# Effect of Alfalfa Green Organic Soil Amendment on Re-Vegetation Success of Native Grass on Sandy Soils

*Bouw, Kayleigh; and Barrett, Danielle. Western Alfalfa Milling Company Ltd. PO Box 568 Norquay SK Canada S0A 2V0, phone 306-594-2362, dvbarrett@wamcoltd.ca www.alfalfagreen.ca*
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***Introduction***

Western Alfalfa Milling Co. Ltd. (WAMCO) regularly evaluates the efficacy of our soil amendment product Alfalfa Green (AG) as it relates to reclamation activities. Sandy soils pose a problem to the reclamation industry as re-vegetation activities are more difficult due to this poor soil structure and limited moisture retention. Preliminary data by Olds College in 1999 showed that alfalfa pellets in sandy soils improved plant height and biomass of barley, canola, and clover when used at a rate equal to 10% of the sand weight. Additionally, our marketing materials indicate that AG helps to increase germination and improve vegetation establishment in sandy soils. We have a recommended application rate of 4mt/ac of AG for use in nutrient deficient soils, which we extrapolate to include sandy soils. This preliminary research was done to see if 4mt/ac is an ideal rate, or if there is a measurable improvement in vegetation establishment and soil health when alternate rates of AG are applied.

***Objective***

The objective of this study was to determine the recommended rate for use of Alfalfa Green in soils that consist of mainly sand and support the hypothesis that using AG improves soil health and vegetation establishment.

***Materials & Methods***

WAMCO recommends 4mt/ac of AG for nutrient deficient soils which was extrapolated to include sandy soils. Therefore the study focused on this rate as well as a high and low treatment. The chosen treatments were a control (0mt), 3mt, 4mt and 5mt/ac equivalents to be replicated four times each on 3' x 6' plots. These rates worked out to be 0.00g AG/plot, 1239.66g AG/plot, 1652.89g AG/plot and 2066.11g AG/plot respectively. Treatments were arranged in a randomized 4 x 4 complete block design. The soil type was sandy loam. This field had previously been seeded with canola and wheat but failed to grow due to the high sand content and has not been occupied with grasses for several years. The plots were seeded with McKenzie's All Purpose Lawn Seed consisting of a blend of creeping red fescue, perennial rye grass, Kentucky blue grass, and fescue; using the manufacturer's recommended rate of 3.03lbs/1000 sq ft (24.83g/plot).

The seed was sprinkled evenly throughout the plot space and then raked in going first east-west and then north-south. The pellets were left as a top dressing and were not incorporated into the soil. In order to simulate authentic reclamation conditions, the plots were not irrigated (since irrigation is not native to our area) and the only moisture added was rain fall.

Coverage and colour were assessed qualitatively by ranking the plots according to a visual scale. Grass height was measured by throwing a 6" x 6" square and measuring with a ruler the average height per square. Root depth was measured at the end of the trial (September 30, 2011) by pulling five grass roots from each plot, measuring them, and then taking the cumulative average length for each application rate. Also, a soil sample was taken on the day of seeding (May 26, 2011) and again at the end of the trial (September 30, 2011) to check for nutrient levels and organic matter in the soil.

Date collected was:
1. Grass height
2. Average coverage as a percentage of plot area
3. Colour of grass on a scale of 1-5
4. Average root depth
5. Change in soil nutrients and organic matter content from the beginning to the end of the trial

Residual effects will be monitored in the spring of 2012 to assess winter survival and spring green up.

***Results***

*Quantitative assessment of grass height*

Grass height was measured to assess the difference in vertical growth possible with different application rates of AG. This indicates whether AG had an impact on rate of growth, compared to just affecting total coverage.

Table 1 outlines the average height of the vegetation for each application rate, followed by a line graph of the data (Figure 1).

Table 1. Quantitative assessment of the average grass height in inches.

| | Date | | | | | |
|---|---|---|---|---|---|---|
| | 05-Jun-11 | 17-Jun-11 | 5-Jul-11 | 28-Jul-11 | 17-Aug-11 | 30-Sep-11 |
| # of days after re-seeding | 10 | 22 | 40 | 63 | 83 | 127 |
| Application rate | | | | | | |
| 0mt/ac | 0 | <1 | 1 | 1 | 1.25 | 1.25 |
| 3mt/ac | 0 | <1 | 1.5 | 1.75 | 1.75 | 2.25 |
| 4mt/ac | 0 | <1 | 1.75 | 1.75 | 2 | 2.5 |
| 5mt/ac | 0 | <1 | 2 | 2.25 | 2.5 | 2.75 |

