Keeping Up With Research 128

PERFORMANCE OF WHEAT VARIETY BLENDS IN KANSAS

R. Bowden[1], J. Shroyer[2], K. Roozeboom[2], M. Claassen[2], P. Evans[3], B. Gordon[2], B. Heer[2], K. Janssen[2], J. Long[4], J. Martin[5], A. Schlegel[6], R. Sears[7],and M. Witt[6]

Wheat variety blends are mixtures of seed of two or more pure varieties. In Kansas, blends have recently increased in popularity and occupied 7% of the wheat acreage in 2001. Only the varieties Jagger and 2137 were planted on more acres. Several potential advantages and disadvantages of blends have been identified.

The first advantage of blends is stabilization of yields. All varieties have some weaknesses that cause fluctuations in yield. A variety might be very susceptible to a disease or insect, it might respond poorly to drought stress, or it might be prone to winter injury. Combining several different varieties with complementary strengths is a way to reduce the yield fluctuations associated with any particular variety. This stability effect is not unique to blends; the same result can be achieved by growing several different varieties in different fields.

A second advantage of blends is the compensation effect. A strong variety may be able to compensate for a weak or injured variety by producing more tillers, bigger heads, or

Kansas State University
Agricultural Experiment Station and
Cooperative Extension Service

heavier kernels. This effect operates only between neighboring plants, so it cannot occur when varieties are grown in separate fields. Blending varieties with different genetic backgrounds should increase the chances of compensation.

The third potential advantage is reduction in disease or pest pressure. According to the literature, this can occur when varieties with different types of genetic resistance are combined. For any particular disease or pest, the resistant members of the blend may shield the susceptible members from spread within the crop canopy. The susceptible members are also farther apart than in a pure stand, so a dilution effect may occur as diseases or pests are transported between susceptible plants.

Mixing the seed is a major disadvantage with blends because of the added time and cost involved in mixing. Many producers don't have the grain handling equipment to do this easily. Also, because the proportions of a blend likely will shift during each growing season, producers might need to remix blends annually, further adding to the time and cost involved.

Another potential disadvantage is variety incompatibility. If early and late varieties are blended, the early varieties may shatter before the late varieties are ready to harvest. If tall and short varieties are mixed, too much straw may be forced through the combine at harvest.

The third potential disadvantage is the lost opportunity to manage varieties separately. If varieties are grown in separate fields, a variety with winter injury can be torn up and planted to a summer crop. If all fields are planted with blends, the injured variety cannot be eliminated. Segregating high protein grain to capture quality premiums would also be more difficult with blends. Likewise, producers often spread their harvest dates by planting varieties with different maturities. That may be harder to achieve with blends.

In order to weigh these advantages and disadvantages, producers must know how blends actually perform in the field. Because innumerable combinations of varieties are possible, performance testing of all blends is not feasible. The objective of this research was to test the performance of several wheat variety blends over several locations and years in order to develop some general recommendations for blending wheat varieties.

Table 1. Blend codes and component varieties of hard red winter wheat.

Blend Code	Varieties
BC1	Karl 92, 2163, Tomahawk
BC2	Karl 92, 7853, 2180
BC3	2163, Pecos, 2172
BC4	Jagger, Tomahawk, 2137
BNE3	7853, Champ, 2163
BNW1	TAM 107, 2163, 7853
BNW2	TAM 107, Vista, Ike
BNW3	Larned, Ike, Arapahoe
BNW4	9001, 7853, Jagger
BNW5	Jagger, TAM 107, 2137
BSW1	Ike, TAM 107, 7805
BSW2	TAM 107, Larned, Tomahawk
BSW3	Ike, Ogallala, TAM 107

Procedures

Blends were prepared by mixing equal proportions of certified seed of three different varieties of hard red winter wheat in a cement mixer. Blends included varieties adapted to different areas of the state (Table 1) and were grown at most locations of the Kansas wheat variety performance tests from 1994-1997. Experiments were arranged in a randomized complete block design with four replications. Plots were 5 feet wide by 15-30 feet long, depending on location. All of the locations were dryland and prior to wheat had been fallow or planted to a rotational crop such as oats or soybean.

For each location and year (location-year), yields were standardized by subtracting the average yields of six check varieties (2137, 2163, 7853, Jagger, Karl 92, and TAM 107) from the yield of each blend or variety. Standardized yield means and standard deviations were calculated separately for eastern (Brown, Franklin, Harvey, Labette, Reno, Republic, Riley, and Sumner counties) and western (Ellis, Finney, Greeley, and Thomas counties) locations. Blends that were tested in fewer than four location-years were not included in this analysis.

The advantage of blends over their components was calculated by subtracting the average yields of the three component varieties from the yield of the blend for each location-year. All blends and location-years were included in this analysis for a total of 100 comparisons.

Results

The relative yield performances of blends and varieties are presented in Fig. 1. Some blends such as BC3 and BNW1, were below average. Other blends, such as BC4 and BNW5, were above average in yield potential.

