Phosphorus Loss Assessment Tool for Ontario (PLATO)

A step-by-step guide for using the PLATO calculator in AgriSuite

Contents:

Why do we need a phosphorus loss assessment tool?

The risk of surface water contamination by phosphorus (P) has raised awareness of the importance of timing, placement and rate of commercial phosphorus fertilizer and manure applications. The Phosphorus Loss Assessment Tool for Ontario (PLATO) is a calculator that has been developed to assess the risk of phosphorus loss on a field-specific basis with the goal of improving application management so that risk of loss is reduced.

Too much phosphorus in surface water increases aquatic plant growth (eutrophication, algae blooms), which generates toxins, depletes oxygen in the water, and degrades the aquatic environment. The risk of surface water contamination by phosphorus cannot be based on soil-test phosphorus level alone. Phosphorus binds tightly to soil particles (particulate P) and the movement of eroded soil from a field by runoff (overland or through surface inlets and, in some cases, soil macropores to drainage tile) is a major factor in determining the risk of surface water contamination. When soil test results indicate that no additional phosphorus is required to achieve maximum economic yield, the risk of dissolved phosphorus movement increases in both overland and tile drainage waters. Manure nutrients contain nitrogen, micro nutrients and organic matter and are often applied even when phosphorus needs have been met. Frequent manure applications can lead to a buildup of soil test phosphorus, which can increase incidental P losses. When manure application is planned in rotation, at rates to match crop needs along with proper timing and placement, the risk of phosphorus loss can be low.

PLATO takes both field characteristics, such as erosion risk and soil test level, as well as P application practices into account, and can help to verify improved phosphorus management.

How can I access PLATO?

The phosphorus risk assessment tool is the latest calculator to be released in the new AgriSuite collection of nutrient management calculators that can be found online at www.ontario.ca/agrisuite . The *Crop Nutrient Calculator*, the *Organic Amendment Calculator* and the *Fertilizer Calculator* provide crop production nutrient recommendations and estimate available nutrients from fertilizer and manure to match crop needs with nutrient applications. The PLATO calculator provides an environmental risk assessment of the site receiving the phosphorus and the phosphorus management practices being employed.

PLATO provides an indexed rating of the risk of phosphorus loss based on:

- field location
- soil erosion potential
- water runoff potential
- presence of subsurface drainage
- phosphorus soil test levels
- phosphorus fertilizer application method, rate and timing
- manure type, application method, rate and timing

Step-by-Step Guide: Using PLATO – entering user input information

PLATO considers the risk of phosphorus loss from a field to be a function of two sub-indices, namely:

1. The natural characteristics of the field receiving the phosphorus application (**Field Characteristic Index**)
2. The field management practices used to apply the phosphorus (**Application Loss Index)**

The Field Characteristic Index value is combined with the Application Loss Index value to provide a **Total Phosphorus Index**. The following sections describe the user inputs required by PLATO to arrive at a Total Phosphorus Index.

Field Characteristic Index

The Field Characteristic Index rates the risk of P loss associated with a field site simply due to the natural or inherent character of that field. These characteristics are features that typically would be slow, and in some cases impossible, to change through field management decisions. Examples include: soil type and topography of the field as they affect soil erosion rates; annual precipitation amount as it affects runoff and erosion; presence of a subsurface drainage system, and; phosphorus soil test levels. The user inputs needed to calculate the Field Characteristic Index is requested under the tool's "Field Information" tab and "Phosphorus Loss" tab. Table 1 (below) summarizes and describes the input requested from the user under these two tabs.

Table 1: Descriptions of User Inputs Requested Under the "Field Information" and "Phosphorus Loss" Tabs to Calculate the Field Characteristic Index

Field Information Tab	
Input Variable	Description and Use of Input
Farm name, Field ID and Field Size	These are unique identifiers for the field that a user may enter to match how they refer to the field location
Location (County, Geotownship)	Used to automatically acquire information such as annual average precipitation
Soil Type (dominant)	• Refers to the name given to the field's dominant soil profile in a County Soil Report or as displayed in Soil Mapping available on-line through OMAFRA's AgMaps Geoportal http://www.omafra.gov.on.ca/english/landuse/gis/portal.htm • Each soil type refers to a soil series which has a unique profile and water infiltration/runoff characteristics. PLATO uses the *Soil type* input and then categorizes soils by Hydrologic Soil Groups (HSGs), which describe the

	natural water infiltration and runoff generating potential of a soil as follows:
	
