

NEWS & VIEWS

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Dr. Adrian Johnston,
Western Canada Director
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Nutrient Balance in Western Canada

NUTRIENT BALANCE should be the goal of every crop producer. It leads to higher yields and quality, more efficient use of inputs, and increased profits. Soil and tissue testing helps guide us toward this goal and, when used regularly, provides the 'road map' for long-term trends in our soil fertility status.

Table 1 presents the amount of nitrogen (N), phosphorus (P) and potassium (K) taken up by the growing crop, and removed in the harvested portion. If the crop residues are all returned to the soil, the removal amount is approximately that which must be replaced to maintain a long-term *status quo*. Both P and K are presented as oxide equivalents (P_2O_5 and K_2O , respectively) to facilitate comparisons between crop removal and the form represented in the common fertilizers being used.

The values in **Table 1** are not recommended rates per unit of production, but merely quantities of nutrients removed in harvested product. It may be possible to farm some highly fertile soils for years (even decades) before their ability to adequately supply certain nutrients is diminished. In fact, this has been the case for many of our soils on the Canadian Prairies. Other soils may be depleted in just a few years. However, soil fertility levels should never be allowed to drop to the point that yields are threatened. In general, soils with more clay and organic matter are better buffered. That is, it takes longer to deplete them of their available nutrients. And, logically, fields intensively managed for higher yields are more rapidly depleted.

Table 1. Nutrient uptake by the growing crop, and removal in the harvested portion of selected crops for western Canada.

| Crops | unit | N | P_2O_5 | K_2O |
|----------------------------|--------|-------------|-------------|--------------|
| Cereals | | | | |
| Barley | lb/bu | 1.53 (1.10) | 0.61 (0.40) | 1.46 (0.35) |
| Oats | lb/bu | 1.38 (0.80) | 0.40 (0.25) | 1.60 (0.20) |
| Corn | lb/bu | 1.18 (0.75) | 0.63 (0.44) | 1.41 (0.29) |
| Wheat | | | | |
| 10% protein ¹ | lb/bu | 1.55 (1.10) | 0.67 (0.50) | 1.47 (0.35) |
| 12% protein | lb/bu | 1.83 (1.30) | 0.67 (0.50) | 1.47 (0.35) |
| 14% protein | lb/bu | 2.12 (1.50) | 0.67 (0.50) | 1.47 (0.35) |
| Oilseeds | | | | |
| Canola | lb/bu | 3.12 (1.88) | 1.30 (0.91) | 2.05 (0.46) |
| Flax | lb/bu | 2.58 (2.00) | 1.42 (1.10) | 2.00 (0.65) |
| Sunflower | lb/bu | 1.17 (0.84) | 0.43 (0.33) | 0.61 (0.18) |
| Soybean ² | lb/bu | 5.80 (4.00) | 1.00 (0.80) | 4.40 (1.40) |
| Pulses | | | | |
| Field peas ² | lb/bu | 3.36 (2.40) | 0.92 (0.76) | 3.00 (0.71) |
| Lentils ² | lb/bu | 3.01 (2.00) | 0.90 (0.62) | 2.57 (1.10) |
| Root crops | | | | |
| Potatoes | lb/cwt | 0.63 (0.35) | 0.27 (0.15) | 0.77 (0.56) |
| Sugar beets | lb/ton | 9.57 (4.00) | 2.49 (1.50) | 17.82 (6.60) |
| Forages | | | | |
| Alfalfa ² | lb/ton | 56 | 15 | 60 |
| Bromegrass | lb/ton | 36 | 13 | 59 |
| Fescue | lb/ton | 38 | 18 | 52 |
| Timothy | lb/ton | 38 | 14 | 62 |
| Barley silage ³ | lb/ton | 40 | 13 | 29 |
| Corn silage ³ | lb/ton | 34 | 14 | 44 |

¹At same moisture content as grain yield measured.

²Legume crops obtain most of their N from atmospheric N fixation.

³Forage yield on a dry matter basis.

The ratios of N: P_2O_5 : K_2O removed by selected crops from **Table 1** are given in **Table 2**. Only the cereals, canola, and field pea grain crops average more N removal than K_2O . This is because relatively little K is removed in the grain compared to N and P in these crops. Much of this K is returned to the soil in crop residue after harvest. Seed contains a high concentration of P; therefore, relative P removal is greatest in these crops. If a crop such as barley is harvested as silage, the ratio of N to K_2O removal is much narrower, reflecting the K_2O in the non-grain portion of the plant. The perennial forage and potato crops all show K_2O removal being higher than both N and P_2O_5 . When grown on soils marginal in K, full agronomic



Agronomic market development information provided by:
Dr. Adrian Johnston, Western Canada Director
Potash & Phosphate Institute (PPI)/
Potash & Phosphate Institute of Canada (PPIC)
12-425 Pinehouse Drive
Saskatoon, Saskatchewan, Canada S7K 5K2
Phone: (306) 956-0619
E-mail: ajohnston@ppi-ppic.org

performance of these crops can be limited in the absence of nutrient amendment.

