Taste Panel Perception of Sweetness and Sweetness Acceptability Compared to High Pressure Liquid Chromatography Analysis of Sucrose and Total Sugars Among Three Phenotypes (*su*, *se*, and *sh*$_2$) at Varying Maturities of Fresh Sweet Corn

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Summary. Increased value of fresh sweet corn (*Zea mays*) during the last decade has lead to increased interest into the characteristics that increase marketability. Sweetness was examined over three phenotypes (*su*, *se*, and *sh*$_2$) to determine if there was an optimum phenotype or cultivar within a phenotype. Each phenotype was isolated to prevent cross-pollinization. Cultivars were grown on sandy loam soil located at the Clemson University Coastal Research and Education Center (Charleston, S.C.). Early, mature, and late harvest dates were also evaluated to determine the optimal harvest date(s) for maximum flavor. High performance liquid chromatography was used to determine sucrose, fructose, glucose, and total sugars. Panelists' evaluation of sweetness and its acceptability significantly correlated with the high performance liquid chromatography analysis for sucrose and total sugars (sweetness, R = 0.70 and 0.61; acceptability, R = 0.64 and 0.55). Sucrose correlated with the total sugars (R = 0.95). As maturity increased, the ability of the taste panel to identify differences in phenotypes also increased. Although sucrose and total sugar levels were different between *se*, *sh*$_2$, and *su*, taste panelists indicated no difference between *se* and *sh*$_2$. *Sh*$_2$ cultivars were considered sweet and acceptable on all harvest dates, but *su* was only acceptable to panelists at early maturity.

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Sweet corn is used for three distinct markets within the United States, which include fresh, canning, and freezing. The U.S. Dept. of Agriculture (USDA) reported that sweet corn value has increased 81% in the last decade, with fresh market accounting for the majority of the crop value (Lucier and Lin, 2001). Consumption of fresh sweet corn has increased 62% from a decade ago (Lucier and Lin, 2001). The reason for the boost in popularity is the introduction of new phenotypes with enhanced flavor and increased shelf life (Hassell et al., 2003). Two phenotypes of sweet corn dominating the marketplace are sugary enhancer (*se*) and shrunken-2 (*sh*$_2$), both of which have contributed to the increase in fresh consumption. *Se* is a mutant from the sugary (*su*) breeding line that produces higher sugar levels without compromising the level of phytoglycogen, a water-soluble polysaccharide that contributes to the creamy texture (Ferguson et al., 1978; Gonzales et al., 1976). *Sh*$_2$, a recessive mutation of field corn, enhances sugar levels, similar to or greater than *se*; however, it does not accumulate phytoglycogen like *se* and *su* (Brecht, et al., 1990; Gonzales et al., 1976). High sugar cultivars are less susceptible to sugar loss after harvest and during storage, increasing the length of marketability for fresh sweet corn (Laughman, 1961). *Sh*$_2$ shelf life is enhanced due to a slower rate of carbohydrate and moisture loss after harvest than *se* (Garwood et al., 1976).

Although there are differences among *su*, *se*, and *sh*$_2$ sweet corn cultivars, the largest factor affecting their marketability is flavor. Flavor perception of sweet corn quality and freshness is greatly influenced by sugar and soluble carbohydrate content. Sugar content is what sets sweet corn apart from other corn and provides what is most often perceived as acceptable flavor to consumers (Culpepper and Magoon, 1927; Evenson and Boyer, 1986). Perception of sweetness more closely correlates with sucrose content than with the reducing sugar levels (fructose and glucose) (Reyes et al., 1982; Zhu et al., 1992). This correlation indicates that as sucrose increased within the kernel, the panelists' perception of sweetness should also increase; however, some studies have shown that consumers do not actually prefer the increased sweetness, which is attributed to sucrose content in sweet corn (Culpepper and Magoon, 1927; Reyes et al., 1982; Zhu et al., 1992). In the work of Reyes et al. (1982), 'Jubilee' (*su*) and 'Xtra Sweet 77' (an older *sh*$_2$ cultivar) were evaluated at two harvest dates (30 and 35 d after pollination). High pressure liquid chromatograph (HPLC) analysis determined sugar content, and samples were rated by panelists on sweetness intensity and desirability. Although 'Xtra Sweet 77' was consistently rated as sweeter than 'Jubilee', panelists did not show a consistent preference for the increased level of sweetness, challenging previous work stating that consumers prefer sweet corn with higher sweetness (Showalter and Miller, 1962). Reyes et al. stated that HPLC analysis indicated that the less mature samples of both phenotypes were higher in sucrose content, but they did not indicate at which maturity each phenotype was preferred by the panelists. Preferred maturity for *se* sweet corn according to sensory evaluation and HPLC analysis of sugars has also not been identified.