	• **Hydrologic Soil Groups (HSGs)** categorize a soil profile's runoff generating potential.
	  ○ **HSG Group A** (low runoff potential) Includes deep sands with low silt and clay content. HSG A soils have high water infiltration rates even when soils are saturated (>0.3 in/hr)
	  ○ **HSG Group B** (moderately low runoff potential) Less aggregated sand soils yet above average infiltration rate when soils are saturated. (0.15 to 0.30 in/hr)
	  ○ **HSG Group C** (moderately high runoff potential) Soils with considerable clay content, below average infiltration under saturated conditions (0.05 to 0.15 in/hr)
	  ○ **HSG Group D** (high runoff potential) Mainly swelling clays, or soils with a nearly impermeable sub-layer near the soil surface. Expect saturated soil infiltration rates of less than 0.05 in/hr.

Soil Texture	• The name given to the ratio of sand, silt and clay fractions, as defined using a soil textural triangle, in the surface layer of the field's dominant soil type. Once the soil type has been selected for a field site, the soil surface texture options appear in a drop-down list.
Soil Test Phosphorus	• Soil fertility level from the most recent sodium bicarbonate (Olsen P) phosphorus test as analyzed by an Ontario accredited lab • Above 30 ppm there is rarely a response to additional applications of phosphorus and there is an increased risk of phosphorus loss to water sources
Phosphorus Loss Tab	
Crop Type and Crop Sub-type	• Choose the crop for which nutrients are being applied. A crop year starts the day after the previous crop is harvested up until the day the current crop is harvested. • Once chosen, the crop is categorized into row crop, small grains or pasture/forage. This influences the runoff potential of the field site.
Subsurface Drainage System	• ***Systematic***. Default tile spacing set at 10 m or 33 ft but can be changed manually by the user to reflect actual spacing • ***Random***. Default tile spacing set at 30 m or 98 ft but can be changed. Note: when dealing with a random tile situation, it is recommended that the tile spacing input be determined by estimating the fraction of the field impacted by the random drainage and using that fraction to divide into the default (10 m or 33 ft) spacing. For example, if 20% of a field's drainage is influenced by random tiles, then the equivalent spacing to enter into PLATO would be: 10m/0.2 = 50 m. • ***None***
Buffer Zones	• A permanently vegetated buffer can exist along ditches or watercourses or in areas of fields where the flow of water is concentrated (e.g. grassed waterways). This input accounts for the sediment delivery reduction benefits of such field features. • Buffer width options include: ○ < 10 ft

	○ 10 - 33 ft ○ > 33 ft
Annual Average Erosion Rate Simple method	• A simple single crop year method based on approximations made using a simplification of the Universal Soil Loss Equation (USLE) is used here. (For more details, see the OMAFRA USLE Factsheet at: http://www.omafra.gov.on.ca/english/engineer/facts/12-051.htm). Inputs previously entered, such as site location, soil type and crop to be grown are combined with additional inputs such as: maximum field slope, tillage type, and direction of tillage. This allows PLATO to estimate a soil erosion rate (tons/ac/yr or mT/ha/yr) using the principles described in the factsheet referenced above. In summary, to arrive at a soil erosion estimate using this method: • Choose "Calculate Value" ○ Enter % slope. Possible sources are soil reports, or direct field measurements. The default slope is 7%. Slope value entered must be > 0. ○ Enter "tillage type". Select the tillage type that best describes the primary tillage practice for the crop to be grown from the drop down menu. ○ Enter "direction of tillage" using the drop-down menu • An information button (ⓘ) reveals the specific details for each factor used for the soil loss calculation.
Annual Average Erosion Rate *Ag Maps – Water Erosion Potential Mapping* Method	• This option is for users that want to estimate their soil erosion rates using more complex approaches such as RUSLE2 for Ontario (the Revised Universal Soil Loss Equation) or with the AgMaps online Water Erosion Potential Calculator. Note, however, that both methods are only accessible when using the desktop version of the PLATO tool. Training on how the AgMaps tool can be used to estimate the annual average soil loss for a single crop year on a field can be viewed at https://youtu.be/YN-tmSsprC4. The resulting value is then MANUALLY entered into the PLATO input field. **Note:** Be sure the units for the soil lass value entered match the units by used by PLATO. • ***"Enter Value"*** estimate using AgMaps to calculate field soil loss To find AgMaps., simply "Google" "AgMaps for Ontario" General steps for using the Water Erosion Potential Calculator, within AgMaps as described in the u-tube video link above, are as follows: • Locate the field of interest using the search options available in AgMaps • Select "Map Layers" and check "Ontario Imagery/Air Photos" while unchecking or sliding the bar for Land Information Ontario Topographic Layer" to the left • Select "Markup & Printing" on the tab bar • Select "Create Map" and scroll to bottom of selection list to choose "Water Erosion Potential Map" • Select "field boundary" button and mark perimeter of the field of interest. (location data should automatically be populated). A colour-coded map defining the field's "Inherent Water Erosion Potential" will be displayed. • To fine-tune the map, go to the "Method to determine C factor" and select "single year crop and tillage method"