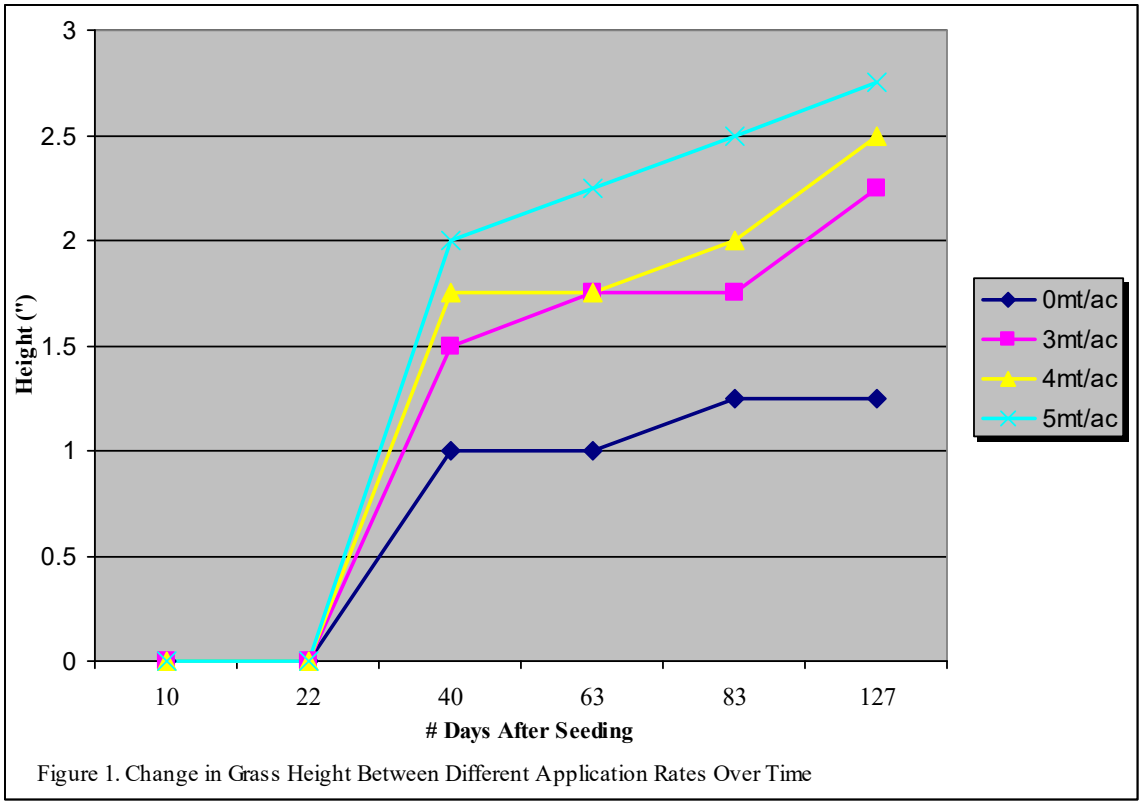

Figure 1. Change in Grass Height Between Different Application Rates Over Time

*Visual assessment of coverage.*

The grass cover of the plots was assessed to determine the difference in overall growth coverage with different application rates of AG. This indicated whether AG had an effect on germination and if there is enough of a nutrient supply to aid in growth on a sandy soil.

Table 2 outlines the estimated visual coverage of each plot, followed by a line graph of the data (Figure 2).

Table 2. Visual assessment of estimated grass coverage per plot as a percent

| Application Rate | 05-Jun-11 | 17-Jun-11 | 5-Jul-11 | 28-Jul-11 | 17-Aug-11 | 30-Sep-11 |
|---|---|---|---|---|---|---|
| # days after seeding | 10 | 22 | 40 | 63 | 83 | 127 |
| 0mt/ac | 0 | <5 | <5 | <5 | 5 | 5-10 |
| 3mt/ac | 0 | <5 | 10 | 30 | 35 | 40 |
| 4mt/ac | 0 | <5 | 15 | 35-40 | 40 | 50 |
| 5mt/ac | 0 | <5 | 20 | 40 | 50 | 55 |

