Characterization of Corn Hybrids in Response to Nitrogen Fertilizer, Plant Population, Foliar Fungicides and their Interactions.

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1. **Introduction:**
   - Recent surveys during the past 3 years have indicated that Ontario corn growers are asking for hybrid-specific management information as a top priority, in addition to yield performance data produced from the public performance trials. The latest poll was surveyed at the Southwest Ag Conference, where over 70% of growers (>450) ranked hybrid-specific management as a top priority or need through corn research/extension.
   - Small-plot and field studies in Ontario have shown yield response to corn hybrid, population, fungicides and nitrogen. These are *the* major agronomic factors in modern corn production. Previous research in Ontario has shown grain yield increases of 50 bu/ac with a fungicide application, but the average response is less than 6 bu/ac. Nitrogen is also very important to both the economics of producing corn and impacts on the environment. Recent observations indicate that hybrids have differential nitrogen use efficiencies (NUE), but little is known on the magnitude of these differences with current top hybrids. The physiological basis of differential responses amongst hybrids is poorly understood and needs further investigation. Higher NUE may be partly associated with extending green leaf area; foliar fungicides tend to extend green leaf area in corn, therefore, fungicides may increase NUE.

2. **Main Objective:**
   2.1. To characterize the response of corn hybrids with different genetic backgrounds to several agronomic variables that includes nitrogen, population, foliar fungicide, and their interactions.

3. **Research Questions:**
   3.1. Does the response to N rate depend on plant population and hybrid (or phenotypic traits)?
   3.2. Does the response to N rate depend on whether a foliar fungicide was applied at tasseling, and does this response depend on the hybrid (or phenotypic traits)?
   3.3. Does the response to N vary with plant population or whether a foliar fungicide was applied at VT in a stand planted at a high population?
   3.4. When yields were affected by nitrogen, plant population, and foliar fungicides what were the main physiological components affected?

4. **Methodology**

   - Six hybrids (Table 1a) were planted following soybean on 30 April 2013 in a split-split-split plot design with 5 replications. The main plot was seeding rate (32,000 and 44,000 plants/ac), the first split was foliar fungicide (with and without fungicide), the second split was nitrogen rate (0, 120, 180, and 240 lbs/ac), and the third split was hybrid. Final populations averaged 32,000 and 42,000 plants/acre and were similar among hybrid, population, nitrogen, and fungicide treatments. The study was conducted at the Ridgetown Campus, University of Guelph, Ridgetown, Ontario, Canada, on a loam soil. Corn was planted at a depth of 4-cm (1-1/2") using a John Deere 7000 planter with a row spacing of 0.76 m (30"). A starter fertilizer of 150 kg/ha (135 lbs/ac) of 8-32-16 was applied to all plots; starter was banded 5 cm below and 5 cm to the side of seed at planting with Ausherman fertilizer coulters. Hybrids were chosen based on a range of tolerance to drought stress and susceptibility to leaf diseases that are common in Ontario (Table 1). The same plant populations were suggested as other CMRA protocols in the United States. Nitrogen was applied at V3 as UAN (28-0-0) using a custom-designed applicator for variable rate application. UAN was knifed-in between crop rows at approximately 12 cm deep. Fungicides were applied on one date when the latest hybrid to silk was at VT; the earliest hybrid silked 8 d prior to application (see Table 1a for the range of silking dates). The fungicide

QUILT™ was applied to the NK hybrids, and ACAPELA™ (picoxystrobin) was applied to the Pioneer hybrids at recommended use rates. Fungicides were applied at a spray volume 15.0 US gallons per acre using a JD 4760 commercial row crop sprayer using flat fan nozzles.

- The measurements performed are presented in Table 1b. Please note that per-plant samples for N and dry matter (points 15 and 16 in Table 1b) are currently being processed as a winter activity; results for N and dry matter harvest indices should be available February 1, 2013.

Table 1a. Corn hybrid maturities and fungicides employed in the multifactor corn hybrid nitrogen population fungicide project at Ridgetown, ON, 2012.

Company	Hybrid	Fungicide Strategy at VT-R2	Relative Maturity (days)	Silk RM (days)	Black Layer RM (days)	Ontario CHU Rating
NK Brand	A	Quilt	86	88	86	2675
NK Brand	B	Quilt	92	93	93	2800
NK Brand	C	Quilt	101	101	102	3050
Pioneer	D	Acapela	100	100	99	3000
Pioneer	E	Acapela	102	107	108	3100
Pioneer	F	Acapela	104	102	104	3150

Permission to publish hybrid names will be requested after 3 years of the study.

Table 1b. Measurement listing for the multifactor corn trial at Ridgetown, ON in 2012.