	○ Select the crop to be grown from the drop-down list ○ Select the primary tillage method used to establish the crop from the dropdown list ○ PLATO will estimate, display and usee a "C Factor" value to generate the Annual Water Erosion Estimate. You can toggle the map display between the potential risk map and the annual erosion map using the radio buttons provided. ○ While at this site, try different scenarios of crop and tillage to determine impact of different management on water erosion. ○ Scroll to the bottom of the page to generate a printable map.

Application Loss Index The Application Loss Index reflects the risk of P loss from fertilizer and/or manure applications. It calculates the risk of loss based on source, rate, timing and placement of phosphorus. Table 2 (below) summarizes the input options.

Table 2: Descriptions of User Inputs Requested Under the "Phosphorus Loss" Tab to Calculate the Application Loss Index

Phosphorus Loss Tab	
Material and fertilizer applications	
Add Fertilizer Application	• The green tab will allow the addition of a commercial fertilizer. It is suggested the application be given a name (e.g. Starter) • Select the date of application • From the drop-down menu select incorporation details • Choose from: ○ *"Enter Phosphate Applied"* if the quantity of P_2O_5 applied per acre is known. Where starter and broadcast P are applied at different times, use 2nd option., ○ *"Calculating the Phosphorus Applied"* by entering each product and application rate. ▪ Choose fertilizer type as *"Liquid"* or *"Dry"* ▪ Choose product type from drop-down menu ▪ Enter application rate • Select "Close" and application will be summarized in a bar beneath the green tabs
Add Material (Manure) Application	The green tab will allow the addition of a manure type or organic amendment. The same manure type could be applied several different times during the year and/or different manure types could be applied. To start "Add Material Type".
Add Material Type	• In a new screen the manure type will be added • It will be easier to keep track of numerous applications during the year by naming the material type (e.g. "Liquid Dairy – Main Barn") • Choose from drop-down menu – material type is liquid or solid • Choose from drop-down menu – material type (e.g. dairy, swine, etc.) • Choose from drop-down menu – nutrient databank or actual analysis • Choose from drop-down menu – dry matter range • If using an actual analysis, enter the % P from the analysis (databank average for chosen dry matter range will be visible under the data cell) • If data is correct select *"Add"*

Edit Material Type	• Once created there will be an option to "*Edit Material Type*" to make changes to selected input details • If data is correct select *"Close"*
Material Application	• Where there are more than one manure types, select the manure type • Suggestion is to name the application (e.g. Liquid Dairy after 1st Cut) • Select application timing (season will default to approximate calendar date). A specific date can be chosen from the calendar • Choose application method from the drop-down list (note only "spreader" option exist with solid materials) • Choose incorporation details from the drop-down menu • Enter the planned material application rate • Each material applied will display a summary of phosphorus applied and index values that represent relative risk of loss ○ Phosphate applied (i.e. lbs/ac) **Note:** This value represents the total amount of phosphorus in the material and does not represent the available phosphorus. ○ Contribution of P lost from surface runoff (index value) ○ Contribution of P lost through tile water (index value) ○ Application subtotal (with information icon that provide risk reduction strategies for reducing P loss from application) **Note:** index values do not represent an actual amount of phosphorus loss (e.g. lbs/acre)
Multiple material applications	• Once all material applications have been entered, a listing of all P applications should appear below the green material tabs • Summary should appear with *"Field characteristic index"* number, and *"Application loss index"* number and *"Total phosphorus index"* score • A colour bar ranging from green to red will give an indication (black line) of risk • Below the colour bar there will be a rating to show risk of phosphorus loss ranging from "*Very Low", "Low", "Moderate"* and "*High".*
Report Tab	
Report	• Summarizes all the information selected to determine the phosphorus loss risk for the selected field • The individual material applications are summarized with application details, including the total phosphate applied. • **Note:** This value represents the total amount of phosphorus in the material and does not represent the available phosphorus. (The available phosphorus is generally 80% of the value shown in the PLATO tool.) • The report can be printed