The objectives of this research were to 1) determine if panelists can determine a preferred sweetness among sweet corn phenotypes; 2) evaluate what effect maturity levels had on panel evaluation of sweetness and sweetness acceptability; 3) ascertain phenotype and maturity effects on sugar content in sweet corn; and 4) assess the relationship between panel evaluations of sweet corn and HPLC analysis.

Materials and methods

Plot establishment. A total of nine cultivars of sweet corn were used with three cultivars per phenotype (*sug-*

ary, *sugary enhanced*, and *shrunken-2*). Cultivars were selected according to seed company recommendations. *Sugary* (*su*) cultivars were comprised of 'NK199', 'Golden Cross Bantam', and 'Jubilee' (Rupp Seeds, Wauseon, Ohio). *Sugary enhanced* (*se*) cultivars were 'Precious Gem', 'Brocade', and 'Lancelot' (Mesa Maize, Olathe, Colo.); and *shrunken* (sh_2) cultivars were 'Rustler' and 'Zenith' (Harris Moran Seed Co., Modesto, Calif.) and 'ACX904' (Abbott and Cobb, Feasterville, Pa.). Cultivars were planted on 28 Mar. 2003; however, *su* and sh_2 cultivars were replanted 9 May due to severe bird damage. Each phenotype was planted using a randomized complete-block design. All phenotypes were isolated into different fields at least 76.2 m (250 ft) apart to prevent cross-pollination. All plots were planted in Younges fine loamy sand at the Clemson University Coastal Research and Education Center (CREC) located in Charleston, S.C. Each cultivar was replicated 4 times with plots consisting of four rows, 12.2 m (40 ft) long, 0.9 m (3 ft) between rows, and 20.3 cm (8 inches) between plants. All plots were seeded with a cone planter mounted on a John Deere Flex planter (John Deere, Moline, Ill.). Plots were watered and fertigated using drip lines, following standard sweet corn practices. Recommended herbicide and pesticide regimens for South Carolina were followed (Hassell, 2004).

HARVEST. All plots were hand harvested at three different maturities. Full maturity was 19 d after 100% silking of the entire plot, determined from previous work done at CREC. Full maturity ears were filled with kernels to the tip and had full kernel color. Early maturity was 5 d before maturity or 14 d after 100% silking where ears were not filled to the tip and full kernel color had not been achieved. Late maturity was 5 d after maturity, or 24 d after 100% silking, where the ears were completely filled and colored, and kernel denting had begun. Twenty-five ears were randomly taken within each treatment, replicated four times.

Ten uniform ears were selected per cultivar per maturity for taste panel. Cobs were cut into 3.81- to 5.1-cm (1.5 to 2 inches) sections (cobbettes) from the center portion using a portable band saw to prevent crushing sample kernels. Cobbettes were then frozen in liquid nitrogen (National Welders, Charleston, S.C.) within 3 h of harvest, placed in 3.8-L (1 gal) freezer bags and then stored in a deep freezer at –34.4 °C (–30 °F).

