Soil Nitrate and Crop Yield in Response to Subsoil Loosening by Paraplow

Brett Ewen, Jeff Schoenau, Mike Grevers, & Garth Weiterman

The paraplow is a deep tillage implement produced by Howard Rotavator in England (see photos). A study was started in 2010 to determine if paraplowing of soils under long-term pivot irrigation in south-central Saskatchewan would alter the soil physical and chemical properties and benefit crop production. Three sites were established south of Birsay, SK under pivot irrigation (Table 1). At each site, five paraplow treatments (Figure 1) were imposed along with an undisturbed control. The treatments were applied in October 2009 and in April 2010 to provide a comparison of fall versus spring treatment. Following spring paraplowing and prior to seeding, soil samples were collected from each plot in depth increments of 0 - 30 cm and 30 – 60 cm. The soils were extracted for nitrate-N using 2.0 M KCl. Square meter yields were taken from each plot at harvest for grain and straw yield.

Over the course of May and June the sites received approximately 250 mm of precipitation. Large nitrogen losses were anticipated from denitrification, leaching and run-off. At site one (Figure 2), soil profile nitrate was generally higher in paraplow treatments than in the undisturbed control, while at site two (Figure 3), nitrate was lower. At site three (Figure 4), there was little difference among the treaments. Paraplowing may have reduced losses of the fall applied N at site one by increasing aeration and reducing denitrification. For site two, at which the N was spring applied, the paraplowing treatments may have increased N leaching and/or denitrification losses. Wheat grain yield (Figure 5) at site two was slightly higher than the control in some of the paraplow treatments. At site three, canola yields were similar among all treatments, consistent with lack of differences in soil available nitrate content.

In one unusually wet year, paraplowing had variable effects on soil profile nitrate content on soils under pivot irrigation. The effects of paraplowing on crop yields were also variable and generally small. Further evaluation is required under more normal conditions of rainfall and temperature.

Table 1. Site Descriptions

	Soil Characteristics	Fall Applied N fertilizer	Spring Applied N fertilizer	Crop
Site One	Solonetzic			Not seeded (flooded)
Site Two	Chernozemic			Hard Red Spring Wheat
Site Three	Vertisolic			Hybrid Canola

