On-Farm Evaluation of Twin-Row Corn in Southern Minnesota in 2010 and 2011

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INTRODUCTION AND OBJECTIVES

Growers are continually striving to increase corn yield and profits. Planting corn in narrow rows is one potential way to do this. University of Minnesota research in southern and central Minnesota has indicated that corn yields can be increased 7 to 9% by planting in 20-inch rows compared to 30 inch rows, but these increases have not been consistently observed (1). It is also hypothesized that populations that optimize yields are greater in narrow rows than in 30-inch rows. Results from University of Minnesota trials conducted in northwestern MN from 2009-2011 indicate that yields were optimized at higher populations in narrow rows than in 30-inch rows (2).

In a twin-row corn system, which is a variation of narrow-row corn, corn is planted in row pairs six to eight inches apart and 30 inches separates the center of row pairs. A major advantage of planting corn in twin row rows compared to 15- or 22-inch rows is that beyond modifications to the planter, no additional major equipment modifications are needed. For example, a standard combine head will work to harvest the crop and narrow row tires, which can be very costly, compared to standard tires, are not essential. Plant arrangement, however, is different in twin rows than in 30-inch rows and plant populations that optimize yield may differ between these row spacings.

Trials conducted in more southern states indicate a potential to increase yields by planting corn in twin rows compared to 30-inch rows, although results have been inconsistent (3). Anecdotal reports from growers in southern Minnesota who are currently planting corn in twin rows indicate a potential for increased yields in twin rows compared to 30-inch rows This study was initiated in 2010 at two on-farm locations in southern Minnesota to determine 1) If row width (30-inch vs. 22-/8-inch twin rows) influences corn grain yield, harvest moisture, stalk lodging, and economic return and 2) If corn planted in twin-rows has a greater response to an increased seeding rate than corn planted in 30-inch rows.

MATERIALS AND METHODS

On-farm trials were initiated the spring of 2010 in southern Minnesota with two farmer cooperators by Welcome and Wilmont who have been planting corn in twin rows for a number of years. Fertilizer was applied according to soil test recommendations and herbicides were applied to control weeds at each site. Both sites have a long-term history of manure use. Further details regarding field histories for each site are listed in Tables 1. The planter used at Wilmont was designed by a manufacturer for twin-row corn production, while the planter used at the Welcome location was modified by the farmer to plant twin rows.

Treatments were arranged in a 2 x 3 factorial experiment in a randomized complete block design with four replications. Two row widths (30-inch vs. 22-/8-inch twin rows) at three target plant populations (33,000, 38,000, and 43,000 plants per acre (ppa)) were evaluated, for a total of six treatments. Plot length was 400 feet and individual plot width was 30 feet (Welcome) or 40 feet (Wilmont). The same planter was used for all treatments within a site. Each planter had dual toolbars and planting units were turned off on one tool bar for the 30-inch rows. Planter seeding rates were adjusted according to planter manual guidelines for each population by row spacing combination. At the Welcome site, the seeding rate was slightly higher for planter units on one tool bar than the other to help prevent seeds from being planted next to each other in the twin-rows. At the Wilmont site, planting rates were first tested in the field using planter monitor readings in order to try and match target populations as closely as possible.

When corn was V4 to V8 in 2010 and @ V3 in 2011, stand counts were taken by counting the number of plants in 100 feet of each harvest row.

Stalk lodging was determined prior to harvest by counting the number of stalk-lodged plants in 100 foot of row at two locations within each plot. Grain yield, moisture, and test weight was determined by harvesting the center 6 (Welcome) or 8 rows (Wilmont) of each plot. A weigh wagon was used at each site to determine plot weight. Grain moisture was adjusted to 15% moisture in yield calculations. ANOVA was used for statistical analysis and means compared using Fisher's Protected LSD at the 0.05 significance level. Data are presented across years and locations as well as for each site year.

RESULTS AND DISCUSSION

Table 1 shows the field background for each site in 2010 and 2011. Sites were planted in a timely manner both years: In 2010 planting occurred on 4/28 and 4/29 (Wilmont and Welcome, respectively) and in 2011 on 5/6 at both locations. The hybrid DKC 48-37, which has resistance to European corn borer, corn rootworm and glyphosate, was planted at each location both years. Figures 1 & 2 show the planters used at each site. When setting planting populations, care was taken to reach target populations as closely as possible but settings were also selected so that populations could be matched as closely as possible between row spacings.