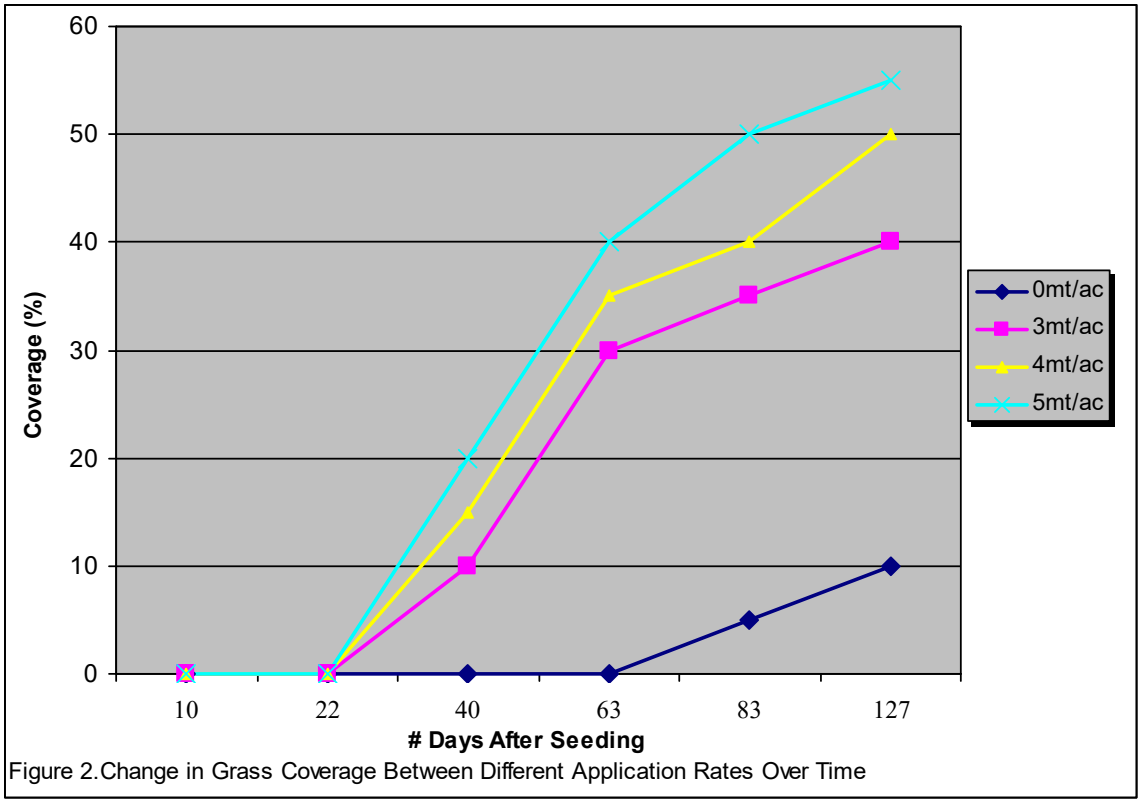

Figure 2.Change in Grass Coverage Between Different Application Rates Over Time

*Colour index.*
The colour of the grass was also assessed qualitatively by a visual scale. A rating system from 1-5 was used with 1 being dull green and 5 being a dark green, starting on day 63 (July 28, 2011). Table 3 outlines the visual assessment of the colour for each application rate.

Table 3. Visual assessment of colour per plot using a qualitative scale of 1-5

| Application Rate | 28-Jul-11 | 17-Aug-11 | 30-Sep-11 |
|---|---|---|---|
| # days after seeding | 53 | 83 | 127 |
| 0mt/ac | 1 | 1 | 1 |
| 3mt/ac | 2.5 | 4 | 4 |
| 4mt/ac | 2.5 | 5 | 5 |
| 5mt/ac | 2.5 | 5 | 5 |

*Root Depth.* Root depth was measured to determine whether increasing levels of AG resulted in an increased ability of roots to penetrate sand at different application rates of AG.

Table 4 outlines the root depth of the grass seedlings as assessed at the end of the study (September 30, 2011).

Table 4. Root depth of the grass seedlings as assessed at the conclusion of the study.

| Application Rate | Average Root Depth (cm) |
|---|---|
| 0mt/ac | 2.4 |
| 3mt/ac | 3.2 |
| 4mt/ac | 4.4 |
| 5mt/ac | 5.9 |

*Soil nutritional analysis.*
A soil analysis was done to determine if higher nutrient levels were present in soils where more AG was applied.

Table 5. Soil analysis comparison of before and after application.

| Application Rate | N | P | K | S | Cu | Mn | Zn | B | Fe | Cl | pH | Organic Matter (%) | E.C. Cal.Sat.Extr (mS/cm) | Soil Texture |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Before Application | 5 | 112 | 239 | 16 | 1.1 | 16.3 | 1.2 | 0.8 | 63 | 4 | 7.8 | 0.8 | 0.2 | Loamy Sand |
| 0mt/ac | 2 | 49 | 102 | 2 | 0.4 | 3.1 | 0.3 | 0.2 | 20 | 1 | 7.8 | 0.9 | 0.2 | Loam |
| 3mt/ac | 14 | 58 | 376 | 9 | 0.3 | 7.0 | 0.5 | 0.4 | 18 | 4 | 7.7 | 0.9 | 0.2 | Loam |
| 4mt/ac | 14 | 58 | 403 | 3 | 0.4 | 7.2 | 0.5 | 0.4 | 19 | 4 | 7.7 | 0.9 | 0.2 | Loam |
| 5mt/ac | 11 | 58 | 439 | 4 | 0.4 | 7.0 | 0.5 | 0.5 | 17 | 3 | 7.8 | 0.8 | 0.2 | Loam |