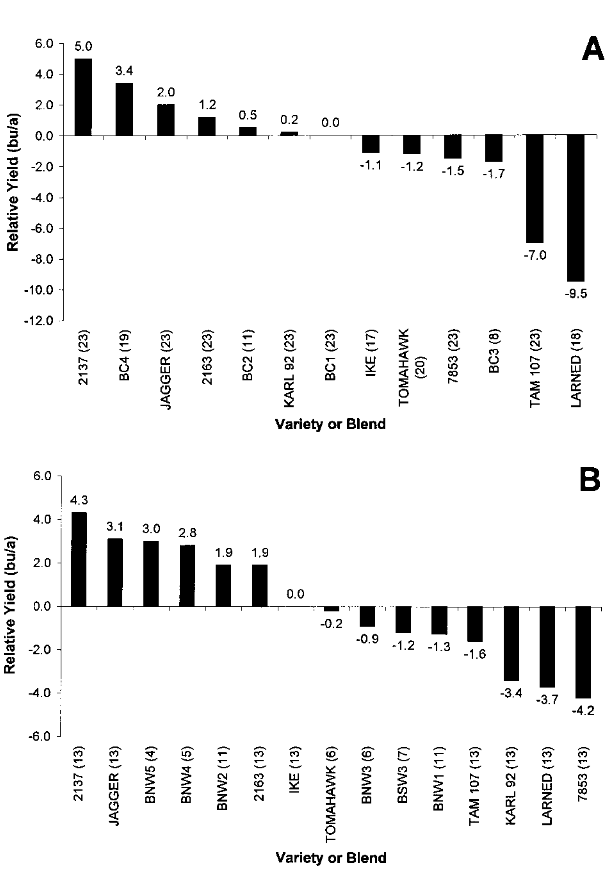

Fig. 1. *Yield advantages of wheat blends and varieties over the averages of six check varieties for A) eastern locations and B) western locations in Kansas. Numbers of location-years for each value are shown in parentheses.*

The variability in yields, expressed as the standard deviation, is illustrated in Fig. 2. At eastern locations, blends always had the least variability, whereas 2137 and Jagger had the most. For Jagger, the large standard deviation was due mostly to very poor performance in a few instances. For 2137, it was due mostly to very good performance in the same instances. At western locations, variability was lower, but blends again had less variability than varieties, with the exception of 2137, which also had low variability.

The frequency distribution of the advantage of blends over the average of their components is presented in Fig. 3. The average advantage was 0.85 bu/a, and that was statistically different from zero (P = 0.005). The median

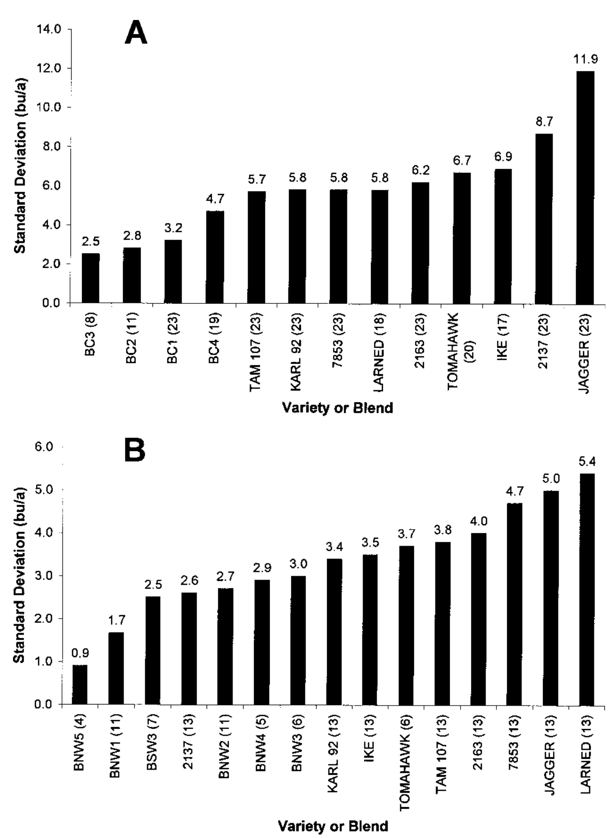

Fig. 2. *Standard deviations of wheat blends and varieties for A) eastern locations and B) western locations in Kansas. Numbers of location-years for each value are shown in parentheses.*

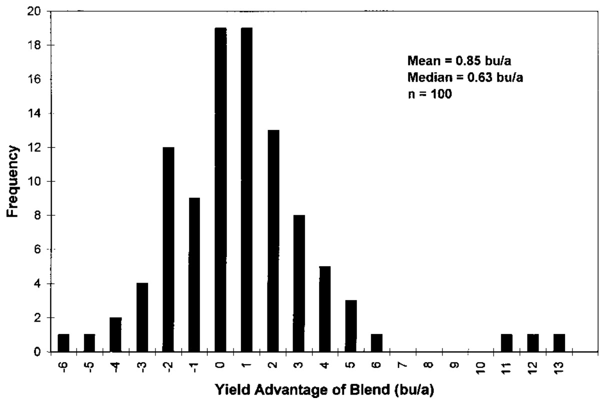

Fig. 3. *Frequency distributions of the yield advantages of wheat blends over the averages of their components.*

(50th percentile) was 0.63 bu/a, which indicates that the distribution was slightly skewed to the positive side. A sign rank test confirmed that the blend advantage was more often positive than negative (P = 0.006).

