

Effect of EarthRenew OMF on Growth and Productivity of Norland Potato under Irrigated Production

EarthRenew OMF is a pelletized organic amendment product produced from heat-treated feedlot manure and bedding. It can improve soil properties, increase water holding capacity, and add nutrients to the soil. The present study is designed to determine the effects of OMF on Norland potato. The objectives of this study is to establish the effectiveness of OMF as an amendment to improve soil properties and moisture holding capacity and to supplement the nutrient needs of the potato crop. Project Objectives include:

- Effect of OMF on tuber yield, size grade, and quality attributes of Norland potato.
- Effect of OMF on soil properties.
- Effect of OMF on fertilizer replacement capacity for producing Norland potato.
- Effect of OMF on soil moisture holding capacity.

This study examined two OMF rates (3.7, 7.4 t/ha) plus a 0 OMF check, and three inorganic, N and P, fertilizer levels (i.e. recommended rate of 200 kg N/ha, 120 kg P₂O₅/ha, 80% of recommendation, 60% of recommendation) plus a no fertilizer-Check. A blanket application of 50 kg K₂O/ha was given for all treatments. All the phosphorus and half of nitrogen were side-banded at planting and the other half of nitrogen was broadcast prior to second hilling. The crop was planted on May 28, 2009. Seed pieces were spaced at 91 cm between-row and 30 cm within-row. The crop was raised using supplemental irrigation. Plots were top-killed on September 9 and harvested on October 8, 2009. Potatoes were graded according to tuber diameter based on Canadian Standards. The 'Marketable Grade' included tubers between 48 mm and 88 mm in diameter. Specific gravity and culinary characteristics were determined using recommended Prairie Regional Variety Testing protocols.

Soil nutrient content was estimated at land preparation, immediately after planting and prior to harvest for the various OMF fertilizer combinations. Leaf Area Index was estimated on 69 and 97 days from planting. Soil moisture tension at 30 cm depth from the top of the hill was recorded weekly.

Soil Organic Matter:

The soil organic matter percentage prior to planting during spring and before harvest for the various OMF is summarized in Table 75. The pre-plant and pre-harvest soil organic matter content without OMF was 2.6%. Application of 3.7 and 7.4 t/ha of OMF had no appreciable effect on soil organic matter content. There was no change in organic matter content for the various OMF treatments between spring and fall.

Soil Moisture:

The growing season of this potato crop received 134 mm of rainfall and 255 mm of irrigation. Figure 7 illustrates the growing-season moisture tension for the two rates of applied OMF treated and untreated soil.

For soil that did not receive OMF, the soil moisture tension predominantly ranged between 40 and 50 cbars. For the soil that received 3.7 and 7.4 t/ha OMF the soil moisture tension averaged around 30 cbars. The OMF treated soil consistently recorded lower soil moisture tensions than the untreated control throughout the growing season (Figure 7). This indicates

that under the normal ridge and furrow potato growing system, OMF was capable of holding more moisture in the effective root zone compared to soil that did not receive OMF. The soil moisture tensions for the 3.7 and 7.4 t/ha OMF were somewhat similar throughout the growing season.

| EarthRenew OMF treatment | Organic matter percent (%) | |
|--------------------------|----------------------------|------|
| | Spring | Fall |
| 0 | 2.6 | 2.6 |
| 3.7 t/ha | 2.7 | 2.7 |
| 7.4 t/ha | 2.7 | 2.7 |

