STRATEGIES TO REDUCE EXCESS SOIL TEST PHOSPHORUS BUILDUP ON LIVESTOCK FARMS

Strategy: Increase Crop Production on Existing Fields

CASE STUDY: DAIRY FARM

The purpose of this case study is to demonstrate reduction of net phosphorus imports into a dairy farm by increasing crop production from existing acres for feed or sale, thus reducing excessive soil-test phosphorus buildup.

Farm Description:
This Central Minnesota dairy operation milks 70 Holstein cows, and with replacement heifers, maintains an average of 132 Animal Units. Lactating cows are housed in a tie-stall barn using oat straw bedding. Stall-barn manure is stored in an earthen liquid pit. Dry cows and replacement heifers are housed on conventional bedding packs utilizing oat straw and chopped corn stalks. The farm has 354 harvested and 324 tilled acres on sandy loam and loamy sand soils. All fields are in dry-land crop production. The herd’s DHIA Rolling Herd Average is 20,000 pounds on 2X milking. They produce all of the forage, grain, and bedding needed for the dairy operation. In most years they sell some corn grain and grass hay.
**Phosphorus Import-Export Analysis:**

This farm purchases feed supplements, and the total phosphorus (P) in the lactation ration ranges from 0.38% to 0.42%. They use 183 lb./acre of a 15-5-5 dry fertilizer corn starter, and broadcast the new seeding alfalfa with 2-6-20 fertilizer. All manure application to the fields is based on nitrogen needs and no manure is imported or exported. Most of the farm’s soil tests are >40-ppm Bray 1-P. This farm is not very far out of P balance, but does illustrate how management changes can shift the P input-output balance and reduce excessive buildup of soil test P. The following chart shows the present P balance on this dairy farm. Note that the P import amount listed under “Forages” is actually a drawdown in inventory in that year instead of a farm-gate import.

<table>
<thead>
<tr>
<th>Phosphorus Balance</th>
<th>Phosphorus (lb.)</th>
<th>Ratios</th>
</tr>
</thead>
<tbody>
<tr>
<td>P Source</td>
<td>Imports</td>
<td>Exports</td>
</tr>
<tr>
<td>Animals</td>
<td>0</td>
<td>285</td>
</tr>
<tr>
<td>Forages</td>
<td>0</td>
<td>371</td>
</tr>
<tr>
<td>Grains</td>
<td>0</td>
<td>590</td>
</tr>
<tr>
<td>Protein/Minerals</td>
<td>1293</td>
<td>0</td>
</tr>
<tr>
<td>Starter Fertilizer</td>
<td>755</td>
<td>0</td>
</tr>
<tr>
<td>Milk</td>
<td>0</td>
<td>1194</td>
</tr>
<tr>
<td>Total P</td>
<td>2419</td>
<td>2069</td>
</tr>
</tbody>
</table>

**Crop Production Background:**

As mentioned earlier, soils on this dairy farm are a mixture of sandy loam and loamy sand. These course-textured soils usually subject this farm’s crops to moisture stress much earlier in the growing season than if it had medium and finer textured soils. This farm manages soil fertility and crops well. The limiting factor in most years is the lack of crop available moisture in late summer. Yields average around 16 tons/acre for corn silage, 4 tons/acre for alfalfa hay, 105 bu./acre for corn grain, and 60 bu./acre for oat grain.

**Irrigation:**

Center pivot irrigation could be an option for this dairy farm based on soil type, topography, and successful irrigation practices by other farms in close proximity. This case study illustrates the result of adding irrigation to 80 of the farm’s 320 crop acres, with half of those irrigated acres in corn grain and the other half in alfalfa hay. A conservative assumption would be that corn grain yield would increase from the current 105 bu./acre to 155 on the irrigated acres, and the alfalfa yield from the current 4 tons/acre to 6. The resulting farm P balance is shown in the table on the next page.

**Results:**

The result is that the farm becomes a modest net exporter of P and the very high soil test values would gradually decline, reducing P in runoff water. Since some neighboring farms with irrigation achieve 200 bu./acre corn, the 155 bu./acre illustrated here may be an underestimate. A higher yield would further increase the P export estimate, as would converting additional acres to irrigation.
The economic return and other positive and negative effects irrigation has in a given situation are beyond the scope of this case study. We are illustrating that increased crop production through a management change can reduce the excess P imports over exports on a farm’s existing acreage. Other practices may also increase crop production such as hybrid selection and fertility management. Visit the University of Minnesota Extension Crop Production web site¹, the UMN Extension Irrigation web site², or the UMN Extension Farm Business Management web site³ for more information.

Conclusions:
1. When crop yields increase, a farm should be able to purchase less forage or feed grains, or sell more forage or grain. This will decrease P imports or increase P exports; either will improve the P balance for that farm.
2. Crop yields on a farm can affect the ratio between acres and animal units needed to achieve P balance.
3. Irrigation or other management changes can increase crop yields, facilitating a reduction in excess P imports relative to exports with existing cropland acres.

References:
1. University of Minnesota Extension Irrigation web site:  
   http://www.extension.umn.edu/agriculture/irrigation/
2. University of Minnesota Extension Crop Production web site:  
   http://www.extension.umn.edu/agriculture/crops/
3. University of Minnesota Extension Agriculture Business Management web site:  
   http://www.extension.umn.edu/agriculture/business/

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