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Agricultural Experiment Station



NEW YORK STATE CORN SILAGE HYBRID TRIALS – 2016

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Twenty-nine corn silage hybrids were tested at two locations in New York (NY) in 2016. Hybrids were planted at the Musgrave Research Farm in Aurora (Cayuga Co.) and at Greenwood Farms in Madrid (St. Lawrence Co.). The ten year average at the Aurora site is 2094 growing degree days (GDD, 86-50°F system) while the Madrid site averages 1831 GDD, from May through August. Seed companies were invited to submit hybrids for both sites for a fee. The purpose of this trial is to provide unbiased, local data to aid in producer's decision making and consultant recommendations. Furthermore, novel approaches to evaluate the impact of varying nutrient and digestibility characteristics of the corn silage hybrids were employed using the Cornell Net Carbohydrate and Protein System (version 6.5.5), which is the dairy nutrition model employed by dairy nutritionists that is used to feed more cows in the U.S. than any other nutrition model.

The reinstatement of the NY trials was made possible with support from dairy producers, participating Seed Companies, Cornell University, the New York Farm Viability Institute and New York State Agricultural Experiment Station.

MATERIALS AND METHODS

All hybrids were planted using a two-row planter at 34,000 plants/acre. Each plot consisted of two 20' rows spaced 30 inches apart. After emergence each row was thinned to 17'5" and a population of 32,000, where emerged population permitted. The Aurora site was planted on May 12th and the Madrid site was planted on May 17th. Hybrids were planted in a randomized complete block design, with 4 replications, by 5-day maturity groups (90-95, 96-100, 101-105 day). The Aurora site was previously corn and received 284 lbs/acre of 10-20-20 with 1% Zinc at planting. The site was treated with a pre-emergence spray program and required a post-emergence rescue treatment to control grasses that emerged due to dry conditions. Additionally 120 units N/acre were applied as sidedress at Aurora. The Madrid site was first year corn following alfalfa and the field preparation, fertilization, and pest management was completed using best agronomic practices by the farm. The Madrid site did not receive sidedress nitrogen.

Corn started tasseling on approximately July 21st in Aurora and July 25th in Madrid. The Aurora site was harvested on three dates, according to maturity group. Early (90-95 day) corn was harvested on August 29th, medium (96-100 day) corn was harvested on September 1st, and late (101-105 day) corn was harvested on September 7th. All maturity groups were harvested on September 13th at the Madrid site. From planting to harvest in Aurora, early corn had 2091 GDD, medium corn had 2143 GDD, and late corn had 2223 GDD (86-50 system). Madrid had 2184 GDD from planting to harvest.

The goal was to harvest all hybrids at about 65% ($\pm 3\%$) moisture. The maturity groups were monitored and harvest decisions were made by doing whole plant dry matter (DM) testing on fill plots prior to harvest. Plots were harvested with a two-row, Kemper rotary head and Wintersteiger Weighmaster system with sample mixing capabilities at a target cutting height of 6 to 8 inches.

An approximate 500-gram sample was taken in duplicate per plot replicate, resulting in 16 samples per entry across the two sites. Samples were sealed in a gallon-sized freezer bag and placed in a cooler with ice packs or a portable generator-powered freezer for transportation back to Cornell University where they were transferred to a -20°C freezer. One of the duplicate samples was kept as a retained sample while the other sample (8 samples/hybrid entry across the two sites) was submitted to Cumberland Valley Analytical Services where NIR procedures were used to determine CP, lignin, ash,

NDFom, 12 hr NDF digestibility, undigested NDF [uNDFom; 30, 120, and 240 hr]] and 7-h starch digestibility. Samples were also analyzed by wet chemistry for starch, NDF, 30 hr NDF digestibility, and 30 hr uNDF.

Corn silage chemistry results were averaged by site and applied to a typical New York higher corn silage-based diet (forage at ~60% of diet DM; corn silage ~70% of forage DM) in a software platform (NDS Professional version 3.9.2.03, RUM&N Sas, Reggio Emilia, Italy), utilizing the Cornell Net Carbohydrate and Protein System (CNCPS v. 6.5.5; Cornell University, Ithaca, NY) biology and dynamic model. The base diet was designed by Dr. Tom Overton with an average corn silage to supply enough nutrients for a cow producing 100 lb of milk. Initially, each hybrid replaced the average corn silage in the diet at the same DM amount (28 lb DM/day). For consistency purposes, the feed library 7-hr starch digestibility value was kept in the model since the samples had not undergone fermentation. Subsequently, dry matter intake of the entire ration was adjusted to supply the cow with the same amount of uNDF240 that the base diet supplied (5.867 lbs/day). This novel approach to hybrid evaluation allows us to account for differences in dry matter intake potential of the total ration based upon hybrid selection and is a more biologically robust representation compared to evaluating hybrids on a constant dry matter intake basis. The predictions made by the CNCPS v.6.5.5 platform were used to evaluate differences in intake potential and subsequent metabolizable energy (**ME**) and metabolizable protein (**MP**) allowable milk yield based upon the nutrient and digestibility characteristics of each hybrid. Only the ME allowable milk yield is reported as it was more limiting than MP allowable milk yield for all hybrids.

