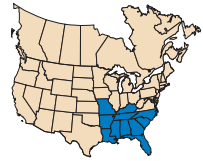

Phosphorus and Potassium Budgets and Soil Test Levels in the Mississippi-Atchafalaya River Basin

By Cliff Snyder

The Mississippi-Atchafalaya River Basin (MARB) includes 41% of the contiguous United States (U.S.), 55% of U.S. agricultural land, and 27% of the U.S. population. It encompasses about 80% of the U.S. corn and soybean acreage, and much of the cotton, rice, sorghum, wheat, and forage acreage. Thus, it is easy to understand the importance of the MARB to the fertilizer industry, the animal industry, and to environmental authorities with interest in non-point source pollution.

The public perception is that excessive loss of nitrogen (N) from farm fields...principally in the upper Midwestern states...and delivery to the Gulf of Mexico causes hypoxia (low dissolved oxygen levels, <2 mg/L). Discharge of soluble phosphorus (P) has been recently considered as another possible contributor to excessive algal/phytoplankton growth, which leads to the abundant deposition of organic matter in the shallow Gulf waters and the subsequent depletion of oxygen in the water column as bacteria decompose the organic matter.

The current scientific thought is that N concentrations in the Mississippi and Atchafalaya rivers and the shallow Gulf are large enough that even a 70% reduction will not affect the development of hypoxia. There is a growing hypothesis that any increase in P (dissolved inorganic P or phosphate) discharge, and especially a narrowing of the dissolved inorganic N to dissolved inorganic P (DIN:DIP) ratio, will stimulate a worsening of the hypoxia condition.

There is also a perception that farmers are using excessive amounts of fertilizer P. The U.S. Geological Survey (USGS) has reported that nutrient use and discharge from the 20 major MARB states has the dominant influence on the load of nutrients delivered from the MARB to the Gulf, because these states include the majority of the agricultural land in the MARB (Goolsby et al., 1999). An evaluation of the recent balance of P inputs as fertilizer and manure and the removal of P in harvested crops in the 20 major states shows that overall, the crop harvest removal of P exceeds fertilizer plus recoverable manure P inputs (from *Plant Nutrient Use in North American Agriculture*, PPI/PPIC/FAR Technical Bulletin 2002-1, Appendix Table 4.1). The crop harvest removal of P exceeds fertilizer plus recoverable P inputs in 11 of the 20 major MARB states.

Mississippi-Atchafalaya River Drainage Basin.

The results of the 2005 PPI soil test summary also indicate that 40% of these 20 major states have experienced a decline in soil test P (based on median values) since 2001 (**Table 1**). The average decline in the median soil test P levels exceeds the average increase in soil test P since the 2001 PPI soil test summary.

Table 1. Median changes in soil test P in the 20 major Mississippi-Atchafalaya River Basin states.

State	Median soil test P, 2001	Median soil test P, 2005	Change since 2001
	ppm		
AR	21	17	-4
CO	25	26	1
IL	36	36	0
IN	33	29	-4
IA	25	25	0
KS	20	21	1
KY	21	18	-3
LA	16	15	-1
MN	16	18	2
MS	32	27	-5
MO	17	18	1
MT	12	14	2
NE	21	22	1
OH	23	25	2
OK	20	19	-1
SD	11	14	3
TN	15	21	6
WV	-	52	-
WI	41	39	-2
WY	19	15	-4
% of states with lower median P levels		40	
Average decrease in states with decreased median P level, ppm		3	
% of states with same median P levels		10	
% of states with higher median P level		45	
Average increase in states with increased median P level, ppm		2.1	

Table 2. Median changes in soil test K in the 20 major Mississippi-Atchafalaya River Basin states.

