COMPOST BLENDS FOR REGENERATIVE AGRICULTURE

Regenerative agriculture is gaining traction in Alberta as farmers look for ways to improve soil health while maintaining productivity. This approach uses practices such as no till, compost fertilizer, intercropping, and cover cropping to build healthier soils and more resilient cropping systems. It may also offer economic benefits, as these practices can be more cost effective and rely less on nonrenewable energy inputs. By using compost as a fertilizer source, we expect to see reduced greenhouse gas emissions, a more diverse microbial community, improved carbon sequestration, and stronger overall soil health while continuing to produce high grain yields.

The trial was originally planned to run for three years. However, Dr. Derek Mackenzie proposed extending it into a fourth year so that the study could return to the same rotational crop used in the first year. Gateway Research Organization (GRO) supported the continuation of the project through in-kind contributions that included compost application, seeding, field maintenance, and harvesting.

The trial is designed to evaluate the economic feasibility of using compost and other soil amendments to supplement or potentially replace synthetic fertilizers. In 2025, canola was planted as part of the planned crop rotation, which includes canola followed by wheat and then pulses.

AGRONOMIC INFORMATION:

Soil amendments applied: May 20, 2025
Seeded: May 23, 2025
Soil Temperature: 20°C
Soil Moisture at Seeding: Adequate
Application rates: each blend @ 10MT/ha scaled to a plot size of 40 m2 x 3 – 120 m2 (0.012 ha) per treatment.
Soil amendments used:
- Compost: 10 MT/ha
- Biochar: 0.825 MT/ha
- Wood Ash: 2.5 MT/ha
- Gypsum: 0.825 MT/ha
- Full Synthetic Fertilizer: 29.0-10.9-6.0-4.8 @ 413.8 lbs/ac
  - 120 lbs/ac Actual N 45 lbs/ac Actual P; 25 lbs/ac Actual K 20 lbs/ac Actual S
- Half Synthetic Fertilizer: 29.0-10.9-6.0-4.8 @ 206.9 lbs/ac

** For synthetic fertilizers – 80% of blend was applied as a deep band, while the remaining 20% was side banded during seeding
Rainfall recorded: May 23 to September 17, 2025: 226.5 mm
Herbicide: Glyphosate @ 270 g ae/ac on June 11, 2025
Desiccant: Reglone Ion @ 1.3 L/ac on Sept. 9, 2025
Harvested: Sept. 18, 2025

RESULTS AND DISCUSSION:

During the first two years of this trial, results indicated that synthetic fertilizers were necessary to maximize crop yield. However, this pattern was not observed in 2024 when faba beans were seeded. In that year, plots receiving only synthetic fertilizer did not produce significantly higher yields than those treated with a combination of compost, biochar, and wood ash. This outcome aligns with the agronomic characteristics of pulse crops such as faba beans, which are capable of biological nitrogen fixation and therefore typically require much lower inputs of synthetic nitrogen fertilizer.

In contrast, the 2025 results followed the trend observed during the first two years of the study. Plots receiving only synthetic fertilizer produced significantly higher yields than all other treatments. Treatments combining soil amendments with synthetic fertilizer ranked second in performance, further indicating that synthetic fertilizers play a critical role in maximizing yield under the current soil conditions.

One explanation for this pattern relates to nutrient availability. Synthetic fertilizers provide nutrients in forms that are immediately available for plant uptake, whereas compost releases nutrients more gradually through mineralization. As a result, plots receiving compost without sufficient synthetic fertilizer exhibited visible nutrient deficiency symptoms during the growing season.

Given the regenerative focus of this study, the amendment-based treatments were not expected to achieve yield parity with synthetic fertilizers over a short timeframe. Instead, regenerative amendments such as compost, biochar, and wood ash are intended to enhance soil health and improve nutrient cycling over time. Continued long-term monitoring may therefore reveal gradual improvements in soil properties and relative performance of these treatments.

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COMPOST TRIAL - GRO, WESTLOCK - 2025

