

# Wild-Proso Millet Differentially Affects Canopy Architecture and Yield Components of 25 Sweet Corn Hybrids

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**Abstract.** Knowledge of cultivar-specific information on crop tolerance, the ability of the crop to endure competitive stress from weeds, has garnered recent interest in organic crop production. Twenty-five commercial sweet corn hybrids from nine seed companies were grown in the presence and absence of wild-proso millet (*Panicum miliaceum* L.) to 1) quantify tolerance in crop growth and yield to weed interference; 2) determine associations between tolerance in crop growth and yield; and 3) identify hybrids differing in tolerance to weed interference. Despite large differences in canopy architecture among hybrids, crop height and leaf uprightiness were minimally affected by weed interference. In contrast, wild-proso millet interference reduced ear number 11% to 98% and ear mass 24% to 82% depending on the hybrid. The ability of a hybrid to make small growth adjustments in the presence of wild-proso millet appeared to have no relationship to yield tolerance. The least competitive hybrids were ‘ACX1413’, ‘Optimum’, ‘Quickie’, ‘Spring Treat’, and ‘Sugar Buns’. The most competitive hybrids were ‘Code128’, ‘Coho’, ‘El Toro’, ‘EX 8716622’, and ‘Legacy’. Although some exceptions were observed, in general, the longer-maturity processing hybrids were more competitive with wild-proso millet than the earlier-maturing fresh market hybrids.

Crop tolerance (CT) to weed interference is the ability of the crop to endure or avoid competitive stress from weeds without substantial reduction in growth or yield. Historically, CT has been a fundamental component of weed management, although the role of CT waned with the introduction of selective herbicides in the mid-20th century. In the last two decades, there has been renewed interest in more fully exploiting CT to reduce risk of weed control failure (Callaway, 1992; Lindquist and Mortensen, 1998). For instance,

recent surveys documented 57% of conventionally managed sweet corn fields suffered yield loss as a result of weeds despite extensive reliance on herbicides for weed control (Williams et al., 2008c). An increasing prevalence of herbicide-resistant weeds and a growing organic market in several crops, including sweet corn, have fueled interest in CT playing a larger role in weed management. In agronomic crops such as wheat, rice, and soybean, efforts have been made to breed for cultivars more competitive with weeds (Jannink et al., 2001; Lemerle et al., 2006; Zhao et al., 2006).

Some corn hybrids vary in CT. In dent corn, which has been the subject of considerably more research on CT than sweet corn, several authors have identified canopy architecture traits important to CT, including plant height, canopy density (Lindquist and Mortensen, 1998), leaf uprightiness (Sankula et al., 2004), canopy closure rate, and maximum leaf area index (Lindquist et al., 1998). Weed interference can influence certain growth characteristics such as height (Cavero et al., 2000; Maddonni et al., 2002) and leaf azimuth orientation (Maddonni et al., 2002). In addition, the mere presence of weeds, and not direct competition for resources, can influ-

ence crop growth. Rajcan et al. (2004) found that the presence of low-growing sod influenced light quality in such a way to alter dent corn growth early in the season. Even at low weed densities, differences were observed in sweet corn hybrid response to weed competition (Williams et al., 2006, 2008b).

The residual weed community (i.e., plants surviving management and persisting to harvest) of most sweet corn fields is often dominated by a small number of weed species. Wild-proso millet (*Panicum miliaceum* L.) is among the most abundant residual weed species observed in sweet corn (Williams et al., 2008c) and is a serious problem in a number of other horticultural and agronomic crops (Harvey and Porter, 1990; Wilson, 1993). Wild-proso millet has a long period of germination and seedling emergence, tolerates most herbicides used in sweet corn, and is a prolific seed producer.

Research on sweet corn-weed competition has included a relatively small number of hybrids (e.g., two to four hybrids) and has produced limited information on crop growth responses to weed interference. Moreover, the seed industry would like to identify cultivars with high CT suitable for organic production systems. The goal of this study was to examine considerably more hybrids than previously reported to gain a more complete understanding of sweet corn tolerance to weed interference. Using wild-proso millet as a model weed, specific objectives were to 1) quantify tolerance in crop growth and yield to weed interference; 2) determine the extent to which crop growth and yield tolerance variables are associated; and 3) identify hybrids differing in tolerance to weed interference.

