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Water Stress and Sweet Corn Seed Production

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Between 13 and 26 acre-inches of irrigation water are required to grow a sweet corn crop in the Treasure Valley. The amount of water actually applied will depend on the inbreds or cultivars grown, plant density per acre, time of planting, seasonal growing conditions and rainfall. About 65% of the water required for sweet corn seed production is needed in July and August. Sweet corn's average consumptive water use may reach 0.28 inches per day in August.

Interruption of irrigation water supplies may become more common-place in the future because of inadequate winter snow pack and increased non-agricultural use of water. With this in mind, studies were undertaken in 1976 and 1978 to determine the effects of soil moisture deficits or drought on sweet corn seed yield and seed quality.

The short-season inbred Luther Hill was grown in 1976. In 1978, 4 mid-season inbreds — the female parent of Iobelle, both parents of Golden Cross Bantam and the female parent of Iochief — were used as seed parents. The male parent of Iochief was used as the common pollinator. All field work was done on a Greenleaf silt loam soil at the Southwest Idaho Research and Extension Center in Parma. Nitrogen was incorporated as ammonium sulfate at 150 pounds per acre. In 1976 weeds were controlled by mechanical cultivation and in 1978 Eradicane was incorporated pre-emergence at 3 pounds per acre. The corn was planted on May 6 in 1976 and May 9 in 1978 at densities of 25,000 and 38,000 plants per acre, respectively.

The level of stress, which occurred once during a particular growth period, varied slightly in severity

Table 1. Effect of drought on both the field performance and subsequent seed quality of Luther Hill sweet corn seed.

Time of stress	Available soil moisture removed	Yield	Ears per acre	Plant height	Stalk rot	Marketable seed**	Germination	Vigor index***	Seedborne *F. moniliforme*
	(%)	(lb/acre)		(inch)	(%)	(%)	(%)		
Silking	75	1750*	295,000	51*	50*	77	93	72*	87*
	85	1649*	305,000	49*	59*	75	94	73*	73*
3 weeks after silking	75	2367	355,000	57	21	78	96	74	61
	85	2146	329,000	56	28	77	96	76	48
6 weeks after silking	75	2425	379,000	58	8	76	90	75	46
	85	2124	304,000	56	13	76	90	74	47
No stress		2682	401,000	60	6	75	96	76	41

* Significantly different from the no-stress control at the 0.05 level.

** Percent marketable seed refers to the amount of marketable seed on a percent basis compared to the total seed harvested.

*** Vigor index is a measure of field performance. This was determined by averaging the results of four vigor testing methods: 4-day count of the standard germination test, cold or vigor test, accelerated aging and rate of germination.

each year. In 1976, available soil moisture was depleted to 75 or 85% at the time indicated in Table 1. This is equivalent to 25 or 15%, respectively, of available soil moisture remaining at a depth of 18 inches. The non-stressed plants in both years were irrigated whenever 40% of available soil moisture was depleted.

In 1978, moderate stress corresponded to 88% moisture depletion at 26-inch soil depth. High stress treatments were exposed to an additional 5 days of water stress after the moderate stress level had been reached. Time of stress occurred once, either during early tasseling, 50% silking or 2 weeks after silking.

Results

Results using an early-season inbred (Table 1) indicate that water deficits, primarily during the time associated with silking, have their major effect on field performance or yield and a subtle effect on seed quality or germination. Both levels of soil moisture depletion during silking resulted in yield loss, reduced plant height and increased percentage of stalk rot. Although stress, particularly during silking, seemed to reduce the number of ears per acre and seed germination, these differences were not statistically significant. Seed vigor was significantly reduced when water deficits occurred at the silking stage. No stress effects were observed in percent marketable seed or seed size distribution.

Mid-season inbreds water stressed at 50% silk, or in some cases during early tasseling, resulted in reduced plant height, up to 80% yield loss and fewer ears per acre (Table 2). Ear length, ear weight and kernel-row number per ear were also reduced in plants stressed at these times. Water stress affected seed size distribution (Table 3). The percentage of small flat and large flat seed decreased in plants that were stressed and the corresponding percentage of small round and large round seed increased in these plants.

Table 4 shows that round seed germinates slower than flat seed. The table also illustrates the deleteri-

Table. 2 Effect of water stress on the field performance of 4 sweet corn inbreds averaged across inbreds.