## ***Discussion***

*Quantitative assessment of plant height.*
The grass seed was slow to start germinating. This may have been due to the lack of moisture as the grass seed was meant to be kept under constant moisture after being spread. As the trial was to represent a reclamation site, it was not irrigated and had to rely on the moisture from the rain. In the first three weeks of the trial there was only a total of 1.7cm of rain. Due to the structure of the soil and low water retention, there was little moisture for the seeds to start to germinate or for the pellets to break down. This likely caused a delay in the grass growth.

By 40 days after seeding (July 5, 2011) there was an observable difference between treatments with regards to grass height. The 5mt application rate had the highest average grass height throughout the rest of the trial, followed by the 4 and 3mt application rates. The control plots had very short, thin grass that was non comparable to the other application rates throughout the trial.

*Visual assessment of coverage.*
At 40 days post seeding (July 5, 2011) there was a qualitative difference between the different application rates. Figure 3 shows an overview of the plots where a difference in total coverage is visible. Figures 4 - 11 show the best plot of each application rate close up so as to get a better visual of what each application looks like mid-trial 63 days after seeding (July 28, 2011), and at the end of the trial 127 days after seeding (September 30, 2011).

Figure 3. Overview of all the plots 40 days after seeding (July 5, 2011).

Figure 4. The best 0mt/ac plot 40 days after seeding (July 5, 2011).

Figure 5. The best 0mt/ac plot 127 days after seeding (September 30, 2011).

Figure 6. The best 3mt/ac plot 40 days after seeding (July 5, 2011).

Figure 7. The best 3mt/ac plot 127 days after seeding (September 30, 2011).

Figure 8. The best 4mt/ac plot 40 days after seeding (July 5, 2011).

Figure 9. The best 4mt/ac plot 127 days after seeding (September 30, 2011).

Figure 10. The best 5mt/ac plot 40 days after seeding (July 5, 2011)

Figure 11. The best 5mt/ac plot 127 days after seeding (September 30, 2011).

The 5mt application rate of AG had the most overall coverage, followed closely by the 4mt application rate. The 3mt application rate and control both fell behind by 40 days post-seeding.

*Colour index.*
Mid-way through the trial (July 28, 2011) the grass was getting long and thick enough to notice colour.

The 4 and 5mt application rates were the first to darken up, with the 3mt application rate lagging behind. The control plots stayed the same light, dull green throughout the entire study, and were noticeably less green than the plots where AG was used.

Though the colour of the plots is not relevant to use in reclamation, it is still interesting to note that the 4 and 5mt application rates had a darker, greener, grass colouration than the control or the 3mt rate.

*Root depth.*
Root depth was measured on the last day of the trial (September 30, 2011). The 5mt application rate again had the longest average root depth, followed by the 4mt application rate. The 3mt application rate and control were not up to par in comparison to the other application rates.

*Soil nutritional analysis.*
The organic matter of the soil did not really change. This may be due to the fact that the AG was not incorporated into the soil, and as the pellets had not fully broken down some remnants still sat on top of the soil. In the spring the soil will be re-tested and WAMCO believes that the organic matter will increase over the winter while the pellets break down fully under the snow cover and have a chance to seep further into the soil.

As expected, potassium content in the soil increased with increasing rates of AG. AS well, there was a significant increase in nitrogen, zinc, manganese, chloride, zinc, and boron levels in the plots treated with AG compared to hose treated with the control. No difference was found between treatments with respect to the levels of copper and iron.

The soil lost some nutrients from beginning to end (such as phosphorous, sulphur, copper, manganese, zinc, and iron) despite the addition of AG. This could be due to the grass taking up these nutrients. The level of sulphur at 3mt/ac is an anomaly. Electroconductivity and pH were unchanged.

Overall, the 4mt application rate appears to have the most readily available nutrients to support growth.

***Conclusion***
This research supports the hypothesis that 4mt/ac of AG is the ideal rate for a sandy soil. There was a large increase in coverage, height, root depth, and colour between the 4mt and 3mt application rate. Though the 5mt application rate had improved coverage and plant height, considering economics of obtaining this marginal improvement it appears that for use in reclamation the 4mt application rate should be great enough to get the desired results for a site consisting of a sandy soil. This research indicates that Alfalfa Green is a useful amendment to re-vegetate sandy soils and will improve germination rates resulting in better coverage and a quicker return to the lands pre-disturbed state.