Total Phosphorus Index is the sum of the Field Characteristics Index and the Application Loss Index. This total score is placed in one of 4 categories ranging from very low to high. It is also illustrated on a sliding colour scale for quick visual reference.

The objective of the PLATO score is to provide all producers with options to shift their P application practices consistently into the *low* to *very low* categories in order to raise the bar in phosphorus management across the province. This would significantly reduce phosphorus loss to water sources in Ontario.

Interpreting PLATO Results

In the ***Application summary***, the contribution from surface and contribution through tile is listed for each application.

Contribution from surface – reflects the phosphorus loss from soil erosion and surface runoff. This portion will be higher where soil erosion potential is high and when there is no tile drainage system or random tile in a field.

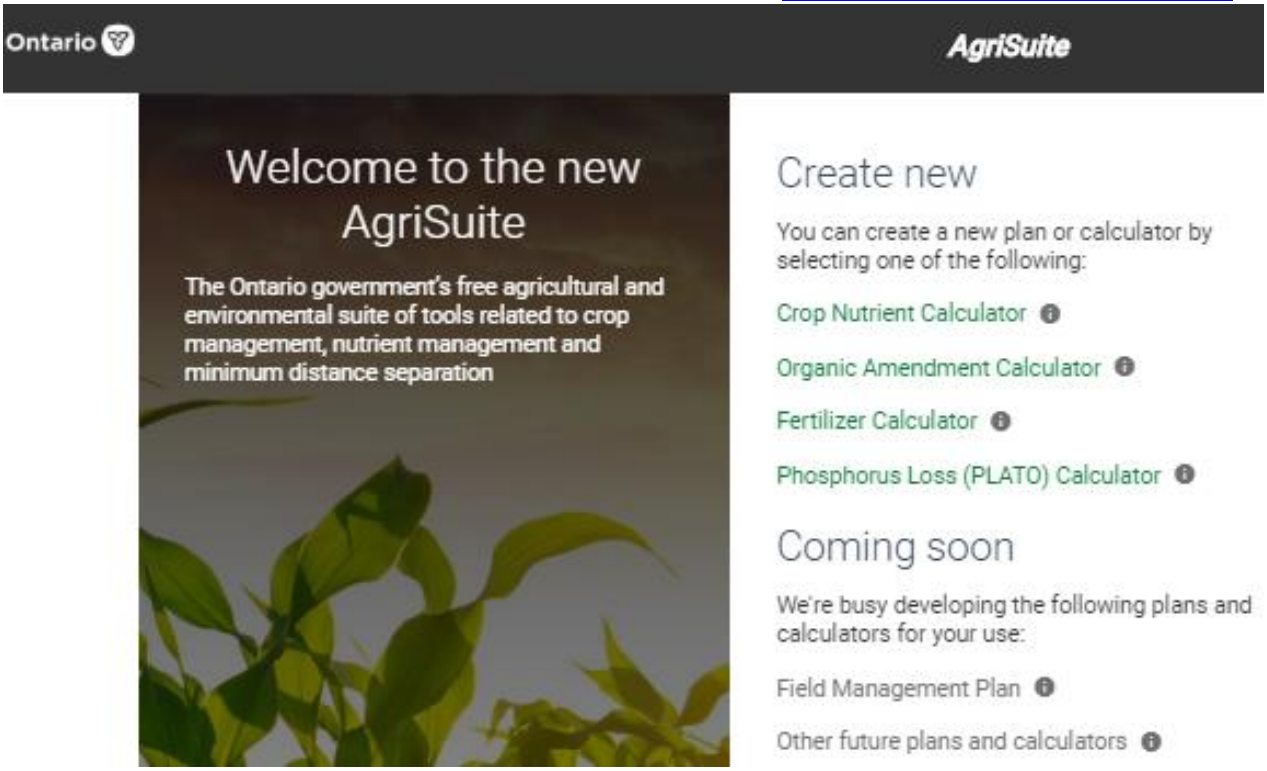
Contribution through tile – Particulate phosphorus can move through macropores in the soil (cracks in heavy soils or earthworm/root channels). Dissolved phosphorus can be lost through tile systems, particularly when the soil test phosphorus increases.

