TILE DRAINAGE DEPTH AND SPACING EFFECT ON SUGARBEET YIELD AND SOIL NITROGEN AVAILABILITY

A. Chatterjee, N. Cattanach, R. Awale, R. Thapa, M. Rakkar, H. Rasmussen
Department of Soil Science, North Dakota State University, Fargo, ND

INTRODUCTION

Drainage depth and spacing decisions are function of soil permeability, crop and soil management, and extent of surface drainage (Randall and Goss, 2001). Deciding on drain spacing and depth is critical for the success of tile drainage (Kladivko et al. 2005). Factors that need to be considered for drain spacing and depth are soil type, permeability and stratification, the crops to be grown, the desired drainage coefficient, and the degree of surface drainage (Wright and Sands 2001). Answering the question, “How close is close enough?” involves balancing costs and benefits. Nangia et al. (2010) indicated that reductions in nitrate-N losses are possible by decreasing the depth or increasing the spacing of tile drains. They showed for a tile drain spacing of 130 feet, reducing the drain depth from 5 to 3 feet deep reduced NO_3-N losses by 31% but reduced crop yield by 60%, while for a tile drain depth of 5 feet, increasing the tile drain spacing from 90 to 130 feet reduced NO_3-N losses by 50% while reducing crop yield by 7%. Increased tile spacing or decreased tile drain depth could be a potential remedy for excess NO_3-N loadings in surface waters. Zhao et al. (2000) observed corn yield increased significantly when drain spacing was changed from 184 to 92 feet but there was much less increase when changing from 92 to 46 feet. It is important to find out which tile depth and spacing will provide the maximum return on tile installation to growers through maintaining soil conditions favorable for crop growth and productivity and soil health.

This long-term on-farm experiment was established to determine how tile depth and spacing influence on (i) sugarbeet yield and quality, (ii) nitrogen availability, and (iii) shift in water-table depth and salt movement throughout the growing season under Fargo-Clay soil.

MATERIALS AND METHODS

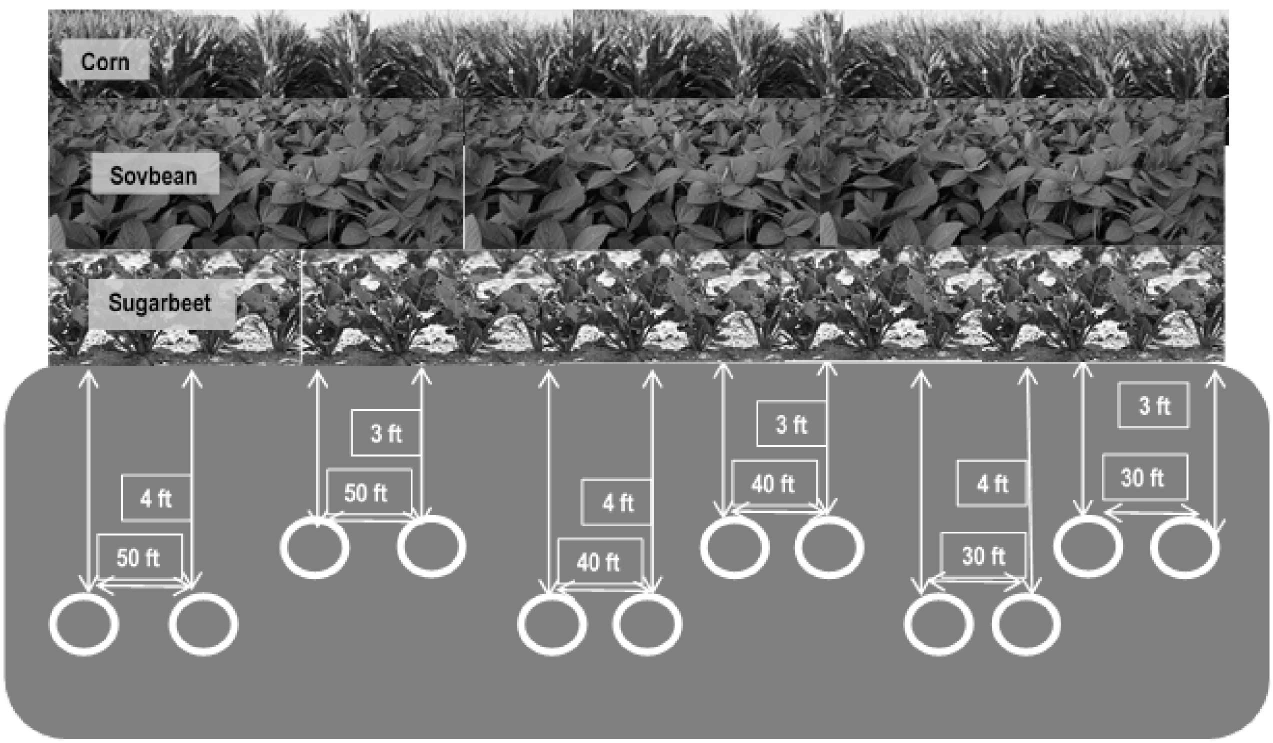

Figure 1. Layout of tile depth and spacing experiment located at Casselton, North Dakota. Two tile lines at 30-, 40-, and 50-ft spacing at 3- and 4-ft depth installed and corn-sugarbeet-soybean are planted in strip on tile lines.

