

Refining Soil Test Recommendations for Wheat

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Objectives:

1. Test the performance of current University of Missouri soil test recommendations for predicting wheat response to P and K in a statewide network of experiments.
2. Explore the possibility that subsoil test values, soil type, or soil region could be used to improve our fertilizer recommendations and make them more site-specific.
3. Evaluate wheat response to S in Missouri, and evaluate factors (including soil test values) that might help predict where responses to S are likely.

Methods:

- Experiments were carried out alongside an existing statewide network of wheat variety trials conducted by the University of Missouri in 2000-2001 and again in 2001-2002. Variety testing personnel planted and harvested the experiments.
- Five experiments were conducted each year, however two of the experiments were not harvested in 2001—one was abandoned in early spring due to poor stand, and a second location was abandoned at harvest due to poor stand. Planting dates were slightly late for the 2000 experiments (Oct. 20 to Nov. 1), and with a very early and cold fall in 2000, the wheat had very little fall growth and in some cases did not emerge until late winter.
- Experiments were distributed across the wheat-growing areas of Missouri (Figure 1).
- Fields used in 2002 were different than fields used in 2001, but were on the same farms.
- P, K, and S fertilizers were hand-applied to separate plots at rates of 80 lb P₂O₅, 80 lb K₂O, and 20 lb S/acre. These rates should be high enough to produce full yield response.
- Two unfertilized check plots were used in each replication.
- Five replications were used.
- Soil samples were taken at depths of 0 to 6, 6 to 12, 12 to 24, and 24 to 36 inches in each experiment and analyzed for pH, P, K, and S.
- Roane wheat was used at all locations.
- Soil series for the Bradford location was Mexico silt loam; for the Trenton location was Grundy silt loam; for the Novelty location was Kilwinning silt loam; for the Mount Vernon location was Gerald silt loam in 2000-2001, and Crelton silt loam in 2001-2002; and for the Portageville location was Tiptonville silt loam in 2000-2001 and Dubbs silt loam in 2001-2002.

