



## Removal of Phosphorus by Field Crops

The New York Phosphorus Index (NY-PI) 2.0, ([http://nmsp.cals.cornell.edu/publications/extension/NYPI\\_2\\_User\\_Manual.pdf](http://nmsp.cals.cornell.edu/publications/extension/NYPI_2_User_Manual.pdf)), aims to rank fields for relative risk of P runoff loss and incentivize best/beneficial management practices for manure and fertilizer application to reduce P runoff risk. The NY-PI 2.0 sets P application categories (in P<sub>2</sub>O<sub>5</sub> equivalent) depending on soil test P and NY-PI score (see Agronomy Factsheet #110). One of the categories is "P-based", which means P application cannot exceed P removal with crop harvest. In this factsheet, we show how to estimate P removal in order to set manure and/or fertilizer application rates if called for by the NY-PI 2.0.

### Yield

Crop yields vary depending on soil type, drainage, management and weather. For alfalfa yield potentials by soil type, see "Potassium Guidelines for Field Crops in New York", at <http://nmsp.cals.cornell.edu/publications/extension/Kdoc2003.pdf>. Corn yield potentials can be found in "Nitrogen Guidelines for Field Crops in New York", downloadable at <http://nmsp.cals.cornell.edu/publications/extension/Ndoc2003.pdf>. Corn yield potentials are given in bu/acre assuming 85% dry matter (DM). To convert to estimates for corn silage planted, divide yield potential in bu/acre by 6.7 to estimate silage yield at 35% DM (Box 1).

#### Box 1: Converting from bu/acre to tons/acre for corn.

The yield potential of a Palmyra soil is 140 bu/acre (85% DM). I am harvesting the corn for silage. What is the yield potential in tons/acre of corn silage?

$$140 / 6.7 = 20.9 \text{ tons/acre (35\% DM)}$$

Regardless of the crop, actual yield records should be used if available. Yield values must be converted to total DM in lbs/acre, as P content of the harvested crop is given as a % of DM (Table 1). To convert from "as-is" yield in tons/acre to total DM in lbs/acre, multiply the "as-is" yield in tons/acre by the % DM and 2000 (Box 2).

#### Box 2: Calculating dry matter (DM) yield of corn silage.

A field yielded 20.9 tons/acre corn silage (35% DM). How much is that in lbs DM/acre?

Step 1: Convert tons/acre at 35% DM to 100% DM:  
 $20.9 * 0.35 = 7.3 \text{ tons DM/acre}$

Step 2: Convert tons/acre to lbs/acre  
 $7.3 * 2000 = 14600 \text{ lbs DM/acre}$

### Percentage Phosphorus in Harvest

Table 1 shows average P content (% P<sub>2</sub>O<sub>5</sub> equivalent on DM basis) of field crops commonly grown in New York.

Table 1: Percentage DM and P<sub>2</sub>O<sub>5</sub> equivalent of common field crops. To convert from P<sub>2</sub>O<sub>5</sub> to P, multiply by 0.44.

Field crop	% P <sub>2</sub> O <sub>5</sub> of DM
Alfalfa	0.74
Alfalfa-grass mix	0.78
Alfalfa-trefoil-grass	0.81
Birdsfoot trefoil	0.81
Birdsfoot trefoil-grass	0.76
Birdsfoot trefoil-clover	0.81
Clover	0.81
Clover-grass	0.76
Clover-seed production	1.94
Crownvetch	0.81
Grasses	0.71
Grass-intensive management	0.71
Barley-spring	0.81
Barley-spring with legume	0.81
Barley-winter	0.81
Barley-winter with legume	0.81
Barley straw	0.52
Buckwheat	0.83
Corn-grain	0.69
Corn-silage	0.55
Millet	0.76
Oats	0.78
Oatlage	0.75
Oats-seeded with legume	0.76
Oats straw	0.46
Rye-cover crop	0.92
Rye-seed production	0.86
Ryelage	0.80
Sorghum-grain	0.76
Sorghum-forage	0.51
Sorghum-sudan hybrid	0.67
Sudangrass	0.69
Soybeans	1.53
Sunflower	1.44
Triticale/peas	0.81
Wheat	0.85
Wheatlage	0.69
Wheat straw	0.32

## Estimated Dry Matter Content

As with yield, if actual DM of a crop is available, use this value. If specific DM levels of the harvest are not known, use 92% DM for straw, 90% for hay, 35% for haylage and silage corn, and 85% for grain.

## Phosphorus Crop Removal

To determine P<sub>2</sub>O<sub>5</sub> removal, multiply the total yield by % DM and 2000 and then by the % P<sub>2</sub>O<sub>5</sub> in the DM. An example is given in Box 3.

