The Oil Drum: Campfire

Discussions about Energy and Our Future

How do we maintain adequate phosphorus and potassium levels for crops?

Posted by Gail the Actuary on March 18, 2010 - 8:18am in The Oil Drum: Campfire
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How do we maintain phosphorous and potassium fertility, as rock-based supplements become in shorter supply, and fossil fuels for mining and transportation become less available? A PennState University website says:

> Most forage crops remove between 15 and 20 pounds of phosphate per ton of hay equivalent and between 45 and 60 pounds of potash per ton of hay equivalent.

One way of maintaining fertility is not to remove plant residues in the first place, unless absolutely necessary. This study talks the importance of leaving wheat crop residues in order to maintain phosphorous levels. Burning biomass residues for heat or electricity or converting biomass to biofuels seems like a step in the wrong direction.

In this post, I will talk about a few ideas I have run across regarding maintaining phosphorus and potassium levels in the soil. I would like to hear what approaches you have been using.

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According to the same Penn State website, manure is an excellent source of phosphorous and potassium. However, some plants may not need the nitrogen it supplies, and in fact, adding nitrogen to legumes "can greatly increase the competition from grass and weeds", according to the same website.

Table 1. Average total nutrient content of manure.

		--------- Nutrient content (lb/ton) ---------		
Animal type	% dry matter	N	P_2O_5	K_2O
Dairy cattle				
solid	13	10	4	8
liquid (lb/100 gal)	–	2.8	1.3	2.5
Veal	2	8	2	11
Beef cattle	12	11	7	10
Swine				
solid	9	14	11	11
liquid (lb/100 gal)	–	3.5	2.0	1.5
Sheep	25	23	8	20
Horse	20	12	5	9
Poultry				
fresh	25	30	20	10
moist	50	40	40	20
crumbly	70	60	55	30
dry	85	100	70	40

Note: When possible, have manure analyzed. Actual values may vary more than 100 percent from averages in the table.

From Penn State website.

Clearly, if animal manure works, humanure would work also. According to this Energy Bulletin post, humanure is composed of 6% nitrogen, 4% phosphorus and 2% potassium.

Besides animal manures, there are various kinds of green manures. One I have come across recently is nitrogen fixing trees (NFT) which are trimmed, and the trimmings used as a green mulch. These trees seem to also provide phosphorus and potassium. According to Nitrogen Fixing Tree Start Up Guide:

> In farm systems using NFTs, it is estimated that 100-1000 lbs. of nitrogen per acre (50-400 kg per hectare) are accumulated every year by the NFTs, depending on species, soil, and climate, *Rhizobium* efficiency, and management.
>
> Incorporating nitrogen fixing trees in certain kinds of farm systems can enable the farmer to grow almost all of the nitrogen fertility necessary for crop production right on-site. Fertility provided by nitrogen fixing plants can promote healthy plants and soil life naturally. One study in Hawaii, for example, found that by using 15% of the land for NFTs, approximately 10 tons of mulch could be produced per acre per year, containing 185 lb nitrogen, 11 lb phosphorous and 72 lb potassium.

There seem to be quite a number of nitrogen fixing trees for various climates, including red alders, mimosas, and many others. Besides being used as a green mulch, NFT can be mixed in forest gardens to maintain soil fertility.

This organic gardening publication of the extension service of West Virginia University provides the following list of sources of phosphorus and potassium:

> **Phosphorus**
>
> Sources include manure, bone meal, fish and poultry meal, and rock phosphate.
>
> **Potassium**
>
> Sources include manure, alfalfa meal, kelp meal, greensand, wood ash, potassium sulfate, and granite dust.

Some of these will be more available long-term than others. The ones that need to be mined and transferred long distances would seem to be particularly at risk of disruption.

I found one letter to the editor at Scientific American (October 2009) intriguing. It is by Norman T Uphoff, Cornell University. It talks about the use of **phosphobacteria** for maintaining soil fertility. It says:

> David A. Vaccari's "Phosphorus: A Looming Crisis" usefully called attention to the critical role of phosphorus as a plant and crop nutrient and to possible future scarcities and constraints. But his focus on it as a fertilizer neglected its abundance in most soils. There is usually 10, 20, sometimes even 30 times more phosphorus in the soil than the amount in "available" forms that plants can readily utilize. The large amount of unavailable phosphorus is continuously, though relatively slowly, converted into available forms through the activity of soil microorganisms, many of which are known as phosphobacteria.
>
> Without these microorganisms, plants could not have been growing in the earth's soils for more than 400 million years. Ironically, the use of inorganic fertilizers can suppress roots' and microorganisms' production of the phosphatase enzymes that are essential for making phosphorus available for plant use. This inhibition is similar to the way that adding inorganic nitrogen to the soil diminishes the production of nitrogenase by plants and microorganisms to sustain their fixation of atmospheric nitrogen, which becomes available for plant nutrition. . .

I notice when I Google *phosphobacteria*, there are a number of websites that come up, selling such bacteria, such as this one. They seem to be mostly in India.

Questions/

1. What approaches are you using for maintaining phosphorus and potassium levels?

2. How scalable are the approaches you are using? Could they substitute for the current rock-based fertilizers?

3. How do you deal with the issue of too many of some nutrients in manure--for example, for sweet potatoes, when you don't want the tops to grow too much, and for legumes, when you don't

want to encourage the weeds?

4. Have you tried using nitrogen fixing trees? How about phosphobacteria? Is there an expert on either of these subjects that would be interested in writing a post?

5. Are you using humanure in your fertilization program?

6. Are there approaches I have missed?