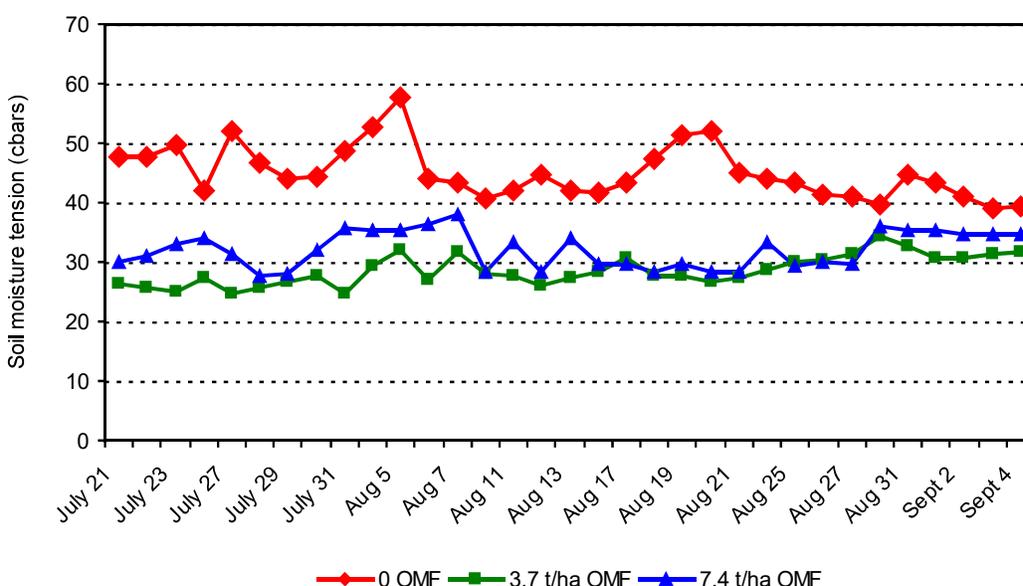


Figure 7. Growing-season soil moisture tension for different rates of EarthRenew OMF in the Norland potato crop grown under irrigation.

Soil NO₃-Nitrogen:

Application of higher rates of OMF improved soil NO₃-nitrogen levels at planting. The spring soil NO₃-nitrogen was highest for 7.4 t/ha OMF, intermediate for 3.7 t/ha, and lowest for the control treatment without OMF (Figure 8-A). Without any fertilizer, the base soil NO₃-nitrogen level was 102 kg nitrate-N/ha. With application of 3.7 and 7.4 t/ha OMF, the soil NO₃-nitrogen levels increased to 163 and 201 kg nitrate-N/ha respectively. The improved soil nitrate-N status with higher rates of OMF was observed under the different fertilizer application rates (Figure 8-A).

The residual soil NO₃-nitrogen levels ranged between 0 - 15 kg nitrate-N/ha indicating that a considerable portion of NO₃-nitrogen was utilized by the crop. This confirms that potatoes are a high nitrogen requiring crop.

Soil Phosphorus:

Similar to NO₃-nitrogen, the spring and fall soil phosphorus levels were higher with addition of OMF (Figure 8-B). For the various fertilizer application rates, the soil phosphorus levels ranged between 54 and 86 kg P/ha for no OMF, 67 and 82 kg P/ha for 3.7 t/ha OMF, and 86 and 93 kg P/ha for 7.4 t/ha OMF.

In contrast to nitrogen, there was a considerable amount of residual P in the soil at harvest, with increased soil P levels for higher OMF rates. Soil P levels were lowest where no OMF was applied. Soil residual P levels were higher under increased OMF application rates (Figure 8-B). The residual phosphorus levels in the soil in response to OMF application ranged between 43 and 83 kg P/ha under no fertilizer control, 44 and 90 kg/ha under 60% rate, 50 and 65 kg/ha under 80% rate, and 45 and 86 kg/ha under full rate.

Soil Potassium:

The rate response of OMF on soil potassium levels was variable (Figure 8-C). Application of OMF did not appear to have any effect on soil potassium levels in the spring with minimal change in the fall.

Mainstem Count and Days to Flower:

The effects of OMF and fertilizer application rates on mainstem count and the date to 50% flowering are summarized in Table 76.

On average, four mainstems were produced in each hill (Table 76). OMF application had no effect on mainstem numbers. Higher fertilizer rates produced more mainstems than lower fertilizer rates.