## Materials and Methods

**Germplasm.** Twenty-five commercial sweet corn hybrids were obtained from nine seed companies (Table 1). Plant breeders from each company were asked to provide up to three hybrids, which might differ in stress tolerance based on observations. All major endosperm types were included as well as hybrids used in both fresh and processing markets. Twenty-three hybrids were used the first year, and on industry request, two additional hybrids were included the second year. In addition, because the field had no history of wild-proso millet, seed of a local biotype was collected the previous year, air-dried, and stored at room temperature for use in the following experiments.

**Experimental approach.** Field experiments were conducted in 2006 and 2007 at the University of Illinois South Farms on a Flanagan silt loam (fine, smectitic, mesic Aquic Argiudoll) soil averaging 3.8% organic matter and pH of 5.8. A single field was divided into two halves, whereby half was used each year. The previous crop was soybean and the experimental site was fertilized at 129 kg-ha<sup>-1</sup> N, 113 kg-ha<sup>-1</sup> P, and 135 kg-ha<sup>-1</sup> K in late March before planting. The experimental area was prepared for planting

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Table 1. Endosperm type, maturity, and primary market of 25 hybrids studied for crop tolerance to wild-proso millet interference in Urbana, IL.

Hybrid	Endosperm type <sup>z</sup>	Maturity (d)	Primary market	Company <sup>y</sup>
ACX1413BC	<i>sh2</i>	71	Fresh	Abbott and Cobb
Beyond	<i>sh2</i>	81	Fresh	Abbott and Cobb
Cahill	<i>su1</i>	73	Processing	Rogers
Code128	<i>su1</i>	83	Processing	General Mills
Code3	<i>su1</i>	78	Processing	General Mills
Code39	<i>sh2</i>	86	Processing	General Mills
Coho	<i>su1</i>	81	Processing	Harris Moran
DMC2184	<i>sh2</i>	82	Processing	Del Monte
Dynamo	<i>su1</i>	78	Processing	Harris Moran
El Toro	<i>su1</i>	81	Processing	Seminis
EX 8716622	<i>sh2</i>	79	Processing	Seminis
Harvest Gold	<i>su1</i>	82	Processing	Seminis
Incredible	<i>se1</i>	85	Fresh	Crookham
Legacy	<i>su1</i>	85	Processing	Harris Moran
Luscious	<i>se1</i>	75	Fresh	Mesa Maize
Mystic	<i>sh2</i>	82	Processing	Del Monte
Optimum	<i>sh2</i>	78	Fresh	Crookham
Overland	<i>sh2</i>	84	Fresh	Rogers
Precious Gem	<i>se1</i>	80	Fresh	Mesa Maize
Quickie	<i>su1</i>	68	Fresh	Crookham
Rocker	<i>su1</i>	85	Processing	Rogers
SCH70064RR	<i>sh2</i>	79	Fresh	IFSI
Spirit	<i>su1</i>	67	Processing	Rogers
Spring Treat	<i>se1</i>	68	Fresh	Mesa Maize
Sugar Buns	<i>se1/su1</i>	72	Fresh	Crookham

<sup>z</sup>Endosperm type: *su1* = *sugary1*; *se1* = *sugary enhancer1*; *sh2* = *shrunken2*.

<sup>y</sup>Abbott & Cobb, Inc., Feasterville, PA; Crookham Company, Caldwell, ID; Del Monte USA, Rochelle, IL; General Mills, LeSueur, MN; Harris Moran Seed Company, Nampa, ID; Illinois Foundation Seeds Inc., Champaign, IL; Mesa Maize, Olathe, CO; Rogers Seeds/Syngenta, Nampa, ID; Seminis Vegetable Seeds, DeForest, WI.

by two passes each of a field cultivator and disk harrow. The study was sprinkler-irrigated three times each in 2006 and in 2007.