For HPLC analysis, the ends of five uniform ears per plot were removed using a portable band saw. Center portions of cobs were then frozen in liquid nitrogen within 3 h from harvest to stop all metabolic activity. Cobs were placed in freezer bags and stored in a deep freezer at –34.4 °C. Kernels were removed from frozen cobs by hitting them with a hammer while in the freezer bags. Kernels were placed into 0.47-L (1 pt) freezer bags and stored until used for HPLC analysis.

All HPLC sample preparation and analysis were performed in the Poole Agriculture Center on Clemson University campus, Clemson, S.C. Samples were prepared using modified methods of Zhu et al. (1992). One hundred grams of kernels were homogenized for 2 min in a blender. Two 2-g samples of homogenate were mixed with 4 mL of 80 ethanol : 20 water mixture in 15-mL centrifuge tubes, heated in 85 °C water-bath for 5 min, and centrifuged at 42,000 g_n for 10 min. Supernatant was decanted and retained. Precipitate was washed using 4 mL of ethanol mixture, heated, and centrifuged as previously described. Two ethanol–water washings were collect and combined with first supernatant and centrifuged for 10 min.

Sample was filtered using 10-mL poly prep column (Bio-Rad, Richmond, Calif.) prepared with 2 mL of cation exchange resin (Amberlite IRA 68; Sigma-Aldrich, St. Louis) and 1 mL of ion-exchange resin (Dowex 50x4-200; Sigma-Aldrich). Columns were washed with 1 mL of 80 ethanol : 20 water mixture before and after 5 mL of sample were filtered. Ethanol mixture was evaporated at 70 °C for 50 min using a Rapidvap (Labconco, Kansas City). Evaporated sample was mixed with 10 mL HPLC-grade water. One milliliter of this mixture was then mixed with 5 mL of HPLC-grade water to be used for HPLC analysis. From this solution, 1.5 mL was placed into autosampler vials (Dionex, Sunnyvale, Calif.).

Twenty microliters were injected into the Dionex DX-300 HPLC (AGP-1 pump and ASM-3 autosampler) and sucrose, glucose, and fructose were separated using a Carbo-Pak PA1 column (4 × 250 mm) (Dionex) maintained at 85 °C. Sugars were detected with an electrochemical detector (pulsed amperometric detector; Dionex). Data was recorded using PeakNet 5.11 software (Dionex). The mobile phase (0.2 M NaOH) was previously filtered and degassed. Quantification of individual sugars was determined based on calibration curves obtained from their respective standards. Standards were prepared at 0.01, 0.05, 0.10, 1.00, and 1.50 $mg \cdot g^{-1}$. This procedure was followed for all nine cultivars at each of the three harvest maturities.

TASTE PANEL. The taste panel consisted of 18 volunteers. Two groups of nine participated in orientation sessions to familiarize them with sweetness. Panelists participated in three tasting sessions, with all sessions being held at the CREC. An incomplete-block design was implemented so that panelists were randomly assigned five samples per session. Cobbettes were thawed at room temperature, 21.7 to 22.8 °C (71 to 73 °F) for 1 h prior to being blanched in unsalted, boiling water for 5 min. Cobbettes were immediately removed from water and placed in 118.3-mL (4 fl oz) Styrofoam containers with lids (Dart Container Corp., Mason, Mich.) to maintain heat until given to panelists. Panelists were asked to rate each sample on the sweetness and sweetness acceptability using two 15-cm (5.9 inches) attribute linear scales with anchor words where 0 cm (0 inches) represented "lacks sweetness and unacceptable" and 15 cm represented "sweet and acceptable."

STATISTICAL ANALYSIS. Data were analyzed as a three factor design with cultivar nested in phenotype, and phenotype and maturity being cross-classified. Taste panel analysis was set as an incomplete block design. Analysis of variance (ANOVA) was performed on main effects and interactions followed by pair-wise means comparison using a general linear model (SAS v.8; SAS Institute, Cary, N.C.) HPLC data were analyzed using a general linear model (GLM) for determining significance of main effects and interactions (Table 1). ANOVA indicated that maturity interacted with phenotype as well as cultivar in analysis of HPLC sugars.