Time of stress	Relative stress level	Yield	Ears per acre	Plant height	Ear weight per plant	Kernel-row number per ear	Cob length
		(lb/acre)		(inch)	(g)		(inch)
Tasseling	Moderate	652	17,166	43*	24	12.0	4.8
	High	318*	11,822*	39*	13*	11.4*	4.6*
Silking	Moderate	203*	10,324*	42*	9*	10.5*	4.5*
	High	140*	8,138*	42*	7*	10.8*	4.4*
2 weeks after silking	Moderate	544*	13,563	46	20	12.3	4.6*
	High	686	14,332	45	24	12.2	4.6*
No stress		786	17,126	48	27	12.3	4.8

*Significantly different from the no-stress control at the 0.05 level.

Table 3. Effect of water stress on the seed size distribution and percent marketable seed of 4 sweet corn hybrids averaged across hybrids.

Time of stress	Relative stress level	% seed distribution				Marketable Seed (%)
		Large flat	Small flat	Large round	Small round	
Tasseling	Moderate	20.4	13.7	18.0	41.0	93.2
	High	20.2	15.1	15.9	42.1	93.2
Silking	Moderate	17.8*	7.8*	19.1	48.8*	93.5
	High	18.7*	10.5*	15.5	49.0*	93.7
2 weeks after silking	Moderate	22.3	14.2	13.4	40.8	90.7
	High	21.6	17.7	12.0	39.9	91.2
Control		23.4	16.4	14.8	40.0	94.6

*Significantly different from the no-stress control at the 0.05 level.

Table 4. A summary of germination tests of sweet corn seed from water stressed and non-stressed plants averaged across either hybrids and seed sizes or treatments and hybrids. *

Time of stress	Relative stress level	Day 2 count	Day 4 count	Final count	Rate of germination	Cold test
Tasseling	Moderate	27.3	95.2	97.7	50.6	83.8
	High	25.2**	94.7	97.6	49.5**	82.5
Silking	Moderate	20.4**	93.7	97.1	47.2**	81.0
	High	19.1**	93.3	97.2	45.9**	76.7
2 weeks after silking	Moderate	29.1	95.6	97.9	51.6	83.3
	High	31.0	96.3	98.5	52.7	82.2
Control		29.9	95.1	97.0	52.2	84.5
Sizes* **						
Rounds		15.1	93.0	97.4	43.1	81.7
Flats		38.1	96.9	98.0	57.5	83.8

* All seed tests are based on percent seed germinated, except rate of germination. In this case, the higher the number, the faster the germination rate.

** Significantly different from the no-stress control at the 0.05 level.

*** Significant differences (0.05 level) existed between seed sizes for all germination tests except final count and cold test.

ous effect of water deficits on the early rates of germination of hybrid sweet corn seed. Trends in seed vigor can be seen in the day 4 count and cold test. The amount of seedborne *F. moniliforme* was increased under drought conditions at silking (Table 1). The relationship between stalk rot and seedborne *F. moniliforme* is not understood but the inbreds that developed high levels of stalk rot under these conditions also had high levels of seedborne *F. moniliforme*.

Conclusions

These data indicate water stress can have a profound effect on seed yield, reducing yields as much as 80% when 88% of available soil moisture is depleted during the flowering stage of plant development. Seed size distribution may be altered, resulting in higher percentages of round seed. Round seed germinates more slowly than flat seed. Seed from stressed plants can show reduced rates of early germination and higher levels of seedborne *F. moniliforme*.

Water stress during early tasseling, silking and 2 weeks after silking can increase the incidence of stalk rot which in turn can reduce yield through excessive lodging. Stress can also delay or lengthen the silking period, thus allowing longer exposure to feeding by corn earworm larvae.

Recommendations

Sweet corn may require as much as 26 acre-inches of irrigation water to produce a seed crop. For most production situations, this means sweet corn needs an uninterrupted water source until at least mid-August.

Irrigate on the basis of water need and not by calendar date. For example, the average daily consumptive rate for an acre of corn in May is only 0.06 acre-inches. In July this increases to 0.25 acre-inches.

Use tensiometers or other reliable soil moisture measuring devices. Locate them properly in the field. A good location usually is two-thirds the distance down the row from the head ditch. Avoid using visual symptoms such as leaf roll and darkening of the leaves to predict irrigation scheduling. When these signs occur, 60% or more of the available soil moisture has probably been depleted and the plant has already been stressed. Corn plants required at least 7 days to recover fully from the water deficits encountered in this study.

No more than 40% of available soil moisture should be depleted. Higher soil moisture depletion later in the growing season will not depress yields as much as stress during silking and tasseling periods.

Practice good weed control.

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