

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 1

In 2004, soil nutrient buildup from fertilizer was studied in three cropping systems at Portageville, Quilin, 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. Corn, soybean, and rice plots were harvested with a combine. Fescue hay was harvested with a mower with a bagging attachment. Grab samples were dried, and weighed to adjust each plot yields to a dry matter basis.

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.

Objectives for year two

We will follow the profitability and soil nutrient levels of these treatments over time. In 2005, 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 2005.

Table 1. Effect of fertilizer build-up programs on first-year corn and soybean yields on a non-irrigated Tiptonville silt loam soil at University of Missouri-Marsh Farm, Portageville, Missouri.

Planted crop	Buildup program†	Recommended		Fert cost‡	Yield	Gross-Fert
		P ₂ O ₅	K ₂ O			
Soybean		---lb/acre---		per acre	bu/acre	per acre
	Untreated check	0	0	0	40.2	\$219
	1-year	0	156	\$27	42.6	\$206
	4-year	0	87	\$15	42.7	\$218
	8-year	0	76	\$13	40.0	\$205
Corn §	N only check	0	0	\$52	123.5	\$190
	1-year	0	183	\$83	138.2	\$188
	4-year	0	85	\$67	127.7	\$183
	8-year	0	68	\$64	127.4	\$186

† Initial soil test levels varied between plots. Averages were 92 lb Bray1-P/a and 230 lb am acetate K/a.

‡ Cost calculations include N on corn. Economics based on \$0.30 per lb N (urea), \$0.30 per lb P₂O₅, \$0.17 per lb K₂O, \$5.46 bu soybean, and \$1.96 bu corn.

§ Birds reduced plant densities in some corn plots.

Table 2. Effect of fertilizer build-up programs on first-year rice and soybean yields on a Crowley silt loam soil at Missouri Rice Research Farm, Quilin, Missouri.

Planted Crop	Buildup program † Soil crop target	Recommended		Fert cost‡	Yield	Gross-Fert
		P ₂ O ₅	K ₂ O			
Rice		---lb/acre---		per acre	bu/acre	per acre
	N only check	0	0	\$45	134.7	\$391
	1-year/rice target	41	5	\$58	138.4	\$390
	4-year/rice target	41	5	\$58	136.4	\$384
	8-year/rice target	41	5	\$58	132.3	\$371
	1-year/soybean target	110	79	\$91	153.9	\$408
	4-year/soybean target	58	39	\$69	154.7	\$432
	8-year/soybean target	50	32	\$65	149.9	\$421
Soybean	Untreated check	0	0	\$0	39.9	\$218
	1-year/rice target	96	82	\$43	52.6	\$244
	4-year/rice target	52	69	\$27	53.3	\$264
	8-year/rice target	45	67	\$25	50.8	\$252
	1-year/soybean target	183	326	\$110	58.3	\$208
	4-year/soybean target	74	130	\$44	51.2	\$235
	8-year/soybean target	56	97	\$33	51.3	\$247

† Initial soil test levels varied between plots. Average levels in the soybean field were 29 lb P/a, 165 lb K/a, and 9.2 CEC. Soil test levels in the rice pan were 37 lb P/a, 249 lb K/a, and 10.4 CEC. Current MU recommended target soil P buildup for rice is 35 lb Bray1-P/a and P target for soybeans is 45 lb P/a. Target ammonium acetate extractable K buildup for rice is 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.

Table 3. Effect of fertilizer build-up programs on average first-year fescue hay yields from an non-renovated pasture on a Tonti-Hogcreek complex (2% slope) near West Plains, Missouri.

Trt No.	Buildup program†	Sulfur	Recommended ‡		Fert cost§	Total hay	Gross-PKS
		lb/acre	---lb/acre---		per acre	ton/acre	per acre
1	Untreated check	0	0	0	\$0	1.52	\$46
2	N only	0	0	0	\$20	2.09	\$33
3	1-year	9	405	155	\$167	2.99	-\$88
4	3-year	9	115	90	\$69	2.81	\$5
5	8-year	9	65	80	\$52	2.63	\$17
6	8-year	0	65	80	\$44	2.33	\$16
7	8-year	12	65	80	\$44	2.67	\$25
8	8-year	24	65	80	\$45	2.62	\$22

† 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.

Table 4. Dry matter yields from three cuttings of fescue hay in fertilizer buildup experiment at West Plains, Missouri.

Trt No.	Buildup program	Sulfur	Recommended		Harvest Date		
			P ₂ O ₅	K ₂ O	May 13	July 9	Nov 16
		lb/acre	---lb/acre---		-----ton/acre -----		
1	Untreated check	0	0	0	0.44	0.56	0.51
2	N only	0	0	0	0.84	0.66	0.60
3	1-year	9	405	155	1.40	0.82	0.76
4	3-year	9	115	90	1.31	0.77	0.73
5	8-year	9	65	80	1.16	0.73	0.75
6	8-year	0	65	80	1.00	0.68	0.64
7	8-year	12	65	80	1.17	0.82	0.69
8	8-year	24	65	80	1.18	0.73	0.71

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