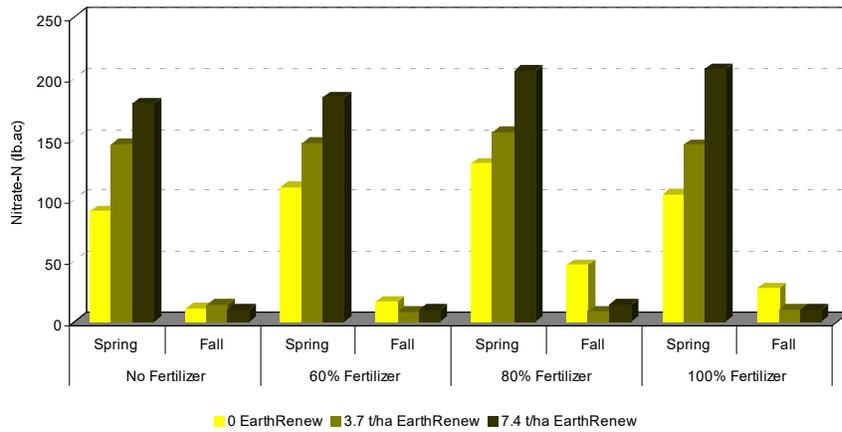
Generally 50% flowering occurred around 61 days from planting. OMF and fertilizer application rates had no effect on flowering date.

Leaf Area Index (LAI):

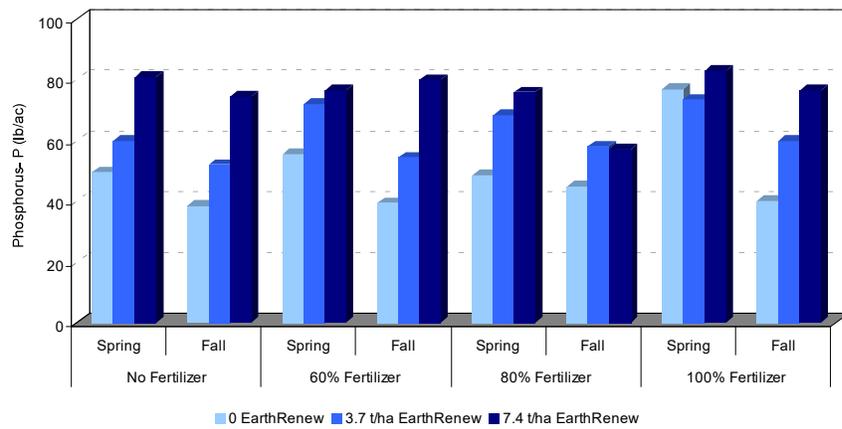
In this study LAI was estimated at full flowering (69 DAP) and prior to top-kill (97 DAP). LAI ranged between 2.0 and 2.7 at 69 DAP and between 2.0 and 2.6 at 97 DAP (Table 77). At flowering, no significant responses were observed for the effect of OMF on LAI. However, at top-kill, higher rate of OMF produced slightly higher LAI than the lower rate or no OMF.

Fertilizer application had no effect on LAI at 69 DAP, whereas at 97 DAP, higher LAI's were recorded at higher fertilizer levels compared to lower fertilizer levels (Table 77).

A



B



C

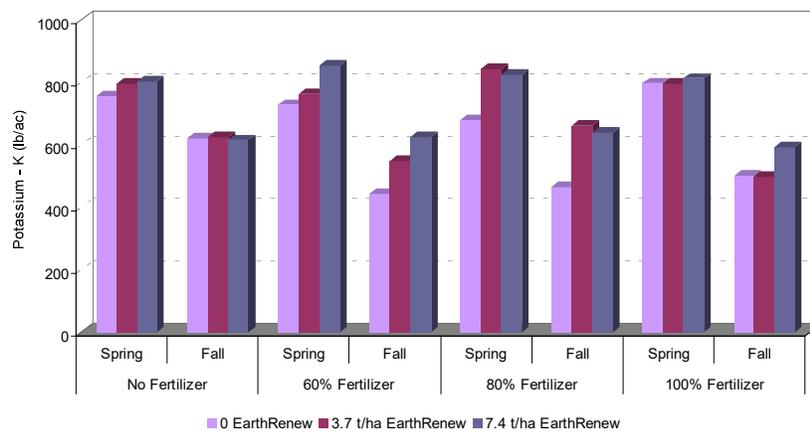


Figure 8. Effects of EarthRenew OMF and fertilizer application on spring and fall soil NO₃-nitrogen (A), phosphorus (B) and potassium (C) levels in an irrigated Norland potato crop.