Both sites had hail in 2011 (Welcome on 7/5/11 and Wilmont on 7/10/11). At the Wilmont site, damage appeared uniform across the plot and according to hail damage estimates should have had minimal impact on yield and minimal damage was observed at the Welcome as well.

Population:

Populations achieved in the field were close to target populations, differing by only 390 to 820 plants/ac from target populations when averaged across row spacings, sites and years (Table 2), and no difference was detected in population between row spacings when averaged across sites and years. Looking at individual site years, stands were slightly lower in twin rows compared to 30-inch rows when averaged across populations at Welcome in 2010 and Wilmont in 2011 (Table 3). Table 4 shows the plant stands for each row spacing by target population combination each year. There was no interaction between row spacing and target population at Welcome, but there was at Wilmont. At Wilmont, stands were similar between row spacings at the lowest target population both years, and the highest target population in 2010. Stands were greater in 30-inch rows at the mid-target population both years, however, and in twin rows at the highest population in 2011. Equipment limitations influenced how closely target populations could be reached, and the highest setting possible for 30-inch rows was used at Wilmont both years for the highest population. Overall, plant stands were closer to target populations in 2011 across sites.

Figures 3 through 8 are pictures of the three planting populations in each row spacing at Wilmont during 2010.

Stalk Lodging:

Averaged across sites and years, row spacing and population had no effect on stalk lodging (Table 2) and there was no row spacing by population interaction. However, differences were found when looking at individual site years. In 2010, stalk lodging was slightly greater in twin rows than 30-inch rows at Welcome (Table 3). Population also had an effect on stalk lodging, with stalk lodging being greater at the highest population than the lowest all sites years except for Welcome in 2010 where no difference was found due to population (Table 5). There was no interaction between row spacing and population in the amount of stalk lodging observed. Drought stress likely contributed to the increased amount of stalk lodging observed at both locations in 2011 compared to 2010.

Grain Moisture, Test Weight, and Yield:

Averaged across sites and years, row spacing, population, and the row spacing by population interaction had no effect on grain moisture at harvest (Table 2). In 2010 at Welcome, grain moisture was slightly higher (0.2%) at the highest population (Table 5). Grain was very dry by harvest each year, averaging less than 14.6 percent across all treatments, sites, and years.

Grain test weight was not affected by row spacing or population and there was no interaction between row spacing and population (Tables 2, 3, and 5).

Averaged across site years, row spacing and population had no effect on yield (Table 2), but there was a significant row spacing by population interaction (Table 6). In twin rows, yields were optimized at the highest population compared to the lower populations. Looking at individual site years, yield was not affected by row spacing at Welcome, but in 2010 the lowest population resulted in lower yields than the higher populations (Tables 3 and 5). At Wilmont in 2010 there was a significant interaction between population and row spacing (Table 7). Yields were greatest at the highest population in twin rows compared to all the other treatments. In comparison, yields in the 30-inch rows were lower at the highest population than the other populations.

CONCLUSIONS:

- A range of populations (low, medium and high) were achieved at each site both years, similar to target populations.
- Although stalk lodging was slightly greater in twin rows at Welcome in 2010, population had the greatest effect on stalk lodging, with the highest population (43,000 ppa) resulting in more stalk lodging that the lowest population (33,000 ppa) 3 of 4 site years.
- Although slight differences were seen at Welcome in 2010, row spacing, population, and the row spacing x population interaction had little effect on grain moisture at harvest. Grain moisture was low at harvest, averaging less than 14.6%, at both locations both years.
- Test weight was not affected by population, row spacing, or the row spacing x population interaction.
- Averaged across sites and years, yields were greater in twin rows at the highest population compared to the lower populations. This indicates that corn was able to take advantage of higher planting populations better in twin rows than in 30-inch rows. The likelihood of a yield response, however, would need to be considered along with the increased cost involved with planting at such high populations.

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Figure 1: Twin-row planter used at the Wilmont, MN site in 2010.

Figure 2: Twin-row planter used at the Welcome, MN site in 2010.

Figure 3: Twin-row corn at Wilmont, 33,000 ppa target population, 2010.

Figure 4: 30-inch corn at Wilmont, 33,000 ppa target population, 2010.

