Evaluating Tile Drainage/Water Management Effects on Wheat, Canola and Soybeans productivity in Heavy Clay soils

Project Duration: 2019-2021

Objectives

The main objective of this research is to assess the impact of tile drainage (15', 30' and 45' wide) and water table management on yield and quality of canola, soybean, and wheat. The data collected from this research will be used to develop computer models that can simulate tile drainage operation under different rainfall patterns, thus extending the usefulness of this research beyond the three-year period.

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Results

The 2019 season has been considerably dry with water table consistently remaining well below the tiles in all the plots. Despite the water table remaining below the tile, in the Soybean plots the water table at the tile was shallower than mid-spacing between the tiles. This may have been due to the impact of the tile installation disturbance of the soil creating a preferential pathway for water to accumulate compare to the soil at mid-spacing of the tile. However, the water table still remained too deep to cause an impact on the yield. In the wheat and canola fields the water table remained too deep to cause any impact on the yield. Figure 1 shows the comparison of water tables throughout the growing season in all the plots with the daily rainfall shown as a bar graph.

Table 1. Effect of tile drainage on plant height, days to maturity and yield of wheat, canola & soybeans at Arborg site.

Treatment	Wheat (30' spacings)			Canola (15' spacings)			Soybeans (45' spacings)		
	Pl Height (inches)	Days to Maturity	Yield (bu/acre)	Pl Height (inches)	Days to Maturity	Yield (bu/acre)	Pl Height (inches)	Days to Maturity	Yield (bu/acre)
Over Tiles	27.7a	80.0	39.3	29.1b	78.7	21.1	20.6	127.3	18.8
In bet. Tiles	23.9b	80.0	36.5	31.5ab	79.3	26.1	18.7	126.7	21.6
No tile	26.2ab	80.0	36.0	33.5a	78.3	18.4	20.5	127.3	21.3
Signi Diff.	**Yes**	**No**	**No**	**Yes**	**No**	**No**	**No**	**No**	**No**
P	**0.02**		**0.76**	**0.03**	**0.37**	**0.13**	**0.38**	**0.55**	**0.45**
CV%	**4.4**		**15.4**	**4.6**	**1.0**	**17.8**	**8.6**	**0.6**	**13.3**

Different letters in each column denotes statistically significant differences among varieties.

Tile drainage did not have any effect on yield of any crop during 2019 crop season. Wheat grown in between the tiles was, however, shorter as compared to when grown on over the tiles. Canola grown on the tiles had reduced plant height as compared to when grown on non-tiled land. This can be explained by the depth of the water table between the treatments. The shallower water table

in drained plots could have contributed to stunted growth. Tiles did not have any influence on days to maturity for any crop type.

Project Findings

Arborg site received only 55% of normal precipitation from May 1 to September 1. Excess moisture was not a limiting factor in crop production this season, meaning that it was difficult to assess the effect of tile drainage on crop production. Yield was not affected by any tile drainage spacing treatment on any crop type, although plant height was affected by tiles in wheat and canola.

Background / Additional Information / References

Excessive soil moisture delays agronomic operations, such as field preparations or seeding, during the early cropping season. These delays can result in a shorter cropping season and sometimes decreased yield. Excess moisture is a big constraint in crop production in Manitoba. The Manitoba Agricultural Services Corporation (MASC) reported that between 1996 and 2014, approximately 40% of crop losses were the result of excess moisture (with some reports placing that number at 55% from 2005-2014).

The presence of heavy clay soils in the Interlake contributes to high moisture content, particularly during the spring. The Province of Manitoba has identified the importance of surface drainage in peat areas of Interlake and built drains (Provincial waterways) for proper runoff after rainfall. In regions with heavy clay soils, removal of surface water alone might not be a solution to excess moisture if the soil below the surface remains saturated.

Draining water from the root zone is important to gain access to a field and to avoid loss of moisture-sensitive crops. Subsurface drainage systems help to remove excess soil moisture from the root zone. The amount of water removed daily is dependent on the drainage rate of the system, which must be carefully considered during the design process. The drainage rate determines the capability of the system to prevent soil saturation during high intensity rainfall events. Other parameters affecting the drainage rate are soil type, topography, tile installation depth and spacing of tile drains.

Tile drainage is becoming popular as a way to control excess moisture in the field to increase crop productivity. Yet, the economic return on investment (ROI) on installing tile drainage is not known for wheat, canola, and soybeans in Manitoba. This research will allow us to assess the impact of water management through controlled drainage on yield and quality of wheat, canola, and soybeans. Detailed soil moisture measurements along with water table depth at different times will help us model water flow within the rootzone and its impact on crop yield. Data collected in this study will be used to calibrate computer models (HYDRUS, DrainMOD) for this location so that weather data from different years could be modeled to assess the long-term impact of tile drainage. The Prairie East Sustainable Agricultural Initiative (PESAI) research site has drains placed at 15', 30', and 45' allowing different degrees of drainage. Rotating the three crops through these different spacings will help assess the impact of different drainage intensities.