The information icons provide some management strategies to consider for reducing the risk of P loss from field characteristics and/or from material applications. They are suggestions only and do not consider what practices may already be occuring in the field.

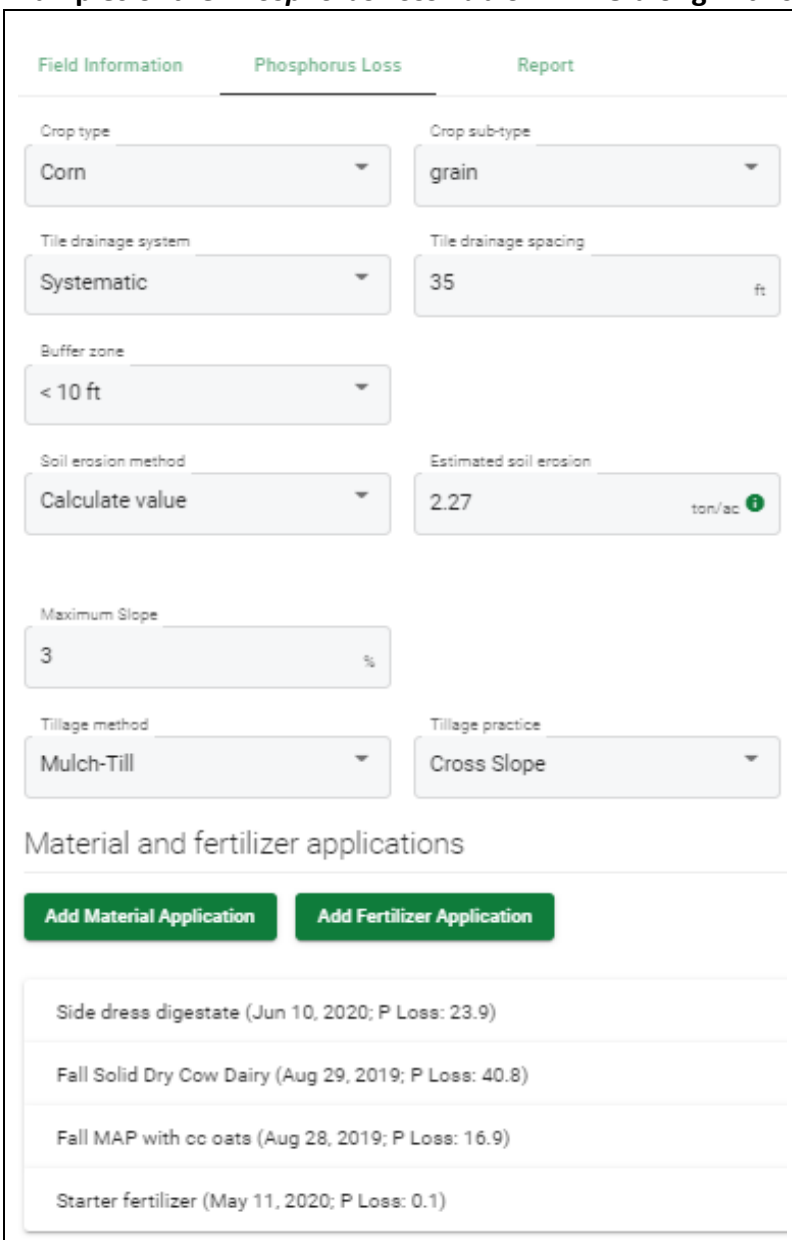
Risk of phosphorus loss will never be totally eliminated. However, using the PLATO tool can help identify areas of greatest risk and opportunities for improvement. A crop needs-focused nutrient management planning approach, combined with 4R Nutrient Stewardship principles, is one of the best ways to minimize risk of P loss.

This project was funded in part through the Canadian Agricultural Partnership (the Partnership), a federal-provincial-territorial initiative.

