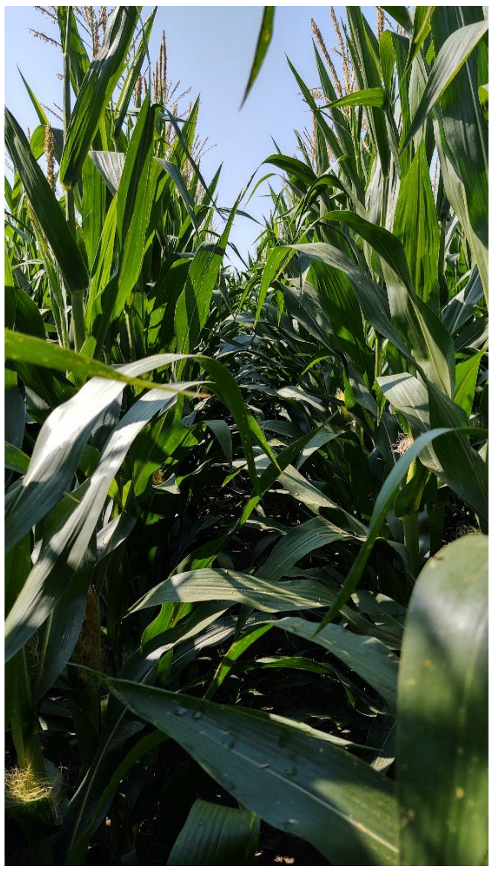
Proceedings of the
74th Northeastern Corn Improvement Conference
(NECC-29)



February 23-24, 2023
Shisler Ballroom,
The Ohio State University
Wooster, OH

74th Northeastern Corn Improvement Conference (NECC-29)
23-24 February, 2023
Shisler Ballroom
The Ohio State University, Wooster, Ohio

Thursday, 23 February

9:00-9:30 Registration (coffee and light breakfast items provided)

9:30-9:45 Introductions and Welcome

Dr. Alex Lindsey, 2023 NECIC Host, Department of Horticulture and Crop Science, The Ohio State University

Dr. Margaret Smith, NIMSS NECC-29 USDA Liaison, Cornell University

9:45-10:00 Break, speaker presentation loading

Session 1: Plant Disease and Management

10:00-10:10 Effect on yield of sugarcane mosaic virus. *M. Jones**

10:10-10:20 Quantifying corn physiological consequences due to Tar Spot Disease to inform management decisions. *H. Kaur**

10:20-10:30 Multi-state assessment of corn response to input-intensive management. *D. Quinn**

10:30-10:45 Q&A for First Speaker Set

10:45-11:00 Break

Session 2: Crop Stress and Quality

11:00-11:15 Dr. Andy Michel, Associate Dean and Director – Wooster Campus, College of Food, Agricultural, and Environmental Science

11:15-11:25 Assessing various N sources and water excess on corn growth and yield. *W. Novais**

11:25-11:35 Using aerial imagery to quantify root lodging damage in corn. *A. Lindsey**

11:35-11:45 Organic matter digestibility index (OMDI) for evaluation of corn silage quality for dairy cows. *S. Welchez**

11:45-12:00 Q&A for Second Speaker Set

12:00-1:15 Lunch

Session 3: Current Hybrid Characteristics and Future

1:15-1:25 Planting time and hybrid maturity selection considerations for optimizing yield and dry down. *B. Agyei**

1:25-1:35 Managing today's corn hybrids *E. Nafziger**

1:35-1:45 Product pipeline for Corteva Agriscience. *J. Schmoll**

1:45-2:00 Q&A for Third Speaker Set

2:00-2:15 Break

Session 4: Future of Corn Research and NECC-29 Program

2:15-4:45 Patterns, emerging areas of concern, novel lines of inquiry
Reassessment of past work
History of NIMSS NECC-29 and Future (Current Duration through 9/30/2023)