The experimental design was a split plot with four replicates. Hybrid was the main plot factor, whereby eight-row  $\times$  9.2 m long main plots were planted on a 76-cm row spacing at 10 seeds per meter of row using a cone planter. Presence or absence of wild-proso millet was assigned to subplots measuring four rows  $\times$  9.2 m. Seed of wild-proso millet were shallowly seeded at 115 nondormant seed/m<sup>2</sup> of row in subplots directly into the center two rows using a cone planter immediately after crop planting. Sweet corn and wild-proso millet were planted on 29 May 2006 and 14 May 2007. After crop emergence, sweet corn plants were thinned to approximately five plants/m<sup>2</sup> of row. In addition, wild-proso millet seedling population density was determined 16 d after emergence.

The study area was kept free of all weeds except wild-proso millet. Atrazine was applied pre-emergence at 1.68 kg·ha<sup>-1</sup> ai to the entire study area, and S-metolachlor was applied pre-emergence at 1.78 kg·ha<sup>-1</sup> ai to weed-free plots. After wild-proso millet emergence, S-metolachlor was applied at 1.78 kg·ha<sup>-1</sup> ai to all plots and incorporated with interrow cultivation. Weeds emerging other than wild-proso millet were controlled with a single application of bentazon at 0.56 kg·ha<sup>-1</sup> ai (2006 only) and weekly hand-weeding.

**Data collection.** Crop growth was measured in the center two rows of both weed-free and weedy subplots throughout the season. Growth stages were determined by counting the number of visible leaf collars

and the appearance of reproductive organs (Ritchie et al., 2003). Plant height was measured from the soil surface to the apex at approximately V2, V6, and silk emergence (R1) stages. A visual rating of leaf uprightness at V6 and R1 was determined using a scale to describe the relative vertical position of the uppermost, fully emerged leaves (Fig. 1). Both weed-free and weedy treatments of each hybrid were harvested 18 to 20 d after silk emergence (R3) in weed-free plots. Marketable ears, measuring 4.5 cm or greater in diameter with husks, were hand-harvested from the center two rows over 6 m of row. Ear number and mass were recorded. Tip fill and kernel depth were measured from five randomly selected ears.

**Statistical analyses.** Crop tolerance to weed interference was characterized by the following variables: height at V2 (CT<sub>H(V2)</sub>), V6 (CT<sub>H(V6)</sub>), and R1 (CT<sub>H(R1)</sub>); leaf uprightness at V6 (CT<sub>L(V6)</sub>) and R1 (CT<sub>L(R1)</sub>); and ear mass (CT<sub>Mass</sub>), ear number (CT<sub>Num</sub>), kernel depth (CT<sub>Kernel</sub>), and tip fill (CT<sub>Fill</sub>) at R3. For each hybrid within each replicate, crop tolerance was calculated as the response variable in weedy subplot divided by response variable in weed-free subplots expressed as a percentage.

All data were examined with Levene's test for homogeneity (Ott and Longnecker, 2001). Variances were found to be homogeneous for all variables and met analysis of variance (ANOVA) assumptions of normality. ANOVA was conducted on each growth and yield tolerance variable, and the means were separated by the protected least significant difference test at  $P < 0.05$  with a

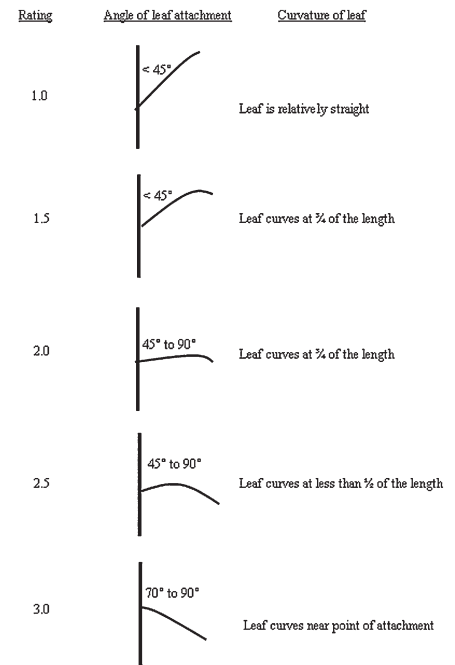


Fig. 1. Rating scale used to describe leaf uprightness of sweet corn hybrids.

