparently too high, or the spray coverage was more complete than in the field.

Commercial fields, 1979. Two commercial fields of 'Chieftain' onions were selected to represent different levels of moisture stress. Folicote emulsion (2%) was applied by a tractor spray rig with 3 nozzles per row and 12.65 kg/cm^2 pressure (spray output was 833 liters/ha). Treated and check plots were in a randomized complete block design with each plot being 4 beds, 102 cm wide and 183 m long, and replicated 4 times. Four sub-plot samples 4.6 m long were harvested per plot. Sprays were applied July 3, and plots were harvested July 29.

Antitranspirants increased yield and bulb size in both fields (Table 4). Field 1 was on a steep grade with 3 rows of onions per 102-cm bed and developed severe weed competition late in the season. Irrigations were at 7-day intervals and wilting was evident between irrigations. Under these conditions, antitranspirants increased bulb size and total yield more dramatically than in Field 2 where less stress was expected. Field 2 produced lower yields of the larger-sized bulbs due to higher plant populations. Under these conditions, antitranspirant treatment increased the yield of 6.4–7.7-cm bulbs and total yield, with a trend toward reducing the yield of bulbs less than 5 cm diameter (there was a significant reduction in number of bulbs under 5 cm) (Table 4, Field 2). Yield increases of 2.8 and 1.5 MT/ha were achieved in Field 1 and Field 2, respectively, at an antitranspirant material cost of less than $40/ha. The economic benefits are significant in view of normally higher prices for the larger bulb size. Gross receipts increased $859 and $463 per ha, respectively, in this instance.

Commercial fields, 1980. A commercial field of 'Zodiac' onions was treated with 2 and 4% Folicote and 6 and 12% tallow emulsion. The tallow emulsion was prepared with 24% animal tallow and 3% non-ionic surfactants (Spans and Tweens) in water. Sprays were applied on July 1, as in 1979. Neutron probe access tubes were placed in each plot and readings taken weekly at 15-, 30-, 60-, and 90-cm depths. The experimental design was a completely randomized block with each plot consisting of 4 beds 102 cm wide and 9.1 m long and replicated 6 times. Onions were harvested July 15 and graded into sizes by weight and number.

Plots were harvested early (15 days after antitranspirant application) due to declining

Table 3. Effect of antitranspirant on yield of lysimeter grown 'Ringmaster' onion plants, 1979.

Treatment	Bulb wt (g)	Plant ht (cm)	Bulb diam (cm)
Check	542a[z]	55a	5.3a
1% Folicote	532a	54a	5.2a
3% Folicote	426b	53a	5.0a

[z]Mean separation within columns by Duncan multiple range test, 5% level.

Table 4. Effect of 2% Folicote spray on yield of stressed (Field 1) and non-stressed (Field 2) 'Chieftain' onions in 1979.

Field	Treatment	Yield (MT/ha) < 5 cm	5–6.4 cm	6.4–7.7 cm	> 7.7 cm	Total	No. bulb/plot < 5 cm	5–6.4 cm	6.4–7.7 cm	> 7.7 cm	Total
1[z]	Check	0.3a[y]	2.0a	6.5a	4.8b	13.6b	4a	9a	17a	8b	38a
	2% Folicote	0.3a	1.2a	6.2a	8.9	16.4a	3a	5b	16a	15a	40a
2	Check	3.3a	7.3a	5.3b	0.2a	16.2b	33a	34a	16a	0a	83a
	2% Folicote	2.7a	8.1a	6.7a	0.1a	17.7a	26b	37a	20a	0a	83a

[z] Field 1, Todd Produce, had a steep grade, thus creating severe stress. Field 2, Gray Farms, was effectively irrigated so had less stress.
[y] Mean separation within colums by field by Duncan's multiple range test, 5% level.

Table 5. Relative soil moisture content (15 and 30 cm depth) in 'Zodiac' onion plots treated July 1, 1980, with antitranspirants and irrigated June 26 and July 10, 1980.

Antitranspirant	Total water in zone (cm): Days after treatment 1: 7.5–22.5 cm	22.5–37.5 cm	8: 7.5–22.5 cm	22.5–37.5 cm	14: 7.5–22.5 cm	22.5–37.5 cm
Check	0.6[z]	6.6a	0.5a	5.9a	1.8a	9.1a
Tallow, 6%	1.1b	7.3a	0.8a	6.8b	2.2b	9.4ab
12%	0.9ab	7.5a	0.7a	7.1b	2.3b	9.8b
Folicote, 2%	0.9ab	7.3a	0.7a	6.9b	2.1ab	9.9b
4%	1.1b	7.1a	0.8a	6.6ab	2.1ab	9.3ab

[z]Mean separation within columns by Duncan multiple range test, 5% level.

