Impact of Crop Residue Type on Phosphorus Release

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It is generally assumed that crop residues will decompose more slowly under no-till (NT) than under conventional tillage (CT) management. With a reduced rate of decomposition, we would expect less nutrients to be released in a given time period. This 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.

Crop residue release of phosphorus (P) was related to P content and ease of decomposition. Tillage system had no effect on the release of P from residues.

To address these questions, a trial was initiated in an established long-term tillage and crop rotation study. The objective was to quantify how much P is released from red clover, field pea, canola, and wheat residues under CT and NT 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: NT and CT, and four different crop rotations that included red clover green manure, 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. Crop residues of the green manure, field peas, wheat, and canola were collected at harvest, weighed, and analyzed for P to determine the amount of P 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 P to determine how much P still remained in the decomposing residues and...by difference from the amounts applied...how much P had been released.

TABLE 1. Impact of previous crop on input and release of P from green manure, field pea, canola, and wheat crop residues, 1998-1999.

	Residue applied		P released			P
Crop residue	DM	P	2 week	5 week	46 week	released
	lb/A					%
Green manure[1]	3,105a[2]	6.5a	4.9a[3]	4.6a	5.1a	78
Field pea	2,061bc	1.4bc	0.1a	0.4a	0.6a	43
Canola	2,610ab	2.4b	0.3b	0.2b	1.2a	50
Wheat	1,458c	0.6c	-0.1a	0.2a	-0.0a	0

[1]Field pea
[2]For residue applied, dry matter and P, numbers in columns followed by the same letter are not significantly different at p = 0.05.
[3]For P released, numbers in rows followed by same letter are not significantly different at p = 0.05.

Crop residue dry matter (DM) returned after the 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, P concentration in the crop residues resulted in a large difference in the amount of total P being returned to the field. While the green manure

crops returned the largest amount of P, spring wheat produced the least crop residue and lowest residue P returned to the field. 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 P applied.

During the 46 to 52 weeks that residue samples were monitored in this study, the amounts of P released were all less than the amounts that had been applied with the residues (**Tables 1** and **2**). The green manure crops released the largest proportion of the residue P (70 to 78%), reflecting the ease of decomposition of this fresh plant material. This release was also rapid, with most of the P returned to the soil within five weeks of application. The mature crop residues proved to be more resistant to decomposition and P release. The slow decomposition and lower P content of the field pea, canola and wheat residue resulted in some immobilization of P during the 46 to 52-week decomposition period.

An evaluation of the carbon (C), lignin, and P in the plant residues was carried out and the results indicated a positive correlation between P release from the residue and percent P, and a negative correlation between P release and residue C:P ratio (data not shown). Whether the residue was buried with CT or left on the surface with NT, there was no effect on P release. **The more resistant parts of the residues, including nutrients they contain, become soil organic matter which decomposes slowly.** Therefore, although only the green manure crops released significant amounts of P, it is advisable that all crop residues be added to the soil because they maintain or increase soil organic matter. Soil organic matter is important not only as a slow-release source of nutrients for crops and soil organisms, but also for maintaining soil structure. Even nutrients added as fertilizers are not utilized efficiently when soil organic matter is low.

Soil organic matter, a slow release source of nutrients, also helps maintain soil structure.

Results of this study illustrate that the release of P from crop residues is influenced by not only the P content of the residue, but the ease of decomposition. The rapid and large release of residue P from green manure crops can be expected to contribute to plant P supply when these fields are recropped. By contrast, wheat residues added significantly less P to the soil, and were just as likely to immobilize as release P in the 46 to 52-week period. Canola and field pea fell somewhere between wheat and the green manure crop, reflecting a higher residue P contribution and lower C:P ratio. Tillage system practiced did not affect amounts of P released by residues. BC

TABLE 2. Impact of previous crop on input and release of P from green manure, field pea, canola, and wheat crop residues, 1999-2000.

	Residue applied		P released			P
Crop residue	DM	P	2 week	5 week	52 week	released
	lb/A					%
Green manure[1]	4,788a[1]	7.6a	1.8b[3]	5.4a	5.3a	70
Field pea	5,445a	5.4ab	1.2a	1.0a	1.3a	22
Canola	4,581a	5.0b	0.9b	1.4b	2.0a	36
Wheat	1,962b	1.5c	0.3a	-0.4a	0.3a	20

[1]Red clover

[2]For residue applied, dry matter and P, numbers in columns followed by the same letter are not significantly different at p = 0.05.

[3]For P released, numbers in rows followed by the same letter are not significantly different at p = 0.05.

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