Bonferroni correction (SAS Institute, 2002). In addition, linear associations between crop tolerance variables were quantified using Pearson correlation coefficients.

## Results and Discussion

The weather was often hotter and drier than the 30-year average during most of the study. Mean monthly temperature was 0.3 and 1.4 °C above the 30-year average in 2006 and 2007, respectively (Table 2). Including irrigation, total water supply was 31 and 97 mm below the 30-year average in 2006 and 2007, respectively. A dry start and end of each experiment was interrupted by above-average water supply in July 2006 and June 2007. These rainfall and irrigation events preceded or coincided with tassel initiation and silk emergence, avoiding severe drought stress during pollination.

Crop and weed emergence coincided within 1 d of each other and crop population density after thinning was similar both years, averaging 4.7 plants/m<sup>2</sup> of row. Wild-proso millet population density averaged 72 and 126 plants per meter of row in 2006 and 2007, respectively. Wild-proso millet population density was within a range that previously caused significant yield losses in dent corn (Wilson and Westra, 1991) and sweet corn (Williams et al., 2008b).

**Tolerance in crop growth.** Plant height varied among hybrids throughout the experiment. For example, mean weed-free height among hybrids at V2 varied  $\approx$ 2-fold, and by R1, height ranged from 124 to 201 cm and 127 to 228 cm in 2006 and 2007, respectively. Differences in height among hybrids occurred earlier in the season and to a greater extent than similar research on fewer hybrids.

Williams et al. (2006) reported three *sugary1* (*su1*) sweet corn hybrids differed in canopy architecture only after V6 with the tallest hybrid averaging 65% more height than the shortest hybrid at R1. In this work, differences in height among hybrids were observed shortly after emergence and some hybrids were 83% to 107% taller than other hybrids by R1. In this study, variation among hybrids in early-season height reflects, in part, greater seedling vigor and seedling growth rate of *su1* endosperm types relative to *shrunken2* (*sh2*) endosperm types (Azanza et al., 1996). Leaf uprightiness also varied considerably among hybrids. Leaf uprightiness of hybrids at V6 and R1 ranged such that some hybrids had leaves positioned high in the canopy (i.e., rating of 1.0), whereas leaves were oriented below the node to which they were attached in other hybrids (i.e., rating of 3.0).

Although not significant at  $P = 0.05$ , wild-proso millet interference resulted in a 6% reduction in overall plant height by R1 (data not shown). Previously, weed interference was observed to influence maximum crop height in early May-planted sweet corn (Williams and Lindquist, 2007); however, direction of sweet corn response varied with year. Weed interference from a tall weed community (averaging 64 cm) resulted in increased crop height, likely as a result of a shade avoidance response, whereas weed interference from a shorter weed community (averaging 23 cm) resulted in decreased crop height relative to a weed-free control (Williams and Lindquist, 2007; Williams and Masiunas, 2006). In this study, wild-proso millet that emerged with sweet corn ranged in height from  $\approx 100$  to 150 cm at the time of sweet corn harvest. Taller hybrids in the present study had a large proportion of leaf area above wild-proso millet compared with the shorter hybrids that were overtopped by the weed.

Despite large differences in canopy architecture among hybrids, tolerance in height growth and leaf uprightiness to weed interference were similar across hybrids ( $P \geq 0.10$ ). Although resources are often plentiful early in the season, presence of weeds can influence corn seedling growth. In the presence of grass sod (which was not competing for resources), certain dent corn seedlings grew taller, had larger leaves, and had a greater shoot-root ratio (Rajcan et al., 2004). Such shade avoidance responses are driven by the ability of the crop to detect light quality, which varies among dent corn hybrids (Maddonna et al., 2002). Light quality interacts with auxin in regulating development of leaf uprightiness in corn seedlings, whereby far-red-enhanced light resulted in more horizontal leaves (Fellner et al., 2003). Fellner et al. (2003) also found that leaf uprightiness of a modern corn hybrid, selected under high plant population densities, was less responsive to shade conditions than an older hybrid and attributed the result to fewer auxin receptors in the modern hybrid. The lack of substantial differences in tolerance among hybrids indicated that wild-proso millet inter-

ference had a limited effect on plasticity in crop height growth and leaf uprightiness.