STAGE		MEASUREMENT	REPS	Hybrids	N*	POP	Fung	SAMPLES OR PLOTS
multifactor		total number of units --->	5	6	4	2	2	480
1	anytime	soil sample- basic test	5	1	1	1	1	5
2	anytime after VT	Final Stand	5	6	4	2	2	480
3	VT	Date of 50% pollen shed	5	6	4	2	2	480
4	VT	Date of 50% silk emerge	5	6	4	2	2	480
5	VT	foliar disease ratings at VT	5	6	4	2	2	480
6	R2	SPAD	5	6	3	2	2	360
7	R3-R4	tissue tests @ R4	4	6	3	2	2	288
8	R4	foliar disease ratings at R4	5	6	4	2	2	480
9	R4-R5	SPAD	5	6	3	2	2	360
10	R6	Date of 50% black layer	5	6	4	2	2	480
11	R6	plant height	5	6	4	2	2	480
12	R5-R6	stay green	5	6	4	2	2	480
13	R6	plant vegetative dry matter @ R6	4	6	3	2	2	288
14	R6	total row length of hand harvested plants	4	6	3	2	2	288
15	R6	N analysis of vegetative DM after grinding	4	6	3	2	2	288
16	R6	hand-harvested plants grain weight	4	6	3	2	2	288
17	R6	hand-harvested plants grain MC	4	6	3	2	2	288
18	R6	seed yield (plot)	5	6	4	2	2	480
19	R6	Lodging (%)	5	6	4	2	2	480
20	R6	hundred seed weight	4	6	3	2	2	288
21	R6	test weight	5	6	4	2	2	480
22	R6	% oil	4	6	3	2	2	288
23	R6	% protein	4	6	3	2	2	288

*All 3-N tmt measurements in 0, 120, 240

5. Preliminary Results

Weather. Briefly, the number of accumulated GDD or Ontario Corn Heat Units (OCHU) was slightly above normal for the 2012 growing season at Ridgetown, Ontario, Canada (data not shown). Emergence was excellent with timely rainfall events after planting. Corn plants were visually drought stressed in a 3-week period that ended approximately 7 days after VT stage of crop development, on average, across hybrids. Timely rains occurred from this stage of corn development to maturity.

Leaf disease. Northern leaf blight, eyespot, and rust are the predominant leaf diseases to infect corn in Ontario. In 2012 at this site however, leaf diseases were relatively low throughout the duration of the grain fill period (<5% green leaf area of the upper canopy infected). As a result, leaf disease data are not presented.

Grain yield. Grain yields varied between 101 and 263 bu/ac depending on the hybrid-treatment combination (Table 2). The effects of hybrid on yield, moisture content at harvest, plant height, lodging, and stay-green near maturity were all highly significant (Table 3; $p<0.001$). More noteworthy, however, was that the response of hybrid depended on the population and the rate of nitrogen; these differences resulted in highly significant Hybrid by Nitrogen interactions (Table 3; $p<0.0001$). For instance, Pioneer "Hybrid E" had the lowest yield with no N applied sidedress (approximately 20 bu/ac lower than any other hybrid; Table 2), but the same hybrid resulted in the highest yield of all hybrids at the highest rate of nitrogen sidedressed (more than 20 bu/ac higher than any other hybrid; Table 2). This trend for "Hybrid E" is also illustrated in the nitrogen response curves presented in Figure 1, with a delta yield from zero to 240 lbs N/ac of 125 bu/ac. In contrast, NK "Hybrid B" had the highest yield with zero N at 155 bu/ac, but yielded 225 bu/ac at the highest N, which equates to a delta yield of 70 bu/ac.

Grain yield response to population was also dependent on hybrid, which produced a Hybrid by Population interaction (Table 3; $p=0.0005$). Averaged across hybrid, increasing plant population from 32,000 to 42,000 plants/acre resulted in an average yield increase of 9 bu/ac, but this was not statistically significant (Figure 2; $p>0.05$). However, some hybrids did respond more favorably to extremely high populations. For example, grain yield of Pioneer "Hybrid E" was 34 bu/ac higher with 42,000 plants/ac compared to 32,000 plants/ac (Table 2 and Figure 2; $p<0.05$).

The response to sidedressed nitrogen depended on the population, which produced a highly significant Nitrogen by Population interaction (Table 3; $p=0.003$). When averaged across hybrid, increasing nitrogen rates from 120 to 180 or 240 lbs/ac increased grain yields by 17 bu/ac at the 32,000 plants/ac, but at the high population of 42,000 plants/ac, grain yields increased by 29 bu/ac when nitrogen rates increased from 120 to 180 or 240 lbs/ac averaged across hybrids (Figure 2). Even though the 3-way interaction among hybrid, nitrogen rate, and population was weak (Table 2; $p=0.26$), NK "Hybrid A" did not respond to the combination of high N and high population (17 bu/ac; $p>0.10$) but "Hybrid E" showed a synergistic yield response of 60 bu/ac (Figure 2; $p<0.0001$). Drought stress was evident with leaf rolling of "Hybrid A" at approximately 10 d after VT, compared to little visual stress (leaf rolling) at approximately 2 d after VT on the same calendar date (Figure 3).