Missouri wheat fertility experiments 2001-2002

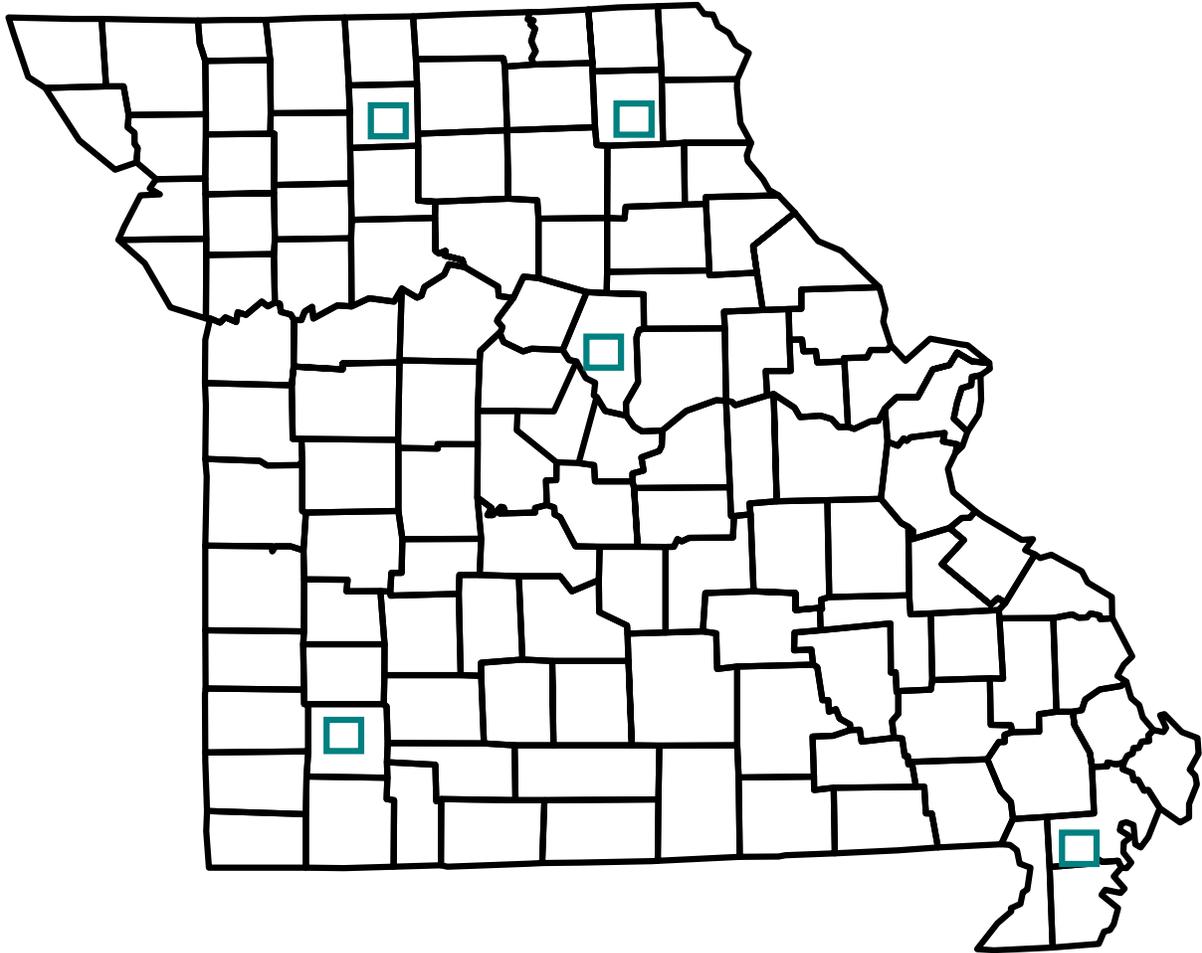


Figure 1. Locations of wheat fertility experiments in 2000-2001 and 2001-2002. All five locations had experiments both years, but the Columbia and Novelty locations were not harvested in 2001 due to poor stands.

Results:

- Average yield across all locations was 42 bu/acre in 2001, and 58 bu/acre in 2002. There were several experiments with outstanding yields, and several with disappointing yields. Overall, these yield levels are about the same as the state average over the past five years.
- Soil test levels were well-maintained for P and adequately maintained for K.
 - Of the eight experiments that were harvested, soil test P was medium in 2 fields and high in 6 fields according to MU soil test interpretations.
 - Soil test K was low in 1 field, medium in 6 fields, and high in 1 field.
 - These soil test levels would suggest minimal chance for yield response to P, but some chance for yield response to K if MU soil test interpretations are accurate for the soils in these experiments.
- Only one of three locations harvested in 2001 had statistically significant (90% confidence) yield response to fertilizer treatments (Table 1). This was at the Mt. Vernon site, where responses to both K (4 bu/acre) and S (5 bu/acre) were observed.
- Of the five experimental locations harvested in 2002, yield responses to fertilizer were seen at Portageville (K and S), at Bradford (K), and possibly at Novelty (P).

Response to P

- Averaged over all eight locations, there was no yield response to P.
- Only one of eight locations showed any evidence of a positive yield response to P. The P treatment increased yield by 3 bu/acre at the Novelty 2002 experiment with 82% confidence. Soil test P (Bray 1) was 40 lb/acre in this experiment, which is at the high end of the medium range, but the second-lowest P value out of the eight sites.
- Lack of response to P was not surprising, since six of the eight locations had soil test P in the high category, and the other two locations were in the medium category.
- At Mt. Vernon, 2002 yields were significantly reduced in the plots receiving P. This is probably because the plots that received P were farther along in flower development when hard freezes hit in late April of 2002.
- Soil test P was not a significant predictor of the yield difference between check plots and P-fertilized plots. This was true for both Bray 1 and Bray 2 soil P tests, and for both normal and deep samples. It appears that current University of Missouri recommendations for P are high enough to support good wheat yields (at the sites where good yields were obtained). Wheat is thought to require higher phosphorus levels than other grain crops (to support good fall growth).
- These experiments can't answer the question of whether current University of Missouri recommendations for P are higher than is economically optimum for wheat production.

