

Decreasing the Phosphorous Index Using Mine Drainage Residuals

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BACKGROUND

The Pennsylvania Phosphorous Index is used to identify situations that have a high risk for the transport of phosphorous (P) from land applied manure to surface waters (PA State Conservation Commission 2009). The P index considers P sources (soil, fertilizer, manure) and transport factors (erosion, runoff, subsurface drainage, distance and connectivity to receiving body). The result is a numerical value that estimates the risk of P loss.

Our project involves the use of mine drainage residuals (MDR) to modify the chemistry of dairy manure and thus effect the P Index result. Our results could be the basis for a new BMP for farmers whose manure management is limited by P.

P INDEX CALCULATIONS

Table 1 shows key aspects of the P Index spreadsheet. A handout is available that shows the complete P index spreadsheet for Table I scenarios. The baseline condition is a field with elevated soil P that receives year-round dairy manure applications totaling 90 lb P₂O₅ per acre per year. The calculated P Index for the baseline condition is 100. This is a high value and requires BMP implementation (Table 2).

P INDEX MODIFICATION

The P Index can be modified by several BMPs shown in Table 1. The setback from the stream could be increased from 150 ft to 250 ft, which lessens the P Index to 86. Manure applications could be decreased by 50%, which lessens the P Index to 75. Application of manure could be restricted to April through October, which lessens the P Index to 87.

Table 1. P Index inputs and results with various BMPs.

	Units or source	Base-line	Increase buffer	Decrease manure	Modify spread	MDR addition
Soil P	ppm P	210	210	210	210	210
Fertilizer						
Rate	lb P ₂ O ₅ /ac	20	20	20	20	20
Method	Injected	0.2	0.2	0.2	0.2	0.2
Manure						
Rate	lb/acre	90	90	45	90	90
Application method	Surface	Surface	Surface	Surface	Surface	Surface
Application time	anytime	anytime	anytime	anytime	Apr-Oct	anytime
PSC	From lab	0.65	0.65	0.65	0.65	0.30
Transport						
Erosion	ton/acre/yr	3	3	3	3	3
Sub-drains		none	none	none	none	none
Distance to Stream	feet	150	250	150	150	150
P Index		100	86	75	87	73

Table 2. P Index Management Guidance (PA State Conservation Commission 2009)

P-Index Value	Rating	Management Guidance
0 to 59	Low	Nutrients can be applied to meet the N crop requirement.
60 to 79	Medium	Nutrients can be applied to meet the N crop requirement. BMPs considered.
80 to 99	High	Nutrients can be applied to meet the P crop removal. BMPs recommended.
> 100	Very High	No P can be applied.

PSC MODIFICATION WITH MDR

The P Source Coefficient (PSC) is a measure of the solubility of manure P and estimates its vulnerability for transport off-site. Currently the PSC is considered fixed. Our project has demonstrated that a dairy manure's PSC can be decreased by the addition of mine drainage residuals (MDR) prior to field application. Figure 1 shows the effect of two MDRs on PSC. A 10 g/L dosing resulted in 70% decrease in PSC and lessened the P Index to 73 (Table 1).

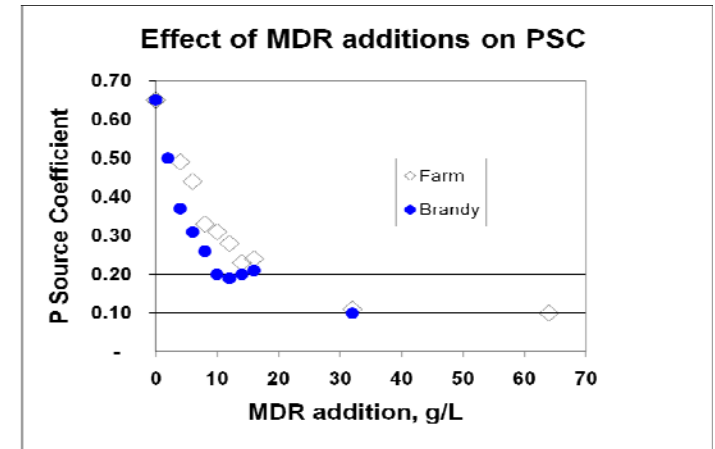


Figure 1. Effect of MDR additions on the PSC of dairy manure.

MDR FEASIBILITY

A 10 g/L MDR dose is equivalent to 83 lb/1000 gallons and has an applied cost of ~\$10/1000 gallons. This is less than the cost to truck manure to another location. We do not know how it compares to productivity costs associated with removing land from production or modifying manure spreading practices. The effect of MDR on crop productivity is currently being assessed in a Penn State University greenhouse study. Concerns about hazardous metals have been investigated and both MDRs are well below the Section 503 concentration limits established by EPA (see handout).

REFERENCES

Pennsylvania State Conservation Commission. 2009. Pennsylvania's Nutrient Management Act Program, Technical Manual, v 4.0. Harrisburg, PA. 373 p.

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