Foliar fungicides after VT did not affect yield when averaged across other treatments, and there were no interactions. On average, fungicide-treated plots yielded 2.9 bu/ac more than the untreated plots ($p>0.10$).

Harvest Moisture. Moisture content at harvest varied among hybrids; average harvest moisture content increased from 18.3% with zero N sidedressed, to 19.3% at 180 lbs N/ac (Table 5). Only two of the six hybrids produced higher harvest grain moisture contents with 42,000 plants/ac compared to 32,000, which caused a significant Hybrid by Population interaction (Table 3; $p=0.02$).

SPAD Meter. Nitrogen rates strongly influenced ear-leaf chlorophyll concentrations (SPAD), with higher readings at the highest N rates when averaged across hybrid. There was an interaction between nitrogen and fungicide at the R2 and R4 readings, but the patterns are not clear. Across all hybrids, the earliest-maturing "Hybrids A and B" produced the highest SPAD meter readings, especially using N rates of 180 or 240 lbs N/ac ($p<0.05$ contrast not shown; Tables 6 and 7).

Anthesis-silking interval (ASI). The ASI was estimated in days. Data are not presented. "Hybrid D had the longest ASI of 2.3 days compared to zero ($p=0.05$) and "Hybrid E" had the shortest ASI of 0.5 days ($p>0.10$; data not shown). Averaged across all hybrids, increasing population from 32,000 plants/ac to 42,000 plants/ac tended to increase ASI, which was expected ($p<0.05$; data not shown).

Stay green. Staygreen (estimated portion of leaf area green during late grain fill) was highly influenced by hybrid, N rate, population, and fungicide (Table 3). There was a strong trend for higher staygreen with increasing rates of nitrogen (Tables 8 and 9), and with the application of a foliar fungicide after VT (Tables 8).

Plant height. Plant height was different among hybrids, and was lower in the 0 N rate than the other three N rates (data not shown). On average, plant height at the 42,000 plants/ac population was 3.3% lower than at 32,000 plants/ac ($p=0.05$; data not shown).

Lodging. Lodging was near zero in the two early NK hybrids ("Hybrids A and B"; data not shown), but lodging was moderate in the later hybrids just before harvest because of stormy weather after the early hybrids were harvested (Table 10). Lodging was influenced by hybrid, N rate, and population (Table 3). Lodging near harvest tended to increase with nitrogen rates and plant population, but the increase was also dependent on the hybrid, which caused 3-way interactions ($p<0.023$; Table 3).

Other measurements. These included date of physiological maturity, dry matter per plant at maturity for determination of harvest index (HI), nitrogen in the stalk per plant at maturity for determination of nitrogen harvest index (NHI), grain quality (protein and oil), and grain yield components (seed weight, number of kernels per ear). Much of these data are in process of collection from samples in storage.

6. Preliminary Summary

It is important to note that the results presented are only from one location in the first year of study. The 6 hybrids chosen for the study were characterized in response to nitrogen, population, fungicides, and their interactions. Differential hybrid responses occurred with high rates of nitrogen and higher populations, independently and in combination with each other. Averaged across hybrid, grain yields responded to nitrogen especially at the highest plant population. More importantly however, hybrids responded differently to nitrogen, population, and the interaction between nitrogen and population. Response to a population increase from 32,000 plants/ac to 42,000 plants/ac varied from 7 to 34 bu/ac depending on the hybrid. Response to an increase of nitrogen from 120 to an average of the 180 and

240 lbs N/ac varied from 13 and 35 bu/ac depending on the hybrid. Response to a combination of high nitrogen and high population varied from 17 to 60 bu/ac, depending on the hybrid. The hybrid that responded the most to higher population and nitrogen showed greater drought tolerance during a water deficient at VT, and a lower ASI, compared to other hybrids. Yields did not respond to a foliar fungicide applied after VT at 32,000 plants/ac and 120 lbs N/ac, and there was no response to fungicide when combined with high rates of nitrogen and/or high populations. Differential fungicide responses with hybrid were expected based on previous research due to the control of disease on susceptible hybrids; the environment was not favorable for leaf disease in this study, which may explain the lack of response due to fungicide.

Table 2. Grain corn yield at harvest as affected by N rates, fungicide, and population at Ridgetown, 2012.