The minimal effect of wild-proso millet interference on sweet corn growth is surprising. The early critical period of weed control in sweet corn (Williams, 2006) is consistent with some explanation beyond resource limitation (Rajcan et al., 2004). Most other weed species in the study were controlled pre-emergence and escapes were removed shortly after emergence. Wild-proso millet size may not have been large enough to alter light quality and induce changes in crop height and leaf uprightiness. Alternatively, sweet corn detection of wild-proso millet may have resulted in changes in growth traits other than plant height and leaf uprightiness such as leaf area and root:shoot ratio. Finally, a

taller weed community than observed here may have enhanced a shade avoidance response in the sweet corn canopy.

*Tolerance in crop yield.* Weed-free yield varied among hybrids for all yield components ( $P < 0.01$ ). For instance, weed-free ear mass ranged from 160 to 437 g/plant in 2006 and 280 to 561 g/plant in 2007. Weed-free ear number ranged from 0.7 to 1.8 ears/plant, tip fill was above 85%, and kernel depth ranged from 8.4 to 11.2 mm.

Wild-proso millet interference differentially reduced ear mass and ear number among hybrids. Although weed interference reduced ear number on average 48%, range of response of  $CT_{Num}$  was 25% to 65% in 2006 and 2% to 89% in 2007 (Table 3). Similar responses were observed for  $CT_{Mass}$ . In

Table 2. Monthly water supply and average daily temperature for the entire month of May, June, July, and August in 2006 and 2007 in Urbana, IL.<sup>z</sup>

Year	Month	Water supply		Avg daily temp			Departure from avg	
		Rainfall ----- (mm)	Irrigation ----- (mm)	Minimum ----- (°C)	Maximum ----- (°C)	Mean ----- (°C)	Water (mm)	Temp (°C)
2006	May	78	0	11.0	22.4	16.7	-44	-0.3
	June	42	25	15.8	27.9	21.9	-40	-0.2
	July	199	8	19.0	30.7	24.8	88	0.9
	August	76	0	18.4	28.3	23.3	-35	0.6
2007	May	41	0	13.0	27.1	20.1	-81	3.0
	June	144	51	16.9	29.1	23.1	88	1.0
	July	87	0	17.0	28.4	22.7	-31	-1.2
	August	38	0	19.7	31.6	25.7	-73	2.9

<sup>z</sup>Departure from 30-year average water supply and mean air temperature are included for reference.

Table 3. Values for crop tolerance to wild-proso millet interference measured in terms of yield components for 25 sweet corn hybrids studied in Urbana, IL.<sup>z</sup>

Hybrid	2006				2007			
	$CT_{Num}^y$	$CT_{Mass}$	$CT_{Fill}$	$CT_{Kern}$	$CT_{Num}$	$CT_{Mass}$	$CT_{Fill}$	$CT_{Kern}$
	-----Percent of weed-free-----							
ACX1413	29	33	101	100	28	34	99	97
Beyond	47	55	99	96	33	38	100	102
Cahill	62	59	96	99	54	49	97	93
Code128	55	66	100	92	81	71	97	89
Code3	45	47	99	94	59	52	102	92
Code39	48	55	100	95	63	68	94	91
Coho	50	68	101	99	69	73	100	97
DMC2184	65	61	100	93	48	49	100	93
Dynamo	52	58	94	107	89	67	97	94
El Toro	63	64	103	91	82	68	97	91
EX 8716622	63	66	100	100	61	48	100	86
Harvest Gold	45	53	101	100	65	60	96	92
Incredible	47	56	99	98	40	56	92	94
Legacy	62	76	100	103	77	72	100	100
Lucious	49	51	98	98	55	41	97	101
Mystic	65	67	100	99	50	51	96	97
Optimum	— <sup>x</sup>	—	—	—	14	34	99	96
Overland	—	—	—	—	47	53	98	94
Precious Gem	50	59	99	95	59	58	99	93
Quickie	39	35	97	93	40	44	90	103
Rocker	62	62	102	93	73	61	98	96
SCH70064RR	53	65	101	96	44	47	100	97
Spirit	59	53	99	100	50	46	97	96
Spring Treat	27	25	97	93	5	31	— <sup>w</sup>	—
Sugar Buns	25	37	99	96	2	18	—	—
Least significant difference	36	39	NS	NS	30	25	10	NS

<sup>z</sup>Mean values for crop tolerance to wild-proso millet interference are separated using Bonferroni-corrected least significant difference.