The experiment was located at Ron Holiday’s farm near Casselton, Fargo, ND. Tile at different depth and spacing was installed in June, 2013. Corn, sugarbeet and soybean are placed in strips and rotated in sequence, corn-sugarbeet-soybean. Two tile lines were installed at three tile spacing, 30-, 40-, and 50-feet and at two depths, 3-feet and 4-feet at each level of tile spacing along with 50-feet long plot of only surface-drained (check). Recommended nitrogen (N) at rate 130 lb N/ac in the form of urea was broadcasted and incorporated using a chisel plough with rotary basket. Sugarbeet variety Crystal 985 Roundup Ready (rhizomainia disease resistant), was planted on May 26/2014 with a John Deere MaxEmerge II planter. Sugarbeet was placed 1.25 inches deep with 5-inch in-row spacing. A 22-inch row spacing was used. Roundup herbicide was applied twice for weed control, plots were not cultivated. Quadris was applied at the four to six leaf stage and again three weeks later to help control rhizoctonia root rot. Two fungicide applications, Supertin/Topsin and Headline were applied for Cercospora leafspot control. Sugarbeet was harvested by hand and 30-, 40- and 50- ft long-middle row of the respective tile depth and spacing. Root yield from each plot was determined and subsamples, for quality analysis, were sent to American Crystal Sugar Quality Tare Lab, East Grand Forks, MN. From each tile depth and spacing, post-harvest soil samples were collected at 0-1 and 1-2 ft depth increments and analyzed for inorganic N content using 2M KCl and Ammonia Analyzer.

RESULTS AND DISCUSSION

Sugarbeet yield and quality were presented in table 1. Highest root yield of 30.26 tons/ac was observed under 30-ft tile spacing and 4-ft depth and lowest yield of 19.51 tons/ac with 50-ft spacing and 4-ft depth. Sugar content did not vary a lot and highest sugar content was found with 40-ft spacing and 3-ft depth. Within 0-1 ft depth, residual soil inorganic N content increased with wider spacing indicating decrease in N uptake, poor N use efficiency and increase in N losses (N_2O denitrification) due to wetness except 50-ft spacing. Deeper tile placement retains more inorganic N within 0-1 ft depth again but it was opposite for 50-ft tile spacing. Differences in residual N in between 0-1 and 1-2 ft depth increased with wider spacing and deeper depth particularly in between 30- and 40-ft spacing. This is the first-year non-replicated data from this long-term trial and outcomes indicate the importance of understanding the variations in yield and nutrient availability across different tile designs in high-clay soils with potential drainage problem.

Table 1. Sugarbeet yield and quality parameters as influenced by different tile spacing and depth

Tile Spacing	Tile Depth	Sugar %	SLM %	Yield (Tons/ac)	RSA (lb/ac)	RST (lb/ton)
30 ft	3 ft	15.5	1.46	24.87	6984	281
30 ft	4 ft	15.3	1.5	30.26	8353	276
40 ft	3 ft	15.7	1.51	26.67	7569	284
40 ft	4 ft	15.2	1.64	25.66	6959	271
50 ft	3 ft	15.3	1.63	20.86	5703	273
50 ft	4 ft	15.5	1.44	19.51	5486	281
	Check	15	1.74	22.13	5869	265

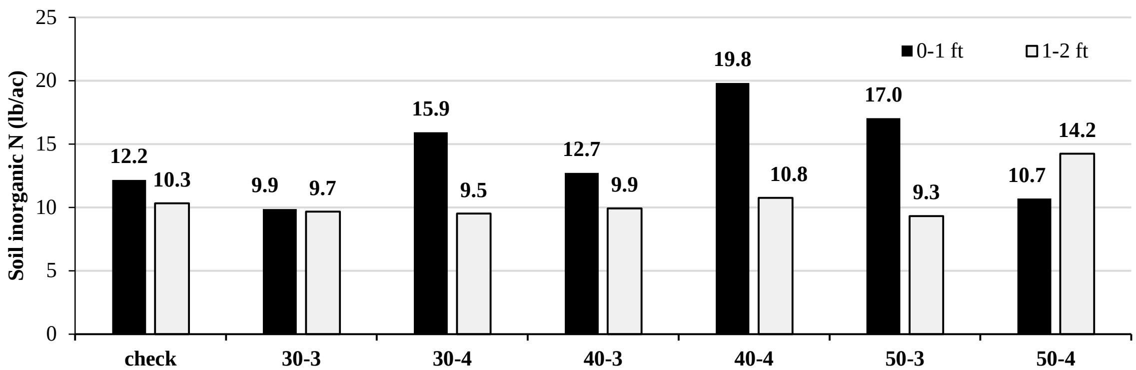

Figure 2. Effect of tile depth and spacing on residual soil inorganic N (lb/ac) at 0-1 and 1-2 ft depth increments

Literature Cited

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