Hybrid	N Rate (lbs/ac)	32,000 ppa				42,000 ppa			
		UTC		Fungicide		UTC		Fungicide	
		Grain Yield (bu/ac @ 15.5% Moisture)							
"Hybrid A"	0	129.3	cd	135.0	cd	124.1	d	154.6	bc
	120	180.6	ab	183.2	a	187.7	a	192.0	a
	180	187.9	a	187.2	a	200.8	a	199.3	a
	240	193.8	a	194.2	a	197.8	a	201.6	a
"Hybrid B"	0	147.2	cd	168.5	c	139.6	d	147.4	cd
	120	207.0	b	218.3	ab	214.6	ab	214.6	ab
	180	221.0	ab	212.6	ab	230.5	ab	223.4	ab
	240	220.5	ab	220.8	ab	230.0	ab	237.2	a
"Hybrid C"	0	149.7	d	148.7	d	136.0	d	148.5	d
	120	206.3	bc	211.3	abc	219.1	abc	210.8	abc
	180	203.1	bc	192.7	c	211.4	abc	225.3	ab
	240	221.1	ab	205.6	bc	235.3	a	230.9	ab
"Hybrid D"	0	133.2	d	138.4	d	124.0	d	136.3	d
	120	198.9	abc	199.0	abc	190.8	c	209.6	abc
	180	207.1	abc	183.5	c	203.3	abc	206.5	abc
	240	218.6	ab	197.7	bc	224.2	ab	226.5	a
"Hybrid E"	0	101.0	f	127.1	ef	133.3	e	133.1	e
	120	197.9	d	210.3	d	227.9	bcd	239.3	abc
	180	209.7	d	217.7	cd	261.1	a	251.0	ab
	240	237.5	abc	224.5	bcd	263.0	a	257.0	a
"Hybrid F"	0	152.4	b	135.5	b	144.1	b	150.1	b
	120	218.1	a	216.2	a	221.6	a	228.4	a
	180	230.3	a	216.4	a	235.6	a	233.7	a
	240	225.9	a	231.2	a	242.9	a	237.6	a

Means with the same letter within hybrid are not different (p=0.05).

Table 3. ANOVA by of multifactor corn hybrid-nitrogen-population-fungicide project at Ridgetown, 2012.

			SPAD		Staygreen (%)		
Fixed Effect	Yield	Moisture	R2	R4	Early	Late	Lodging
	Type 3 Test of Fixed Effects (p>F)						
Hybrid	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**<.0001**
Fungicide	0.7659	0.3509	0.1026	0.2016	**0.0621**	0.0851	0.3185
N Rate (N)	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**0.0062**
Population	0.1741	0.1202	**0.0636**	0.1246	0.1915	**0.0567**	**0.0067**
Hybrid*Fungicide	0.7207	0.4686	0.9555	0.635	0.3067	0.5657	0.4902
Hybrid*N	**<.0001**	0.2828	0.4462	0.1333	**0.0007**	**<.0001**	**<.0001**
Hybrid*Population	**0.0005**	**0.0213**	0.7776	0.794	0.2374	**0.0032**	**<.0001**
Fungicide*N	**0.0175**	0.7657	**0.0071**	**0.0793**	0.1254	0.9804	0.7813
Fungicide*Population	0.5121	0.2681	0.3088	0.4822	**0.0529**	0.5847	0.1162
N*Population	**0.003**	0.6547	0.4929	0.9709	0.266	0.1287	**0.057**
Hybrid*Fungicide*N	0.9451	0.6313	0.957	0.6569	0.9155	0.6443	0.9449
Fungicide*N*Pop	0.9035	0.2201	0.2281	0.4046	0.3484	**0.0437**	0.5706
Hybrid*Fungicide*Pop	0.2588	0.6978	0.3791	0.4595	0.2917	0.1317	**0.0024**
Hybrid*N*Population	0.9735	0.8802	0.9798	0.7927	0.494	0.2629	**0.0239**
Hybrid*Fungicide*N*Pop	0.8797	0.5776	0.9593	0.4554	0.8431	0.7804	0.6924

Table 4. Average grain corn yields at harvest as affected by hybrid and N rates across fungicide and plant populations at Ridgetown, 2012.

N Rate	Hybrid											
(lbs/ac)	A		B		C		D		E		F	
	Grain Yield (bu/ac @ 15.5% Moisture)											
0	135.7	b	150.7	c	145.7	c	133.0	c	123.6	c	145.5	b
120	185.9	a	213.6	b	211.8	ab	199.6	b	218.9	b	221.1	a
180	193.8	a	221.9	ab	208.1	b	200.1	b	234.9	a	229.0	a
240	196.8	a	227.1	a	223.2	a	216.7	a	245.5	a	234.4	a

Means with the same letter within hybrid are not different (p=0.05).

