Linear correlation analysis revealed a number of interesting relationships that were statistically significant. Both protein (r = -0.44) and oil (r = -0.58) were correlated negatively with starch content. Although yield was correlated negatively with protein content (r = -0.25) and correlated positively with oil content (r = 0.26), the correlation coefficients were relatively small. Examination of the various parameters listed in the table indicates that relatively high-yielding hybrids with relatively high levels of one or more grain quality components can be identified.

More complete agronomic information is available in the 2000 Kansas Performance Tests with Corn Hybrids, which can be obtained from county KSU Extension offices or at *www.ksu.edu/kscpt*. Authors can provide references to other studies.

We thank the cooperators at the Kansas State University experiment fields and research/extension centers for providing the samples.

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GRAIN QUALITY COMPONENTS OF CORN HYBRIDS

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Corn production and utilization in Kansas have increased over the past decade. In 1990, 1.45 million acres of corn were harvested with a reported production of 188.5 million bushels compared with 2000, in which 3.25 million acres were harvested with a total production of 416 million bushels. Market specialization has accompanied market growth in Kansas. Acreage devoted to specialty corns (white, yellow food grade, waxy, high oil, nutrient dense, and high amylose) increased over 40 % nationwide from 1996 to 1999. In Kansas, approximately 126,000 acres of specialty corn were planted during 1999.

Animal feed still represents the predominant end use for Kansas corn, and nutritional properties including protein and oil content represent significant value to end users. A 1% increase in corn protein content over 8% (the typical value entered in least cost formulations) represents an additional $4 to $6 per ton nutritional value to the corn, depending on the price of soybean meal, which it replaces in the animal ration. A 1% increase in corn fat content, which replaces choice white grease at $0.11 per pound, adds an additional $2.20 nutrient value per ton of corn. High starch content provides additional value to wet corn millers. A study at the University of Illinois indicated that corn hybrids possessing 69-72% starch have a $0.06/bu to $0.10/bu higher value than commodity corn.

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Procedures

Several factors can contribute to differences in corn quality, including fertility, weather, and genetics. The Kansas Crop Performance Tests provide an opportunity to evaluate nutritional quality components of a large number of corn hybrids at several locations. Grain samples were obtained from 20 separate tests, 10 in 1997, 5 in 1999, and
5 in 2000: northeast—Severance, Powhattan, Manhattan; east/southeast—Topeka (dryland and irrigated), Ottawa, Erie; north central—Clay Center (irrigated); northwest—Colby (dryland and irrigated), Tribune (irrigated); and southwest—St. John (irrigated). Corn yield, protein, oil, and starch components are reported on a constant moisture basis. Quality components were measured using a Foss Grainspec (Foss North America, Eden Praire, IL) near-infrared whole-grain analyzer.

Two hybrids that were present in every test were used as checks: Pioneer 3162 and Golden Harvest H-2530. At every location, each hybrid was compared to the average of these two check hybrids. These differences were averaged over the total number of tests where the comparisons were made (N) and were used to calculate the standardized values presented. Hybrids are listed in order of decreasing protein percent because of the importance of that component in livestock rations, however, ranking by oil percent, starch percent, yield, or maturity parameters may be just as appropriate for other applications.

Results

Table 1 summarizes grain quality components and some agronomic performance characters for hybrids that were grown in five or more of the sampled tests. Yield, days to half silk, and harvest moisture are included to provide a summary of agronomic performance for comparison purposes.

The corn hybrids displayed rather narrow ranges for the various quality parameters (protein 1.7%, oil 0.7%, starch 1.4%). However, the differences, especially for protein, were large enough to have a potential economic impact for livestock feeders.

Table 1. Kansas corn hybrid grain quality and agronomic performance summary, 1997–2000[1].