| Table 76. EarthRenew OMF and fertilizer rate effects on mainstem number per hill and date of 50% flowering for Norland potato grown under irrigation. | | |
|--|--------------------------|-----------------------|
| Treatment | Mainstem number per hill | Date of 50% flowering |
| EarthRenew OMF: | | |
| 0 | 4.3 | 61 |
| 3.7 t/ha | 4.2 | 61 |
| 7.4 t/ha | 4.3 | 61 |
| Fertilizer: | | |
| No Fertilizer | 3.8 | 61 |
| 60% N and P | 3.7 | 61 |
| 80% N and P | 4.6 | 60 |
| 100% N and P | 5.0 | 61 |
| ANOVA | | |
| <u>Source</u> | | |
| OMF | ns | ns |
| Fertilizer | ***(0.5) | ns |
| OMF x Fertilizer | ns | ns |
| *** and ns indicate significance at P<0.001 level of probability and not significant respectively. Value within parenthesis is LSD estimate at 5.0% level of significance. | | |

| Table 77. EarthRenew OMF and fertilizer rate effects on Leaf Area Index for Norland potato grown under irrigation. | | |
|---|--------------------|--------------------|
| Treatment | 69 DAP (Flowering) | 97 DAP (Flowering) |
| EarthRenew OMF: | | |
| 0 | 2.4 | 2.1 |
| 3.7 t/ha | 2.4 | 2.2 |
| 7.4 t/ha | 2.2 | 2.6 |
| Fertilizer: | | |
| No Fertilizer | 2.3 | 2.0 |
| 60% N and P | 2.2 | 2.3 |
| 80% N and P | 2.0 | 2.6 |
| 100% N and P | 2.7 | 2.5 |
| ANOVA | | |
| <u>Source</u> | | |
| OMF | ns | ns |
| Fertilizer | ns | *(0.5) |
| OMF x Fertilizer | ns | ns |
| * and ns indicate significance at P<0.05 level of probability and not significant respectively. Value within parenthesis is LSD estimate at 5.0% level of significance. | | |

Tuber Yield:

The effects of OMF and fertilizer rates on total and marketable tuber yield are summarized in Table 78. Soil amended with OMF produced significantly higher 'total' and 'marketable' tuber yields compared to un-amended soil. The corresponding yield increases were 8% for marketable yield and 6% for total yield.

Application of 3.7 t/ha and 7.4 t/ha OMF produced similar yields indicating that increasing the rate of OMF from 3.7 t/ha to 7.4 t/ha did not produce any added yield advantages.

The highest marketable yield of 43.0 t/ha and total yield of 46.7 t/ha were obtained with a combined application of 1.5 t/ac OMF and 80% of the recommended fertilizer compared to only the recommended fertilizer level without OMF that produced 39.4 t/ha of marketable tubers and 44.4 t/ha of total tubers (Table 79 and Table 80).

Application for OMF or inorganic fertilizer had no effect on average tuber size (Table 78).

| Table 78. Effects of EarthRenew OMF and fertilizer on total and marketable yield and average weight of marketable tubers for Norland potato grown under irrigation. | | | |
|---|--------------------|-------------------------|-------------------------------------|
| Treatment | Total yield (t/ha) | Marketable yield (t/ha) | Average marketable tuber weight (g) |
| EarthRenew OMF: | | | |
| 0 | 39.5 | 35.3 | 178 |
| 3.7 t/ha | 42.0 | 38.2 | 189 |
| 7.4 t/ha | 41.3 | 37.0 | 188 |
| Fertilizer: | | | |
| No Fertilizer | 37.9 | 34.2 | 191 |
| 60% N and P | 40.0 | 35.9 | 189 |
| 80% N and P | 42.1 | 38.2 | 178 |
| 100% N and P | 43.8 | 39.2 | 181 |
| ANOVA | | | |
| <u>Source</u> | | | |
| OMF | *(1.7) | *(2.0) | ns |
| Fertilizer (F) | ns | ns | ns |
| OMF x Fertilizer | ns | ns | ns |
| * and ns indicate significance at P<0.05 level of probability and non significant respectively. Values within parentheses is LSD estimate at 5.0% level of probability. | | | |

