

SALT AND SODICITY TOLERANCE OF BARLEY AND OATS

Barley and oats are one of the most salt and sodicity tolerant annual crops producers can profitably grow in North Dakota. However, at certain salinity and sodicity levels, even barley and oats can result in significant losses. Especially important are the levels of salinity and sodicity in the top six inches of the soil. A trial was initiated to determine the threshold of soil salinity (Electrical Conductivity or EC) and sodicity (Sodium Adsorption Ratio or SAR) for barley and oats. Four barley and oat varieties were planted at the Langdon REC at three different salinity and sodicity levels in 2020.

Soil Analysis Results

Two-foot deep composite soil samples separated into 0-6 and 6-24 inch depths were taken in May 2020 from each level of salinity and sodicity (replications 1, 2 and 3) by taking three cores for each sample. Soil EC, SAR and pH were analyzed by using the saturated paste extract method, whereas, standard methods were used to analyze NO₃-N, P and K (Table 1).

Table 1. Soil EC, SAR, pH, NO₃-N, P and K results of the three replications for the 0-6 and 6-24 inch depths.

Site	Sample ID	Depth (inches)	EC (dS/m)	SAR	pH	NO ₃ -N (lbs./acre)	P (ppm)	K (ppm)
Rep 1	Low to moderate salinity-sodicity	0-6	3.99	7.12	7.18	5	20	299
		6-24	7.32	15.05	7.71	6	5	137
Rep 2	Moderate to high salinity-sodicity	0-6	7.80	18.13	7.61	6	29	247
		6-24	10.39	20.92	7.95	6	2	148
Rep 3	Very high salinity-sodicity	0-6	10.50	27.30	7.59	5	51	270
		6-24	9.86	32.87	7.81	6	4	169

Trial Design, Plot Sizes and Planting Data

Trial design was randomized split block. Plot sizes were 4.7 X 22 feet. Details are in Table 2.

Table 2. Barley and oat varieties, seeding rates and depths and fertilizer rates per acre.

Crop	Variety	Planting Date	Seeding Rates (live seeds/acre)	Seeding Depth (inches)	Fertilizer Application (lbs./acre)
Barley	AAC Synergy (2-row)	June 1, 2020	1.25 million live seeds per acre	1 – 1.5	Based on soil NO ₃ -N, P and K analysis a uniform rate of 120 lbs. of N was applied as Urea to all three replications.
	ND Genesis (2-row)				
	Pinnacle (2-row)				
	Tradition (6-row)				
Oats	CS Camden	June 1, 2020	1.00 million live seeds per acre	1 – 1.5	Based on soil NO ₃ -N, P and K analysis a uniform rate of 120 lbs. of N was applied as Urea to all three replications.
	ND Heart				
	Rockford				
	Souris				

Results and Discussion

There were significant differences between the three replications starting from seedbed preparation, germination, plant growth and vigor, maturity, yield and quality. See pictures to compare growth and maturity of the three replications.



Barley and oat varieties growing on replication 1 (low to moderate salinity-sodicity) on July 28 and September 15, 2020.

