

Soil Sampling and Fertility Build-up Management

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Many soil test laboratories allow farmers to select the number of years they want to build low or medium P or K soil levels in fields back to optimum levels. Sometimes this decision has a huge effect on the amount of fertilizer that a farmer will apply in a given year. If a grower does not check an option box on a soil test submission form, MU soil test labs use an 8-year default build-up time to calculate fertilizer recommendations. Unfortunately, no field research has been conducted to suggest which buildup option is the most profitable method to manage crop nutrients. Long build-up programs help farmers manage their financial resources by spreading fertilizer costs over many years. However, growers need information concerning the magnitude of yield loss that may occur early in an 8-year build-up as compared to shorter build-up (1 to 4 years).

Accomplishments in Year 2

In 2005, soil nutrient buildup from fertilizer was studied in three cropping systems at Portageville, Qulin, and West Plains, Missouri. Cropping systems included continuous corn, continuous soybean, corn/soybean/wheat rotation, rice/soybean rotation, and fescue hay and pasture. All experiments were randomized complete blocks with four replications. Permanent markers were placed to help locate research plots in following years. In early March, composite soil samples were collected from each plot and analyzed at the MU Delta Center Soil Test Laboratory.

Yield goals used to calculate P and K fertilizer recommendations were 175 bu/acre for corn, 45 bu/acre for soybean, 6075 lb (135 bu)/acre for rice, 2 tons fescue hay/acre, and 175 cow days/yr for fescue pasture. Standard treatments include an untreated check, 1-year, 3 or 4-year, and 8-year buildup fertilizer programs. In the soybean/rice rotation test, treatments were included to compare using soybean versus rice soil test target levels. Current MU recommend target soil P buildup for rice is 35 lb Bray-P/acre and soybeans is 45 lb Bray-P/acre. Target ammonium acetate extractable K target buildup for rice is 125+(5XCEC) and 220+(5XCEC) for soybeans. In the fescue tests, three S treatments were added to the standard treatments. Corn plots received 175 lb N/acre, rice received 150 lb N/acre (3-way split), and fescue received 50 lb N/acre in April and 30 lb N/acre in September.

Since we intentionally selected fields that needed P or K fertilizer, the untreated check usually produced lower yields than other treatments (Table 1-4). Overall, the 3 and 4-year buildups showed the most consistent profitability. As expected the 1-year buildup was the most expensive treatment. In the fescue hay experiment 1-year buildup treatment resulted in an economic loss for the first year. Results from the corn/soybean/wheat test were not reported in 2005 because of significant yield losses from birds in the wheat and raccoons in the corn. The field is adjacent to a wooded area along the Portage Bay ditch.

Objectives for year three

We will follow the profitability and soil nutrient levels of these treatments over time. In 2006, the only P and K that will be applied to the 1-year buildup will be an amount to offset annual crop removal. All plots will be sampled and tested again in March 2006.

Table 1. Effect of fertilizer build-up programs on first-year rice and soybean yields on a Crowley silt loam soil at Missouri Rice Research Farm, Qulin, Missouri in 2005.

Planted Crop	Buildup program † Soil crop target	2005 Rates		2004	2005
		P ₂ O ₅	K ₂ O	Yield	Yield
Rice		---lb/acre---		---bu/acre---	
	N only check	0	0	135	114
	1-year/rice target	41†	38†	138	131
	4-year/rice target	52	69	136	129
	8-year/rice target	45	67	132	124
	1-year/soybean target	41†	38	154	128
	4-year/soybean target	74	130	155	129
	8-year/soybean target	56	97	150	128
Soybean	Untreated check	0	0	40	39
	1-year/rice target	38†	65†	53	47
	4-year/rice target	38	65	53	49
	8-year/rice target	38	65	51	45
	1-year/soybean target	38†	65	58	54
	4-year/soybean target	58	39	51	46
	8-year/soybean target	50	32	51	43

† Only crop removal P and K was applied to 1-yr treatment following full buildup applications in 2004. Rice and soybeans were rotated between Field 4 and 5 at the Missouri Rice Farm. Initial soil test levels levels in the Field 4 was 29 lb P/a, 165 lb K/a, and 9.2 CEC and Field 5 was 37 lb P/a, 249 lb K/a, and 10.4 CEC.