Data were analyzed using PROC GLM in SAS 9.4 (SAS Institute, Cary, NC). The least significant difference (**LSD**) values reported for separating hybrid means for each location were generated at the $P=0.10$ level. For interpretation purposes, if the difference between two hybrids is greater than the reported LSD, there is a 90% probability that this is not due to random variation and there is a true varietal difference between the hybrids. Differences between RM group averages were determined at the $P=0.10$ level. For interpretation purposes, if superscripts are different between the RM means, there is a 90% probability that there is a true difference between RM groups.

Hybrids were considered good performers if the yield and predicted ME allowable milk yield was above the average. Hybrids were considered exceptional performers if both the yield and the predicted ME allowable milk yield were above average at both locations.

RESULTS AND DISCUSSION

Growing Conditions

Aurora

Aurora experienced below normal precipitation in April and experienced moderate rainfall in early May prior to planting. Following planting rain was scarce throughout the remainder of May, June and July (Table 1, Figure 1a) resulting in significant stress to the crop. Rain in late July did come at the critical time midway through pollination, with later season hybrids experiencing less stress at pollination, and rain in August helped the crop finish stronger than expected, though well below the documented potential for this location. Continued rain showers in late August and early September resulted in fluctuating whole plant dry matters that made it a challenge to pinpoint harvest timing.

Madrid

Madrid also experienced below normal precipitation in April which continued through May. While total rainfall for the season (Table 1) was actually slightly less than the Aurora site the timing of the rain was much better (Figure 1b) and the crop did not exhibit the same visual stress observed at Aurora. This resulted in much better yield performance across hybrids at the Madrid location.

Results

Results are presented in Tables 2 and 3 as well as Figures 2 and 3. The tables provide yield and forage quality (crude protein, aNDFom, starch, lignin, 30 hr NDFDom, 240 hr uNDFD and predicted milk yield) results for each hybrid entry. Average silage yields were increased by approximately 2.3 tons/acre at Aurora and approximately 0.9 tons/acre at Madrid, with each RM group increase (i.e. 84-95 d to 96-100 d, 96-100 d to 101-107 d). The larger than expected yield difference between maturity groups at Aurora is likely attributable to the extended period with very little rainfall (Figure 1a) and the fact that the early season hybrids began to pollinate prior to the return of more regular rainfall which helped the longer season hybrids during pollination. Dry matter decreased by approximately 1.4% with each RM group increase at Madrid, where we harvested all hybrids on the same day. The opposite occurred at Aurora where we saw an increase by approximately 1.6% with each RM group increase.

A season such as this provides an opportunity to evaluate hybrid performance under variable growing conditions. The figures identify hybrids that performed above average in both crop yield and milk yield (top right quadrant) at each location. Only two hybrids were above the average in both crop yield and milk yield at both locations (Figure 2 and 3). The hybrids performing above average at both locations are more likely to maintain a high level of performance across varying growing conditions.

Due to very different growing conditions experienced at the two sites, there was a large difference in the uNDF overall mean values which translated into large differences in the predicted milk yield when corrected for uNDF240. The predicted ME allowable milk yield on a DMI equivalent was not as variable (range: 102.3 to 108.3 lb at Madrid, 105.6 to 109.0 lb at Aurora) as the predicted ME allowable milk yield on an uNDF240 equivalent (range: 88.6 to 128.0 lb at Madrid, 105.8 to 139.3 lb at Aurora). This would be expected when dry matter intake of the total ration is allowed to vary to meet a constant uNDF240 intake.

Based on the overall mean for predicted milk yield on an uNDF240 equivalent, corn silages performed exceptionally better at the Aurora site than at the Madrid site (120.8 vs. 97.8 lb/d, respectively). However, the overall mean corn silage yield was drastically lower at Aurora than Madrid, when adjusted to 65% moisture (17.7 vs. 28.4 tons/acre). Due to higher fiber digestibility content in the hybrids grown at Aurora, it is predicted that dairy cows will consume more feed compared to Madrid, as reflected in the adjusted TMR DMI (65.8 vs. 56.6 lb/d, respectively). With lower yields and higher predicted DMI at Aurora, dairy farmers feeding corn silages grown under these environmental conditions are more likely to be constrained by inventory for the following year compared to farmers feeding corn silages grown at Madrid.