State	Median soil test K, 2001	Median soil test K, 2005	Change since 2001
	ppm		
AR	156	120	-36
CO	348	328	-20
IL	149	178	29
IN	128	144	16
IA	152	172	20
KS	332	294	-38
KY	135	128	-7
LA	114	110	-4
MN	158	156	-2
MS	158	132	-26
MO	147	150	3
MT	276	259	-17
NE	362	364	2
OH	150	168	18
OK	164	150	-14
SD	278	268	-10
TN	99	100	1
WV	-	92	-
WI	111	125	14
WY	188	145	-43
% of states with lower median K levels		55	
Average decrease in states with decreased median K level, ppm		19.7	
% of states with same median K levels		0	
% of states with higher median K level		40	
Average increase in states with increased median K level, ppm		12.9	

The potassium (K) budget in the 20 major MARB states and the 2005 soil test summary results both show that significantly less K is being applied than is being removed in crop harvests (**Table 2**). The median soil test K levels in 50% of the 20 major MARB states has declined since the 2001 PPI soil test summary. Just as was observed with soil test P, the rate of decline in the median soil test K levels exceeds the rate of soil test increase among these states.

Contrary to popular belief, there are more soil samples with soil P testing in the agronomically responsive range than in the non-responsive range (**Figures 1a** and **1 b**). More than 78% of the soil samples tested below 50 parts per million (ppm) in Bray 1 equivalent-extractable P and 94% tested 100 ppm or below. Clearly, elevated soil test P is a relatively minor issue in most of these MARB states.

The frequency distribution of soil test K levels for the 20 major MARB states also

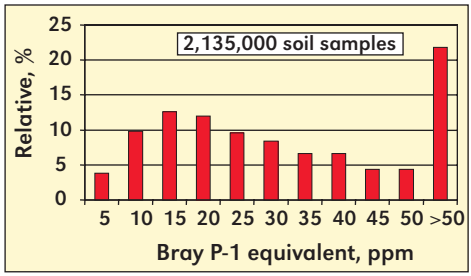

Figure 1a. Soil test P frequency distribution for the 20 major MARB states in 2005.

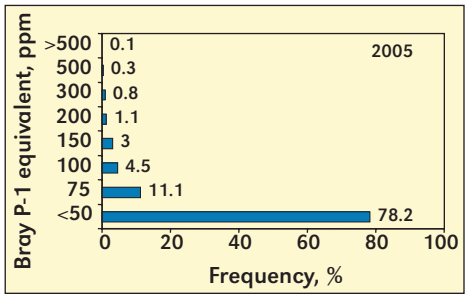

Figure 1b. Soil test P frequency distribution for the 20 major MARB states in 2005.

reflects the K balance, and it shows the strong need for continued and increased K fertilization (**Figure 2**). The bulk of the soil samples test below 200 ppm, levels at which an agronomic response to K may be expected by corn and soybeans in Iowa (Mallarino et al., 2003).

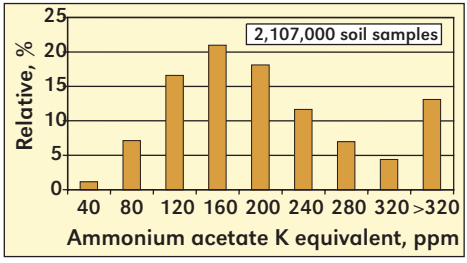

Figure 2. Soil test K frequency distribution for the 20 major MARB states in 2005.

Summary

These data for fertilizer and recoverable manure use, nutrient balance estimates, and soil test P and K results in the 20 major MARB states indicate:

- there is a strong need for P and K fertilization to sustain soil productivity;
- almost 80% of the sampled soils have extractable P in the agronomic range;
- few soil test P levels have been raised to levels that would appear to present a direct threat to water quality;
- P and K removal from farm fields in crop harvests is out-stripping fertilizer plus recoverable manure in 40 to 50% of the 20 major MARB states;
- farmers, crop advisers, and fertilizer dealers should pay close attention to individual field and farm nutrient budgets to ensure that P and K are not limiting N use efficiency and farm profitability;
- continued soil testing, evaluation of trends, and estimates of nutrient balance can contribute to a better understanding of agronomic opportunities and potential environmental challenges. BC

Dr. Snyder is PPI Southeast Director, located at Conway, Arkansas; e-mail: csnyder@ppi-far.org.

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