Moderators: *Margaret Smith, Alex Lindsey and Osler Ortez*

4:45 Adjourn, dinner on own

Friday, 24 February

8:30-9:00 Light breakfast

Session 5: State Reports and Planning Session

9:00-10:15 State Reports from 2022 season (10-15 min/state)-OH, PA, MI, IN, IL, MO, NY

10:15-11:00 Planning Session for Future Meetings

11:00 Adjourn & Boxed Lunch to Go

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Potyvirus resistance in commercial corn germplasm: vulnerability and yield penalties

M.W. Jones, C. Nacci, and E.W. Ohlson*
United States Department of Agriculture – Agricultural Research Service, Corn Soybean Wheat Quality Research Unit, Wooster, OH

A major focus of the USDA-ARS Corn and Soybean Virus Lab is understanding the genetics and mechanisms of virus disease resistance. In its early years, the research group conducted evaluations of commercial hybrids for yield and resistance to maize dwarf mosaic (MDMV) and maize chlorotic dwarf (MCDV) under natural infection conditions using a site infested with Johnsongrass, the primary overwinter host of MDMV, at Portsmouth, Ohio. Recent field surveys have found high incidence of MDMV in sweetcorn fields in Southern Ohio but not in fields of hybrid field corn. This research examines current commercial field corn hybrids for resistance to two of the most common maize viruses worldwide, MDMV and sugarcane mosaic virus (SCMV), and their effects on yield.

MDMV and SCMV are vectored by multiple species of aphids and can also be mechanically transmitted. The use of a motorized mist blower and the production of large volumes of infective plant sap enable large scale field inoculations to be conducted, thus facilitating accurate comparisons of different viruses and of inoculated and uninoculated treatments in locations without natural infection. In our experiments, resistance was quantified by scoring visual mosaic symptoms on individual plants and calculating the percentage of symptomatic plants on a plot basis. Initial experiments used 30 commercial hybrids inoculated with MDMV or SCMV. Subsequent experiments looked at the effect of virus infection on yield.

In 2014 only one hybrid was susceptible to MDMV. Twenty-nine of thirty hybrids were susceptible to SCMV with an average SCMV infection rate of 47% and a range of 0 – 87%. The same hybrids were tested in 2015 and resulted in one hybrid susceptible to MDMV and 28/30 susceptible to SCMV with a mean infection rate of 61% and range of 0 - 92%. In 2016, one hybrid was infected with MDMV, and all were infected with SCMV. SCMV infection averaged 76% and ranged from 30 - 94%. A different set of 48 hybrids was used for the trials in 2017, 2020, and 2021 and the inoculations with MDMV were eliminated in 2020 and 2021. Mean SCMV infection percentages for all entries were 77%, 75%, and 60% for the three years respectively. Mean yield penalties (mock inoculated yield minus SCMV inoculated yield) were 23 bu/ac (11%), 19 bu/ac (9%), and 25 bu/ac (10%) respectively.

Potyvirus resistance in maize is controlled by three genes located on chromosomes 6, 3, and 10. Near isogenic lines (NILs) developed from the resistant inbred line Pa405 as the donor and the susceptible inbred line Oh28 as the recurrent parent have been used to study interactions between resistance loci and MDMV and SCMV. NILs for *Wsm1* on chromosome 6 are resistant to MDMV but susceptible to SCMV. NILs for *Wsm2* (chm3) and *Wsm3* (chm10) are ineffective in controlling both MDMV and SCMV. Combinations of *Wsm1* and either *Wsm2* or *Wsm3* confer resistance to both MDMV and SCMV. The susceptibility of hybrids to SCMV, but not MDMV, suggest that most commercial hybrids have *Wsm1* but lack the *Wsm1/Wsm2* or *Wsm1/Wsm3* combinations. Introgressing *Wsm2* or *Wsm3* into commercial corn hybrids in combination with *Wsm1* would be an effective management strategy for reducing yield impacts associated with SCMV infection.

