Crop Yield Improvements Over the Last 50 Years as Measured by Southwest Kansas Crop Performance Results

John Holman, Curt Thompson, and Alan Schlegel, Agronomy Department, Southwest Research Extension Center, Kansas State University

"Knowledge for Life"

INTRODUCTION

A primary objective in Agronomy is to increase crop yields through improved varieties/hybrids and production practices. Crop variety/hybrid performance tests of irrigated corn, irrigated wheat, dryland wheat, irrigated grain sorghum, dryland grain sorghum, and irrigated soybeans were conducted at the Southwest Research Extension center in Garden City, Kansas annually over the last 50 years. This historical data set allows us to determine the average annual yield increase from improved crop genetics and production practices.

METHODS

For each crop, the varieties/hybrids yields were averaged for each year from 1956 through 2006. These trial averages were regressed against year to measure the level of crop yield improvement throughout the last 50-year period.

RESULTS

The greatest crop improvement has clearly occurred in irrigated corn. During this time period irrigated corn yields increased 2.2 bu/acre annually (P≤0.0001). Corn yields increased primarily through improved corn hybrids. Corn yields were also increased through improved fertility management, weed control practices, insect resistance, and increased plant populations. Irrigated and dryland wheat yields increased 0.28 and 0.25 bu/acre annually (P≤0.07) from varieties with reduced lodging, earlier maturity, increased disease resistance, and improved yield potential. Wheat yields were highly variable throughout the 50-year time period due to environmental conditions. Hot temperatures during grain fill, spring time freezes, rust, and hail reduce and cause significant year to year yield variation. In addition, seasonal precipitation variation contributes to yield variability observed in dryland wheat varieties. These environmental challenges likely mask some of the yield improvements made in wheat varieties. Irrigated grain sorghum has consistently yielded an average of 121 bu/acre, and dryland grain sorghum yield increased 0.67 bu/acre annually (P≤0.001). Sorghum yields were improved through varieties with reduced lodging and improved yield potential, and better production practices. Sorghum harvested early on in variety trials likely harvested lodged plants that producers were unable to harvest, thus irrigated sorghum producer yields have likely increased since 1955 do to more of the total crop being collected. Irrigated group II and III soybeans have increased 0.22 bu/acre annually (P≤0.06) from varieties with higher yield potential and greater tolerance to iron chlorosis. Irrigated group IV soybeans were evaluated between 1984 and 2001 and averaged 51 bu/acre during that time. Variety/hybrid performance tests have and will continue to assist producers make decisions of what varieties or hybrids to plant.

