# Impact of Crop Residue Type on Potassium Release

By N.Z. Lupwayi, G.W. Clayton, K.N. Harker, T.K. Turkington, and A.M. Johnston

**Greater than 90% of crop residue potassium (K) was released to the soil within one year of addition. Tillage system had no effect on the release of K from the crop residues.**

It is generally assumed that crop residues will decompose more slowly under no-till than under conventional tillage management. With a reduced rate of decomposition, we would expect less nutrients to be released in a given time period. This assumption may not always be correct, given that the amount of a nutrient released from crop residue depends not only on the decomposition rate, but also on the nutrient concentration in the original crop residue. This could be affected more by crop type than any management input.

To address these questions, a study was initiated in an established long-term tillage and crop rotation experiment. The objective was to quantify how much K is released from red clover, field pea, canola, and spring wheat residues under conventional and no-till seeding systems.

The trial was conducted at Fort Vermilion in northwestern Alberta in 1998-1999 and 1999-2000, using an established study evaluating two tillage systems: conventional tillage (CT) and no-till (NT), and four different crop rotations that included red clover green manure (GM), field peas, canola, and wheat. In 1998-1999, the red clover did not survive the winter and was replaced with a field pea green manure crop. Crops were grown on soils that had soil test levels of 150 parts per million (ppm) K (0.5M $NaHCO_3$-extractable), and no fertilizer K was added. Crop residues of the green manure, field peas, wheat, and canola were collected at harvest, weighed, and analyzed for K to determine the amount of K being returned to the plot. The residues were then placed in decomposition-resistant litter bags with 1 mm mesh and either buried in the soil (CT), or placed on the soil surface (NT). The bags were sampled periodically over a 12-month period and the residues analyzed for K to determine how much K still remained in the decomposing residues and, by difference from the amounts applied, how much K had been released.

**Table 1.** Impact of previous crop on the input and release of K from green manure, field pea, canola, and wheat crop residues, 1998-1999.

| Crop residue | Residue applied | | K released | | | % K released |
|---|---|---|---|---|---|---|
| | DM | K | 2 wk | 5 wk | 52 wk | |
| | lb/A | | | | | |
| Field pea GM | 3,105a[1] | 32.4a | 30.3a[2] | 29.6a | 30.2a | 93 |
| Field pea | 2,061bc | 28.3a | 12.9b | 21.5a | 26.6a | 94 |
| Canola | 2,610ab | 35.9a | 17.4c | 28.6b | 34.2a | 95 |
| Wheat | 1,458c | 22.8a | 8.3b | 18.4a | 20.9a | 92 |

[1] For residue applied (dry matter and K) numbers in columns followed by the same letter are not significantly different.
[2] For K released, numbers in rows followed by the same letter are not significantly different.

Crop residue dry matter returned to the soil by the

**Table 2.** Impact of previous crop on the input and release of K from green manure, field pea, canola, and wheat crop residues, 1999-2000.

| Crop residue | Residue applied DM | Residue applied K | K released 2 wk | K released 5 wk | K released 52 wk | % K released |
|---|---|---|---|---|---|---|
| | lb/A | | | | | |
| Red clover GM | 4,788a[1] | 94.2a | 32.1b[2] | 81.0a | 91.4a | 97 |
| Field pea | 5,445a | 73.8ab | 37.7b | 45.1b | 66.3a | 90 |
| Canola | 4,581a | 53.3bc | 38.8b | 43.5ab | 49.1a | 92 |
| Wheat | 1,962b | 31.5c | 13.0b | 16.4b | 30.0a | 95 |

[1] For residue (applied dry matter and K) numbers in columns followed by the same letter are not significantly different.
[2] For K released, numbers in rows followed by the same letter are not significantly different.

different crops was considerably higher in 1999-2000 relative to 1998-1999, reflecting the higher crop production during the 1999 growing season (**Tables 1** and **2**). However, crop residue yield resulted in a large difference between the two study periods in the amount of total K being returned to the field. While the total amount of K returned varied by crop grown, all crop types released at least 90% of their K in 52 weeks. Wheat produced the least amount of crop residue and lowest residue K returned to the field in both years. The amounts of residues produced and added to the soil did not differ significantly between tillage treatments, and there were no significant interactions between tillage and crop residues in residue DM produced or K returned to the field (data not shown).

During the 52 weeks that residue samples were monitored in this study, the amount of K released was very similar to that which had been applied with the residues (**Tables 1 and 2**). Unlike the release of phosphorus (P), where green manure crops released the largest proportion of the residue P (70 to 78%), all crop types released 90% or more of their residue K. The reason for the difference is that, unlike N and P, K is not a structural component of plant tissue. This release of K was rapid, with most of the K returned to the soil within 5 weeks of application. Whether the residue was buried with CT or left on the surface with NT, there was no effect on K release recorded. However, there were significant interactions between tillage and sampling time under canola residues in 1998-1999 and pea residues in 1999-2000 (interaction data not shown). In both cases, more K was released under zero tillage than under conventional tillage in the first 5 weeks of decomposition. The reason is that canola residues contained more K under zero tillage than conventional tillage in 1998-1999, and the same was true for pea residues in 1999-2000.

**The results of this study illustrate that all crop residues considered released more than 90% of their accumulated K in the 52-week period.** The rapid and large release of residue K can be expected to contribute to plant K supply when these fields are recropped. Given the very small proportion of plant K that is removed from the field in grain harvest, the return of residue K shown here will help to maintain soil test K levels. The use of no-till seeding systems, relative to conventional tillage, had no effect on the K released by the crop residues. However, sometimes residues returned more K to the field under zero tillage than under conventional tillage. BC

*Dr. Lupwayi (e-mail: LupwayiN@agr.gc.ca) is with the Agriculture and Agri-Food Canada (AAFC) Research Farm, Beaverlodge, Alberta. Dr. Clayton, Dr. Harker, and Dr. Turkington are with theAAFC Research Centre, Lacombe, Alberta. Dr. Johnston is PPI/PPIC Northern Great Plains Director, located at Saskatoon, Saskatchewan.*