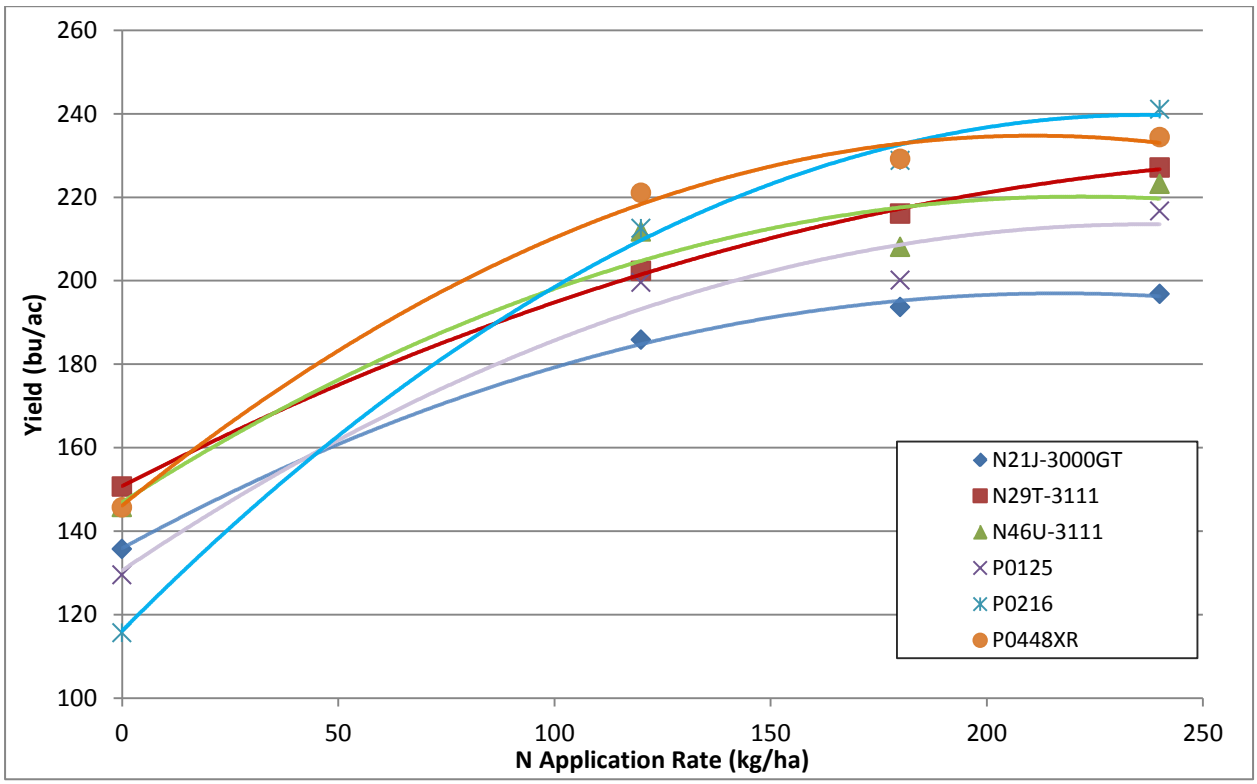

Figure 1. Nitrogen response curves for six hybrids, averaged across population and fungicide treatment, at Ridgetown, 2012.

Preliminary Multifactor Analysis 2012

CHANGE FROM NORMAL	AVERAGE ACROSS HYBRIDS	HYBRID A	HYBRID B
POPULATION	+9	+7	+34 *
NITROGEN	+17 *	+13	+35 *
FUNGICIDE	+4	+3	+10
POP + N	+29 **	+17	+60 ***
POP + F	+12	+11	+33 *
N + F	+12	+14	+33 *
POP + N + F	+29 **	+21	+51 **

Normal Practice: 32K ppa + 120 lbs N/ac + no fungicide
Change: POP=44K ppa; N=240 lbs/ac; Fungicide= Quilt or Acapela @ VT
*, **, *** = significantly different than normal practice at 0.05, 0.01, and 0.001

Figure 2. Hybrid differences with increases with population, nitrogen, and fungicide alone, and combined (POP+N, POP+F, N+F, POP+N+F).

