



Cor9-2011 - Evaluating the Economic Benefits of Corn Hybrid Traits

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Evaluating the Economic Benefits of Corn Hybrid Traits **(St Clair SCIA Regional Partner Grant)** **(Final Report)**

Purpose:

Seed corn companies offer a number of different traits in their corn hybrids. The traits include: glyphosate tolerance (Roundup Ready), glufosinate tolerance (LibertyLink), resistance to corn borer, and resistance to corn rootworm. More traits are in development such as drought tolerance, nitrogen use efficiency, other herbicides and new insect protection, these and more will be offered in the near future. Seed companies initially offered one trait, then progressed to offering two or three traits in the same hybrid. Refuge plantings were required for the insect traits. The industry is rapidly moving towards SmartStax which has more than three traits and may have more than one mode of action. They have also moved to Refuge in a Bag (RIB) which eliminates the need for a separate refuge but only offers less than 20% refuge. The traits currently available on the market fall into two categories: herbicide tolerance or resistance to pests. With each added trait there is an added cost as the seed companies attempt to recover the cost of research and development and make a profit. There are many choices and many different field situations. It can be difficult for a farmer to decide which hybrid and trait to choose and to evaluate if the extra cost was good insurance, by covering its cost in extra yield or provided some other benefit. This project aimed to evaluate a corn hybrid and the same hybrid with one or more traits for yield, economic return and other agronomic characteristics.

Methods:

A corn hybrid was selected which had no traits and the equivalent hybrid with one or more traits, i.e. Hybrid 640, 640 Bt, 640 glyphosate tolerant, 640 Bt + glyphosate tolerant was compared. A second set of hybrids was sometimes included in the same plot. An attempt was made to have the set of corn hybrids replicated at least three times. To make it easier to get 3 or more replications some co-operators split the planter with three or more hybrids. The project area is large enough that different hybrids were sometimes chosen as the number of crop heat units declines significantly from Amherstburg to Grand Bend. The hybrids were tested in different soil textures, crop rotations and other growing situations. Soil samples for fertility analysis were taken from each plot to ensure fertility was not limiting. The hybrids were monitored throughout the season for early growth, plant stand, weed control, and insect and disease pressure. At harvest stand evaluations and yields were recorded. The economics and other benefits of the hybrid and the associated traits were evaluated. As the project progressed it became more difficult to find comparisons to a hybrid with no traits (isoline). Therefore the comparison at many of the sites was the glyphosate tolerant hybrid compared to hybrids with one or more insect protection (Bt) traits.

Results:

For the full results from 2009 see the 2010 issue of Crop Advances. The plots were harvested in a reasonable time given the cool summer and later maturity of the corn crop in 2009. None of the Roundup Ready hybrids were sprayed with glyphosate as it was too difficult to do so with the non glyphosate tolerant hybrids in close proximity. The full results for 2010 can be found in the 2011 issue of Crop Advances. The 2010 plots were

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harvested earlier that year due to early planting and lots of heat during the season which resulted in an early maturing crop. Glyphosate was used on both the Maizex sites and at the Florence site on the Dekalb hybrids. The 2011 season was a challenging one. A very wet spring delayed planting of all plots except one until June and prevented a number of plots from being planted. The plot that was planted in May received 4" of rain in the 6 days following planting. Glyphosate was used on the Maizex and Dekalb plots and a conventional herbicide program was used on the plots with the Pioneer hybrids due to the isoline being in close proximity to the glyphosate tolerant hybrids. The harvest was delayed somewhat due to wet fall conditions.

Country Farm Seeds provided two hybrid sets the first year. The CF 870 set was provided both years and the CF 771/2 set was only provided in 2009. The CF 771 with no traits yielded better than the hybrids with Roundup Ready (RR) and European Corn Borer (ECB) even with moderate ECB pressure in the plot see table 1b. The CF 870 set did not show any yield advantage to the traits in 2009 at any of the three sites and one of them was corn on corn (Table 1a). On average the hybrids with traits yielded lower than the hybrid with no traits. In 2010 one of the sites again showed no yield advantage to the hybrids with traits. However, the second site which was corn on corn in the same field as the previous year showed a yield advantage to RR and ECB hybrids. An even greater yield advantage was seen in the triple stack hybrid (RR, ECB, corn rootworm (CRW)). The roots of the non CRW hybrids were not examined for feeding damage but there was no significant difference in lodging between hybrids observed.