When evaluating milk yield on an uNDF240 equivalent between RM groups, hybrids with a relative maturity greater than 95 days tended to produce more milk than hybrids in the 84-95 day RM group at Madrid. When observing Aurora, hybrids with a relative maturity less than 101 days resulted in a higher milk yield than hybrids in the 101-107 day RM group.

CONCLUSIONS

The locations of our trials underlined the highly variable rainfall patterns experienced across NY State in 2016 and highlighted how critical timing of rainfall can be rather than total accumulation.

In general the eastern part of NY state experienced adequate rainfall with amounts diminishing as you moved west across the state, though there were large variations within regions. Producers in areas with adequate rainfall reported average to well above average yields while other areas ranged from below average yields to complete crop failure. As was the case at our Aurora location, August rains in some locations helped save the crop from complete failure, though it was clearly still below average.

The impact of weather patterns and growing conditions on key factors, notably fiber digestibility and starch, influencing forage quality and milk producing potential on these hybrids was very evident when comparing the differences in crop yield and predicted milk yield across the two trial locations (Figure 2 & 3).

Predicting milk yield with the use of the CNCPS model provides dairy farmers and dairy nutritionists in NY with a more applicable approach for evaluating different corn silage hybrids. The predicted ME allowable milk yield on an uNDF240 equivalent reflects how much DMI the cow might be able to consume based on rumen fill and passage rate. These results demonstrate how crucial it is to adjust rations based on the predicted DMI rather than replacing corn silages on a dry matter equivalent.

The results of this study will be published on www.fieldcrops.org and appear in the What's Cropping Up? Newsletter in the winter of 2016-2017 and will be disseminated electronically through several channels of Cornell University and Cornell Cooperative Extension.

ACKNOWLEDGEMENTS

We thank the seed companies that participated in 2016 for their collaboration. We urge all seed companies to participate in our corn silage testing program in 2017 so we can provide the best information under New York growing conditions to our New York dairy producers.

We thank Greenwood Dairy for their ongoing collaboration and support of the program; Paul Stachowski and Jeff Stanton at the Cornell Musgrave Research Farm, Aurora for their efforts during field operations; Greg Godwin, Kitty O'Neill and Mike Hunter for assistance at harvest and Buzz Burhans and Ermanno Melli for providing us with the NDS software and technical assistance. We appreciate the guidance of Dr. Bill Cox, Dr. Jerry Cherney, Phil Atkins and Ken Paddock in implementing the 2016 trials.

Additional financial support was provided by New York Farm Viability Institute and the Cornell University Agricultural Experiment Station.

Table 1. NYS Corn Silage Trials, 2016 Weather Data					Long Term Weather Means			
Month	Precipitation (inches)		GDD (86/50 F)		Precipitation		GDD (86/50 F)	
	Aurora	Madrid	Aurora	Madrid	Aurora	Madrid	Aurora	Madrid
May	2.00	0.94	303	323	3.14	3.16	320	281
June	0.74	2.37	483	454	3.84	3.36	498	448
July	1.90	2.22	673	627	3.25	3.46	639	574
August	4.56	3.25	713	649	3.45	3.49	600	538
Seasonal	9.20	8.78	2172	2053	13.68	13.47	2056	1841
10 yr Mean	14.10	14.89	2094	1831				

Figure 1. Accumulation of Growing Degree Days (GDD) from Planting through Harvest and Individual Rainfall Events from May 1st through Harvest at Aurora (1a) and Madrid (1b).

