The effect of row spacing and plant population on corn grain yield over two dry years in Manitoba

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Introduction

- Studies from the corn belt of North America have shown that corn grown on narrow row widths (15-inch to 22-inch) north of 43 ºN in North America had a yield advantage over wider (30-inch or more) rows (Lee 2006, Butzen and Paskiewicz 2008).
- Reducing row width can also result in yield reduction due to stress caused by high plant populations density (Pederson and Lauer, 2003).
- In Manitoba, a study conducted by Giesbrecht (1969) showed that row spacing of 20-, 26-, 32- and 37-inches did not have any effect on corn grain yield although yield increased with plant population density upto 30,350 plants /ac.
- Since then, new corn hybrids had been developed for shorter growing seasons as well as hybrids that can withstand high plant population density stress (Tollenaar, 1991).

Objective

- To evaluate the effect of row-spacing and plant population densities on corn grain yield of two hybrids in Manitoba

References

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Table 1: Monthly average air temperature and sum of precipitation at the three sites Values in parentheses represent the percent departure from the 30 year normal (1981-2010)

Month	Air temperature (ºC)			Precipitation (mm)		
	Carman -18	Carman -19	Kelburn -18	Carman -18	Carman -19	Kelburn -18
April	5 (+2)	7 (0)	7 (+3)	0 (-28)	18 (-10)	0 (-27)
May	10 (+3)	15 (-2)	15 (+4)	48 (-20)	37 (-31)	33 (-36)
June	17 (+2)	19 (0)	19 (+2)	97 (+6)	38 (-53)	69 (-26)
July	20 (0)	20 (0)	20 (0)	43 (-28)	57 (-13)	69 (-11)
Aug	18 (0)	19 (-1)	19 (0)	31 (-38)	62 (-7)	35 (-36)
Sep	13 (-3)	11 (-1)	11 (-2)	43 (-6)	151 (+102)	69 (+18)
Oct	3 (-3)	3 (-3)	3 (-2)	36 (-7)	46 (+3)	38 (-5)

Table 2: The effect of row spacing and plant population on corn grain yield averaged over two hybrids at three site-years

Row spacing	Plant population	Carman -18	Carman -19	Kelburn -18
inch	Plants /ac			
			bu /ac	
22		85.2	61.7	82.8b
30		93.7	64.6	86.5a
	26000	83.3	60.6	90.4a
	32000	90.9	67.0	89.3a
	38000	93.7	59.8	85.5ab
	45000	87.8	68.8	80.8bc
	55000	83.4	60.2	77.9c
Source of variation		– – – F-test probability – – – –		
Row spacing (R)		0.0888	0.5729	<.0001
Plant population (P)		0.8897	0.7050	0.0192
R x P		0.6366	0.1214	0.2223

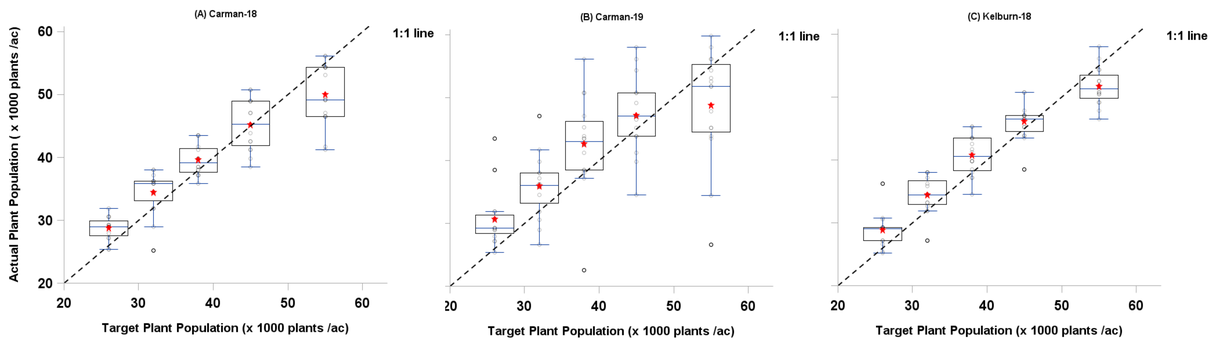

Figure 1.The actual vs target plant population at three site years (A) Carman-18 (B) Carman-19 and (C) Kelburn-18. The 1:1 dashed line represents the values when actual plant population would be equal to the target plant population. Red stars are the treatment mean of actual plant population

Key Findings

- The growing conditions were very dry in 2018 and 2019 that enabled us an opportunity to evaluate plant population and row spacing factors under stressful conditions (Table 1)
- Growing season precipitation was below normal at all the sites with high precipitation in September at Carman-19 and Kelburn-18 site-years (Table 1).
- The main effect of hybrids, plant populations and row spacings on corn grain yield was significant only at Kelburn-18 but not at Carman18 and Carman19 sites (Table 2). The effect of dry conditions on corn grain yield was likely much larger than the differences between the plant population treatments.
- The range of corn grain yields for the plant population tested was between 83.3-93.7 bu /ac at Carman-18, 59.8-68.8 bu /ac at Carman-19 and 77.9-90.4 bu /ac at Kelburn-18, well below the targeted corn grain yield of 150 bu /ac due to dry years (Table 2)
- At the Kelburn-18 site-year, higher corn yields were obtained when plant population density ranged between 26000-32000 plants /ac and when planted on 30-inch row spacing on this heavy clay soil in a dry year.

Materials and Methods

Site description

- Field study initiated at two sites on
  1. sandy loam soil at the University of Manitoba's Ian N Morrison Research farm in 2018 (Carman-18) and 2019 (Carman-19)
  2. heavy clay soils at Richardson International's Kelburn farm in 2018 (Kelburn-18) and 2019 (Kelburn-19). Kelburn-19 site-year was abandoned due to heavy infestation of cutworms when the corn was at V1 –V2 stage .
- Total precipitation received during 2018 growing season was 74 % of the normal precipitation for Carman18 and Kelburn18 and was 65 % below normal except in September at Carman19 and Kelburn-18 site-years

Experimental Design

RCBD with 4 replicates

Treatments

- Complete factorial design
  - Two row spacings:22-inch and 30-inch
  - Five plant populations: 26000, 32000, 38000, 44000 and 55,000 seeds /ac
  - Two hybrids :DKC 27-55 (Fixed ear) and DKC 30-07 (Flex ear)

Field Management

- Fertilizers were applied at the time of planting to target corn yield of 150 bu /ac

Sample collection:

- Corn was harvested for grain yield from the central 3-rows for 22-inch and central 2 rows for 30-inch with a 2 row corn header on a small plot combine

Statistical analysis

- Data were analysed using linear mixed model implemented in the Proc Glimmix procedure of SAS for each site-year. Treatment factors plant population, row spacing, hybrids and their interactions were considered as fixed factors. Replication was treated as random factors

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