Quantifying physiological impact of foliar stresses in corn

H. Kaur, E. Holm, and M.P. Singh*
Department of Plant, Soil, and Microbial Sciences, Michigan State University, East Lansing, MI

Tar spot (caused by *Phyllachora maydis)* is a fungal disease of corn that has recently become a threat in Michigan and the North Central Region and has led to high yield losses. Therefore, it is crucial to understand how this pathogen interacts with corn plant in order to minimize such losses and identify optimal management strategies. As an obligate biotroph, *P. maydis* requires plant metabolites (such as carbohydrates produced in photosynthesis) as a food source to grow and reproduce. Under high disease pressure the pathogen will put a strong demand on plant resources, and hence impact the plant strength and grain yield. This along with leaf lesions (both visual and virtual) reduce healthy leaf surface area for photosynthesis and carbohydrate production and will eventually reduce yield. Therefore, understanding physiological response of hybrids with differing levels of resistance to this pathogen is critical in preventing the negative influence of disease on corn growth and productivity. Also, since timing of management options is extremely critical for this disease, it is important to develop and understand the time series between tar spot disease progression and leaf physiological health. Thus, this study was conducted to understand the differential physiological impact of tar spot in susceptible or resistant corn hybrids for photosynthetic productivity and metabolic changes to help determine the necessity and timing of management strategies, eventually leading to novel tar spot management strategies.

Field trials were conducted in a randomized complete block design with 4 replications at two Michigan locations (Ingham and Ottawa) in 2022. Treatments included three hybrids differing in their resistant levels to tar spot (resistant, tolerant, and susceptible) and three fungicide treatments: 1) non-treated, 2) one fungicide application at the silking stage (R1), and 3) two applications of fungicide [one at R1 and one at dough stage (R3)] using Delaro 325 SC at label rate of 8oz acre^{-1}. Following R1, the trials were scouted for tar spot. Photosynthetic measurements were conducted weekly using LI-6400 starting the first week of August. Trials were harvested at physiological maturity using Kincaid 8-XP plot combine and data on yield and test weight were collected. Data was analyzed using proc reg and proc nlin in SAS 9.4.

Overall, tar spot severity was low (<20%) in 2022 and observed only at Ottawa. Irrespective of the disease, photosynthetic rate decreased linearly with the age of plant for all three hybrids and the rate of decline was not significantly different among hybrids. Photosynthetic rate showed a decline when disease was present in all hybrids. Maximum disease severity observed was lower in resistant hybrids as compared to tolerant and susceptible hybrids. Also, disease severities were lower in plots with two fungicide applications than in plots with just one application or non-treated control plots. Decline in photosynthetic rate with a unit increase in disease severity (as indicated by β values obtained from the non-linear model) was higher in resistant hybrid ($\beta = 2.26$) than in susceptible ($\beta = 1.61$) and tolerant ($\beta = 1.74$) hybrids. These data suggest that although resistant hybrid has lower disease severities, the cost of resistance is paid by a higher overall loss in photosynthetic rate for a given disease level. Lower disease severities but higher β values for resistant hybrid indicate that incorporation of resistant traits to fight the infections may come at an additional cost, and might not impact overall carbon assimilation compared to other hybrids. No difference in yield was associated with tar spot, as expected due to low disease severity and late occurrence.

A simulated study was also conducted in Ingham, MI to understand the impact of loss in green leaf area at various reproductive stages due to various biotic or abiotic stresses. Data showed that the lowest yield was observed when ear leaf and the leaves below the ear leaf were lost earlier in the season around silking (yield was 16% less than healthy plants), indicating that it is important to preserve leaf area early on to retain high yield potential. The reduction in yield was comparatively less when the leaf loss occurred at later stages (silking+20 days and silking+40 days) indicating that delayed management may not be as profitable and might increase overall cost of operation. More data are needed to identify thresholds for fungicide timing and stress levels.