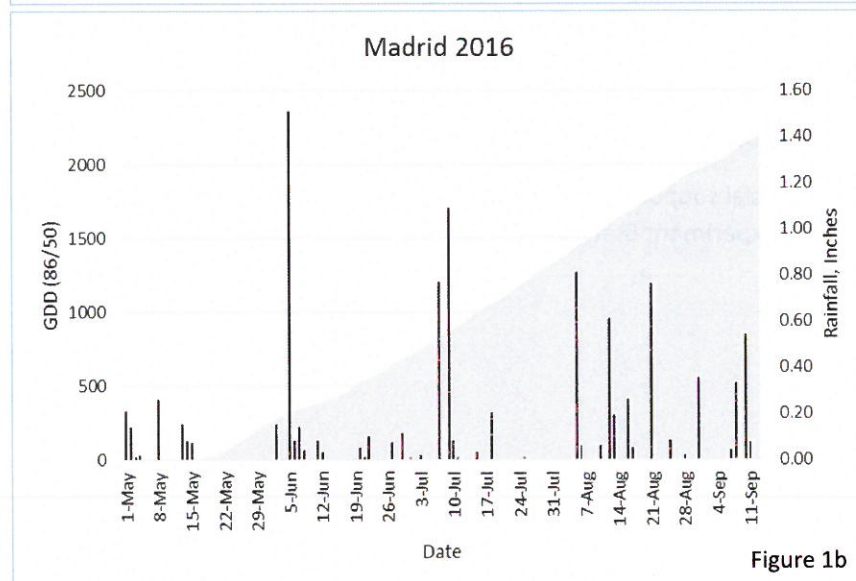
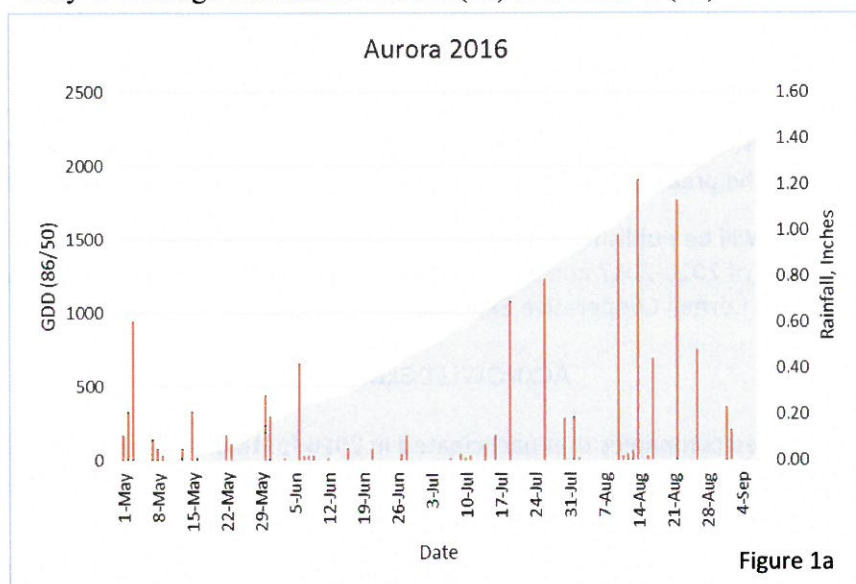


Table 2 cont.

[illegible]

LSD (0.10)

Overall Mean

Table 3 cont.

