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Performance of Wheat Variety Blends in Kansas

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Performance of Wheat Variety Blends in Kansas

**Keywords**
Keeping up with research; 46 (April 1980); Kansas Agricultural Experiment Station contribution; no. 80-313-S; Wheat variety blends; Blends; Performance; Kansas

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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 discount if one variety has a low test weight. Although data are not shown here, test weights of 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. Clearly 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

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Department of Plant Pathology, Department of Agronomy, Northwest Research Extension Center, Southeast Agriculture Research Center, Agricultural Extension-Hays, Southwest Research-Extension Center, AgriPro Biosciences, Inc., Junction City, KS.

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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 often farther apart than in a pure stand, so a dilution effect may occur as diseases or pests are transported between susceptible plants.

Another potential disadvantage is variety incompatibility. If early and late varieties are blended, the early varieties may suffer from freeze injury in early spring. 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 BNW3, were above average. Nevertheless, the advantage was 0.85 bu/a, and that was statistically different from zero (P = 0.005). The median advantage 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).

There 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.

Discussion

Wheat variety blends vary 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 medicated varieties produced medicated yields. Therefore, producers should check their yield-varieties.

Blends tended to have more stable yields than pure varieties. Yuletability may help avoid the hardship experienced when a “race to the bottom” occurs. 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 would like to have blends that perform well on average.
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. Because innumerable combinations of varieties are involved, performance testing of all blends is not feasible. To weigh these advantages and disadvantages, 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 varieties are grown in separate fields, blends will shift before the late varieties are ready to harvest. If tall varieties (2137, Jagger, TAM 107) are mixed in a cement mixer at harvest. Blends included varieties adapted to eastern (Brown, Franklin, Harvey, Labette, Reno, Republic, Riley, and Sumner counties) and western (Ellis, Finney, Greeley, and Thomas counties) locations. Plots were 5 feet wide by 15-30 feet long, depending on location and variety. Yields were standardized by subtracting the average yields of six check varieties from 1994-1997. Experiments were arranged in a randomized complete block design with four replications. Procedures

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

<table>
<thead>
<tr>
<th>Blend Code</th>
<th>Varieties</th>
</tr>
</thead>
<tbody>
<tr>
<td>BC1</td>
<td>Karl 92, 2163, Tomahawk</td>
</tr>
<tr>
<td>BC2</td>
<td>Karl 92, 7853, 2180</td>
</tr>
<tr>
<td>BC3</td>
<td>2163, Pecos, 2124</td>
</tr>
<tr>
<td>BC4</td>
<td>Jagger, Tomahawk, 2137</td>
</tr>
<tr>
<td>BNW3</td>
<td>7853, Champ, 2163</td>
</tr>
<tr>
<td>BNW1</td>
<td>TAM 107, 2163, 7853</td>
</tr>
<tr>
<td>BNW2</td>
<td>TAM 107, Vista, Ike</td>
</tr>
<tr>
<td>BNW3</td>
<td>Larned, Ike, Arapahoe</td>
</tr>
<tr>
<td>BNW4</td>
<td>9001, 7853, Jagger</td>
</tr>
<tr>
<td>BNW5</td>
<td>Jagger, TAM 107, 2137</td>
</tr>
<tr>
<td>BSW1</td>
<td>Ike, TAM 107</td>
</tr>
<tr>
<td>BSW2</td>
<td>TAM 107, Larned, Tomahawk</td>
</tr>
<tr>
<td>BSW3</td>
<td>Ike, Ogala, TAM 107</td>
</tr>
</tbody>
</table>

The advantage of blends over their component varieties 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.

The relative yield performances of blends and varieties are presented in Fig. 1. Some blends such as BC3 and BNW4, were below average. Other blends, such as BC4 and BNW5, were above average. Blends always had the least variability, whereas 2137 and Jagger had the most. For 2137, the large standard deviation was due to compensating for 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 be wary of 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

Discussion

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Results

The relative yield performances of blends and varieties are presented in Fig. 1. Some blends such as BC3 and BNW4, were below average. Other blends, such as BC4 and BNW5, were above average. Blends always had the least variability, whereas 2137 and Jagger had the most. For 2137, the large standard deviation was due to compensating for Jagger, which apparently 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 be wary of high yielding varieties.