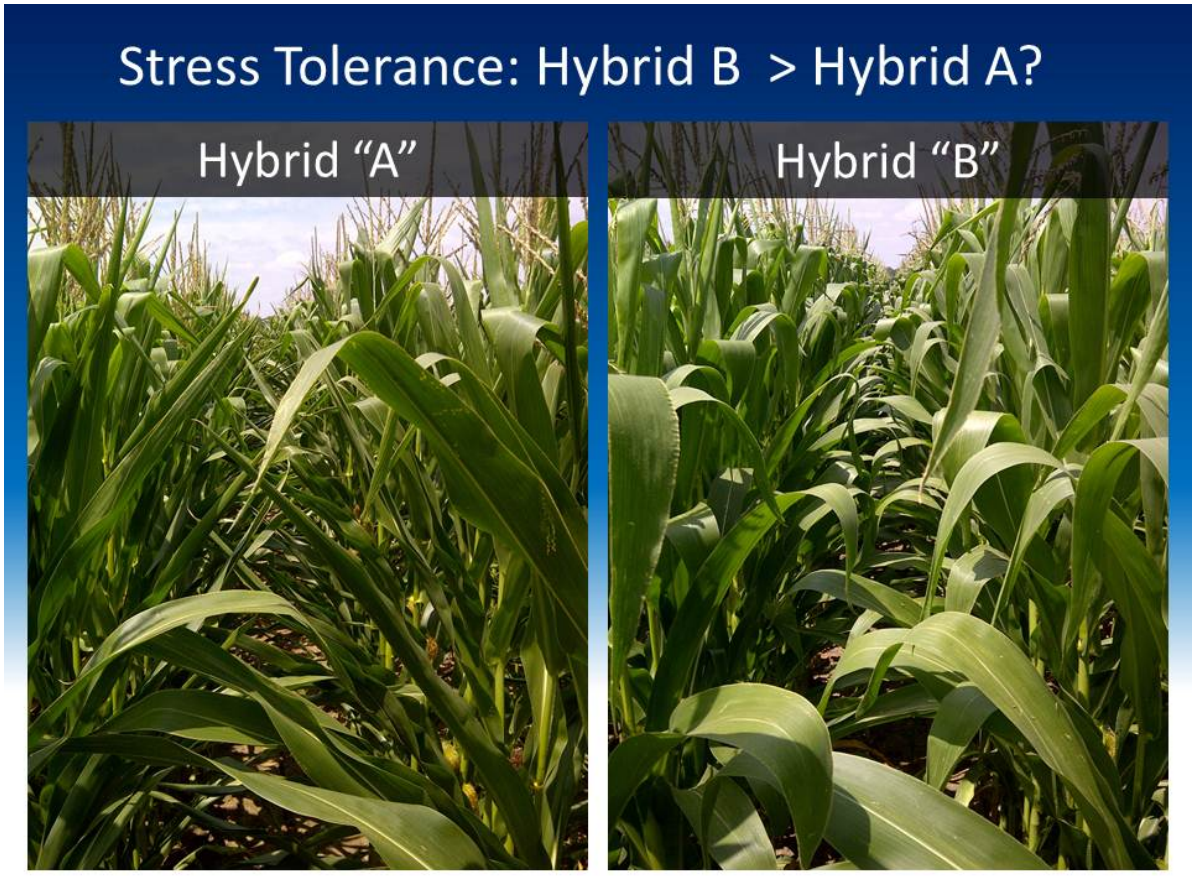

Figure 3. Visual differences of Hybrid A and Hybrid B at R1 under drought stress at Ridgetown, Ontario, Canada, in 2012.

Table 5. Moisture content at harvest as affected by N rates, fungicide, and population at Ridgetown, 2012.

Hybrid	N Rate (lbs/ac)	32,000 ppa				42,000 ppa			
		UTC		Fungicide		UTC		Fungicide	
		Harvest Moisture (%)							
"Hybrid A"	0	19.6	cd	19.8	cd	19.4	d	19.7	cd
	120	20.1	bcd	20.5	abcd	20.6	abc	20.3	abcd
	180	20.6	abc	20.7	abc	21.4	a	20.6	abc
	240	20.6	abc	19.8	cd	20.7	abc	21.0	ab
"Hybrid B"	0	20.1	e	20.0	e	20.5	cde	20.5	cde
	120	20.3	de	20.9	bcde	21	bcde	21.5	abc
	180	20.6	cde	21.9	ab	21.6	abc	21.7	abc
	240	21.4	bcd	21.4	bcd	21.5	bcd	22.7	a
"Hybrid C"	0	16.5	d	16.5	d	16.6	cd	17.1	abcd
	120	17.8	ab	17.6	abcd	17.3	abcd	17.8	abc
	180	16.9	bcd	17.2	abcd	17.5	abcd	18.2	a
	240	17.8	ab	18.0	ab	17.1	abcd	18.1	ab
"Hybrid D"	0	18.3	abcde	18.0	bcde	17.4	e	17.7	de
	120	18.3	abcde	18.8	abc	17.9	cde	18.5	abcde
	180	19.1	ab	18.8	abcd	19.4	a	18.6	abcde
	240	18.9	abc	19.4	a	18.8	abcd	19.2	a
"Hybrid E"	0	17.8	ab	17.7	ab	17.3	b	17.6	ab
	120	18.2	ab	17.7	ab	18.1	ab	17.9	ab
	180	18.4	ab	18.4	ab	17.7	ab	18.5	ab
	240	17.9	ab	18.2	ab	18.6	a	17.9	ab
"Hybrid F"	0	18.0	bc	17.8	c	18.3	bc	18.1	bc
	120	17.9	c	17.8	c	19.1	ab	18.6	abc
	180	18.7	abc	18.7	abc	19.2	ab	19.6	a
	240	18.5	abc	17.8	c	17.7	c	19.6	a