| EarthRenew OMF rate | Marketable yield (t/ha) | | | | Mean |
|--|-------------------------|-------------|-------------|--------------|-------------|
| | No Fertilizer | 60% N and P | 80% N and P | 100% N and P | |
| 0 | 35.1 | 36.4 | 30.5 | 39.4 | 35.3 |
| 3.7 t/ha | 35.1 | 34.2 | 43.0 | 40.7 | 38.2 |
| 7.4 t/ha | 32.4 | 37.0 | 41.2 | 37.6 | 37.0 |
| Mean | 34.2 | 35.9 | 38.2 | 39.2 | |
| ANOVA | | | | | |
| <u>Source</u> | | | | | |
| OMF | | | | | |
| Fertilizer | | | | | |
| OMF x Fertilizer | | | | | |
| * and ns indicate significance at P<0.05 level of probability and non significant respectively. Value within parenthesis is LSD estimate at 5.0% level of probability. | | | | | |

| EarthRenew OMF rate | Total yield (t/ha) | | | | Mean |
|--|--------------------|-------------|-------------|--------------|-------------|
| | No Fertilizer | 60% N and P | 80% N and P | 100% N and P | |
| 0 | 38.7 | 40.8 | 33.8 | 44.4 | 39.5 |
| 3.7 t/ha | 30.8 | 37.9 | 46.7 | 44.7 | 42.0 |
| 7.4 t/ha | 36.2 | 41.2 | 45.7 | 42.2 | 41.3 |
| Mean | 37.9 | 40.0 | 42.1 | 43.8 | |
| ANOVA | | | | | |
| <u>Source</u> | | | | | |
| OMF | | | | | |
| Fertilizer | | | | | |
| OMF x Fertilizer | | | | | |
| * and ns indicate significance at P<0.05 level of probability and non significant respectively. Value within parenthesis is LSD estimate at 5.0% level of probability. | | | | | |

Culinary Characteristics:

Table potato tuber quality characteristics such as specific gravity, baking, boiling properties and after-cooking discolouration were compared for Norland tubers produced in soil amended with OMF and un-amended soil.

There was no difference between the OMF treatments and standard fertilizer on the culinary properties such as tuber specific gravity; texture, colour, and flavour of baked potato; texture, colour, flavour, and sloughing of boiled potato; and after cooking darkening (Table 81).

| Table 81. Effects of EarthRenew OMF and fertilizer rates on tuber specific gravity and culinary properties of Norland potato grown under irrigation. | | | | | | | | | |
|--|------------------|--------------|-----------|------------|--------------|-----------|------------|----------------|------------------------------|
| Treatment | Specific gravity | Baked | | | Boiled | | | | After-cooking discolouration |
| | | Texture | Colour | Flavour | Texture | Colour | Flavour | Sloughing | |
| EarthRenew OMF: | | | | | | | | | |
| 0 | 1.085 | Slightly wet | Off white | Acceptable | Slightly wet | Off white | Acceptable | Little or none | None |
| 3.7 t/ha | 1.085 | Slightly wet | Off white | Acceptable | Slightly wet | Off white | Acceptable | Little or none | None |
| 7.4 t/ha | 1.084 | Slightly wet | Off white | Acceptable | Slightly wet | Off white | Acceptable | Little or none | None |
| Fertilizer: | | | | | | | | | |
| 0 | 1.086 | Slightly wet | Off white | Acceptable | Slightly wet | Off white | Acceptable | Little or none | None |
| 60% N and P | 1.084 | Slightly wet | Off white | Acceptable | Slightly wet | Off white | Acceptable | Little or none | None |
| 80% N and P | 1.084 | Slightly wet | Off white | Acceptable | Slightly wet | Off white | Acceptable | Little or none | None |
| 100% N and P | 1.085 | Slightly wet | Off white | Acceptable | Slightly wet | Off white | Acceptable | Little or none | None |