Table 6. Effects of antitranspirant sprays on yield and percent size distribution of field grown 'Zodiac' onions, 1980.

Antitranspirant	Bulb diam < 7.7 cm		Bulb diam > 7.7 cm		Total
	Yield (MT/ha)	Grade (%)	Yield (MT/ha)	Grade (%)	Yield (MT/ha)
Check	10.8a[z]	36	19.6a	64	30.4ab
Tallow, 6%	11.2b	34	21.6a	66	32.9c
12%	12.4b	37	20.7a	63	33.1c
Folicote, 2%	10.3a	36	21.9a	68	32.3bc
4%	10.7a	36	19.1a	64	29.9a

[z] Mean separation in columns by Duncan's multiple range test, 5% level.

onion prices. In spite of the short period between treatment and harvest, the antitranspirant treatments appeared to affect soil moisture levels (Table 5) and yield (Table 6). Comparative neutron probe readings indicated significant (odds 4:1) conservation of soil moisture at the 15-cm depth within 24 hr of application. For onions, this is the area requiring adequate moisture for maximum yields (8). The differences in soil moisture level continued to be evident until harvest. At the 30-cm depth, differences were not evident until 8 and 14 days after treatment. No differences in soil moisture were measured at the 60- and 90-cm depths. The period following treatmennt was characterized by a daily maximum temperature average of 37.3°C with a daily minimum relative humidity average of 29% and average pan evaporation rate of 1.44 cm per day. These conditions, and a skip of an intended irrigation July 3 (2 days after treatment) due to pump failure, produced severe moisture stress on the crop (evident 8 days after treatment, Table 5). The stress differences (measured by neutron probe) were still evident 4 days after the July 10 irrigation.

Even though only 2 weeks passed between treatment and harvest, yield differences were evident (Table 6) and they were inversely related to level of soil moisture (Table 5). Tallow emulsions increased yields over checks and the high concentrations of Folicote. As reported above for the mini-lysimeter study and earlier for potatoes (4, 5), higher levels of Folicote appear to limit plant growth and yield.

In summary, antitranspirants appeared to be effective in limiting water use by onions and therefore tended to conserve available soil moisture, thus enabling the producer to extend the period between irrigations without limiting yield due to moisture stress. Moisture stress does occur when irrigations are delayed, and antitranspirants can partially alleviate this stress.

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Southernpea Response to Glyphosate Desiccation[1]

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Abstract. **Seed weight, germination, seedling emergence, and yields were examined following desiccation of southernpea [*Vigna unguiculata* (L.) Walp cv. Mississippi Purple] plants with glyphosate [N-(phosphonomethyl)glycine]. Dry seed weight was not reduced by the desiccation process; however, seed quality of those treated at immature stages was reduced. Germination, seedling emergence, and yield from seed desiccated at immature stages were significantly less than from seeds desiccated at more mature stages of development. No differences were apparent between desiccation at mature stages and the control.**

One of the limiting factors in the production of southernpeas as a dry product in areas of unpredictable rainfall is the difficulty involved in mechanical harvesting. Indeterminate growth of the plant results in various stages of seedpod maturity and succulent growth throughout the season. Harvest dates can be selected to have a majority of dry seed pods, but a combine cannot effectively separate the dry seeds from the bulk of succulent plant material.

Chemical defoliation is used on other crops which have different types of growth to facilitate mechanical harvesting, and plant desiccation has been evaluated. Glyphosate was more effective than sodium chlorate or paraquat (1,1'-dimethyl-4,4'-bipyridinium ion) in reducing the moisture content of grain, leaves, and stems of grain sorghum [*Sorghum bicolor* (L.) Moench]. Additional responses were inhibition of axillary buds and reduced germination of grain treated at greater than 30 % moisture content (1). A10% v/v solution of glyphosate applied to the inflorescences of wild oat (*Avena fatua* L.) at the "soft and hard cheese" stage of development prevented the production of any viable seed (6). Preharvest desiccation of cotton with glyphosate resulted in significant injury to the seeds which were immature at the time of treatment (4).

Response of soybeans [*Glycine* (L.) Merr] to glyphosate varied among varieties and with the stage of development at the time of application (3). Seeds of several turfgrasses were unaffected by glyphosate application to the soil immediately before planting or directly

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