Means with the same letter within hybrid are not different (p=0.05).

Table 6. SPAD readings at developmental stage R2 by as affected by N rates, fungicide, and population at Ridgetown, 2012.

Hybrid	N Rate (lbs/ac)	32,000 ppa		42,000 ppa	
		UTC	Fungicide	UTC	Fungicide
"Hybrid A"	0	50.8 cd	52.6 bc	46.7 d	51.7 c
	120	59.0 a	59.9 a	56.9 ab	57.9 a
	240	61.4 a	60.6 a	60.5 a	59.4 a
"Hybrid B"	0	50.9 d	57.3 bc	51.5 d	53.3 cd
	120	59.4 ab	60.7 ab	58.7 ab	57.1 bc
	240	61.0 ab	62.0 a	60.5 ab	58.9 ab
"Hybrid C"	0	47.6 c	49.6 bc	42.7 d	45.1 cd
	120	54.9 a	56.7 a	56.2 a	53.8 ab
	240	56.9 a	57.9 a	56.0 a	54.8 a
"Hybrid D"	0	48.1 cd	51.6 bc	45.0 d	46.9 d
	120	55.9 ab	58.2 a	54.9 ab	54.6 ab
	240	57.4 a	58.1 a	55.8 ab	54.9 ab
"Hybrid E"	0	48.5 b	48.9 b	47.0 b	48.7 b
	120	56.0 a	55.8 a	55.1 a	53.9 a
	240	54.7 a	56.8 a	54.5 a	55.0 a
"Hybrid F"	0	51.7 bc	49.8 cd	46.5 d	51.2 c
	120	57.1 a	57.8 a	56.3 a	55.6 ab
	240	58.6 a	58.3 a	57.6 a	56.4 a

Means with the same letter within hybrid are not different (p=0.05).

Table 7. SPAD readings at developmental stage R4 by as affected by N rates, fungicide, and population at Ridgetown, 2012.

Hybrid	N Rate (lbs/ac)	32,000 ppa		42,000 ppa	
		UTC	Fungicide	UTC	Fungicide
"Hybrid A"	0	30.9 f	36.5 e	30.0 f	36.6 e
	120	53.2 bcd	53.1 abcd	49.8 d	51.1 cd
	240	58.4 a	57.4 ab	54.8 abcd	55.7 abc
"Hybrid B"	0	30.8 de	31.7 d	25.8 e	26.1 de
	120	48.8 bc	51.6 abc	47.9 bc	46.4 c
	240	56.3 a	56.5 a	53.1 ab	54.6 a
"Hybrid C"	0	32.8 de	32.3 de	29.4 e	35.2 d
	120	52.4 abc	55.7 ab	50.6 bc	48.6 c
	240	57.1 a	57.4 a	55.0 ab	55.2 ab
"Hybrid D"	0	25.1 c	33.7 b	27.0 c	24.9 c
	120	50.1 a	51.9 a	50.0 a	50.0 a
	240	55.3 a	54.4 a	53.0 a	50.9 a
"Hybrid E"	0	29.5 b	33.2 b	29.0 b	29.2 b
	120	49.9 a	51.9 a	50.0 a	49.3 a
	240	54.4 a	52.6 a	52.7 a	53.0 a
"Hybrid F"	0	35.9 c	35.0 c	33.9 c	31.2 c
	120	53.6 ab	53.8 ab	51.5 b	52.9 ab
	240	57.2 a	56.3 ab	54.7 ab	54.5 ab

Means with the same letter within hybrid are not different (p=0.05).

Table 8. Stay-green estimates by hybrid mid-August as affected by N rates, fungicide, and population at Ridgetown, 2012.