Materials and Methods

Wheat, Canola and Soybeans were seeded on different tile spacing plots in addition to 60m long and 20m wide control plots on non-tile land. The plots on the tiles were about 200m long and 20m wide for all the crops. Wheat was seeded on 30' tile spacing with three replicates. Wheat variety AAC Brandon was planted on May 24, 2019 with a target seeding rate of 2.5 bushels/acre. Canola variety L233P was planted on 15' tile spacing plots on May 29 with a seeding rate of 7 lbs/acre. Similarly, soybean variety Karpo R2 was seeded on 45' tile spacings on May 28 with a seeding rate of 180,000 plants/acre. Recommended fertilizers were applied during seeding based on soil test. Recommended weed control was followed for all three crops.

Level logger sensors were installed on all the tiled plots at mid-spacing between tiles as well as in the control plots. The widely spaced drains at 45' had additional level loggers installed at the tile location as well. The data from the loggers is presented in Fig. 1.

The data on plant height, days to maturity, lodging and yield were taken from different treatment plots. Wheat was harvested on August 30 followed by canola on Sep 9 and soybeans on October 8. For harvesting, two 10-metre long strips (25m long in case of soybeans) were combined from each plot on and in between the tiles. Plant phenology and yield data were analysed using MINITAB.

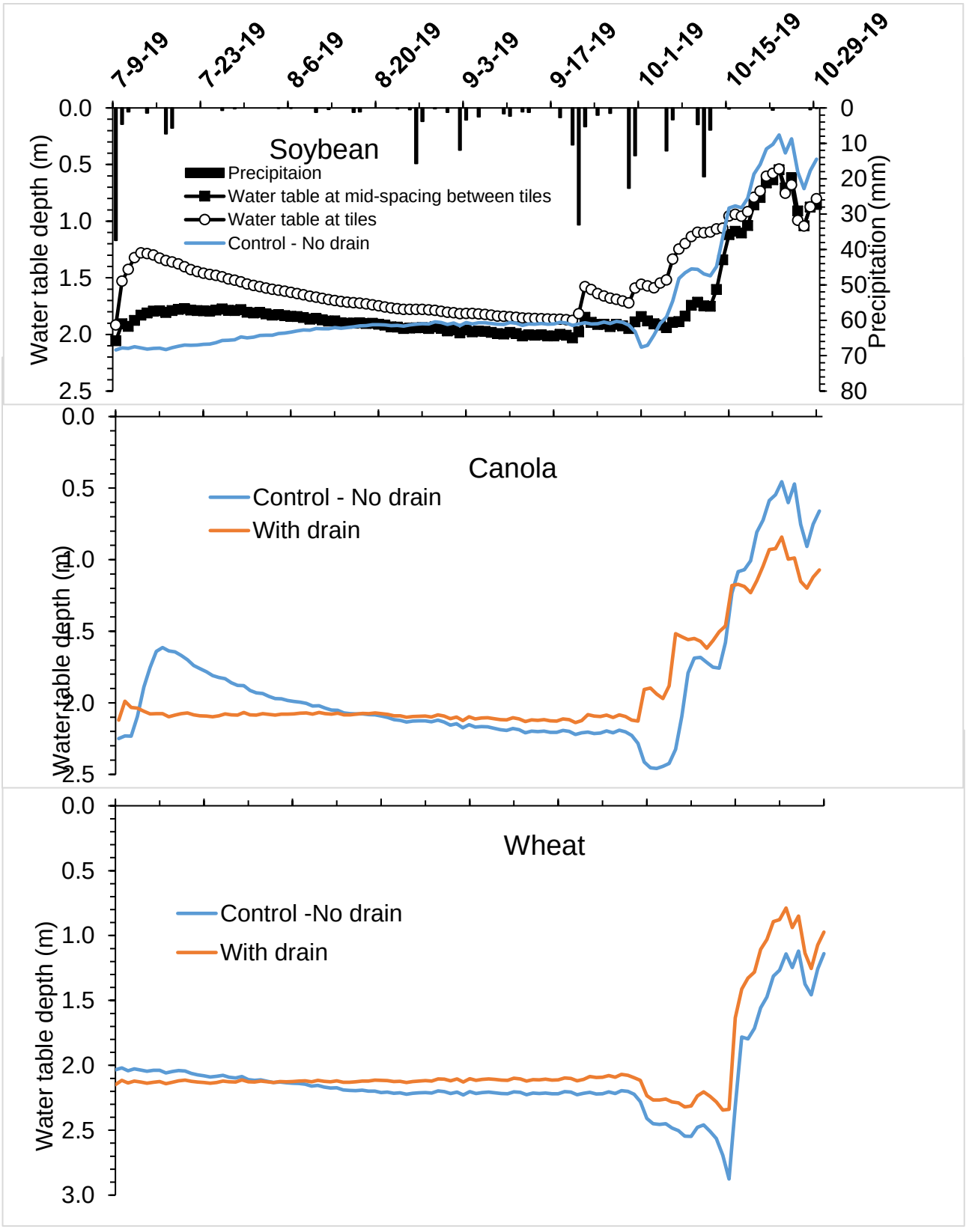

Figure 1. Comparison of water table depths and precipitation throughout the 2019 season.