Table 2. Nutrient removal ratios for selected crops grown in western Canada.

| Crop type | N : P ₂ O ₅ : K ₂ O |
|---------------------|--|
| Wheat (12% protein) | 3.71 : 1.43 : 1.00 |
| Barley | 3.14 : 1.14 : 1.00 |
| Canola | 4.09 : 1.98 : 1.00 |
| Field peas | 3.38 : 1.07 : 1.00 |
| Barley silage | 1.34 : 0.44 : 1.00 |
| Alfalfa | 0.93 : 0.25 : 1.00 |
| Bromegrass | 0.61 : 0.22 : 1.00 |
| Potato | 0.63 : 0.27 : 1.00 |

This information takes on more meaning when compared to the fertilizer consumption for the prairie provinces (Table 3). The N:K₂O ratio in this region has changed very little over the past two decades, reflecting the abundant supply of K that exists in most soils. Clearly, many farmers continue to rely heavily on native soil K to produce their crops.

Likely the largest change in fertilizer use has come with the increase in N consumption relative to P. Over the 20-year period considered, the N:P₂O₅ ratio increased from 1.83 to 2.81 in Manitoba, 1.24 to 2.51 in Saskatchewan, and 1.86 to 2.87 in Alberta. While soil N supplying power has declined in many parts of the Prairie Provinces, these fertilizer consumption numbers indicate that the increase in N use has come with only a marginal increase in P₂O₅ consumption.

In a summary of average annual crop removal of P₂O₅ and K₂O for the period 1998-00 for the Prairie Provinces, only Manitoba showed P₂O₅ replacement being close to removal (Table 4). In fact fertilizer P₂O₅ consumption accounted for only 73 percent of Saskatchewan crop removal and 87 percent in Alberta. The even lower percent replacement for K removal clearly indicates that many growers in the Prairie Provinces of western Canada are mining their soils of K. This is not necessarily a bad practice as long as the K supply continues to be adequate for optimum yield and quality. However, it is important to monitor these soils so they do not slip into a deficient situation where crop yields and quality are compromised.

Recently, a survey of soil testing labs in the Prairie Provinces was completed to monitor soil P and K levels from the fall of 2000 and the spring of 2001. This summary reported that 73 percent of the soils in Manitoba, 86 percent of the soils in Saskatchewan, and 59 percent of the soils in Alberta tested medium or lower in P. While the percentages of medium or lower P testing soils are down slightly from the survey in 1997, the results indicate that the majority of fields are being managed at or below P removal levels. The levels of medium or lower K soil tests were 19 percent, 15 percent, and 33 percent for Manitoba, Saskatchewan, and Alberta, respectively.

Ideally, soil fertility planning based on soil testing to estimate residual nutrient levels, crop removal and fertilizer additions will move us closer to not only maintaining long-term soil fertility, but also helping to achieve maximum production potential. ■

Table 3. Consumption of N, P₂O₅ and K₂O (million lb) for the Prairie Provinces, 1980-2000.

| Year | Manitoba | | | Saskatchewan | | | Alberta | | |
|------------------------|----------|-------------------------------|------------------|--------------|-------------------------------|------------------|---------|-------------------------------|------------------|
| | N | P ₂ O ₅ | K ₂ O | N | P ₂ O ₅ | K ₂ O | N | P ₂ O ₅ | K ₂ O |
| ----- Million lb ----- | | | | | | | | | |
| 1980 | 379.9 | 208.2 | 42.9 | 314.5 | 254.6 | 16.3 | 550.1 | 295.7 | 54.7 |
| 1985 | 520.3 | 233.4 | 45.3 | 653.3 | 407.7 | 25.5 | 779.0 | 383.6 | 60.4 |
| 1990 | 512.6 | 229.6 | 53.9 | 604.3 | 329.4 | 27.3 | 776.3 | 341.2 | 80.2 |
| 1995 | 672.0 | 260.0 | 64.4 | 984.3 | 419.8 | 31.9 | 850.3 | 327.7 | 89.5 |
| 2000 | 720.6 | 256.1 | 91.6 | 1,199.0 | 478.4 | 63.0 | 1,120.3 | 389.8 | 126.8 |

Table 4. Crop removal and fertilizer use for P₂O₅ and K₂O in the Prairie Provinces, 1998-00 average.

| Province | P ₂ O ₅ | | | K ₂ O | | |
|--------------|--|----------|--------------------|-----------------------------------|----------|--------------------|
| | Removal ¹ ----- Million lb ----- | Fert use | Fert/Removal, % | Removal ----- Million lb ----- | Fert use | Fert/Removal, % |
| Manitoba | 258.4 | 263.7 | 102 | 331.0 | 92.2 | 28 |
| Saskatchewan | 672.7 | 493.9 | 73 | 640.1 | 58.5 | 9 |
| Alberta | 451.1 | 393.1 | 87 | 607.0 | 127.9 | 21 |

¹ Removal based on nutrient content in Table 1 and average yield in the period 1998-00 for the crops alfalfa, barley, canola, corn (grain), corn (silage), dry beans, dry peas, flaxseed, lentils, mustard, oats, other hay, potatoes, rye, soybeans, sugar beets, sunflower, and wheat.

² Fertilizer use from Agriculture and Agri-food Canada, Strategic Policy Branch.