Hybrid	N Rate (lbs/ac)	32,000 ppa				42,000 ppa			
		UTC		Fungicide		UTC		Fungicide	
		Stay Green (%)							
"Hybrid A"	0	42	f	43	ef	25	g	42	f
	120	58	cd	63	bc	52	de	58	cd
	180	71	ab	66	abc	68	ab	71	ab
	240	70	ab	68	ab	66	abc	75	a
"Hybrid B"	0	44	fg	48	ef	37	g	37	g
	120	53	cdef	56	cde	51	def	59	bcd
	180	71	a	71	a	66	ab	62	abc
	240	67	ab	70	a	59	bcd	70	a
"Hybrid C"	0	63	ef	60	f	61	f	67	def
	120	75	abcd	69	cdef	72	bcde	71	bcde
	180	83	a	78	abc	79	ab	80	ab
	240	82	a	77	abc	75	abcd	84	a
"Hybrid D"	0	46	f	55	ef	48	f	48	f
	120	70	bc	72	abc	60	de	66	cd
	180	81	a	79	ab	73	abc	75	abc
	240	81	a	78	ab	76	ab	80	a
"Hybrid E"	0	52	e	57	e	53	e	50	e
	120	75	cd	75	cd	73	d	76	bcd
	180	86	a	81	abcd	78	abcd	80	abcd
	240	83	abc	81	abcd	85	ab	85	ab
"Hybrid F"	0	55	ef	56	ef	51	f	54	ef
	120	69	bcd	71	abc	61	de	68	cd
	180	76	abc	78	ab	75	abc	76	abc
	240	79	a	77	abc	75	abc	78	ab

Means with the same letter within hybrid are not different (p=0.05).

Table 9. Stay-green estimates by hybrid late September (R5-R6) as affected by N rates, fungicide, and population at Ridgetown, 2012.

Hybrid	N Rate (lbs/ac)	32,000 ppa		42,000 ppa	
		UTC	Fungicide	UTC	Fungicide
		Stay Green (%)			
"Hybrid A"	0	0 c	0 c	0 c	0 c
	120	0 c	2 c	1 c	2 c
	180	3 bc	17 a	2 c	4 bc
	240	7 abc	7 abc	3 c	15 ab
"Hybrid B"	0	0 d	0 d	0 d	0 d
	120	2 d	2 d	1 d	5 d
	180	5 d	18 abc	10 bcd	7 cd
	240	28 a	20 ab	4 d	18 abc
"Hybrid C"	0	12 f	16 f	9 f	17 f
	120	32 e	35 e	40 de	41 cde
	180	56 ab	55 ab	54 ab	48 bcd
	240	62 a	54 ab	52 abc	56 ab
"Hybrid D"	0	2 g	6 fg	0 g	1 g
	120	26 de	36 cd	19 e	16 ef
	180	46 bc	59 a	38 c	38 bc
	240	50 ab	60 a	44 bc	41 bc
"Hybrid E"	0	6 e	9 e	2 e	6 e
	120	38 d	43 cd	41 cd	47 cd
	180	63 a	61 ab	61 ab	52 bc
	240	62 ab	68 a	66 a	66 a
"Hybrid F"	0	8 d	3 d	1 d	2 d
	120	39 bc	39 bc	30 c	32 c
	180	49 ab	51 a	45 ab	48 ab
	240	56 a	51 a	49 ab	47 ab

Means with the same letter within hybrid are not different (p=0.05).

Table 10. Stalk lodging at harvest by hybrid as affected by N rates, fungicide, and population at Ridgetown, 2012.

Hybrid	N Rate (lbs/ac)	32,000 ppa				42,000 ppa			
		UTC		Fungicide		UTC		Fungicide	
						%			
"Hybrid C"	0	4	bc	2	c	20	a	10	abc
	120	3	c	2	c	14	ab	4	bc
	180	3	bc	2	c	10	abc	7	bc
	240	4	bc	2	c	14	ab	10	abc
"Hybrid D"	0	20	bc	12	cdef	29	ab	37	a
	120	8	defg	5	efg	20	bc	19	c
	180	4	fg	2	fg	11	cdefg	14	cde
	240	2	fg	2	g	11	cdefg	16	cd
"Hybrid E"	0	5	cdefg	3	defg	10	abcdefg	13	abcd
	120	7	bcdefg	1	g	12	abcdef	15	abc
	180	7	bcdefg	3	efg	19	a	13	abcde
	240	3	efg	2	fg	19	a	17	ab
"Hybrid F"	0	11	fgh	7	h	22	cdef	35	b
	120	17	efgh	11	gh	18	defg	16	efgh
	180	25	bcde	13	fgh	32	bc	51	a
	240	28	bcd	19	defg	55	a	53	a

Means with same letter within hybrid are not different (p=0.05). Lodging notes for "Hybrids A and B" are not presented; data on those hybrids were recorded approximately 3 weeks before other hybrids with later maturities, with lodging near zero.