Hybrid	Protein (%)	SE[2]	Oil (%)	SE	Starch (%)	SE	Yield (bu/a)	SE	Days to silk	SE	Moisture (%)	SE	N[3]
Patriot 6168	9.1+	0.2	3.2	0.1	61.1-	0.1	152	7.7	80.5+	0.7	18.2+	0.4	5
CropPlan Genetics 818	9.0+	0.1	3.8+	0.1	60.6-	0.2	177+	6.3	79.1	2.0	18.3	0.6	5
Wilson 2330	8.9+	0.2	3.3	0.1	60.7-	0.2	160	9.0	82.2+	2.2	21.2+	0.5	6
Delange DS1997	8.8+	0.1	3.4	0.1	60.8-	0.2	158	4.6	82.1+	1.9	17.8	0.6	8
Cargill 7770	8.7+	0.1	3.4	0.1	61.2-	0.1	171+	2.8	79.1	0.6	17.7+	0.3	14
Asgrow RX740	8.7+	0.2	3.6+	0.1	61.1-	0.2	165	4.0	79.7	1.5	16.3	0.4	8
Pioneer 3237	8.7+	0.1	3.2	0.1	61.5-	0.1	173+	2.6	80.7+	0.9	17.9+	0.4	8
Pioneer 32K61	8.7+	0.2	3.3	0.1	61.5	0.2	175+	5.0	81.1+	1.2	17.3	0.4	8
Garst 8363Bt	8.7+	0.1	3.5	0.1	61.2-	0.2	172	7.1	78.6	1.7	19.2+	0.6	5
Cargill 6997	8.7	0.2	3.6+	0.1	60.8-	0.3	145	6.6	76.3-	2.0	15.9	0.6	5
Midland 798	8.7+	0.1	3.9+	0.1	61.0-	0.3	172	7.9	81.5+	1.4	19.6+	0.8	7
Agsource 7890	8.7	0.2	3.8+	0.2	60.5	0.6	169	6.2	81.0+	1.3	19.8+	0.9	5
Delange DS 1995	8.6	0.3	3.5	0.1	61.1-	0.2	150	13.4	82.3+	1.9	19.6	1.8	5
Cargill 4111	8.6+	0.1	3.4+	0.0	61.2-	0.1	145-	2.9	76.1-	1.3	13.6-	0.5	20
Asgrow RX897	8.6+	0.2	3.5+	0.1	61.1-	0.1	170	5.8	81.2+	0.9	19.8+	1.0	6
Patriot 7197	8.6	0.2	3.5+	0.1	61.4-	0.1	161	4.6	80.4+	1.1	18.7+	0.6	5
Garst 8325	8.6	0.2	3.4	0.1	61.0-	0.2	155	5.4	80.0	0.9	17.7	0.5	5
Asgrow RX889	8.6+	0.1	3.7+	0.1	60.7-	0.3	166+	2.4	80.8+	1.5	19.3+	0.8	8
NK N79- L3	8.5	0.2	3.5	0.1	61.5	0.2	174+	4.9	78.6	1.1	18.9+	0.5	5
Mycogen 7250	8.5	0.2	3.5	0.1	61.1-	0.2	165+	3.2	77.9-	0.5	17.0	0.2	7
Check, Full- Pioneer 3162	8.5+	0.0	3.3	0.0	61.7	0.1	160	2.0	79.0	0.3	18.7+	0.2	20
Golden Harvest H- 2581	8.4	0.2	3.5	0.1	61.1-	0.1	164	4.3	79.7+	0.4	17.5	0.7	7
Hoegemeyer 2649	8.4	0.2	3.6+	0.1	60.9-	0.2	163	4.8	78.5	1.7	16.0-	0.2	5
Asgrow RX799Bt	8.4	0.2	3.5+	0.1	60.9-	0.2	176+	3.7	79.1	1.4	19.3+	0.4	9
Midwest Seed G 8795	8.4	0.3	3.8+	0.1	60.7	0.4	172	7.4	80.6+	0.8	18.8+	0.7	5
Bo-Jac 415	8.4	0.2	3.4	0.2	61.1	0.3	168	6.3	80.4+	0.8	15.9	0.4	6
NC+ 5018	8.4	0.1	3.5	0.2	60.8-	0.2	169	5.8	80.6+	1.1	16.4	0.4	6
NC+ 5445	8.3	0.1	3.5	0.1	61.1-	0.1	166	3.9	79.8+	0.8	17.6	0.5	8
Patriot 7172	8.3	0.3	3.6	0.1	61.2-	0.1	156	8.3	80.8+	1.5	19.5	1.2	5