Table 1b. Country Farm - Hybrid Traits, Yield and Economics

Hybrids	Traits	HU	2009 Florence	Seed Cost	Yield Gain	Net*
			bu/ac	/bag	/ac	\$/ac
CF771	None	3100	145.4	\$130	NA	NA
CF772YGCB	ECB	3100	139.7	\$170	0	\$(16.00)
CF772RBt	RR, ECB	3100	136.2	\$200	0	\$(28.00)

*Assume seeding rate of 32,000 seeds per acre and corn price of \$4.50/bu
 Traits: ECB = European Corn Borer, RR = Roundup Ready, CRW = Corn Rootworm

Dekalb provided the same set of hybrids for all three years except DKC 52-63 was not available in 2011. All of the hybrids had one trait. The RR trait was present in all hybrids, ECB was added in the second hybrid and the third hybrid was a triple stack. They were tested at 3 locations the first two years and at one location the third year. In 2009 two sites showed no yield advantage to the additional traits but the third site showed a yield advantage to the hybrids with the insect resistance traits see table 2. In 2010 one of the hybrids with insect resistance showed a yield advantage at two sites. In 2011 the hybrid with the insect resistance traits showed a yield advantage. On average there was no yield advantage to the insect resistance traits over the hybrid with the glyphosate tolerance trait.

In 2010, Maizex provided two hybrids, one with RR and the other a triple stack. They were tested at two sites and on average there was no yield advantage to the insect resistance traits see table 3a. In 2011, two different hybrids were provided for testing. The triple stack in table 3b shows a significant yield advantage over the hybrid with glyphosate alone but there was only one rep of the glyphosate trait hybrid and only two reps of the triple stack hybrid so it is hard to be sure that the difference is real.

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Table 1a. Country Farm - Hybrid Traits, Yield and Economics

Hybrid	Traits	HU	2009			2010		Ave. bu/ac	Seed Cost /bag	Yield Gain /ac	Net* \$/ac
			RGTN	KVL	AMB	KVL	AMB				
CF870	None	3300	178.5	165.6	197.0	161.4	160.3	172.6	\$158	NA	NA
CF870YGCB	ECB	3350	170.8	155.5	178.2	156.4	167.0	165.6	\$220	0	(24.80)
CF870R	RR	3325				157.2	179.3	168.3	\$210	0	(20.80)
CF870VT3	RR, ECB, CRW	3350	177.3	156.0	191.1	153.8	188.6	173.4	\$241	0	(33.20)

*Assume seeding rate of 32,000 seeds per acre and corn price of \$4.50/bu
 Traits: ECB = European Corn Borer, RR = Roundup Ready, CRW = Corn Rootworm
 Location notes: RGTN = Ridgetown, KVL = Kingsville, AMB = Amherstburg
 Site notes: The AMB site is continuous corn in a vertical tillage system. There was a low level of ECB pressure at this site in 2010. Feeding was evident on the CF870 and CF870R hybrids. There was no evidence of ECB feeding on the other two hybrids.

Table 2 Dekalb - Hybrid Traits, Yield and Economics

Hybrid	Traits	HU	2009			2010				2011	Ave. bu/ac	Seed Cost /bag	Yield Gain /ac	Net* \$/ac
			KVL	AMB	FL	FLC	FLS	CRN	FL2	FL2				
DKC52-62	RR	3100	189.5	176.2	172.2	150.4	185.5	162.8	144.1	144.8	165.7	\$247	NA	NA
DKC52-63	RR,ECB	3100	174.9	172.4	179.8	147.5	196.0	157.0	141.4		167.0	\$275	1.3	(5.35)
DKC52-59	RR,ECB CRW	3100	177.5	173.9	182.9	149.6	165.5	166.1	153.2	151.6	165.0	\$290	0	(17.20)

*Assume seeding rate of 32,000 seeds per acre and corn price of \$4.50/bu, Traits: ECB = European Corn Borer, RR = Roundup Ready, CRW = Corn Rootworm, Locations: KVL = Kingsville, AMB = Amherstburg, FL = Florence, FLC and FLS = Florence clay and sand, CRN = Croton, Site notes: The AMB site is continuous corn in a vertical tillage system. There was a low level of ECB pressure at this site in 2009. Feeding was evident on the DKC52-62 hybrid. There was no evidence of ECB feeding on the other two hybrids. Insect damage at the FL site was low in 2009 and very low in 2010. Insect feeding was very low at the CRN site in 2010. In 2010 and 2011 insect damage was low at the FL2 site. In 2011 the FL2 site experienced some uneven growth due to the wet spring.

Table 3a Maizex - Hybrid Traits, Yield and Economics

Hybrid	Traits	HU	2010		Ave. bu/ac	Seed Cost /bag	Yield Gain /ac	Net \$/ac
			Dresden	Tilbury				
MZ5286R	RR	3175	214.5	158.1	186.3	\$227	NA	NA
MZ5288CBR	RR, ECB, CRW	3200	216.0	155.3	185.7	\$272	0	(18.00)
*Assume seeding rate of 32,000 seeds per acre and corn price of \$4.50/bu Traits: ECB = European Corn Borer, RR = Roundup Ready, CRW = Corn Rootworm Site notes: insect pressure was very low at both sites.								