<sup>y</sup> $CT_{Num}$  = tolerance in ear number;  $CT_{Mass}$  = tolerance in ear mass;  $CT_{Fill}$  = tolerance in tip fill;  $CT_{Kern}$  = tolerance in kernel depth.

<sup>x</sup>Hybrids Optimum and Overland were added in 2007.

<sup>w</sup>An insufficient number of marketable ears were produced in weedy plots to measure kernel depth and tip fill. NS = nonsignificant.

contrast, hybrids were largely similar for CT<sub>Fill</sub> and CT<sub>Kern</sub>. Williams and Masiunas (2006) reported tolerance in sweet corn yield and ear traits to giant ragweed (*Ambrosia trifida* L.) interference. Marketable ear mass was among yield variables most affected by giant ragweed interference, whereas effects on tip fill and kernel depth were minimal (Williams and Masiunas, 2006). Bonaparte and Brawn (1974) reported that of 16 traits in four dent corn hybrids, grain yield per plant and yield per unit area were the most elastic traits, whereas kernel row number and ear height varied the least. Similar results were observed in the present study as evidenced by CT<sub>Num</sub> and CT<sub>Mass</sub> varying significantly among hybrids, whereas CT<sub>Fill</sub> and CT<sub>Kern</sub> varied least.

Sweet corn yield in the presence of wild-proso millet was positively correlated with weed-free yield, although higher-yielding hybrids were not inherently better at tolerating wild-proso millet interference than lower-yielding hybrids. For instance, for each 10-g increase in weed-free ear mass, there was a 9.2- to 10.2-g increase in weedy ear mass yield (data not shown). Similar positive correlations between weedy and weed-free values occurred with other yield components. Using many of the same hybrids, a detailed analysis of the effects of underlying principal crop canopy factors on weed biomass and fecundity is reported by So et al. (2009).

*Correlations among tolerances in growth and yield.* Few associations were observed among tolerances in crop growth and yield to wild-proso millet interference. Crop tolerance for height at R1 was weakly associated with CT for ear mass in 2007 as evidenced by a correlation coefficient of 0.23; however, this association was not observed in 2006 (Table 4). Weak and inconsistent results between the 2 years suggests that the subtle effects of weed interference on crop height growth and leaf uprightiness were largely independent of yield tolerance to wild-proso millet. Traits that improve light interception such as height and leaf area distribution contribute to yield stability in the presence of weed interference (Callaway, 1992; Lindquist and Mortensen, 1998; Lindquist et al., 1998; Williams et al., 2008b). Wild-proso millet interference either failed to influence crop growth or influenced traits other than plant height and leaf uprightiness, thereby limiting the extent to which tolerances in growth and yield variables were related.

*Most tolerant versus least tolerant hybrids.* Sweet corn hybrids most tolerant to wild-proso millet interference were mainly processing hybrids. Five processing hybrids with the highest CT<sub>mass</sub> across years included 'Code128', 'Coho', 'El Toro', 'EX 8716622', and 'Legacy' (Table 3). Sweet corn hybrids that were least tolerant to wild-proso millet interference were five fresh market hybrids, including 'ACX1413', 'Optimum', 'Quickie', 'Spring Treat', and 'Sugar Buns'. Hybrids most and least tolerant to weed interference differ in maturity. The five most tolerant hybrids mentioned are considered 79 d or

Table 4. Correlation coefficients among growth and yield values for tolerance in sweet corn to wild-proso millet interference.<sup>z</sup>