DeKalb DK641	8.3	0.2	3.4	0.1	61.6	0.2	163	3.9	79.2	0.9	16.8	0.2	7
Mycogen 2888IMI	8.3	0.1	3.7+	0.1	61.1-	0.3	167	5.1	80.4+	0.9	19.1+	0.6	7
DeKalb DK626	8.3	0.2	3.6+	0.1	61.0-	0.1	171+	3.8	79.7	1.0	16.0	0.4	7
DeKalb DK647BtY	8.2	0.1	3.4+	0.0	60.9-	0.1	177+	6.0	80.3+	1.4	17.9+	0.4	7
Midland 786	8.2	0.1	3.8+	0.2	60.6-	0.3	178+	6.4	81.3+	1.6	18.8+	0.4	9
Cargill 8311	8.2	0.2	3.6+	0.1	61.3-	0.1	177+	6.1	81.2+	1.2	19.1+	0.6	9
Asgrow RX813	8.1	0.1	3.5+	0.1	61.5-	0.1	165+	2.6	80.6+	0.7	18.1+	0.5	10
Pfister 3049	8.1	0.2	3.8	0.3	60.6	0.5	168+	3.4	80.4+	0.7	18.1+	0.4	5
Bo- Jac 544	8.1	0.1	3.3	0.0	61.6-	0.1	157	3.3	80.4+	0.8	15.9-	0.2	6
Garst 8366	8.1	0.1	3.5+	0.1	61.2-	0.1	164	3.6	79.7	1.0	16.3	0.2	6
Mycogen 2725	8.1	0.1	3.5+	0.1	61.5-	0.1	161	3.2	77.8	1.8	16.3	0.2	8
Cargill 8011	8.1	0.2	3.4	0.1	61.3-	0.1	156	5.6	80.9+	0.9	17.3	0.5	9
Bo- Jac 614	8.0	0.1	3.5+	0.1	61.4	0.3	172+	4.2	81.6+	0.8	19.0+	0.2	6
Asgrow RX730YG	8.0	0.1	3.4	0.1	61.5	0.2	174	8.0	78.3	1.2	17.4	0.4	5
AgriPro AP 9565	8.0	0.2	3.4+	0.0	61.8	0.2	161	4.0	75.8-	1.3	16.3-	0.1	5
NC+ 4880	7.9	0.1	3.4	0.1	61.6	0.1	168+	2.2	77.5-	1.1	15.9	0.3	7
Midland 774	7.9	0.1	3.5	0.1	61.3	0.2	169+	3.5	80.5+	0.9	17.4	0.4	5
Check, Mid–GH H-2530	7.9-	0.0	3.2	0.0	61.8	0.1	155	2.0	78.8	0.3	14.7-	0.2	20
Pfister 3977	7.9	0.1	3.8+	0.1	60.4-	0.4	178+	4.2	79.0	1.1	19.9+	0.9	5
Cargill 6888	7.8-	0.1	3.5	0.1	61.5	0.2	170+	3.9	77.7	1.4	16.1	0.4	6
Midwest Seed G 7711	7.7-	0.2	3.5	0.1	61.7	0.2	169	6.5	78.1	1.3	16.6	0.4	6
Mycogen 2833	7.7	0.2	3.5	0.1	61.4	0.2	180+	5.5	77.2-	1.2	16.8	0.4	5
Maturity Check, Short-G8590	7.4-	0.1	3.7	0.2	61.6	0.3	166	3.2	77.9	0.9	15.9-	0.2	5

1 Average performance standardized to mean of check hybrids. Grain protein, oil, starch, and yield adjusted to 15% moisture.

[2]SE Standard Error of standardized mean estimates; measure of consistency.

[3]N Number of comparisons with checks; mean estimates were calculated only for those with at least 5 comparisons.

\+ Statistically significantly higher than the mean of the check hybrids ($P < 0.5$).

– Statistically significantly lower than the mean of the check hybrids ($P < 0.5$).