Taste panel evaluation main effects and interactions were analyzed using the mixed model ANOVA with panelists assigned as the random variable (Table 2). The ANOVA indicated that cultivar interacted with taster on all

Table 1. Sources of variation[z] in the analysis of variance (ANOVA) for early, mature and late harvested *sugary*, *sugary enhancer*, and *shrunken-2* sweet corn for high pressure liquid chromatography (HPLC) measurements.

	Percentage of total sums of squares[z]	
	HPLC	
Source of variation	Sucrose	Total sugar
Phenotype (P)	65*	56*
Rep (R)	3	4
Cultivar (phenotype) (C)	6*	7*
R × C	2	3
Maturity (M)	7*	9*
M × P	4*	3*
M × C	4*	6*
Error	9	12
R^2	0.91	0.88
CV	22.35	18.40

[z]The sum of squares for each of the factors in the ANOVA have been converted to percentages of the total sum of squares.
*F values significant at $P = 0.05$.

Table 2. Sources of variation[z] in the analysis of variance (ANOVA) for early, mature, and late harvested *sugary*, *sugary enhancer*, and *shrunken-2* sweet corn of taste panel evaluation of sweetness and acceptability.

	Percentage of total sums of squares[z]	
Source of variation	Sweetness	Sweetness acceptability
Phenotype (P)	34*	31*
Taster (T)	30*	30*
Cultivar (phenotype) (C)	3*	2 (0.06)
T × C	13*	14*
Maturity (M)	1*	2*
M × P	1*	3*
M × C	3	3
Error	14	15
R^2	0.86	0.85
CV	30.14	28.84

[z]Significance determined using the mixed procedure in SAS.
[y]The sum of squares for each of the factors in the ANOVA have been converted to percentages of the total sum of squares.
*F values significant at $P = 0.05$.

Table 3. Statistical analysis of panel evaluation of sweetness and sweetness acceptability of three maturities[z] within *sugary* (*su*), *sugary enhancer* (*se*), and *shrunken-2* (*sh₂*) phenotypes of sweet corn, pooled over cultivar.

	Panel scores[y]	
	Sweetness	Sweetness acceptability
Sugary (su)		
Early	6.8 fg[x]	7.8 f
Mature	4.7 h	5.0 g
Late	3.7 h	4.5 g
Sugary enhancer (se)		
Early	9.0 b–e	10.3 ad
Mature	9.3 bd	10.4 ac
Late	7.6 ef	8.1 f
Shrunken-2 (sh_2)		
Early	10.1 bc	10.2 ae
Mature	10.4 ab	10.8 ab
Late	10.9 a	11.3 a

[z]Maturity determined by number of days after 100% silking of individual plot; early =14 d, mature = 19 d, late = 24 d.
[y]Scores are mean centimeter values of 18 panelists' ratings using a 15-cm (5.9 inches) linear attribute scale with anchor words.
[x]Means separated within columns using *t*-test least square means separation test at $P \leq 0.05$.

organoleptic tests. Although contributing minor portions, maturity interacted with phenotype for sweetness, suggesting these attributes change by phenotype harvested at different maturities. The major portion of main effects for sweetness, sweetness acceptability were phenotype and taster, repectively.

Results

Taste panel. Panelists were able to identify differences in the sweetness level of *sugary* (*su*), *sugary enhancer* (*se*) and *shrunken-2* (sh_2) phenotypes, with sh_2 rating highest in sweetness (Table 3). Although panelists indicated differences in the sweetness level of the three phenotypes, they found no difference in the acceptability of sh_2 and *se*. Panelists were able to distinguish between early and late harvest samples but not mature samples, in sweetness and acceptability scores. This is due to phenotype characteristics. *Su* cultivars were not as sweet at early harvest as sh_2 and *se*, receiving a sweetness score of 6.8, which decreased by 46% to 3.7 at late harvest. Acceptability scores for early harvest *su* cultivars were only at 7.8 and decreased 42% by late harvest, similar sweetness scores. *Se* cultivars remained constant across early and mature harvests in both sweetness and acceptability scores. Although the panel scores decreased at late harvest for *se*, they were comparable to the early harvest score for *su* cultivars. Sh_2 was the only phenotype that did not show a drop in panel ratings with maturity. Sh_2 panel scores of sweetness increased with maturity, with late harvest being significantly higher than early harvest. Panelist indicated no difference in acceptability of sh_2 cultivars at early, mature, or late harvest dates.