Company/Brand	Hybrid	NDF		12 hr		30 hr		120 hr		240 hr		Predicted ME Allowable Milk Yield, DMI Equivalent		uNDF240 Intake, DMI Equivalent		Adjusted TMR DMI, DMI Equivalent		Predicted ME Allowable Milk Yield, uNDF240													
		% DM		aNDFom		NDFD		%NDF		Wet Chem		% DM		NIR		% DM		NIR		% DM		NIR		lbs/day		CNCPS value		lbs/day		CNCPS value	
		Wet Chem	NIR	% DM	NIR	Wet Chem	NIR	Wet Chem	NIR	Wet Chem	NIR	% DM	NIR	% DM	NIR	% DM	NIR	% DM	NIR	% DM	NIR	% DM	NIR	lbs/day	CNCPS value	lbs/day	CNCPS value	lbs/day	CNCPS value		
84-95 days RM																															
Hubner Seed	H4094RC2P	35.1	34.3	31.7	67.0	11.6	13.0	9.0	7.7	108.4	5.2	67.7	125.7																		
Kings Agri-seed, Inc.	Masters Choice MCT 4054	36.5	35.8	27.3	64.6	12.9	13.7	9.3	7.8	107.6	5.2	67.2	123.9																		
Seedway	SW3654RR	40.2	38.4	32.6	66.8	13.4	13.5	8.5	6.9	106.8	5.0	70.9	131.1																		
Dyna-Gro	D325S56	36.9	35.7	31.3	64.9	13.0	13.9	10.4	9.0	107.5	5.6	63.8	116.4																		
Seedway	SW3600 GENSS	36.9	35.8	31.0	65.0	13.0	13.6	9.7	8.3	107.0	5.4	65.9	120.2																		
Hubner Seed	H6157RCSS	38.7	37.8	27.4	65.0	13.5	14.4	9.8	8.3	106.0	5.4	65.1	117.5																		
Kings Agri-seed, Inc.	Masters Choice MCT 4572	37.8	36.2	28.3	62.2	14.3	14.4	10.1	8.7	106.4	5.5	64.2	116.0																		
Seedway	SW3768 GENSS	36.4	36.0	27.9	66.4	12.3	13.9	9.8	8.4	107.6	5.4	66.4	122.3																		
	84-95 day RM Mean	37.3 ^A	36.2 ^A	29.7 ^A	65.2 ^A	13.0 ^A	13.8 ^A	9.6 ^A	8.1 ^A	107.2 ^A	5.3 ^A	66.4 ^A	121.6 ^A																		
96-100 days RM																															
Kings Agri-seed, Inc.	Masters Choice MCT 4632	36.5	36.2	27.8	66.8	12.1	13.6	9.1	7.7	107.4	5.2	67.7	124.7																		
Mycogen	TMF2Q419	36.8	36.2	29.6	65.9	12.5	13.4	8.9	7.5	107.7	5.2	68.2	126.0																		
Hubner Seed	H6187RCSS	33.2	35.5	26.5	63.0	12.3	14.1	9.9	8.5	107.4	5.4	65.6	120.2																		
Dairyland Seed	HiDF3197RA	35.9	36.5	29.3	67.1	11.8	14.0	9.6	8.1	108.2	5.3	66.8	123.6																		
Channel	197-685TXRIB	36.7	36.5	28.0	66.8	12.1	13.2	8.6	7.1	108.1	5.0	70.0	130.4																		
Channel	198-985TXRIB	37.4	36.7	26.8	67.3	12.2	14.0	9.5	8.1	107.7	5.3	66.2	121.6																		
Hubner Seed	H6191RCSS	37.1	35.5	28.2	64.3	13.3	14.5	10.6	9.3	107.0	5.6	62.8	113.6																		
Doebler's Hybrids	3916GRQ	36.7	37.1	26.5	65.7	12.6	14.2	9.7	8.3	107.1	5.4	65.4	119.4																		
Mycogen	F2F499	36.0	36.6	29.2	69.6	11.0	12.7	7.9	6.4	109.0	4.8	73.5	139.3																		
Dyna-Gro	D39RR12	35.9	36.2	26.7	66.0	12.3	13.8	9.3	7.9	107.8	5.2	67.0	123.7																		
Dairyland Seed	HiDF3700RA	37.7	38.0	26.9	66.2	12.7	14.1	9.4	7.9	107.7	5.2	67.1	123.7																		
	96-100 day RM Mean	36.3 ^B	36.4 ^A	27.8 ^B	66.2 ^{A,B}	12.3 ^B	13.8 ^A	9.3 ^A	7.9 ^A	107.7 ^A	5.2 ^A	67.3 ^A	124.2 ^A																		
101-107 day RM																															
Hubner Seed	H5222RC3P	34.0	33.7	32.4	66.3	12.0	13.7	10.1	8.8	108.0	5.5	63.9	117.1																		
Doebler's Hybrids	RPM 4115AM	34.4	34.0	31.8	67.3	11.0	13.5	10.0	8.7	108.0	5.4	64.6	118.6																		
Kings Agri-seed, Inc.	Masters Choice MCT 5250	34.1	33.4	33.7	68.3	10.1	13.6	10.2	8.9	108.3	5.5	63.5	116.7																		
Channel	203-445TXRIB	34.6	34.4	30.2	66.1	11.7	14.5	11.3	10.1	107.3	5.8	60.4	108.8																		
Kings Agri-seed, Inc.	Masters Choice MCT 5371	37.1	36.2	29.4	63.5	13.4	15.2	11.5	10.2	105.6	5.9	59.8	105.8																		
Doebler's Hybrids	RPM 563HXR	36.0	35.2	29.9	65.8	12.4	13.7	9.5	8.2	107.5	5.3	65.7	120.6																		
Seedway	SW5554GT	34.9	34.7	32.1	67.2	11.2	13.5	9.6	8.3	107.7	5.4	65.6	120.4																		
Kings Agri-seed, Inc.	Masters Choice MCT 5661	36.1	35.3	31.4	68.4	11.4	14.2	10.8	9.5	106.9	5.7	61.4	110.6																		
Hubner Seed	H5333RC3P	34.3	34.0	30.2	66.3	12.4	12.9	9.2	7.9	108.4	5.3	66.7	123.6																		
Channel	207-275TXRIB	34.5	33.8	35.0	67.3	11.4	13.3	9.6	8.3	108.4	5.4	65.2	120.5																		
	101-107 day RM Mean	35.0 ^C	34.5 ^B	31.6 ^C	66.7 ^B	11.7 ^C	13.8 ^A	10.2 ^B	8.9 ^B	107.6 ^A	5.5 ^B	63.7 ^B	116.3 ^B																		
	LSD (0.10)	2.7	2.5	2.9	3.2	1.5	1.5	1.6	1.7	1.9	0.5	5.8	14.2																		
	Overall Mean	36.1	35.7	29.6	66.1	12.3	13.8	9.7	8.3	107.5	5.4	65.8	120.8																		

Figure 2. Relationship between Silage Yield and Milk Production Potential at Madrid, NY. Hybrids located in the top right quadrant were above the overall mean for both crop yield and milk production potential and are considered good performers. Hybrids located in the bottom left quadrant were below the mean for yield and milk production potential. Hybrids in the top left quadrant were below the mean for yield and above the mean for milk production potential and hybrids in the bottom right quadrant were above the mean for yield and below the mean for milk production potential. Hybrids that were above average for crop and milk yield at both locations are marked and noted in the legend.

