NEW METHODS TO MANAGE FERTILITY FOR CROP ROTATIONS BASED ON RECOMMENDATIONS PROVIDED BY THE HANEY SOIL TEST

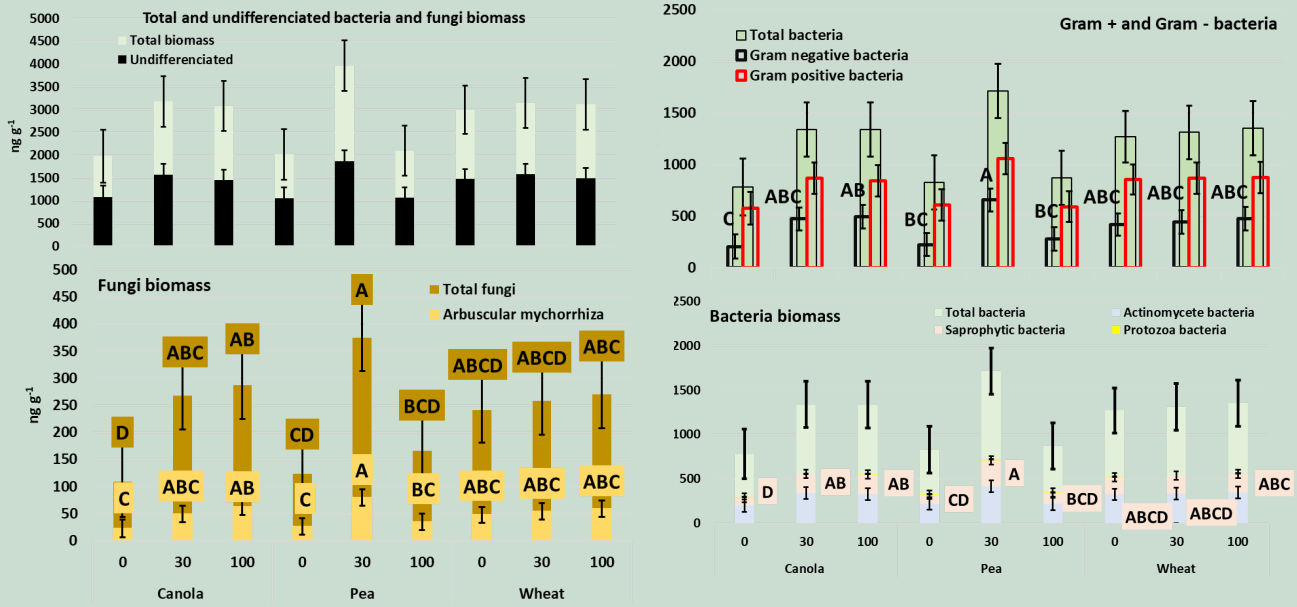
Highlights

- **Mineral N from previous season may have boosted populations of these microorganisms, hence generating more biomass compared to other treatments.**
- **•Wheat was planted in plots where canola was sown the year prior**
- **•Pea was planted in plots where wheat was sown the year prior**

Soil samples were sent to two different places, one is a standard lab which will provide you with a soil analysis and fertility recommendations and the other is WARD labs in Kearney Nebraska, which provides you with the same but, unlike the former, it shows you N content through a different method (thus concludes on fertility recommendations based on the N content measured from such method). This method is called Haney test, developed by Rick Haney of United States Department of Agriculture and Agricultural Research Service in Temple, Texas. Moreover, WARD labs gives you results for a phospholipid fatty acid test, which is used to profile different phylla of bacteria and fungi in the soil. Since both tests can recommend you how much N is required in the soil to seed the next crop for the upcoming season, it bears to ask the question, which one is better?

Over the last three years, canola, pea and wheat have been rotated in the same trial and treated under different fertilization rates. Fertilization treatments were set as follows. A) 0% (Control) - N recommendations from standard lab. 100% of the recommended N will be applied. B) N recommendations from the standard lab will be 30%. Then it will be topped up with that recommended by the WARD Haney analysis to equate the total recommended by Haney. C) N recommendations from WARD lab. 100% of the N recommended from the Haney soil test will be added.