Panel evaluation of sweetness and sweetness acceptability indicated that overall, 'ACX904' (sh_2) was the sweetest and most preferred cultivar (Table 4). Other sh_2 cultivars were comparable in acceptability. The three cultivars of *se* were comparable to sh_2 'Rustler' and 'Zenith' in panel acceptability, and to 'Rustler' in sweetness. *Su* cultivars were not comparable to either *se* or sh_2 in sweetness or acceptability.

Sugar analysis. Sucrose, similar to panel rating of sweetness, varied at all three harvest dates and among *su*, *se*, and sh_2 (Table 5). Sh_2 had a 60% greater total sucrose concentration for all harvest dates than *su*, and 49% greater than *se*. S*u* did not exhibit differences in sucrose concentration at early and mature harvest or early and late harvest, but differences in sucrose did exist between mature and late harvests. Similar trends are observed in s*e* sucrose concentrations as they decrease at maturity and then increase at late harvest to be slightly higher than early harvest, although not significantly different. Sh_2 cultivars do not follow *su* or *se* in this trend, but remain constant

Table 4. Statistical analysis of panel evaluation of sweetness and sweetness acceptability of nine cultivars of *sugary* (*su*), *sugary enhancer* (*se*), and *shrunken-2* (sh_2) phenotypes of sweet corn, pooled over maturities.

	Panel evaluation[z]	
Cultivar	Sweetness	Sweetness acceptability
Sugary (su)		
NK199	5.1 gh[y]	5.7 c
Golden Cross Bantam	4.8 gh	5.1 c
Jubilee	5.3 g	6.5 c
Sugary enhancer (se)		
Brocade	9.2 bc	9.7 b
Lancelot	8.8 c–e	9.7 b
Precious Gem	8.0 c–f	9.3 b
Shrunken-2 (sh_2)		
Rustler	9.2 b–d	10.2 ab
Zenith	10.4 b	10.4 ab
ACX904	11.9 a	11.3 a

[z]Scores are mean centimeter values of 18 panelists' ratings using a 15-cm (5.9 inches) linear attribute scale with anchor words.
[y]Means separated within columns using *t*-test least square means separation test at $P \leq 0.05$.

Table 5. Statistical analysis of the interaction of early, mature, and late maturity[z] levels and phenotypes on sucrose and total sugars in *sugary*, *sugary enhancer*, and *shrunken-2* sweet corn, cultivar response pooled.

	Sucrose	Total sugar[x]
	---------mg·g^{-1} [y] --------	
Sugary (su)		
Early	3.99 de[w]	7.02 de
Mature	3.00 e	6.32 e
Late	4.52 cd	7.46 de
Sugary enhancer (se)		
Early	5.41 c	8.54 cd
Mature	4.12 de	6.14 e
Late	5.66 c	9.17 c
Shrunken-2 (sh_2)		
Early	8.63 b	12.19 b
Mature	8.87 b	11.50 b
Late	12.28 a	15.14 a

[z]Maturity determined by number of days after 100% silking of individual plot early = 14 d, mature = 19 d, late = 24 d.
[y]Sucrose and total sugar determined by high performance liquid chromatography on fresh weight; 1 mg·g^{-1} = 1000 ppm.
[x]Total sugars is the sum of glucose, fructose, and sucrose.
[w]Means within columns and main effects separated using *t*-test least square means separation test at $P \leq 0.05$.

Table 6. Analysis of maturity, cultivar, and phenotype interaction on sucrose and total sugars in early, mature and late *sugary*, *sugary enhancer*, and *shrunken-2* sweet corn.