CROP YIELD TRENDS

Figure1. Irrigated Corn

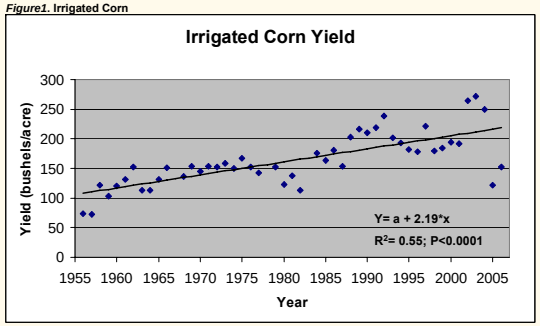


Figure 2. Irrigated Wheat

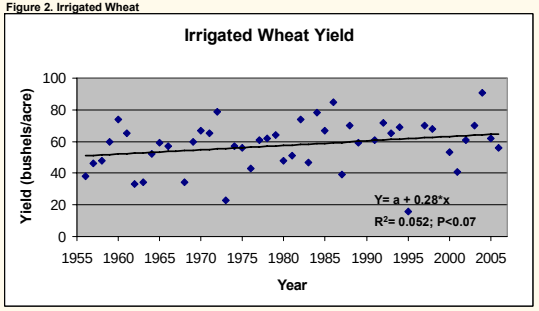


Figure 3. Dryland Wheat

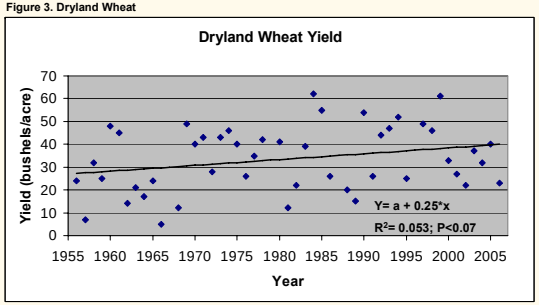


Figure 4. Irrigated Sorghum

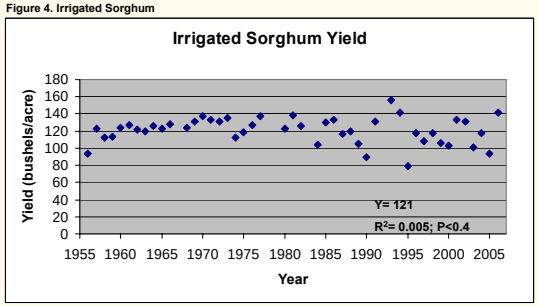


Figure 5. Dryland Sorghum

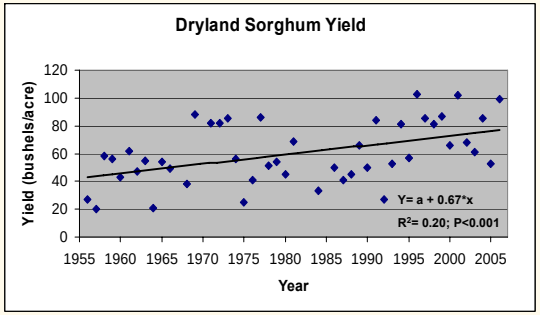


Figure 6. Irrigated Group II and III Soybean

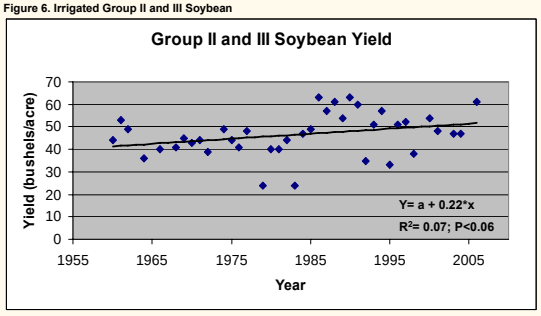
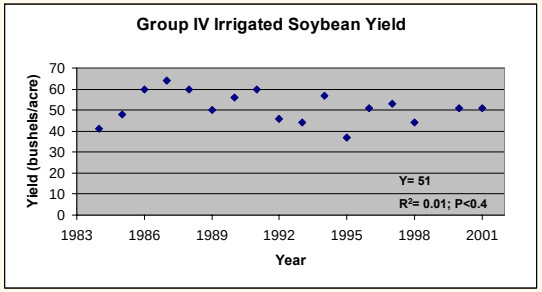
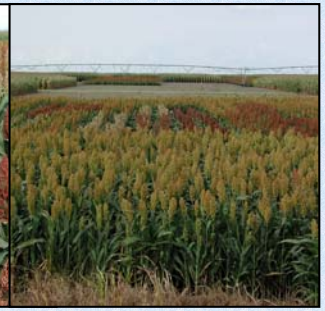


Figure 7. Irrigated Group IV Soybean





HISTORICAL WEATHER DATA

Table1. Historical Precipitation Data for Garden City and Tribune.

Year	Garden City	Tribune	Year (continued)	Garden City	Tribune
1950	19.35	15.19	1979	20.97	16.52
1951	29.02	25.37	1980	16.21	20.51
1952	10.29	9.59	1981	17.41	15.20
1953	13.99	12.37	1982	20.71	18.91
1954	15.15	12.11	1983	15.81	15.54
1955	19.73	8.96	1984	16.25	19.29
1956	6.54	9.36	1985	19.72	15.29
1957	21.36	17.12	1986	15.23	15.59
1958	28.37	30.06	1987	20.43	21.80
1959	18.07	12.54	1988	11.52	15.64
1960	16.63	11.52	1989	19.54	16.39
1961	19.39	15.23	1990	18.76	16.48
1962	18.64	16.74	1991	20.70	20.55
1963	15.88	9.87	1992	20.58	19.82
1964	12.23	12.49	1993	24.78	20.67
1965	27.70	18.02	1994	18.94	18.76
1966	12.08	14.09	1995	22.26	18.64
1967	22.94	19.69	1996	19.25	21.88
1968	15.35	12.49	1997	24.82	24.72
1969	27.48	25.40	1998	22.19	17.49
1970	14.97	11.29	1999	21.80	21.38
1971	17.90	13.37	2000	17.72	15.37
1972	26.82	18.81	2001	20.67	13.74
1973	17.06	18.32	2002	11.99	10.01
1974	11.86	10.21	2003	17.65	16.71
1975	15.71	11.15	2004	24.69	26.30
1976	11.36	8.75	2005	18.15	18.99
1977	21.10	15.56	2006	22.71	19.38
1978	15.82	19.95	*Average*	*18.03*	*15.02*

DISCUSSION/SUMMARY

- Irrigated corn yields increased 2.2 bu/acre annually (Figure 1).
- Irrigated wheat yields increased 0.28 bu/acre annually (Figure 2).
- Dryland wheat yields increased 0.25 bu/acre annually (Figure 3).
- Irrigated sorghum yields were unchanged and averaged 121 bu/acre (Figure 4). Although irrigated sorghum yields were not increased, lodging was reduced and producers have increased the amount of crop they harvest.
- Dryland sorghum yields increased 0.67 bu/acre annually (Figure 5).
- Irrigated group II and III soybean yields increased 0.22 bu/acre annually (Figure 6).
- Irrigated group IV soybeans were unchanged and averaged 51 bu/acre between 1984 and 2001 (Figure 7).
- Crop yields are highly variable throughout the 50 year time period due to environmental conditions. Hot temperatures during grain fill, spring time freezes, rust, and hail reduce and cause significant year to year yield variation. In addition, seasonal precipitation variation contributes to yield variability observed in dryland yields (Table 1).
- Environmental challenges likely mask some of the yield improvements made in crop hybrids/varieties.

REFERENCES

1. Annual field day reports for the Southwest Research Extension Centers in Garden City and Tribune.
2. Historical weather records from Kansas State University Agronomy Department, Mary Knapp State Climatologist

CURRENT RESEARCH

Current research is compiling historical yield data for Tribune. Once the data is compiled, yield data for Garden City and Tribune will be evaluated to determine the impact of precipitation during the preceding fallow period and crop growth on yield variability. Long-term historical yield and weather data might allow us to estimate crop yield from precipitation obtained during the preceding fallow period. Being able to estimate crop yield from moisture received before the crop is planted will be a tool for making management decisions.