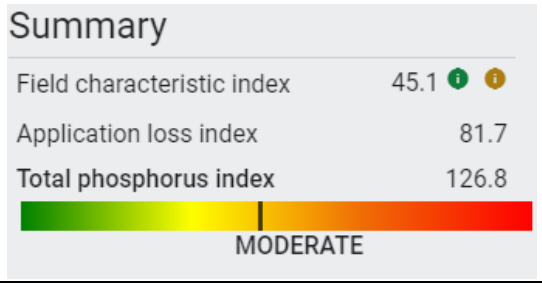
Home page for Agrisuite on-line Tools available at www.Ontario.ca/agrisuite

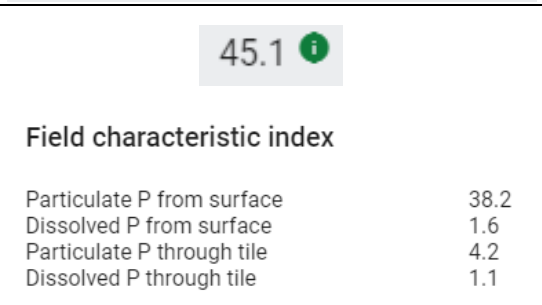


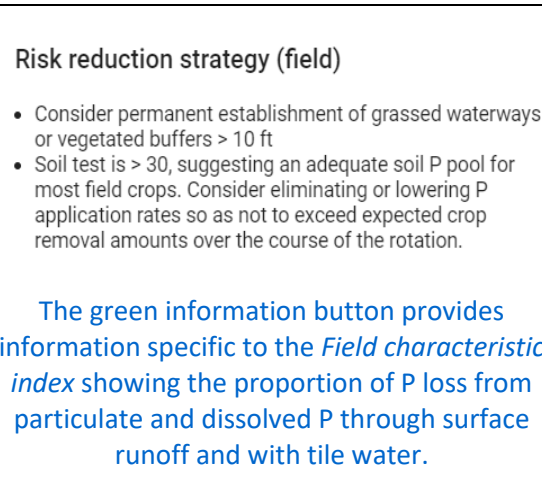
Examples of the *Phosphorus Loss Tab* of PLATO along with summary details.



The field information and material and fertilizer applications for the crop year provide a breakdown of risk and provides the option for the user to try various scenarios for determining variations in risk based on specific management practices.







The green information button provides information specific to the *Field characteristic index* showing the proportion of P loss from particulate and dissolved P through surface runoff and with tile water.

The brown information button provides some strategies to consider for reducing the risk of P loss from field characteristics. These are suggestions only and do not consider what practices may already be occuring in the field.

Application Summary and information icons

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Each material application is summarized into a bar that shows application name, date and total P loss (index) for that specific application. When totaled they should add up to the application loss index value provided in the summary
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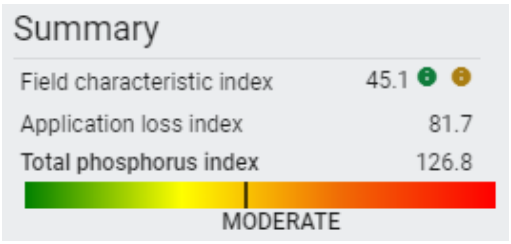

Each material application contributes to the Application loss index. Specific contribution details are provided for each application
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Risk reduction stategy (application)

Consider banding, injecting or incorporating within 48 hrs of application
Consider lower P application rates
Consider less frequent P applications over the course of the rotation

The brown information button provides some strategies to consider for reducing the risk of P loss from material applications (manure and/or fertilizer). The P loss values are higher when timing is outside the growing season, when rates are high, and/or when the phosphorus remains on the surface for prolonged periods of time. Different sources of manure will have a variation of phosphorus solubility, however, appliation rate and timing will have a greater bearing on risk These are suggestions only and do not consider what practices may already be occuring in the field.
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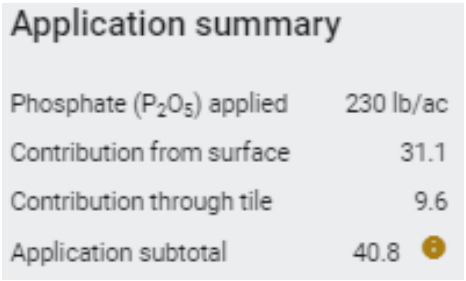

Total phosphate (lbs/ac P_2O_5) applied with each application (shown above) displays the total P (100%) in the material and may not reflect the amount available to a crop. Approximately 80% of the total phosphate is assumed to become available to a crop, and depending on material source, treatment and timing, availability could range from days to months.
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