Figure 5: Twin-row corn at Wilmont, 38,000 ppa target population, 2010.

Figure 6: 30-inch row corn at Wilmont, 38,000 ppa target population, 2010.

Figure 7: Twin-row corn at Wilmont, 43,000 ppa target population, 2010.

Figure 8: 30-inch row corn at Wilmont, 43,000 ppa target population, 2010.

Table 1. Background information for twin-row corn sites in 2010 and 2011.

	2010	
	Welcome	**Wilmont**
Previous Crop	Soybean	Soybean
Tillage	Conventional	Conventional
Planter	White planter with dual toolbars	Kinzie Twin Row Planter, with auto guidance
Hybrid	DKC 48-37	DKC 48-37
Planting Date	4/29/10	4/28/10
Stand Counts	6/17 & 6/18/10 @ V8 corn	6/9/10 @ V4 corn
Lodging Ratings	10/12/10	10/14/10
Harvest Date	10/12/10	10/20/10
	2011	
	Welcome	**Wilmont**
Previous Crop	Soybean	Soybean
Tillage	Conventional	Conventional
Planter	White planter with dual toolbars	Kinzie Twin Row Planter, with auto guidance
Hybrid	DKC 48-37	DKC 48-37
Planting Date	5/6/11	5/6/11
Stand Counts	6/2/11 @ V3 corn	6/1/11 @ V3 corn
Lodging Ratings	10/6/11	10/12/11
Harvest Date	10/7/11	10/12/11

Table 2. Effect of row spacing (averaged across populations) and population (averaged across row spacings) on plant stand, stalk lodging, grain moisture, test weight, and yield averaged across locations (Welcome and Wilmont) and years (2010 and 2011).

	Averaged Across Locations (Welcome & Wilmont) and Years (2010-2011)				
Row Spacing	**Plant Stand**	**Stalk Lodging**	**Grain Moisture**	**Test Weight**	**Yield**
(plants/ac)	(plants/ac)	--- Stalk lodging (%) ----	----- Moisture (%) -----	---- Test weight (lb/bu) -----	----- Yield (bu/ac) -----
30" Rows	37680	2.3	14.6	59.2	207.4
Twin Rows	37190	2.2	14.5	59.5	207.6
LSD (.05)	**NS**	**NS**	**NS**	**NS**	**NS**
	Averaged Across Locations (Welcome & Wilmont) and Years (2010-2011)				
Target Population	**Plant Stand**	**Stalk Lodging**	**Grain Moisture**	**Test Weight**	**Yield**
(plants/ac)	---- (plants/ac) ----	--- Stalk lodging (%) ----	----- Moisture (%) -----	---- Test weight (lb/bu) -----	----- Yield (bu/ac) -----
33,000	32610	0.9	14.5	59.4	205.4
38,000	37510	2.1	14.6	59.4	207.8
43,000	42180	3.8	14.6	59.3	209.2
LSD (.05)	**1600**	**NS**	**NS**	**NS**	**NS**

Table 3. Effect of row spacing averaged across target populations on plant stand, stalk lodging, grain moisture, test weight, and yield at Welcome and Wilmont in 2010 and 2011.

	2010									
	Plant Stand		Stalk Lodging		Grain Moisture		Test Weight		Yield	
Target Population	Welcome	Wilmont	Welcome	Wilmont	Welcome	Wilmont	Welcome	Wilmont	Welcome	Wilmont
	--- (plants/ac) ---		--- Stalk lodging (%) ----		----- Moisture (%) -----		---- Test weight (lb/bu) -----		----- Yield (bu/ac) -----	
30" Rows	38040	35520	0.0	0.4	14.7	14.6	59.0	58.2	225.5	212.3
Twin Rows	36880	35330	0.3	0.9	14.6	14.4	59.3	59.7	224.6	218.6
LSD (.05)	440	NS	0.2	NS	NS	NS	NS	NS	NS	2.5
	2011									
	Plant Stand		Stalk Lodging		Grain Moisture		Test Weight		Yield	
Row Spacing	Welcome	Wilmont	Welcome	Wilmont	Welcome	Wilmont	Welcome	Wilmont	Welcome	Wilmont
	----- (plants/ac) -----		--- Stalk lodging (%) ----		----- Moisture (%) -----		---- Test weight (lb/bu) -----		----- Yield (bu/ac) -----	
30" Rows	38670	38590	2.8	6.4	14.5	14.6	59.9	59.2	183.5	208.4
Twin Rows	38290	38260	2.3	5.4	14.6	14.5	59.8	59.2	182.7	204.4
LSD (.05)	NS	320	NS	NS	NS	NS	NS	NS	NS	NS

Table 4. Evaluation of interaction between row spacing and target population on stand at Welcome and Wilmont in 2010 and 2011.

