



INCREASING PHOSPHORUS AVAILABILITY THROUGH GREEN MANURE, COMPOSTED MANURE AND ROCK PHOSPHATE

Interim Research Report W2006-17

INTRODUCTION

Green manure crops have long been used to add nitrogen to organic cropping systems. Renewed attention is being paid to green manure crops because phosphorus (P) may also become more plant-available following certain green manure crops. It is thought that certain plants (e.g. mustard, buckwheat, legumes) create acidic environments around the root zone and are thus able to extract P from the soil. The goal of this project is to determine phosphorus availability to crops following different green manures.

METHODS

Field trials were initiated at three Manitoba locations to test the effect of green manure crops on P uptake by subsequent crops. In 2004, trials were established at Glenlea, Graysville and Clearwater. The Glenlea trial was conducted on soil that had been farmed organically for 12 years and was known to be low in available soil P. The green manure crops tested at Glenlea include mustard, buckwheat, sorghum sudangrass, fababean, berseem clover and oat. The subsequent crop was wheat. At Graysville the green manures tested were mustard, buckwheat, sorghum sudangrass, pea and alfalfa. The subsequent crop was potato. At Clearwater the green manure crops were mustard, buckwheat, pea, alfalfa and oat. The Clearwater site was dropped in 2005 because high soil P levels (over 80 kg P ha⁻¹) were thought to mask treatment effects, and also because of poor establishment of the mustard and buckwheat green manures in 2004. This site was replaced with one at Carman. The green manure crops were established at Carman in 2005 and test crops will be grown on these plots in 2006.

P uptake into the green manure crops was measured in 2004. The green manures were

worked down in fall 2004 and a single crop (wheat at Glenlea, potatoes at Graysville) was planted over the entire area in spring of 2005. Measurements on the 2005 crop included top-growth dry matter yield and tuber yield for potatoes, and dry matter yield at anthesis, and seed yield for wheat. At Glenlea the wheat plots were organized in a split-plot design with additional treatments of manure, rock phosphate, Jumpstart, Jumpstart + rock phosphate, and a control.

PRELIMINARY RESULTS

The P uptake values for green manure crops at Glenlea and Graysville in 2004 are presented in Table 1. At Glenlea, highest P uptake occurred with an oat green manure, while clover was significantly lower than all others. At the Graysville site, P uptake was highest with Alfalfa. Crops that took up the greatest amount of P also produced the greatest amount of biomass.

Table 1. Phosphorus uptake by green manure crops in 2004

	Total P uptake (kg ha ⁻¹)	
	Glenlea	Graysville
Oat	10.6 a ¹	-
Faba bean	7.7 b	-
Clover	2.6 c	-
Buckwheat	7.9 b	11.1 b
Mustard	7.4 b	13.3 b
Sorghum	7.2 b	13.9 b
Pea	-	11.4 b
Alfalfa	-	19.0 a
LSD	1.6	4.5
P>F	<0.001	0.015
Mean	7.2	13.8
C.V. (%)	12.0	21.1

¹ Means for each site in the same column followed by the same letter are not statistically different (P ≤ 0.05, LSD)

Table 2. Wheat dry matter and grain yields from wheat crops grown with different amendments and preceding green manure crops at Glenlea in 2005

Green Manure Crop	Oat	Buckwheat	Faba bean	Mustard	Sorghum	Clover
Subplot	Dry Matter (t ha ⁻¹)					
control	2.35	2.79	2.87	3.46	2.17	3.14
manure	2.19	2.47	3.58	3.24	2.71	3.90
rock phosphate	2.20	2.45	2.81	3.67	2.31	3.78
Jumpstart	2.25	2.57	2.90	4.00	2.00	3.75
Jumpstart + rock P	2.03	2.63	3.46	3.72	1.72	2.75
	Grain Yield (t ha ⁻¹)					
control	1.15	1.14	1.23	1.13	0.88	1.09
manure	1.03	1.42	1.43	1.30	1.08	1.35
rock phosphate	0.98	1.29	1.39	1.07	1.12	1.34
Jumpstart	0.93	1.30	1.10	1.07	0.84	1.05
Jumpstart + rock P	0.96	1.10	1.31	0.93	0.92	1.20

Mustard green manure appeared to be most beneficial for wheat dry matter production, but faba bean appeared to be better for grain yield in the following wheat crop in this trial. Preliminary results suggest that composted beef cattle manure following buckwheat, faba bean or clover, and rock phosphate following faba bean or clover may be beneficial for wheat grain yield. Soil amendments were least beneficial following oat green manure. The addition of Jumpstart to rock P did not improve grain yield.

Alfalfa green manure was superior to sorghum green manure for potato tuber production in the following year.

This study suggests that green manures differ in phosphorus uptake, but that this does not necessarily determine their relative benefit to succeeding crops. Soil amendments were variably effective, with the greatest relative advantage probably due to manure.

THE BOTTOM LINE...

Green manures including buckwheat, mustard, faba bean, pea and clover provided benefits in wheat and potato production. Manure and rock P showed potential for increasing yields.

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Table 3. Potato yields at Graysville in 2005

	Topgrowth Dry Matter	Tuber Yield
	kg ha ⁻¹	
Alfalfa	834 a ¹	8079 a
Mustard	716 ab	6245 ab
Pea	646 ab	6041 ab
Buckwheat	580 ab	5650 ab
Sorghum	489 b	4931 b
LSD	378	2669
P>F	0.061	0.044
Mean	670	6218
C.V (%)	35.17	26.7

¹ Means in the same column followed by the same letter are not statistically different ($P \leq 0.05$, LSD)

CREDITS

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