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Results

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The third potential advantage is reduction in disease or pest pressure. Because innumerable combinations of varieties are spread their harvest dates by planting varieties with different maturities. That may be harder to achieve with blends. Likewise, producers often high protein grain to capture quality premiums would also be more difficult with blends. Likewise, producers often 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 to spread within the crop canopy. The susceptible 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 transmuted 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.

The third potential disadvantage is the lost opportunity to get the best variety, and one getting the worst, they may produce mediocre yields. Therefore, producers should blend only high yielding varieties.

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 only high yielding varieties.

BLENDS always had the least variability, whereas 2137 and Jagger had the most. For Jagger, the large standard deviation was due mostly to very good performances 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. 2. A sign rank test confirmed that the blend advantage was more often positive than negative (P = 0.006). The observed advantage was 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.

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BLENDS tended to have more stable yields than pure varieties. Yield stability may help avoid the hardship experienced with a “race to the bottom” with all varieties. 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.

<table>
<thead>
<tr>
<th>Location and Year</th>
<th>Blend Code/Components</th>
<th>Yield (bu/a)</th>
<th>Winter Survival %</th>
<th>Tillers/meter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Harvey 1996</td>
<td>BC2</td>
<td>43.2</td>
<td>26.3</td>
<td>71.5</td>
</tr>
<tr>
<td></td>
<td>Karl 92</td>
<td>37.3</td>
<td>88.8</td>
<td>119.0</td>
</tr>
<tr>
<td></td>
<td>7853</td>
<td>26.8</td>
<td>6.3</td>
<td>27.1</td>
</tr>
<tr>
<td></td>
<td>2180</td>
<td>13.6</td>
<td>2.8</td>
<td>22.8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>32.6 avg</td>
<td>32.6 avg</td>
<td>56.3 avg</td>
</tr>
<tr>
<td>Tomahawk 1997</td>
<td>BC4</td>
<td>51.0</td>
<td>38.8</td>
<td>70.6</td>
</tr>
<tr>
<td></td>
<td>Jagger</td>
<td>6.3</td>
<td>1.0</td>
<td>4.0</td>
</tr>
<tr>
<td></td>
<td>2137</td>
<td>43.7</td>
<td>28.8</td>
<td>54.3</td>
</tr>
<tr>
<td></td>
<td>64.7 avg</td>
<td>40.8 avg</td>
<td>53.7 avg</td>
<td></td>
</tr>
<tr>
<td>Jagger 1997</td>
<td>BC4</td>
<td>77.7</td>
<td>ND</td>
<td>ND</td>
</tr>
<tr>
<td></td>
<td>Jagger</td>
<td>42.3</td>
<td>ND</td>
<td>ND</td>
</tr>
<tr>
<td></td>
<td>Tomahawk</td>
<td>68.7</td>
<td>ND</td>
<td>ND</td>
</tr>
<tr>
<td></td>
<td>2137</td>
<td>83.1</td>
<td>ND</td>
<td>ND</td>
</tr>
<tr>
<td></td>
<td></td>
<td>64.7 avg</td>
<td>ND</td>
<td>ND</td>
</tr>
</tbody>
</table>

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. Bigger 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 extra tillering, bigger heads, 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 analysis, this difference still had a small but significant advantage (data not shown). This residual advantage could be due to disease suppression or to some 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. Clearly 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

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Poor yield is unknown. However, differential stress that compensation occurred. The reason for Jagger's relatively lower yield was because only 87 bu/a, and the blend yielded 74 bu/a. The varieties yield differently. In Republic County in 1997, Compensation will not necessarily occur just because the differential injury occurs early enough in the season to allow time for extra tillering, bigger heads, or biomass. 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 have poor test weight. A second advantage of blends is the compensation effect. A strong variety may be able to compensate for a weak or 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 2137 bu/a so little or no compensation occurred. The reason for Jagger's relatively low 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.

On average, blends had a yield advantage of less than 1 bu/a over their component varieties. This difference, although statistically significant, may not be economically significant. Bigger 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 biomass. Stand establishment problems, winterkill, and early spring freezes are situations where blends 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 be 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. A second advantage of blends is the compensation effect. A strong variety may be able to compensate for a weak or 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 2137 bu/a so little or no compensation occurred. The reason for Jagger's relatively low 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.

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