Distribution of soil fungi and bacteria from soil samples



PROPRIETARY TRIALS

Proprietary Trials - Seeding, Maintenance, and Harvest Information									
Seeding			Maintenance						Harvest
			Fertilizer			Herbicide			
Date	Rate (plants per ft^2)	Depth (in)	Date	Product	Rate (lbs ac^{-1})	Date	Product	Rate (L ac^{-1})	Date
Compost pellets as soil ammendments									
June 2	30	1.5	June 2	S15	See table	May 20	Heat LQ (Saflufenacil) & RoundUp (Glyphosate)	0.059 1	Sept 28
						June 14	Esteem (Fluoxypyr, Clopryralid, MCPA)	0.24, 0.084, 0.281	
Intercropping corn and annual cover crop grazing									
June 1Ψ	1Ψ	0.5Ψ	May 27	Urea	140	May 26	RoundUp (Glyphosate)	1	Not harvested
June 28Ӿϖ§Ϋ	4Ӿ	Broadcast Ӿϖ§Ϋ	June 1	S15	100	June 16	R/T 540 (Glyphosate)	1	
	2ϖ§					July 18	RoundUp (Glyphosate)	1	
	15Ϋ								
Develop a Crystal Green based production program for barley, canola, oat and pea focused on increasing yield and improving P agronomic efficiency									
May 23¥£	8¥	1.5¥£Φ	May 23 £¥	See table		May 20£¥	Heat LQ (Saflufenacil) & RoundUp (Glyphosate)£Φ¥	0.059 1£Φ¥	May 23¥
	29£		June 1 *Φ			May 31Φ			Sept 9£
June 1Φ	30Φ					June 12¥	Viper (Imazamox)¥	0.404¥	Sept 22/28Φ
June 2*	10*	0.5*				June 14£	Esteem (Fluoxypyr, Clopryralid, MCPA)£Φ	0.24, 0.084, 0.281£Φ	Oct 21*
						June 15Φ			
						June 15*	Odyssey (Imazamox & Imazethapyr)*	17 g/ac*	
						Aug 23¥	Reglone Ion (Diquat Ion)¥Φ*	0.83¥Φ*	
						Sept 12Φ			
						Oct 7*			

Ψ Corn Ӿ Crimson clover ϖ Graza forage radish § Hairy vetch Ϋ Italian ryeg
£Barley *Canola ΦOat ¥Pea

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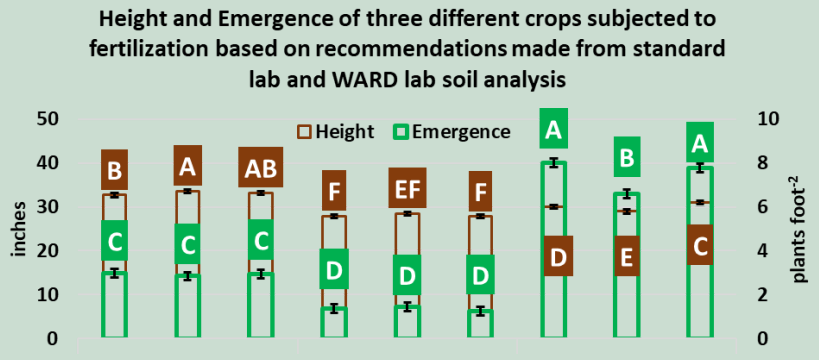
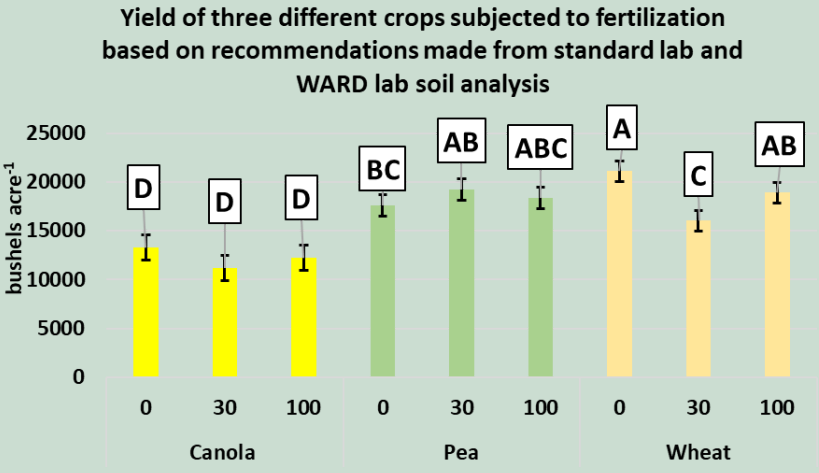
Soil samples obtained are taken before seeding and fertility is conducted. For simplicity results will be presented based on the crop planned to be seeded in the growing season of 2022. Total biomass was the same in all soil plots (P=0.0719) as well as biomass of undifferentiated bacteria and fungi (P=0.0804). Total bacteria (P=0.0931, and special phylogenetic bacteria such as actinomycete (P=0.0516) and protozoa (P=0.6162) were also the same across all treatments. Saprophytic bacteria (p=0.0188) and gram negative bacteria (P=0.0374) were greater in plots where pea plants were going to be sown at 30% of standard lab recommendations. Saprophytic and gram negative bacteria biomass was as great in plots destined to be sown with wheat and in plots to be sown with canola following 30% of standard lab N recommendations and 100% Haney recommendations as those found in plots to be sown with pea at 30% of the standard lab recommendation. Gram positive bacteria biomass on the other hand, was the same (P=0.1711).