Cultivar	Maturity[y]	Sucrose	Total sugar[x]
		---------- mg·g^{-1} [z] ---------	
Sugary (su)			
NK199	Early	3.76 i–k[w]	7.35 g–j
	Mature	2.70 k	7.88 f–j
	Late	5.53 g–i	9.44 d–h
Golden Cross Bantam	Early	3.82 i–k	6.37 i–k
	Mature	2.95 k	4.55 k
	Late	4.24 h–k	6.52 i–k
Jubilee	Early	4.39 h–k	7.35 g–j
	Mature	3.36 jk	6.53 i–k
	Late	3.79 i–k	6.41 i–k
Sugary enhancer (se)			
Brocade	Early	4.54 h–k	7.31 g–j
	Mature	4.24 h–k	6.22 i–k
	Late	6.09 gh	9.78 d–f
Lancelot	Early	4.54 h–k	7.08 h–j
	Mature	3.75 i–k	5.76 jk
	Late	5.68 g–i	9.55 d–g
Precious Gem	Early	7.14 fg	11.23 c–e
	Mature	4.68 h–k	6.46 i–k
	Late	5.21 g–j	8.18 f–i
Shrunken-2 (sh_2)			
Rustler	Early	8.12 ef	11.62 cd
	Mature	6.10 gh	9.03 e–h
	Late	10.29 cd	13.07 bc
Zenith	Early	9.26 de	13.29 bc
	Mature	9.04 d–f	11.36 c–e
	Late	13.03 ab	15.91 a
ACX904	Early	8.53 d–f	11.66 cd
	Mature	11.46 bc	14.12 ab
	Late	13.51 a	16.45 a

[z]Sucrose and total sugar determined by high performance liquid chromatography on fresh weight; 1 mg·g^{-1} = 1000 ppm.
[y]Maturity determined by number of days after 100% silking of individual plot; early =14 d, mature = 19 d; late = 24 d.
[x]Total sugars is the sum of fructose, glucose, and sucrose.
[w]Means separated within columns using *t*-test least square means separation test at $P \leq 0.05$.

at early and mature harvest [8.63 and 8.87 mg·g^{-1} (8630 and 8870 ppm)] then rising at late harvest to 12.28 mg·g^{-1} (12280 ppm). Overall sucrose levels for early harvest decreased from 6.01 mg·g^{-1} (6010 ppm) fresh weight to 5.33 mg·g^{-1} (5330 ppm) at mature harvest, but increased to 7.49 mg·g^{-1} (7490 ppm) at late harvest.

Su cultivars showed no difference in sucrose levels (Table 6). Sucrose levels were higher at early harvest of *se* 'Precious Gem' compared to 'Brocade' and 'Lancelot'; however, levels decreased with maturity. At late harvest there was no difference in sucrose levels of *se* cultivars. Sucrose levels in sh_2 cultivars were not different at early harvest, but were all different at mature harvest. At late harvest, 'Zenith' and 'ACX904' were similar in sucrose levels, having the greatest sucrose levels of any cultivar, while 'Rustler' was significantly lower.

Total sugar concentrations, although different at early, mature, and late harvest, were not different between *se* and *su* phenotypes (Table 5). The early and mature harvests of *se* cultivars were not different in total sugar concentration from the *su* cultivars. *Su* and *se* total sugars exhibited trends like those seen with sucrose, in that total sugars decreased with mature harvest and increased to the greatest concentration at late harvest. Sh_2 total sugars also followed sucrose trends, with early and mature harvest concentrations not being different and late harvest being over 3 mg·g^{-1} (3000 ppm) higher in total sugars.