Trt	Treatment	Height		Yield (bu/ac)		Test Weight		TKW		Oil	
No.	Name	cm		Adjusted @ 10% moisture		Kg/HL		g		%	
1	CONTROL	76.7	e	33.7	e	70.1	a	4.0	a	45.4	abc
2	SYNTHETIC FERTILIZER	125.7	a	71.7	a	70.4	a	3.4	b	44.4	bc
3	COMPOST	111.7	bc	47.7	cd	70.0	a	3.6	b	45.7	abc
4	COMPOST+1/2 SYNTHETIC	116.7	b	67.7	b	70.7	a	3.6	b	44.2	c
5	COMPOST+BIOCHAR	102.0	cd	48.7	cd	70.1	a	3.4	b	46.6	ab
6	COMPOST+BIOCHAR+1/2 SYNTHETIC	110.7	bcd	67.3	b	71.4	a	3.5	b	45.3	abc
7	COMPOST+ASH	104.7	cd	48.3	cd	70.1	a	3.3	b	47.0	a
8	COMPOST+ASH+1/2 SYNTHETIC	116.3	b	66.7	b	70.9	a	3.4	b	45.3	abc
9	COMPOST+ASH+BIOCHAR	107.0	bcd	49.3	cd	69.5	a	3.4	b	47.1	a
10	COMPOST+ASH+BIOCHAR+1/2 SYNTHETIC	110.0	bcd	63.0	b	69.7	a	3.6	b	45.2	abc
11	COMPOST+ASH+GYPSUM	107.7	bcd	51.0	c	70.3	a	3.4	b	46.3	abc
12	COMPOST+ASH+GYPSUN+BIOCHAR	100.3	d	44.7	d	69.8	a	3.3	b	47.0	a
13	COMPOST+ASH+GYPSUM+BIOCHAR+1/2 SYNTHETIC	112.3	bc	65.0	b	70.4	a	3.5	b	44.9	abc
	LSD P=.05 (% mean diff)	6.88 (7%)		3.35 (6%)		1.13 (2%)		0.30 (9%)		1.42 (4%)	
	Standard Deviation	4.08		1.99		0.67		0.18		0.84	
	CV	3.79		3.56		0.95		5.16		1.84	

Means followed by same letter or symbol do not significantly differ (P=.05, Student-Newman-Keuls).
Mean comparisons performed only when AOV Treatment P(F) is significant at mean comparison OSL.

COMPOST TRIAL ECONOMIC ANALYSIS, CONTRIBUTED BY DR. DEREK MACKENZIE

What follows is a back of the envelope estimate that was generated with the aid of a large language model:

The cost comparison between synthetic fertilizer and compost application reveals that synthetic fertilizer is significantly more economical, costing approximately $175 per hectare compared to $1000 per hectare for 9 tons of compost and 1 ton of biochar. However, applying 9 tons of compost and 1 ton of biochar per hectare annually may significantly enhance soil carbon sequestration.

In this scenario, compost with 45% organic carbon content, contributes approximately 4.0 tons of carbon per hectare per year, considering its gradual mineralization and stabilization in soil. Biochar, which contains 75% carbon and is highly recalcitrant, adds an additional 0.5 tons of stable carbon per hectare per year. Together, these amendments result in a total annual carbon storage of approximately 4.5 tons per hectare, equivalent to 16.3 tons CO_2e(carbon dioxide equivalent) per hectare.

With carbon credit prices ranging from $20 to $50 per ton of CO_2e, this practice could generate $326 to $815 per hectare in carbon credits annually. We estimate that at $50 per ton CO_2e these practices, along with increased yield, will have ROI equivalent to using synthetic fertilizer alone. Although compost and biochar are more expensive due to higher material, transportation, and application costs, this treatment offers long-term benefits such as enhanced soil structure, increased organic matter, and improved nutrient retention.

These advantages plus increased yield and carbon credits will make the ROI on compost use more positive and equivalent to synthetics alone. The inclusion of biochar notably increases the long-term carbon retention due to its resistance to decomposition, offering a durable strategy for enhancing soil health, mitigating greenhouse gas emissions, and supporting sustainable agriculture. This demonstrates a significant economic incentive for adopting sustainable soil amendments alongside their benefits for soil health and productivity.

It was found through biochemical soil analysis, however, that adding biochar, ash, and gypsum tends to increase biochemical markers, particularly amino acids and basal respiration. So, adding these soil amendments have been shown to increase soil microbial health. In addition, compost, ash and gypsum were found to have the highest microbial biodiversity. Further results to be examined include greenhouses gas emissions and carbon sequestration potential for these various soil amendments and their combinations. It is believed that combinations with compost will have higher respiration, but also higher carbon sequestration, leading to higher net carbon sequestration in soils.

Additional carbon and greenhouse gas data was collected from soil tests that have not yet been analyzed at the time of printing of this report.

CONCLUSION:

While work still needs to be done to create a recipe or series of recommendations based on soil types and quality, there appears to be the possibility of a combination of soil amendments and crops that might capture carbon, produce economic crops, make use of organic soil amendments and improve soil health. Until this ultimate combination of conditions is discovered and thoroughly vetted, it is noted that there is still

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much work to be done to accomplish these goals.

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