	CT <sub>HtV2</sub>	CT <sub>HtV6</sub>	CT <sub>HtR1</sub>	CT <sub>LfV6</sub>	CT <sub>LfR1</sub>	CT <sub>Mass</sub>	CT <sub>Num</sub>	CT <sub>Kern</sub>	CT <sub>Fill</sub>
CT <sub>HtV2y</sub> <sup>z</sup>	—	0.02	-0.07	0.10	0.06	-0.14	-0.11	-0.33*	-0.08
CT <sub>HtV6</sub>	-0.02	—	0.11	0.00	0.00	0.17	0.05	-0.02	0.02
CT <sub>HtR1</sub>	0.05	-0.03	—	-0.07	-0.02	0.03	0.09	-0.05	0.00
CT <sub>LfV6</sub>	0.15	-0.05	-0.03	—	-0.06	-0.10	-0.03	0.12	-0.08
CT <sub>LfR1</sub>	-0.04	-0.12	0.05	0.11	—	0.14	0.10	-0.02	0.01
CT <sub>Mass</sub>	-0.04	-0.20	0.23*	-0.13	0.17	—	0.86*	-0.05	0.09
CT <sub>Num</sub>	0.07	-0.17	0.18	-0.10	0.08	0.79*	—	0.18	0.09
CT <sub>Kern</sub>	0.19	0.02	0.08	-0.07	-0.04	0.17	0.13	—	0.10
CT <sub>Fill</sub>	-0.18	0.05	0.00	-0.13	0.01	0.18	0.06	-0.27*	—

<sup>z</sup>Coefficients above and below the diagonal are for 2006 and 2007, respectively. Significant (*P* value ≤ 0.05) coefficients are identified with an asterisk.

<sup>y</sup>CT<sub>HtV2</sub> = tolerance in height at V2; CT<sub>HtV6</sub> = tolerance in height at V6; CT<sub>HtR1</sub> = tolerance in height at R1; CT<sub>LfV6</sub> = tolerance in leaf uprightiness at V6; CT<sub>LfR1</sub> = tolerance in leaf uprightiness at R1; CT<sub>Mass</sub> = tolerance in ear mass; CT<sub>Num</sub> = tolerance in ear number; CT<sub>Kern</sub> = tolerance in kernel depth; CT<sub>Fill</sub> = tolerance in tip fill.

longer hybrids, whereas four of the five least tolerant hybrids are 72 d or shorter hybrids (Table 1). However, maturity alone does not fully account for differences in CT among hybrids. For instance, 73-d maturity 'Cahill' was among the most tolerant hybrids for marketable ear mass. In addition, 81-d hybrid 'Beyond' was among the least tolerant hybrids for yield traits in 2007. Moreover, a relatively poor association was observed between thermal time to silking and CT among hybrids (data not shown).

This study investigated CT of 25 sweet corn hybrids and found a greater range of crop response than previously reported. Williams et al. (2008a) reported yield of 'Rocker' was less influenced by variation in wild-proso millet interference compared with yield of 'Cahill'. Compared with a broader range of germplasm in the present study, 'Cahill' and 'Rocker' have relatively similar crop tolerances to wild-proso millet interference. In addition, yield of 'Spirit' was found to be less tolerant to weed interference compared with yield of 'WHT2801' and 'GH2547' (Williams et al., 2008b). With the exception of *Rp-G* rust resistance, hybrids 'GH2547' and 'Rocker' are essentially identical. In the present work, neither 'Rocker' nor 'Spirit' were among the most or least tolerant hybrids to weed interference. Differences in CT among sweet corn hybrids were recently identified; however, CT in yield varies to a greater extent among hybrids than previously reported.

Of the 25 hybrids tested for CT, no hybrid escaped yield loss as a result of weed interference; however, some hybrids endured wild-proso millet interference considerably better than others. The hybrids with the greatest CT were dominated by later-maturing, processing hybrids, whereas early-maturing hybrids were often less tolerant to wild-proso millet interference. Wild-proso millet interference had little effect on crop height and leaf uprightiness, suggesting weed interference was insufficient to induce major changes in these components of crop canopy architecture. Competitive ability of hybrids would be valuable information in weed management decision-making, particularly where

weed control options are limited such as in organic production systems.

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