'Golden Cross Bantam' had lower

Table 7. **The relationship of panel evaluation of sweetness and sweetness acceptability with sucrose and total sugar in three phenotypes (*su*, *se*, and *sh*$_2$) of early, mature, and late sweet corn.**

	Phenotype[z]				Maturity[y]		
Relationship	Overall[x]	*su*	*se*	*sh*$_2$	Early	Mature	Late
Total sugars to sweetness	0.65*	0.15	–0.06	0.50	0.70*	0.52	0.93*
Total sugars to sweetness acceptability	0.57*	0.16	–0.17	0.37	0.53	0.43	0.93*
Sucrose to sweetness	0.72*	0.02	0.05	0.56	0.75*	0.71*	0.90*
Sucrose to sweetness acceptability	0.65*	0.19	–0.07	0.53	0.60	0.64	0.90*

[z]Correlations (R) calculated using Pearson's correlation coefficient (n = 9).
[y]Maturity determined by number of days after 100% silking of individual plot; early =14 d, mature = 19 d; late = 24 d. Correlations (R) calculated using Pearson's correlation coefficient (n = 9).
[x]Correlations (R) calculated using Pearson's correlation coefficient (n = 27).
*Significant at $P \leq 0.05$.

total sugars at mature harvest than the other *su* cultivars, while 'NK199' had greater total sugars at late harvest than 'Golden Cross Bantam' and 'Jubilee' (Table 6). Like sucrose concentrations, cultivar differences of total sugars existed in *se* cultivar 'Precious Gem', which had higher total sugars at early harvest, but became similar to 'Brocade' and 'Lancelot' with mature and late harvest. These cultivar differences also existed in *sh*$_2$ cultivars with late harvest 'Zenith' and 'ACX904' having the greatest overall total sugars.

Correlations. The relationship between panelists' scores of sweetness and acceptability to sucrose content were R = 0.72 and 0.65, respectively (Table 7). In individual phenotypes, the relationship between panel scores and sugar analysis were nonsignificant, but this relationship was significant with maturities. The relationship of sucrose to sweetness was significant across all maturities, gaining strength with increased maturity. Early harvest had a R = 0.75, while late harvest was R = 0.90. Panel rating of sweetness acceptability and sucrose content were significant only at late harvest.

Total sugars showed a similar trend to sucrose in correlations with taste panel evaluation of sweetness and acceptability, with an overall R of 0.65 and 0.57 (Table 7). Significant relationships within phenotypes did not exist with total sugars and panel evaluations; however, like sucrose, relationships did exist within maturities. Early harvested samples had a R of 0.70 that increased to 0.93 at late harvest between total sugars and panel evaluation of sweetness. The only relationship between panel acceptability scores and total sugars in regards to maturity was late harvest.

Discussion

Panelist evaluation of sweetness, like HPLC analysis of sucrose, determined differences in the sweetness of *su*, *se,* and *sh*$_2$, with *su* receiving the lowest scores for sweetness and while *sh*$_2$ received the highest. Although panelists identified *se* and *sh*$_2$ to be different in sweetness, they found no difference in the sweetness acceptability. This did not correlate with the total sugars. HPLC analysis of total sugars found no difference between *su* and *se* total sugar content. This supports the work of Reyes et al. (1982), who found that the perception of sweetness is closely related to sucrose content. However, Zhu et al. (1992), suggested that a blend of sugars may produce a more preferable sweetness than greater concentrations of individual sugars, suggesting that total sugar content may have more of an effect on the sweetness perception.

Differences existed between early, mature, and late samples, depending on phenotype. According to panel evaluations of sweetness and acceptability, s*h*$_2$ cultivars ranked the highest across the three maturities. Unlike *se* and *su* cultivars, s*h*$_2$ did not decrease in panel evaluation with maturity. *Su* cultivars were sweet only at early harvest; however, this sweetness was not acceptable to panelists. S*e* cultivars were sweet and acceptable at early and mature harvest, but not at late. Sweetness and sweetness acceptability of *sh*$_2$ remained constant among the three maturities, in all cases being comparable to or superior to *se* and *su* cultivars. *Sh*$_2$ did not lose panel quality ratings with maturity nor does it lose sucrose or total sugar concentrations with maturity. This suggests *sh*$_2$ would provide sweet corn growers with a longer harvest window without affecting sweetness and sweetness acceptability, compared to *se* phenotype.

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