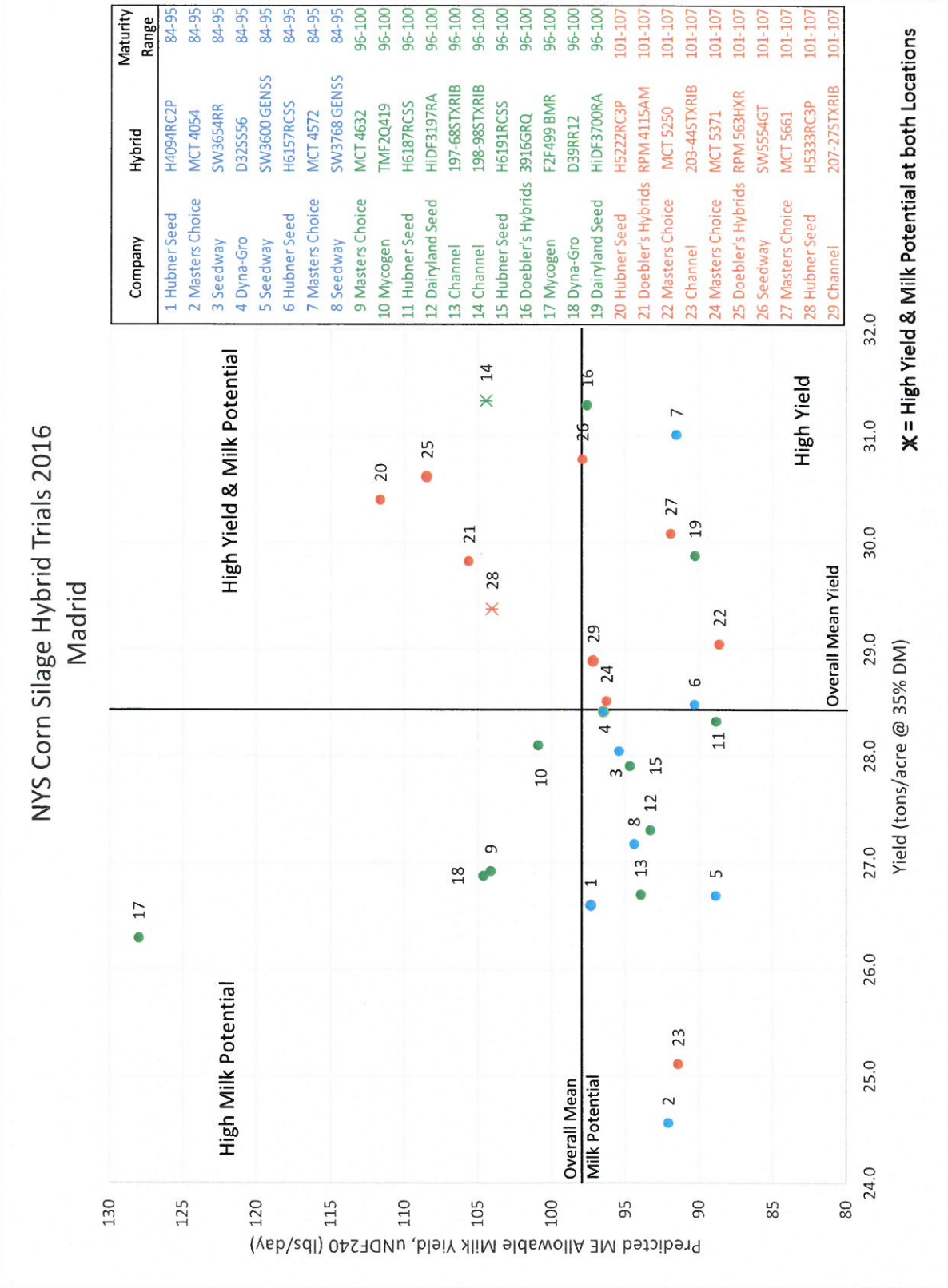


Figure 3. Relationship between Silage Yield and Milk Production Potential at Aurora, NY. Hybrids located in the top right quadrant were above the overall mean for crop yield and milk production potential and are considered good performers. Hybrids in the bottom left quadrant were below the mean for yield and milk production potential. Hybrids located in the top left quadrant were below the mean for yield and above the mean for milk production potential and hybrids located in the bottom right quadrant were above the mean for yield and below the mean for milk production potential. Hybrids that were above average for crop and milk yield at both locations are marked and noted in the legend.