Table 3b Maizex - Hybrid Traits, Yield and Economics – Grande Point 2011

Hybrid	Traits	HU	Ave. bu/ac	Seed Cost /bag	Yield Gain /ac	Net \$/ac
MZ5560R	RR2	3300	203.9	\$253	NA	NA
MZ5562DBR	RR2, ECB, CRW	3300	225.3	\$278	21.4	\$97
*Assume seeding rate of 32,000 seeds per acre and corn price of \$5.00/bu Traits: ECB = European Corn Borer, RR2 = Roundup Ready 2, CRW = Corn Rootworm Site notes: Insect damage was very low. 2 replications of MZ5562DBR and only one replication of MZ5560R.						

Pioneer supplied five hybrids in 2011 including the isoline (hybrid with no traits). The hybrids were planted at two different locations. At one location all the hybrids with traits yielded more than the isoline (Table 4). At the other location there was no yield advantage to the traits over the isoline.

The yield is an important part of assessing the value of a trait or set of traits but the economics, mainly the additional seed cost for the trait(s) is key to the bottom line. The corn hybrids without any traits for the most part had the least expensive seed cost per bag at a retail price of \$130 and the triple stacks topped out at \$290. The tables above illustrate the net dollars per acre based strictly on seed cost versus yield gain for the hybrid with trait(s) for the three years of the project. From Table 1a when the sites are averaged it is apparent that all of the hybrids with traits did not payback any of the extra cost for the seed with traits compared to the hybrid without traits. Tables 1b, 2 and 3a are comparisons of hybrids with the glyphosate trait to hybrids with one or more insect resistance traits. Again when averaged there was no extra yield to cover the extra cost of the other traits. Table 3b shows a significant payback for the insect resistance traits but there was only one rep of the glyphosate tolerant hybrid. Table 4 again has a comparison with the isoline but in this case the cost of it is not much different than the other hybrids. Again when averaged there was very little payback to the hybrids with traits. Only one hybrid gave some payback.

On average the traits did not pay but there were a number of sites on their own which would have paid for the traits. In the Country Farm 870 hybrids the Amherstburg site in 2010 saw a payback for all of the hybrids with traits compared to the isoline. For the Dekalb hybrids four out of the eight sites over the three years saw a payback to one or

more of the hybrids with Bt traits. And there was an advantage to the Pioneer hybrids with traits compared to the isolate at one of the two sites in 2011. As mentioned earlier,

Table 4. Pioneer - Hybrid Traits, Yields and Economics

Hybrid	Traits	HU	2011				Ave. bu/ac	Seed Cost /bag	Yield Gain /ac	Net \$/ac
			Kingsville		Amhrstbg					
PO35F38	None	3150	19.8	178.5	18.9	150.1	164.3	\$270	NA	NA
PO35F37	RR2	3150	15.9	182.4	20.4	145.0	163.7	\$261	0	\$0.00
PO35F40	HX1 (CB), LL, RR2	3150	21.6	189.2	20.2	138.7	164.0	\$260	0	\$0.00
PO35F44	HXX (CB, CRW), LL, RR2	3150	21.1	193.0	20.1	141.8	167.4	\$287	3.1	\$8.70
PO35F33	YGCB, HX1, LL, RR2	3150	20.7	171.7	19.4	148.9	160.3	\$270	0	\$0.00

*Assume seeding rate of 32,000 seeds per acre and corn price of \$5.00/bu
 Traits: ECB = European Corn Borer, RR2 = Roundup Ready 2, CRW = Corn Rootworm, LL = LibertyLink. Site notes: The Amherstburg location received 4" of rain in the 6 days after planting which impacted the stand. This location also suffered from bird damage in a portion of the plot. Insect pressure was very low at both sites.

glyphosate was not used at sites where the isolate was present, so it is difficult to evaluate the economics of that trait. The lower yield of some of the hybrids with traits or moisture differences were also not taken into account.

Summary:

Over the three years of the project, the yield results for the plots when averaged did not show a yield advantage to corn hybrids with traits no matter what the trait or combination of traits was. There were seven sites out of nineteen where the hybrids with traits showed enough of a yield advantage to cover the extra cost of the traits and more. Generally the insect pressure, namely European Corn Borer, was low to very low. The two sites where there was a yield advantage to the traits occurred where there was a little more insect pressure.

The traits included in the corn hybrids are there to allow the use of a herbicide or to protect the crop from an insect. The traits therefore provide options to protect yield of that hybrid rather than providing increased yield. The traits that are offered add to the producer's toolbox to manage weeds and insects. Experience and scouting information for a particular field should go into the decision of which traits to use as that is the way to get the most value from them. Resistance management is something that should be top of mind when using these hybrids. Refuge in a bag may make it easier but the scientific

community is not convinced that the amount of refuge provided with that method is sufficient. Resistance to the corn rootworm trait has already been confirmed in the U. S. and every year it seems another weed develops resistance to glyphosate. So if we see value in having these tools we need to use them wisely. The project had difficulty evaluating the Roundup Ready (RR) trait as it was grown in close proximity to the isoline making it impossible to spray glyphosate. There were other economic considerations the project did not explore.

The key to success with corn trait selection is to consider why a particular trait or set of traits might suit the cropping system based on risk of pest infestation or other management considerations.

Next Steps:

The project is complete.

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