	2010				2011			
	Welcome		Wilmont		Welcome		Wilmont	
Target Population	30" Rows	Twin Rows	30" Rows	Twin Rows	30" Rows	Twin Rows	30" Rows	Twin Rows
(plants per acre)	---------- population (plants per acre) ----------				---------- population (plants per acre) ----------			
33,000	33730	32550	30070	30610	33960	33610	33430	32940
38,000	37910	36770	35950	34370	38750	38420	39800	38120
43,000	42490	41340	40530	41020	43300	42830	42530	43730
Interaction LSD (.05) within location and year	NS		850		NS		580	

Table 5. Effect of target population averaged across row spacing on plant stand, stalk lodging, grain moisture, test weight, and yield at Welcome and Wilmont in 2010 and 2011.

	2010									
	Plant Stand		Stalk Lodging		Grain Moisture		Test Weight		Yield	
Target Population	Welcome	Wilmont	Welcome	Wilmont	Welcome	Wilmont	Welcome	Wilmont	Welcome	Wilmont
(plants per acre)	Population (plants/ac)		--- Stalk lodging (%) ----		----- Moisture (%) -----		---- Test weight (lb/bu) -----		----- Yield (bu/ac) -----	
33,000	33140	30340	0.0	0.0	14.6	14.4	58.9	59.0	222.1	213.7
38,000	37340	35160	0.3	0.8	14.6	14.4	59.4	59.5	226.8	216.3
43,000	41910	40780	0.1	1.3	14.8	14.7	59.4	58.5	226.2	216.3
LSD (.05)	**540**	**600**	**NS**	**0.6**	**0.2**	**NS**	**NS**	**NS**	**2.9**	**NS**
	2011									
	Plant Stand		Stalk Lodging		Grain Moisture		Test Weight		Yield	
Target Population	Welcome	Wilmont	Welcome	Wilmont	Welcome	Wilmont	Welcome	Wilmont	Welcome	Wilmont
(plants per acre)	---- (plants/ac)		--- Stalk lodging (%) ----		----- Moisture (%) -----		---- Test weight (lb/bu) -----		----- Yield (bu/ac) -----	
33,000	33780	33180	1.2	2.4	14.5	14.4	59.9	59.2	180.5	205.4
38,000	38590	38960	2.2	5.4	14.8	14,7	59.9	59.1	184.7	203.5
43,000	43070	43130	4.3	10.0	14.5	14,5	59.9	59.3	184.1	210.4
LSD (.05)	**500**	**390**	**2.5**	**5.7**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**

Table 6. Evaluation of interaction between row spacing and target population on stand and yield averaged across sites (Welcome and Wilmont) and years (2010 and 2011).

	Average 2010-2011			
	Population		Yield	
Target Population	30" Rows	Twin Rows	30" Rows	Twin Rows
(plants per acre)	---------- (plants/ac) ----------		---------- (bu/ac) ----------	
33,000	32800	32430	206.6	204.3
38,000	38100	36920	210.2	205.5
43,000	42140	42230	205.4	213.0
LSD (.05)	**NS**		**7.8**	

Table 7. Evaluation of interaction between row spacing and population on yield at Welcome and Wilmont in 2010 and 2011.

	2010				2011			
	Welcome		Wilmont		Welcome		Wilmont	
Target Population	30" Rows	Twin Rows	30" Rows	Twin Rows	30" Rows	Twin Rows	30" Rows	Twin Rows
(plants per acre)	---------- yield (bu/ac) ----------				---------- yield (bu/ac) ----------			
33,000	222.9	221.4	211.8	215.7	180.8	180.2	210.7	200.0
38,000	227.1	226.5	215.6	217.1	190.7	178.7	207.4	199.6
43,000	226.6	225.8	209.4	223.1	178.9	189.4	207.2	213.6
Interaction LSD (.05) within a location and year		NS		4.3		NS		NS