Response to K

- Averaged over all eight locations, there was a 1.5 bu/acre yield response to K (91% confidence). This makes sense, since 7 of 8 locations tested low or medium for K.

- Statistically significant responses (>90% confidence) to K were seen at three locations out of eight :
 - Bradford 2002, 3 bu/acre response, soil test was low (138 lb K/acre)
 - Portageville 2002, 3 bu/acre response, soil test was medium (222 lb K/acre)
 - Mt. Vernon 2001, 4 bu/acre response, soil test was medium (216 lb K/acre)
 - These were the three locations with the lowest values for soil test K
- Soil test K was related to yield response.
 - It was a significant (95% confidence) predictor of the yield difference between check plots and K-fertilized plots. When soil test was low, K response was higher. For the three locations with soil test potassium < 230 lb/acre, average yield response to K was 3.5 bu/acre.
 - When soil test potassium was above 230 lb/acre, little or no yield response was seen.
 - This definitely shows that current University of Missouri recommendations for K are high enough to support good wheat yields.
 - These experiments can't answer the question of whether current University of Missouri recommendations for K are higher than is economically optimum for soybean production.
 - Soil test K from deep samples was no better at predicting yield response to K than normal samples.

Response to S

- Averaged over all eight locations, there may have been a 2 bu/acre yield response to S (84% confidence).
- The largest and clearest response to S was at Portageville in the 2001-2002 season, when S treatment increased yield by 8 bu/acre with 99.9% confidence. This experiment had the lowest value for soil test S among all the experiments. The soil test from the Portageville 2000-2001 experiment also showed low S levels, but no yield response to S was seen that year; however, yields were very low, so not much S would have been required.
- A statistically significant response (97% confidence) to S was also seen at the Mt. Vernon location in the 2000-2001 season. However, the high soil test value for S and the high subsoil S at this location suggest that the yield response to S might not be real.
- There was weak evidence that soil test S was useful for identifying where yield response would occur, but only for deep samples. Soil test S to a 24" depth was a weak predictor of the yield difference between check plots and S-fertilized plots (77% probability). The two locations with the largest yield differences (Portageville 2002 and Trenton 2001) also had low soil test S in the top two feet. For the three locations with soil test S less than 30 lb/acre in the top two feet, plots receiving S had average yields that were 4 bu/acre higher than check plots.

Table 1. Yields From Wheat Fertilizer Trials 2001-2002.

LOCATION	COUNTY	YEAR	YIELD WITH FERTILIZER TREATMENT:			
			UNFERTILIZED CHECK	K	P	S
Bradford	Boone	2002	27	30 [†]	27	26
Trenton	Grundy	2002	94	95	96	95
Novelty	Knox	2002	73	74	76 [§]	74
Mount Vernon	Lawrence	2002	53	50	37	52
Portageville	New Madrid	2002	40	43 [*]	42	48 ^{***}
Trenton	Grundy	2001	45	46	46	51
Mount Vernon	Lawrence	2001	48	52 [†]	49	53 [*]
Portageville	New Madrid	2001	29	28	28	27

*** This yield is greater than the yield of the unfertilized check with greater than 99.9% confidence.

* This yield is greater than the yield of the unfertilized check with greater than 95% confidence.

† This yield is greater than the yield of the unfertilized check with 90 to 95% confidence.

§ This yield is greater than the yield of the unfertilized check with 80 to 90% confidence.

Summary and Conclusions:

- Averaged over all experiments, it appears that wheat yield responded to potassium applications (1.5 bu/acre with 91% confidence) and possibly to S as well (2.1 bu/acre with 84% confidence).
- Current University of Missouri soil test based recommendations for P and K ensure that enough P and K is available to maximize yields. We did not find any regions or soil types that need to have higher recommendations.
- These experiments can't answer the question of whether current University of Missouri recommendations for P and K are higher than is economically optimum for wheat production.
- There was a 3.5 bu/acre yield response to K when soil test K was below 230 lb/acre.
- There was weak evidence that low soil test S can indicate a location that is likely to respond to S fertilizer.
- Subsoil nutrient concentrations did not help to predict yield response to any of the nutrients.

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