Three observations showed a large advantage for blends (11, 12, 13 bu/a) over their components. The performances of these blends and their components are shown in Table 2. Two cases where blends showed a large advantage were due to compensation for freeze injury in Harvey County in 1996. Extra spring tillering by the hardier varieties (2137, Karl 92) compensated for the injured varieties (Jagger, 2180, 7853, Tomahawk). The third case occurred in Franklin County in 1997 and again was due to compensation for Jagger, which apparently suffered from freeze injury in early spring.

Discusssion

Wheat variety blends varied in yield performance. Some blends performed competitively with 2137 and Jagger, which were the two best varieties at both eastern and western locations. The best blends tended to have 2137 and Jagger as components. Blends of mediocre varieties produced mediocre yields. Therefore, producers should blend only high yielding varieties.

Blends tended to have more stable yields than pure varieties. Yield stability may help avoid the hardship experienced when a “race horse” variety stumbles. The more stable yields also may be useful in managing land owned by different landlords. Rather than one landlord getting the best variety, and one getting the worst, they

Table 2. Performance of wheat blend components in three cases where blends had a large advantage.

Location and Year	Blend Code/Components	Yield (bu/a)	Winter Survival %	Tillers/meter
Harvey 1996	BC2	43.2	26.3	71.5
	Karl 92	57.3	88.8	119.0
	7853	26.8	6.3	27.1
	2180	13.6	2.8	22.8
		32.6 avg	32.6 avg	56.3 avg
Harvey 1996	BC4	51.0	38.8	70.6
	Jagger	6.3	1.0	4.0
	Tomahawk	43.7	28.8	54.3
	2137	67.1	92.5	102.8
		39.0 avg	40.8 avg	53.7 avg
Franklin 1997	BC4	77.7	ND*	ND
	Jagger	42.3	ND	ND
	Tomahawk	68.7	ND	ND
	2137	83.1	ND	ND
		64.7 avg	ND	ND

*ND = Not done.

both can share a high and stable yield with certain blends. For example, BC4 achieved yield performance at least as good as that of Jagger, but with less than half the variability.

On average, blends had a yield advantage of less than 1 bu/a over their component varieties. This difference was statistically significant, but may not be economically significant. Biggest responses were noted when differential injury allowed compensation to occur. This can happen when the differential injury occurs early enough in the season to allow time for extra tillering, bigger heads, or heavier kernels. Stand establishment problems, winterkill, and early spring freezes are situations where blends might be able to compensate for an injured variety.

Compensation will not necessarily occur just because varieties yield differently. In Republic County in 1997, Jagger yielded 57 bu/a, Tomahawk yielded 72 bu/a, 2137 yielded 87 bu/a, and the blend yielded 74 bu/a. The component average was 72 bu/a so little or no compensation occurred. The reason for Jagger's relatively poor yield is unknown. However, differential stress that occurs late in the season might not allow time for compensation. Likewise, injury that affects yield without affecting plant size, such as a late frost that causes sterility, might not allow compensation.

When the three cases of a large compensation effect were removed from the data set, the blends still had a small but significant advantage (data not shown). This residual advantage could have been due to disease suppression or to more subtle compensation effects. More research is needed to clarify how and when these effects occur.

Although data are not shown here, test weights of blends were about equal to the average test weight of blend components. In rare cases, blends could help avoid a discount if one variety has a low test weight.

Conclusions

1. On average, wheat blends yielded 0.85 bu/a more than their component varieties. Under some conditions, such as differential winterkill, tolerant varieties can compensate for injured varieties and result in a large advantage for blends.
2. Blends had more stable yields than pure varieties. This property may be useful in managing land owned by several different landlords.
3. Wheat varieties for blends should be chosen carefully. Only high yielding varieties should be blended. Known weaknesses in one variety should be complemented by known strengths in other components. Closely related varieties should not be blended because they will tend to share the same weaknesses. Large differences in maturity and height should be avoided.
4. Producers should consider remixing blends annually to avoid shifts in blend proportions.
5. Blends have several disadvantages including the time and cost of mixing seed and the loss of opportunities to manage varieties individually.

Acknowledgments

Financial support of this work by the Kansas Wheat Commission and the Finnup Foundation is gratefully acknowledged.

[1]Department of Plant Pathology, [2]Department of Agronomy, [3]Northwest Research- Extension Center, [4]Southeast Agriculture Research Center, [5]Agricultural Research Center-Hays, [6]Southwest Research-Extension Center, [7]Agripro Biosciences, Inc., Junction City, KS.

Contribution no. 01-176-S from the Kansas Agricultural Experiment Station.

Kansas State University
Agricultural Experiment Station
and Cooperative Extension Service
Manhattan, Kansas

SRL 128 March 2001