Table 2. Average annual effect of fertilizer build-up on profits of rice/soybean cropping system on a Crowley silt loam soil at Missouri Rice Farm, Qulin, Missouri in 2004-5.

Buildup program † Soil crop target	Fertilizer Costs	Gross Return ‡	
		Rice/Soybean	Gross-Fert
-----dollars per acre-----			
N only check	\$23	\$309	\$287
1-year/rice target	\$48	\$354	\$307
4-year/rice target	\$46	\$355	\$309
8-year/rice target	\$45	\$338	\$294
1-year/soybean target	\$72	\$382	\$310
4-year/soybean target	\$57	\$362	\$306
8-year/soybean target	\$49	\$354	\$304

† Current MU recommended target soil P rice buildup is 35 lb Bray1-P/a and P target for soybean 45 lb P/a (target K buildup rice 125+(5XCEC) and 220+(5XCEC) for soybeans). Cost calculations include N on rice. Economics based on \$0.30 per lb N (urea), \$0.30 per lb P₂O₅, \$0.17 per lb K₂O, \$5.46 bu soybean, and \$3.24 bu rice.

‡Rice and soybeans were rotated between two fields at the Missouri Rice Farm.

Table 3. Dry matter yields from two cuttings of fescue hay in fertilizer buildup experiment at West Plains, Missouri in 2005.

Trt No.	Buildup program	Sulfur 1b/acre	Recommended P ₂ O ₅	K ₂ O ---lb/acre---	2005 Harvest Date June 2	Nov 16	Total
1	Untreated check	0	0	0	0.53	0.34	0.87
2	N only	0	0	0	0.79	0.46	1.25
3	1-year	9	18†	68†	1.40	0.62	2.03
4	4-year	9	117	90	1.43	0.57	1.99
5	8-year	9	65	79	1.28	0.67	1.94
6	8-year	0	65	79	1.31	0.59	1.89
7	8-year	12	65	79	1.44	0.57	2.01
8	8-year	24	65	79	1.26	0.62	1.88

† Only crop removal P and K was applied to 1-yr treatment following full buildup applications in 2004.

Table 4. Cumulative effect of fertilizer build-up programs (2004+2005) profits and fescue hay yields from a non-renovated pasture on a Tonti-Hogcreek complex (2% slope) near West Plains, Missouri.

Trt No.	Buildup program†	Two-year Cumulative-----					
		S 1b/acre	P ₂ O ₅	K ₂ O ---lb/acre---	Cost‡ per acre	Hay ton/acre	Gross-PKS per acre
1	Untreated check	0	0	0	\$0	2.4	\$72
2	N only	0	0	0	\$40	3.3	\$60
3	1-year	18	423	223	\$204	5.0	-\$54
4	4-year	18	230	180	\$138	4.8	\$6
5	8-year	18	130	160	\$104	4.6	\$33
6	8-year	0	130	160	\$88	4.2	\$38
7	8-year	24	130	160	\$88	4.9	\$58
8	8-year	48	130	160	\$88	4.5	\$47

† Initial average soil test levels were 8 lb Bray1-P/a and 162 lb am. acetate extractable K/a.

‡ Economics based on \$0.37 per lb N (am. nitrate), \$0.30 per lb P₂O₅, \$0.17 per lb K₂O, \$0.41 per lb S, and \$30.00 per ton fescue hay (\$15 for 1000 lb round bale). N credit was given to DAP and am. sulfate and S credit to triple super phosphate.

Budget

Expenses	2004	2005	2006
Res. Specialist salary (0.4)	\$12,400	\$12,958	\$13,541
Fringe benefits	\$3,100	\$3,240	\$3,385
Supplies	\$1,500	\$1,545	\$1,591
Travel	\$1,000	\$1,030	\$1,061
Total	\$18,000	\$18,773	\$19,578