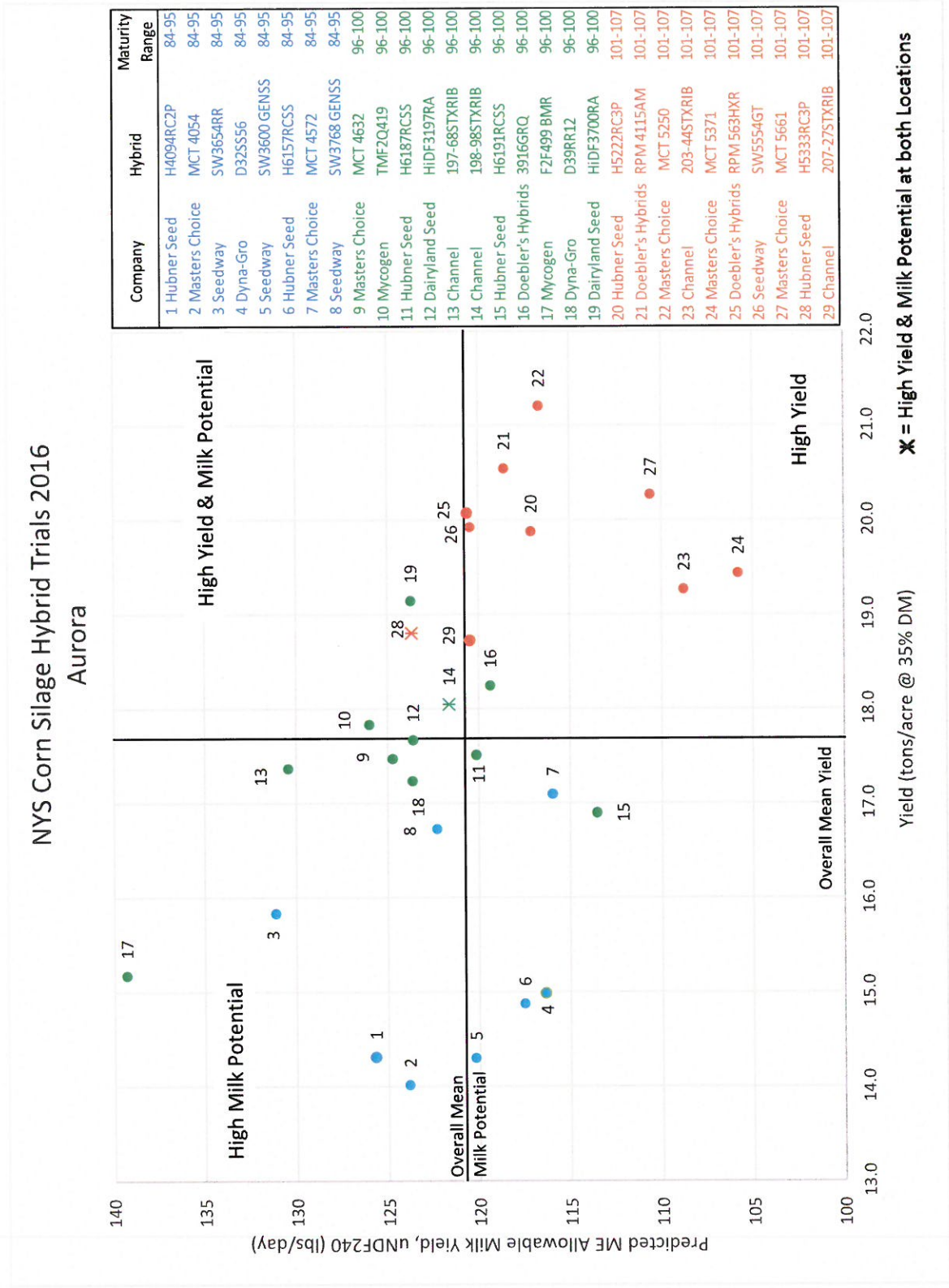


Table 4. Trait Descriptions

Trait Family Product	Bt protein(s)	Insects controlled or <i>suppressed</i> Above ground-----in soil	Herbicide tolerant	
Agrisure				
Agrisure 3010, 3010A	Cry1Ab	ECB SWCB CEW FAW SB	---	GT LL
Agrisure 3000 GT, 3011A	Cry1Ab, mCry3A	ECB SWCB CEW FAW SB	RW	GT LL
Agrisure Viptera 3110	Cry1Ab, Vip3A	BCW CEW ECB FAW SB SWCB TAW WBC	---	GT LL
Agrisure Viptera 3111	Cry1Ab, mCry3A, Vip3A	BCW CEW ECB FAW SB SWCB TAW WBC	RW	GT LL
Agrisure 3122 E-Z Refuge	Cry1Ab,Cry1F, mCry3A, Cry34/35Ab1	BCW ECB FAW SB SWCB WBC CEW	RW	GT
Agrisure Viptera 3220 E-Z Refuge	Cry1Ab, Cry1F, Vip3A	BCW CEW ECB FAW SB SWCB TAW WBC	---	GT
Agrisure Duracade 5122 E-Z Refuge	Cry1Ab, Cry1F, mCry3A, eCry3.1Ab	BCW ECB FAW SB SWCB WBC CEW	RW	GT
Agrisure Duracade 5222 E-Z Refuge	Cry1Ab, Cry1F, Vip3A, mCry3A, eCry3.1Ab	BCW CEW ECB FAW SB SWCB TAW WBC	RW	GT
Herculex				
Herculex 1 (HX1)	Cry1F	BCW ECB FAW SB SWCB WBC CEW	---	LL RR2 (most)
Herculex RW (HXRW)	Cry34/35Ab1	---	RW	
Herculex Xtra (HXX)	Cry1F, Cry34/35Ab1	BCW ECB FAW SB SWCB WBC CEW	RW	
Optimum				
Intrasect (YHR)	Cry1F, Cry1Ab	BCW ECB FAW SB SWCB WBC CEW	---	LL RR2
AcreMax (AM)	Cry1F, Cry1Ab	BCW ECB FAW SB SWCB WBC CEW	---	LL RR2
Intrasect Leptra (VYHR) AcreMax Leptra (AML)	Cry1F, Cry1Ab, Vip3A	BCW CEW ECB FAW SB SWCB TAW WBC	---	LL RR2
AcreMax RW (AMRW)	Cry34/35Ab1	---	RW	LL RR2
AcreMax1 (AM1)	Cry1F, Cry34/35Ab1	BCW ECB FAW SB SWCB WBC CEW	RW	LL RR2
TRIssect (CHR)	Cry1F, mCry3A	BCW ECB FAW SB SWCB WBC CEW	RW	LL RR2
