
Balancing Nutrient Inputs with Removals

Adrian M. Johnston, P.Ag., CCA

Potash and Phosphate Institute of Canada, 12 – 425 Pinehouse Drive, Saskatoon, SK, S7K 5K2

Key Words: nutrient inputs, nutrient removal, nutrient balance, phosphorus, potassium

Abstract

A nutrient input – removal workbook was developed to assist CCAs and farmers in understanding the impact of crop management on soil fertility. Used in combination with soil testing, the PKalc program can help with understanding the estimated impacts of management on current and future crop production, by balancing the nutrient removal by crops grown and nutrients added.

Introduction

Nutrient management planning regulations and guidelines are gaining interest amongst provincial governments in western Canada. This is largely in response to the expanding livestock industry. The information required to develop a comprehensive nutrient management plan is extensive, including soil texture, soil test nutrient levels, tillage practices, nutrient application and removal history, just to mention a few. In an attempt to help agronomists and Certified Crop Advisers (CCAs) working with growers to document nutrient inputs and removals an Excel program was developed by Dr. Scott Murrell of the Potash & Phosphate Institute (PPI). The program is called PKalc, and provides a means of determining phosphorus (P) and potassium (K) inputs and removal on a field basis. The PKalc workbook is available from the PPI website, under the Tool Box section. A copy of the workbook can be downloaded from this site, as well as an example and quick start guide. See:
<http://www.farmresearch.com/pkalc/default.asp>

Nutrient Balance Workbook

The PKalc workbook operates with information on past crop production and nutrient inputs. The input – removal component of the program is to be used as a guide in evaluating the impact of cropping history. It does not replace soil testing as a means of establishing the status of soil nutrients, such as deficient, marginal or sufficient.

FormMain – Summary Page

This first page of the workbook provides a summary of additions to all of the work sheets. You can move from the summary page to the individual work sheets once you set the security level in Excel to medium, allowing all of the spreadsheet macros to function (on the Standard Toolbar, click Tools | Macro | Security. In the Security dialog box, select the Security Level tab and select Medium). On completion of the exercise the balance of inputs and removals is summarized on this page.

FormNutr – Nutrient Inputs

This page provides for the listing of all nutrient sources being used on the field. The P and K sources are named, classified as commercial fertilizer, liquid manure, solid manure or irrigated lagoon liquid. This selection automatically establishes the units for the nutrient concentration, such as % P₂O₅ and K₂O for commercial fertilizer, lb P₂O₅ and K₂O/1000 gal for liquid manure or lb P₂O₅ and K₂O/ton for solid manure. Finally the analysis of each nutrient input is entered based on the fertilizer blend or laboratory analysis for the manure.

FormCoeff – Crop Removal Coefficients

This page of the work book allows you to select the crops that are being grown, and in turn the appropriate crop P₂O₅ and K₂O removal values in the harvested portion. There is a large directory of crops to select from, and the default removal values are those which PPI has collected from reported research and our own sampling over the years. If the actual P and K content of the harvested crops are known, or the CCA or farmer have numbers they prefer to use, these can be entered in the “user-defined removal coefficients” and will become the new default values. The removal values are calculated using the oxide forms (P₂O₅ and K₂O) and as a result P and K percent values would need to be converted (P₂O₅ = P x 2.29; K₂O = K x 1.2).

FormAdd – Nutrient Additions

Each nutrient addition to the field can be recorded in this spread sheet page. The date of application, the source of nutrient (which comes from the FormNutr list previously entered) and the application rate are all entered. The resulting calculations provide a listing of the nutrients added and total additions for P₂O₅ and K₂O.

FormRem – Nutrient Removal in Crops Harvested

This page provides the opportunity to enter the date, crop and yield harvested from the field. These inputs then result in the calculation of the P₂O₅ and K₂O nutrient removal using the removal per unit of production values from the FormCoeff page. If alternative data was entered in the FormCoeff page specific to the crop grown then these are used as the default. This completes the data entry for the workbook, with the remaining pages summaries for printing.

PrintReport – Summary Report of the Balance

This page provides a detailed summary of inputs and removals from the field, and a balance to indicate the net change for the time period in question. This page can be printed out and given to the grower to consider future options based on soil test results.

PrintCoeff – Crop Coefficients Table

This page of the work book provides a listing of the crop removal coefficients for P₂O₅ and K₂O. This summary is an excellent starting point for CCAs to introduce a farmer to the concept of nutrient removal, and can be used as a guide to making fertilizer application decisions. For example, if a farmer has fields which generally test low in plant available P, then applying fertilizer P₂O₅ based on the estimated yield goal is an option in the absence of a soil test. This table also provides a clear comparison of the P₂O₅ and K₂O removal differences between crops.

Uses of the PKalc Program

The development of the PKalc program came about for a number of reasons, the principle one being the ability to demonstrate the nutrient input and removal balance on a particular field. Again it must be stressed that the program is designed to work as a complement to a soil test for the field, providing the base-line for fertility management decision. Additional uses include:

- It can also be used by the CCA to provide a grower with reason for considering changes to a fertility program. Often CCAs are dealing with farmers who are questioning the poor productivity of a field. The classic example is the declining productivity of forage stands in the absence of nutrient replacement.
- Assessing the impact of manure additions is also a potential use of the program. When manure is added to a field the loading of P_2O_5 and K_2O can be accounted for and used to balance future crop removals. As always, the greatest limiting factor with manure additions is the high variability in nutrient content, uniformity of application, and predictability of nutrient release pattern.
- Another use for this program is to help growers understand future management decisions on nutrient removal. For example, if a grower is interested in seeding a field to forages they could forecast nutrient removal based on estimated hay production, and in turn apply nutrients up-front to meet this future removal. In the subsequent years the actual forage yields could be entered and a more accurate estimate of inputs and removal maintained.

Summary

The PKalc program should be viewed as a tool to evaluate the balance between nutrient inputs and removals. The workbook should be used as part of a nutrient management program, including soil testing as the foundation for management decisions. The program can be used to evaluate 'poor producing fields', as well as forecast the impact of planned crop management decisions. The Potash and Phosphate Institute welcomes input on the program from users. All correspondence should be forwarded to the author at 306-956-0619 or Email: ajohnston@ppi-ppic.org.