Pulse Crop Production Under Non-Saline and Saline Conditions

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High soil salinity is a major problem for agricultural production in North Dakota, including pulse crops. Salinity induces osmotic stress (i.e. physiological drought) and ion toxicity and imbalance, resulting in reduced plant growth and yield (quantity and quality) and even death under severe conditions. The objective of this research was to determine the effects of genotype and seed inoculant on pulse crop production under saline and non-saline conditions.

Two research sites were identified at the North Central Research and Experimental Station, Minot, ND in 2019: one with a soil electrical conductivity ($EC_{1:1}$) of 2.02 at the 0 – 6 inch (i.e. saline) and the other with an $EC_{1:1}$ of 1.36 dS m^{-1} (i.e. non-saline). Prowl (48 oz/A), Pursuit (2 oz/A), and Glyphosate (64 oz/A) were applied as a tank mixture on May 14, 2019 before seeding. Six pea, seven lentil, and four chickpea cultivars/advanced lines (Tables 1-3) were seeded at 7.6, 14, and 4 seed/ sq. ft., respectively, on May 21, 2019. Each experimental plot size was 6 x 30 ft with 8″ row spacing. Two seed inoculants, N-Dure (0.5 tsp/plot) and Tag Team (0.5 tsp/plot), were applied at seeding. Section 3EC (5.5 oz/A) and Asana (8 oz/A) were applied on June 10 and July 7, respectively, for weed control. Plant density was quantified on June 27, 2019 and crops were harvested on Sept. 6, 2019. Plant density, seed yield, and 1,000 seed weight (TSW) were analyzed.

No crops were harvested from the saline site due to a severe breakout of kochia, although plant density was measured in June. For field pea, Tag Team-treated plots had more plants than N-Dure-treated ones under the non-saline condition (Table 1). The highest TSW was observed in ‘LG Sunrise’ and ‘NDP130079’ and the lowest TSW was observed in ‘Cruiser’. However, no differences in the yield of field pea were observed. Similarly, Tag Team-treated lentils produced more seedlings than N-Dure-treated plants under the non-stress conditions (Table 2). Under the saline condition, ‘NDL140120’ and ‘NDL140122’ produced more plants than ‘NDL150418’. Lentil yield was affected by seed inoculant, while, TSW was affected by genotype. Genotype differences were observed in plant density under the non-saline condition and TSW in chickpea (Table 3), in which ‘CDC Frontier’ had lower plant density and TSW than other genotypes. Seed inoculant did not affect plant density and production in the present study in chickpea.

Table 1. Pea growth and yield as affected by genotype and seed inoculant. Yield and 1,000 seed weight were only analyzed under the non-saline condition.

	Plant density (Plant/A)		Yield	1,000 seed weight
Treatment	Non-saline	Saline	(lbs/A)	(g)
Genotype				
Agassiz	188,139a[†]	220,780a	2412.8a	203.5ab
Cruiser	170,899a	229,675a	1766.5a	180.4d
LG Sunrise	183,141a	155,671a	2330.2a	208.7a
NDP130079	190,997a	216,577a	2236.4a	213.0a
NDP130081	194,525a	154,152a	1749.5a	194.8bc
NDP150214	191,815a	216,061a	2256.3a	185.0cd
Inoculant				
N-Dure	167,002b	193,760a	2159.1a	197.8a
Tag Team	206,170a	203,879a	2091.4a	197.3a

[†]Means followed by the same letter within each column were not significantly different at $P \leq 0.05$ level.

Table 2. Lentil growth and yield as affected by genotype and seed inoculant. Yield and 1,000 seed weight were only analyzed under the non-saline condition.

Treatment	Plant density (Plant/A)		Yield (lbs/A)	1,000 seed weight (g)
	Non-saline	Saline		
Genotype (G)				
CDC Green	220,327a†	235,440ab	1287.6a	72.1a
CDC Richlea	233,750a	230,168ab	1385.0a	43.8bc
NDL140120	278,809a	300,641a	1108.7a	57.4b
NDL080187	232,899a	184,302ab	739.0a	51.8bc
NDL140122	239,676a	307,693a	1581.8a	41.4c
NDL140158	238,039a	204,381ab	1702.4a	44.5bc
NDL150418	225,358a	149,338b	1185.6a	48.7bc
Inoculant (I)				
N-Dure	214,837b	238,240a	1084.2b	51.1a
Tag Team	261,980a	222,322a	1484.4a	51.4a

†Means followed by the same letter within each column were not significantly different at $P \leq 0.05$ level.

Table 3. Chickpea growth and yield as affected by genotype and seed inoculant. Yield and 1,000 seed weight were only analyzed under the non-saline condition.

Treatment	Plant density (Plant/A)		Yield (lbs/A)	1,000 seed weight (g)
	Non-saline	Saline		
Genotype (G)				
BGC090017	10,2667a†	9,9343a	2315.8a	406.1a
CDC Frontier	72,111b	6,7925a	2149.0a	336.8b
CDC Orion	111,833a	10,2119a	3181.6a	398.4a
Sawyer	110,000a	8,1762a	2293.0a	400.9a
Inoculant (I)				
N-Dure	103,889a	8,7502a	2505.5a	382.0a
Tag Team	9,4417a	8,8073a	2464.2a	389.1a

†Means followed by the same letter within each column were not significantly different at $P \leq 0.05$ level.