Intrasect TRIssect (CYHR) AcreMax TRIssect (AMT)	Cry1F, Cry1Ab, mCry3A, Cry34/35Ab1	BCW ECB FAW SB SWCB WBC CEW	RW	LL RR2
Intrasect Xtra (YXR) AcreMax Xtra (AMX)	Cry1F, Cry1Ab, Cry34/35Ab1	BCW ECB FAW SB SWCB WBC CEW	RW	LL RR2
Intrasect Xtreme (CYXR) AcreMax Xtreme (AMXT)	Cry1F, Cry1Ab, mCry3A, Cry34/35Ab1	BCW ECB FAW SB SWCB WBC CEW	RW	LL RR2
Yieldgard/Genuity				
YieldGard CB (YGCB)	Cry1Ab	ECB SWCB CEW FAW SB	---	RR2
YieldGard VT Rootworm	Cry3Bb1	---	RW	RR2
YieldGard VT Triple	Cry1Ab, Cry3Bb1	ECB SWCB CEW FAW SB	RW	RR2
Genuity VT Double PRO or RIB complete	Cry1A.105, Cry2Ab2	CEW ECB FAW SB SWCB	---	RR2
Genuity VT Triple PRO or RIB complete	Cry1A.105, Cry2Ab2, Cry3Bb1	CEW ECB FAW SB SWCB	RW	RR2
Genuity SmartStax or RIB Complete	Cry1A.105, Cry2Ab2, Cry1F, Cry3Bb1, Cry34/35Ab1	BCW CEW ECB FAW SB SWCB WBC	RW	LL RR2
Others				
Powercore Powercore Refuge Advance	Cry1A.105 Cry2Ab2 Cry1F	BCW CEW ECB FAW SB SWCB WBC	---	LL RR2
Smartstax Startstax Refuge Advance	Cry1A.105, Cry2Ab2, Cry1F, Cry3Bb1, Cry34/35Ab1	BCW CEW ECB FAW SB SWCB WBC	RW	LL RR2
BCW = black cutworm	SB = stalk borer	GT = glyphosate tolerant		
CEW = corn earworm	SWCB = southern corn borer	LL = Liberty Link, glufosinate tolerant		
ECB = European corn borer	TAW = true armyworm	RR2 = Roundup Ready 2, glyphosate tolerant		
FAW = fall armyworm	WBC = western bean cutworm			
RW = corn rootworm				

Source: Handy Bt Trait Table, Michigan St University

<http://www.msuent.com/assets/pdf/28BtTraitTable2016.pdf>