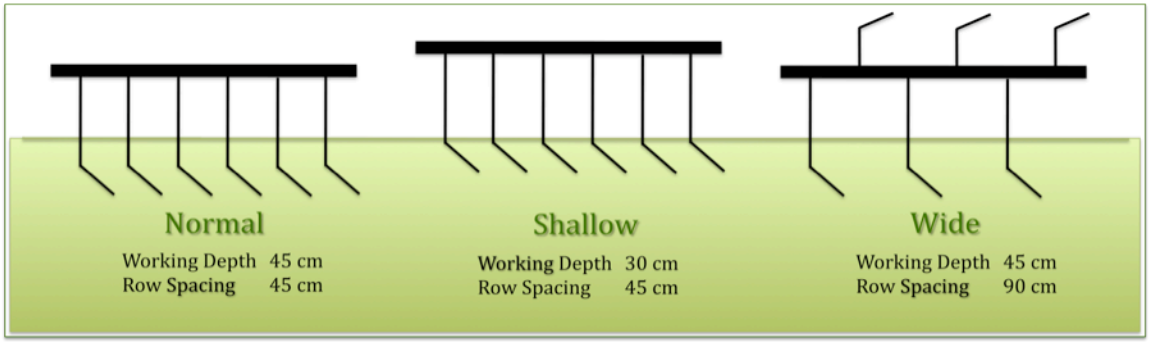

Figure 1. Treatments imposed using the paraplow

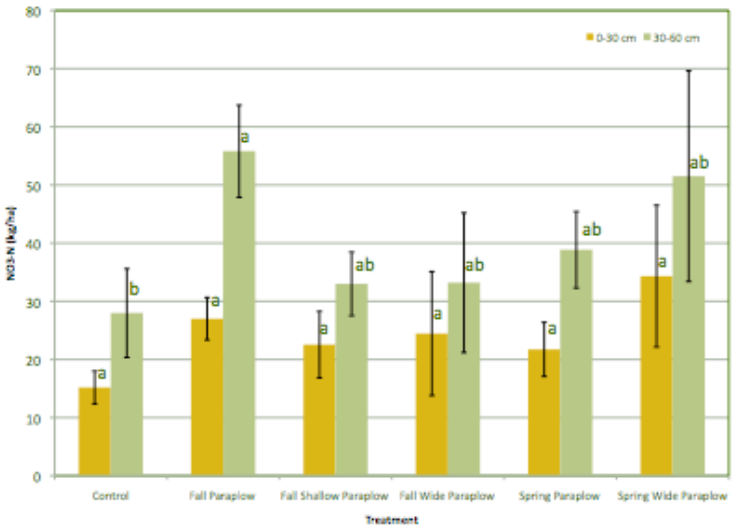

Figure 2. Soil profile Nitrate at Site One.

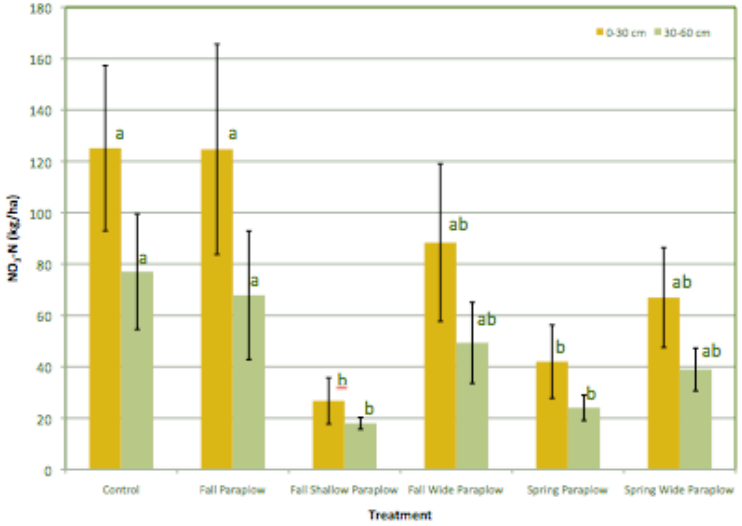

Figure 3. Soil profile Nitrate at Site Two.

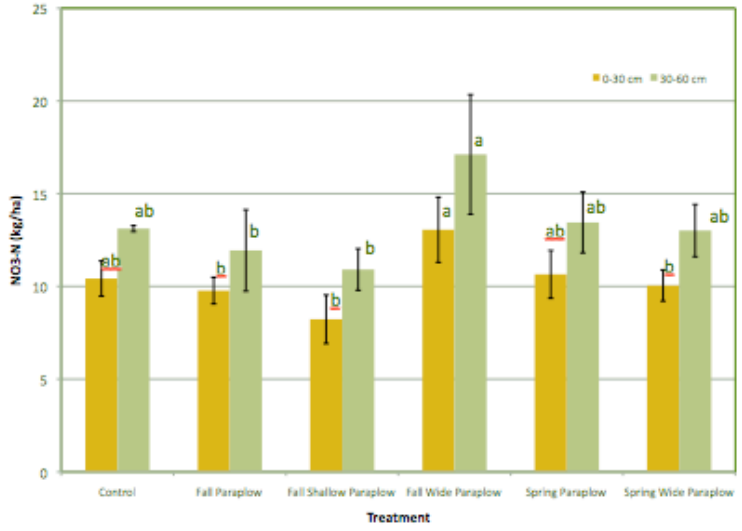

Figure 4. Soil profile Nitrate at Site Three.

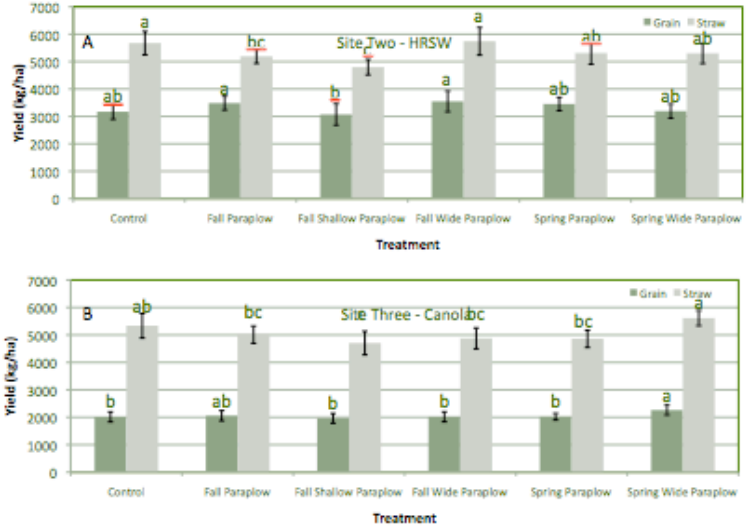

Figure 5. Crop Production at Site Two (HRSW) & Three (Canola).