Total fungi biomass (P=0.0009) and arbuscular mychorhiza (P=0.0710) followed the same differences as those found in aprophytic and gram-negative bacteria. Biomass of fungi as a total and arbuscular mychorhiza was exceeding in plots destined to be sown with wheat and in plots to be sown with canola following 30% of standard lab N recommendations and 100% Haney recommendations and in plots to be sown with pea at 30% of the standard lab recommendation.





. It is possible that excess fertilizer from previous crops may have induce an increase in saprophytic bacteria, gram negative bacteria, arbuscular mychorhiza, and total fungi biomass. As such, crops destined for wheat were previously fertilized and sown to canola and plots where pea was going to be planted were previously planted with wheat. Both these crops require more N than pea. Mineral N from previous season may have boosted populations of these microorganisms, hence generating more biomass compared to other treatments.

Emergence, height, and yield varied at each crop and under different fertilization treatments (P=0.001). These parameters analysed provided expected outcomes (number of seedlings, plant height and number of seeds produced will be different in canola, pea and wheat given their physiological differences). Thus, test weight differed according to crop species (P=<0.0001). Test weight was greater in pea grain, followed by wheat and finally canola grain with the lightest weight in pounds per bushel.

NEW METHODS TO MANAGE FERTILITY FOR CROP ROTATIONS BASED ON RECOMMENDATIONS PROVIDED BY THE HANEY SOIL TEST

Pea

In pea, there was 88% more emergence in partial and full Haney N recommendation fertilizer treatments than in control. Number of emergent seedings in control treatments and full Haney N recommendation treatments were 253% greater than those numbers found in plots fertilized with 30% of standard lab N recommendations. Moreover, emergence was 362% greater in control and in 30% of standard lab N recommendation treatments than in treatments where full rate Haney N recommendations took place. Pea stands height was 18% greater in control plots compared to those plots with either partial or full Haney N recommendations. Pea plant height in control and in full Haney N recommendation plots were 10% taller compared to those plots where partial Haney N recommendations took place. In addition, stand fertilized following full Haney N recommendations were 7% shorter compared to those pea stands fertilized under full and 30% of standard lab N recommendations. There were 44% more bushels per acre from pea grain obtained in plots fertilized partial and full Haney N recommendation treatments than in control. Yield from plots fertilized under partial Haney N recommendations was 34% greater than in full Haney N recommendations and control.

Wheat

In wheat, there was 22% more emergence in partial and full Haney N recommendation fertilizer treatments than in control. Number of emergent seedings in control treatments and full Haney N recommendation treatments were 52% greater than those numbers found in plots fertilized with 30% of standard lab N recommendations. Moreover, emergence was 73% greater where full rate Haney N recommendations took place. Wheat stands height in control plots was 13% taller compared to those plots with either partial or full Haney N recommendations. But height in wheat fertilized at 30% of standard lab rate N recommendations were 14% shorter than those found in control and in full Haney N recommendation fertilizer rate plots. Plots fertilized under full and partial Haney N recommendations yielded 48% more than those plots following the full N rate recommended by a standard lab. In fact, wheat stands being fertilized at 30% of the standard rate yielded 24% more than those plots fertilized at full N rate of standard lab recommendations and full N rate Haney recommendations. Wheat plots where Haney N recommendations were followed to the full rate also yielded 24% compared to full and 30% standard lab N recommendation rates. Fertilizer rates however produced no impact in protein content ($P=0.4154$) or lodging ($P=0.1335$).

Canola

In canola, there was 59% more percentage in partial (30% standard lab rate N recommendation) and full Haney N recommendation fertilizer treatments than in control. Number of emergent seedings in control treatments and full Haney N recommendation treatments were 139% greater than those numbers found in plots fertilized with 30% of standard lab N recommendations. Moreover, emergence was 200% greater in control and in 30% of standard lab N recommendation treatments than in treatments where full rate Haney N recommendations took place. Height in Canola was 11% greater in control plots compared to those plots with either partial or full Haney N recommendations. Canola stands 10% taller were found in control and in full Haney N recommendation plots compared to those plots where partial Haney N recommendations took place. Canola yielded 84% more in partial and full Haney N fertilizer recommendation treatments than in control. As such, 66% yield was reported in plots with full Haney N fertilization recommendations than in plots where standard lab N recommendations were followed either in full rate (control) or at 30%.

Based on these results, it seems that following either partial or full Haney recommendations may cause better yields. This can be explained twofold. First, Haney N recommendations (both partial and full) were applied four weeks after seeding. It is possible, the N added at this stage was used as a quicker rate and may have resulted in more yield production. Second, standard lab rates compared to Haney rates were either the same or lower. Those treatments were N applied and was greater in 30% recommendations of the standard lab rate. The rest of the rate is complemented with that recommended by the WARD Haney analysis to equate the total recommended by Haney. Only wheat had an increase in yield under these treatments, and even then , the increase was the same as that found in the full fertilizer rate (24%). Overall, it can be argued that both recommendations are the same, as actual increase cannot be justified by amount of fertilizer added but rather at the time when fertilizer was applied.