### Box 3: Estimating P<sub>2</sub>O<sub>5</sub> removal for corn silage.

The yield potential of a Palmyra soil is 20.9 tons/acre (35% DM). What is the estimated P<sub>2</sub>O<sub>5</sub> removal?

Step 1: Convert tons/acre at 35% DM to 100% DM:

$$20.9 * 0.35 = 7.3 \text{ tons DM/acre}$$

Step 2: Convert tons/acre to lbs/acre:

$$7.3 * 2000 = 14600 \text{ lbs DM/acre}$$

Step 3: Multiply DM yield by % P<sub>2</sub>O<sub>5</sub>:

$$14600 * 0.55/100 = 80 \text{ lbs P}_2\text{O}_5\text{/acre}$$

$$\text{(or } 80/20.9 = 3.8 \text{ lbs P}_2\text{O}_5\text{/ton of silage)}$$

To estimate crop removal for grain crops, first convert bu/acre to lbs/acre using test weights (lbs/bu). Common test weights are listed in Table 2. An example of a corn grain calculation is given in Box 4.

Table 2: Standard test weight and dry matter of corn grain and small grains.

Field Crop	% DM	Test weight (lbs/bu)
Barley	85	48
Corn - Shelled	85	56
Corn- Ear	85	68
Oats	86	32
Rye	86	56
Soybeans	87	60
Wheat	87	60

### Box 4: Estimating P<sub>2</sub>O<sub>5</sub> removal for grain corn.

The yield potential of a Palmyra soil is 140 bu/acre (85% DM). What is the estimated P<sub>2</sub>O<sub>5</sub> removal?

Step 1: Convert bu/acre to lbs/acre (100% DM):

$$140 * 56 * 0.85 = 6664 \text{ lbs DM/acre}$$

Step 2: Multiply DM yield by % P<sub>2</sub>O<sub>5</sub>:

$$6664 * 0.69/100 = 46 \text{ lbs P}_2\text{O}_5\text{/acre}$$

$$\text{(or } 46/140 = 0.33 \text{ lbs P}_2\text{O}_5\text{/bu of grain)}$$

## Manure Application to Crop Removal

Once P<sub>2</sub>O<sub>5</sub> crop removal is estimated, the associated maximum manure and fertilizer application rates can be determined. The

planner and producer must decide how to apportion P<sub>2</sub>O<sub>5</sub> between manure and fertilizer if both are used. Once the P<sub>2</sub>O<sub>5</sub> fertilizer rate (if any) has been determined, this amount should be deducted from the total amount of P<sub>2</sub>O<sub>5</sub> that can be applied with manure (Box 5).

### Box 5: Calculating manure application limit.

Crop removal is 103 lbs P<sub>2</sub>O<sub>5</sub>/acre. Starter contains 15 lbs P<sub>2</sub>O<sub>5</sub>/acre. What is the approximate manure target assuming N is not an issue and manure contains 4 lbs P<sub>2</sub>O<sub>5</sub> per ton or 16.7 lbs per 1000 gallons?

Step 1: Calculate P<sub>2</sub>O<sub>5</sub> that can be applied with manure:

$$103 - 15 = 88 \text{ lbs P}_2\text{O}_5\text{/acre}$$

Step 2: Convert to amount of manure:

$$88/4 = 22 \text{ tons/acre}$$

$$(88/16.7) * 1000 = 5270 \text{ gallons/acre}$$

## Practical Implications

Targeting manure and fertilizer application to P removal may be desired to limit increasing soil test P or required if a farm must follow the NY-PI. Where this is the case, P removal can be estimated by multiplying yield in lbs of DM and P<sub>2</sub>O<sub>5</sub> content of that yield. This factsheet shows how to approximate P removal.

## Additional Resources

- Nutrient Management Spear Program Fact Sheet Series: <http://nmsp.cals.cornell.edu/guidelines/factsheets.html>.
- The New York Phosphorus Runoff Index. Version 2.0; User's Manual and Documentation. [http://nmsp.cals.cornell.edu/publications/extension/NYP\\_I\\_2\\_User\\_Manual.pdf](http://nmsp.cals.cornell.edu/publications/extension/NYP_I_2_User_Manual.pdf)

## Disclaimer

This fact sheet reflects the current (and past) authors' best effort to interpret a complex body of scientific research, and to translate this into practical management options. Following the guidance provided in this fact sheet does not assure compliance with any applicable law, rule, regulation or standard, or the achievement of particular discharge levels from agricultural land.

For more information



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