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Brett Ewen[1], Jeff Schoenau[1], Mike Grevers[1], & Garth Weiterman[2]

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Introduction

The paraplow is a deep tillage implement produced by Howard Rotavator in England (see photos). A study was started in 2010 to determine if paraplowing of soils under long-term pivot irrigation in south-central Saskatchewan would alter the soil physical and chemical properties and benefit crop production.

Materials & Methods

Three sites were established south of Birsay, SK under pivot irrigation (Table 1). At each site, five paraplow treatments (Figure 1) were imposed along with an undisturbed control.

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Site Three	Verisolic			Hybrid Canola

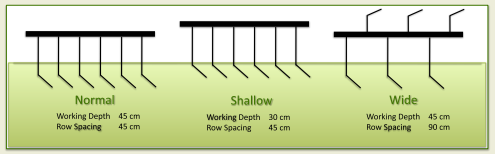

Figure 1. Treatments imposed using the paraplow.

- The treatments were applied in October 2009 and in April 2010 to provide a comparison of fall versus spring treatment.
- Following spring paraplowing and prior to seeding, soil samples were collected from each plot in depth increments of 0 - 30 cm and 30 – 60 cm.
- The soils were extracted for nitrate-N using 2.0 M KCl.
- Square meter yields were taken from each plot at harvest for grain and straw yield.

Results & Discussion

Over the course of May and June the sites received approximately 250 mm of precipitation. Large nitrogen losses were anticipated from denitrification, leaching and run-off. At site one (Figure 2), soil profile nitrate was generally higher in paraplow treatments than in the undisturbed control, while at site two (Figure 3), nitrate was lower. At site three (Figure 4), there was little difference among the treaments. Paraplowing may have reduced losses of the fall applied N at site one by increasing aeration and reducing denitrification. For site two, at which the N was spring applied, the paraplowing treatments may have increased N leaching and/or denitrification losses.

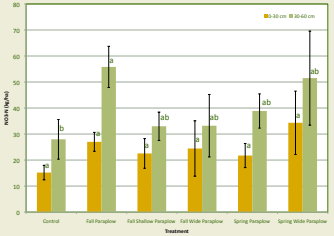

Figure 2. Soil profile Nitrate at Site One.

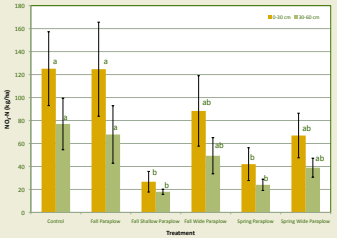

Figure 3. Soil profile Nitrate at Site Two.

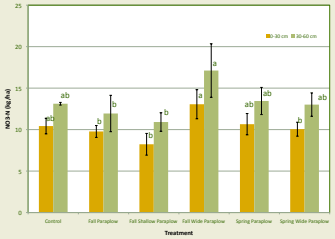

Figure 4. Soil profile Nitrate at Site Three.

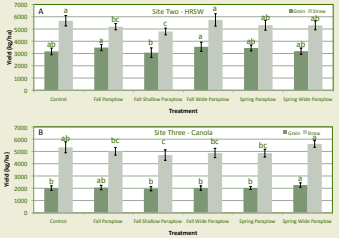

Figure 5. Crop Production at Site Two (HRSW) & Three (Canola).

Wheat grain yield (Figure 5) at site two was slightly higher than the control in some of the paraplow treatments. At site three, canola yields were similar among all treatments, consistent with lack of differences in soil available nitrate content.

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Conclusion

- In one unusually wet year, paraplowing had variable effects on soil profile nitrate content on soils under pivot irrigation.
- Effects of paraplowing on crop yields were also variable and generally small.
- Further evaluation is required under more normal conditions of rainfall and temperature.

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