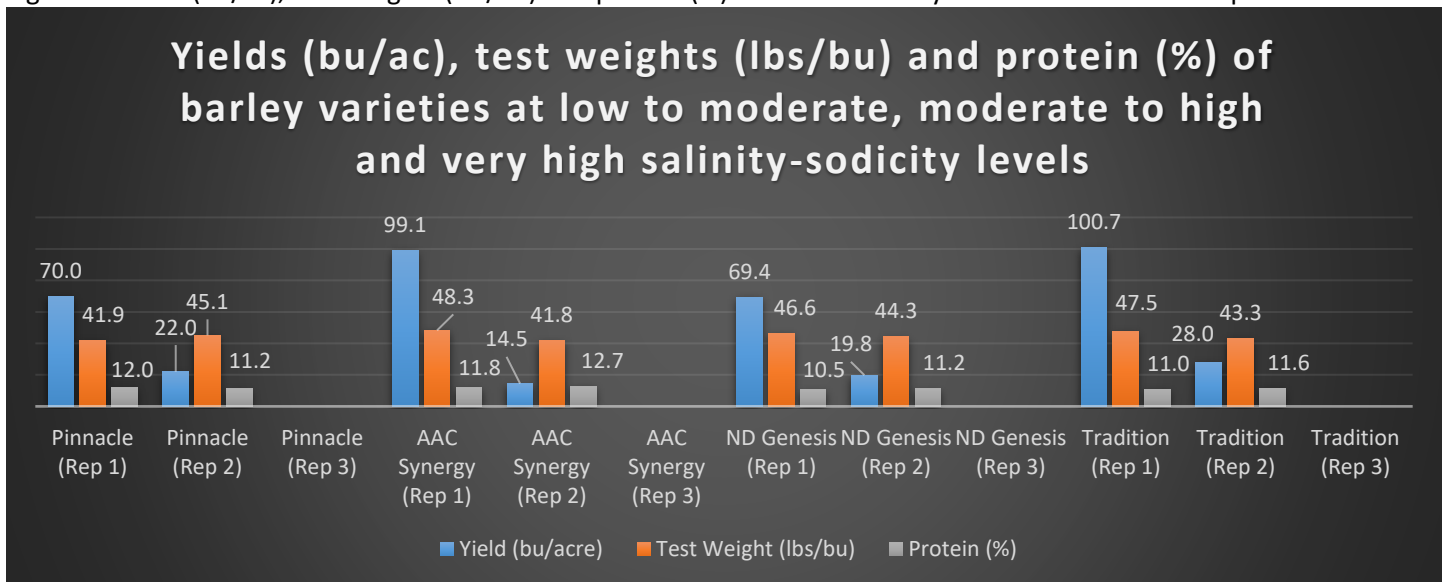


Barley and oat varieties growing on replication 2 (moderate to high salinity-sodicity) on July 28 and September 15, 2020.



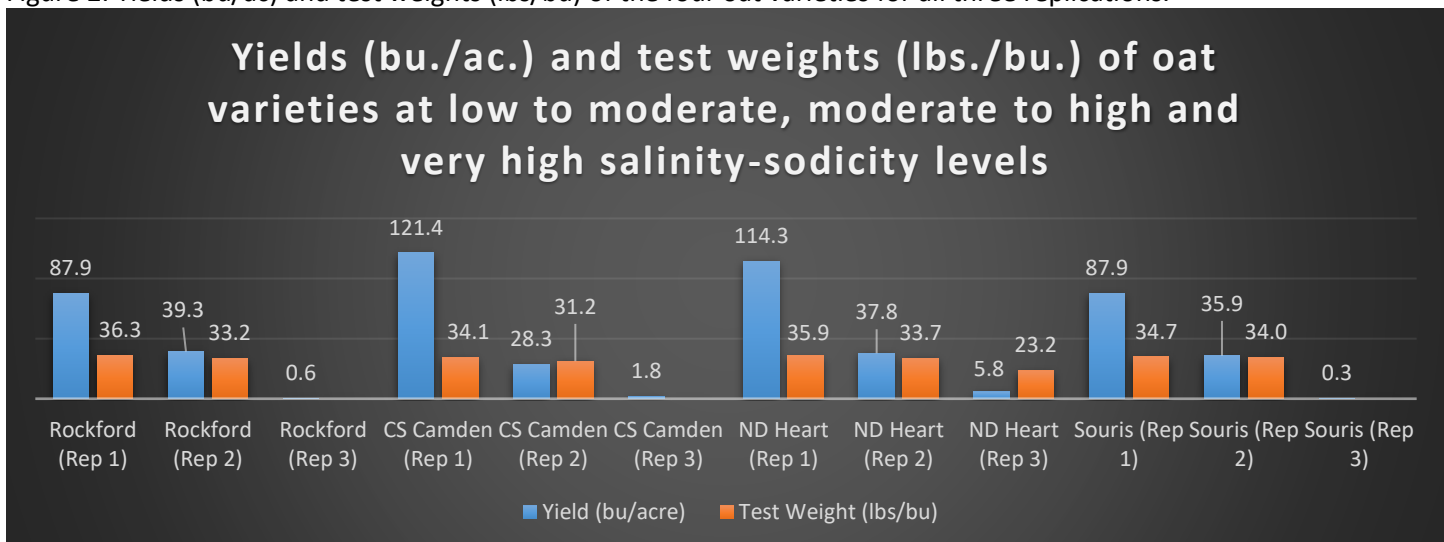
Barley and oat varieties growing on replication 3 (very high salinity-sodicity) on July 28 and September 15, 2020. Average barley yield of replication 1 was 84.8 bu/acre versus 21.1 bu/acre of replication 2. That was a 75 percent reduction in yield (Figure 1). Replication 1 also had five percent higher average test weight compared to replication 2. However, average protein of replication 2 was slightly higher than replication 1. Replication 3 resulted in 100 percent loss. Tradition (six-row) barley had the highest yields in replications 1 and 2 versus the other three two-row varieties.

Figure 1. Yields (bu/ac), test weights (lbs/bu) and protein (%) of the four barley varieties for all three replications.



Average yield of oats in replication 1 was 102.8 bu/acre versus 35.3 bu/acre of replication 2 and 2.1 bu/acre of replication 3. That was 65 and 98 percent reduction in yields (Figure 2). Replication 1 had 6.3 and 83.5 percent higher average test weight than replications 2 and 3. One key observation was that oats had some growth in replication 3, whereas, barley had zero growth pointing to a slightly higher salt-sodicity tolerance of oats compared to barley.

Figure 2. Yields (bu/ac) and test weights (lbs/bu) of the four oat varieties for all three replications.



Summary: At an EC of 3.99 dS/m and SAR of 7.12 in the 0-6 inch soil depth, both barley and oats produced higher yields and quality. Increased EC and SAR levels in the topsoil may result in significant economic losses.