Overall, preliminary results from this study showed that foliar diseases (such as tar spot) result in reduction of photosynthetic capacity of the plant due to loss of green leaf area which can ultimately decrease the overall yield. The yield decline is higher if the loss in photosynthetic area occurs earlier in the growing season. Use of resistance hybrids can prevent occurrence of higher disease severities; however, it may come at a cost of higher decline in overall carbon assimilation rate compared to tolerant hybrids at the same disease severity.

Multi-state assessment of corn response to input-intensive management

D.J. Quinn and M. Bartaburu*
Department of Agronomy, Purdue University, West Lafayette, IN

Introduction

With recent increases in corn grain prices, weather variability, nutrient deficiencies and losses, emerging diseases, and overall declines in yearly percent yield gains, many farmers have been driven toward using different tactics and technologies to improve corn production. One popular strategy by farmers to maintain yield potential and optimize production is through combinations of higher seeding rates, additional macro and micronutrient fertilizer, and fungicide use. However, some of these management decisions can often be expensive, unnecessary, and may increase the potential for biological resistance and nutrient losses when used improperly. In 2022, the Corn Agronomy Program at Purdue University established a state-wide research trial to evaluate corn physiological, yield, and economic responses to single and combinations of different management intensities and commonly marketed inputs. In addition, with recent claims of improved "stay-green" and plant health benefits from various intensive practices and fungicide applications, we wanted to understand how these practices and/or products can impact late-season grain fill duration, kernel number, and kernel weight accumulation in corn. The research trials encompassed both small-plot and field-scale research trials spanning from southern, central, and northern Indiana. In addition, two out-of-state locations were included from Michigan and Kentucky in collaboration with Michigan State University and the University of Kentucky. The goals of this research were to 1) evaluate corn physiological, yield, and economic response to management practices and applied inputs alone and in combination across multiple locations and 2) determine the impact of combined intensive practices and corn fungicide applications on grain fill duration, kernel number, and kernel weight accumulation.

Materials and Methods

The experiment was first established in May 2022, in five locations (six total fields) throughout Indiana, Michigan, and Kentucky. The locations included: West Lafayette, IN (ACRE), Butlerville, IN (SEPAC, 2 fields), Columbia City, IN (NEPAC), East Lansing, MI, and Lexington, KY. Three out of the six research fields were field-scale trials with plots that measured 30 feet wide (12, 30-inch rows) and ran the entire length of the field (500 – 1,000+ feet long). The center 6-8 rows of each of these plots were harvested with a commercial combine and a calibrated yield monitor to determine treatment differences. A small-plot trial was established at ACRE, East Lansing, and Lexington for more intensive plant and corn kernel development measurements. At each location we incorporated eight total treatments described below:

1. Control treatment (C) based on Purdue University seed rate and nitrogen (N) fertilizer recommendations (Camberato et al., 2022; Nielsen et al., 2022): 30K seeds per acre and N

fertilizer application as starter (2x2) and V5 growth stage sidedress. Total N rates ranged between 180 and 200 lbs N per acre and agronomic optimum nitrogen rates (AONR) were used.
2. C + sub-surface banded starter (2x2) fungicide (Flutriafol; Xyway LFR)
3. C + 20% increase in corn seeding rate (36K seeds per acre)
4. C + sulfur fertilizer (5.2 gallons per acre as ammonium thiosulfate (ATS) at V5 sidedress)
5. C + foliar micronutrients (zinc, manganese, and boron applied at the V6 growth stage)
6. C + late-season N application (starter N (2x2) + V5 sidedress N (60% remaining N rate) + V10-12 growth stage sidedress N surface-banded with drop tubes on a sprayer (40% remaining N rate), total N rate remained the same as other treatments).
7. C + foliar fungicide applied at the R1 growth stage (Prothioconazole, Trifloxystrobin, Fluopyram; Delaro Complete)
8. Intensive treatment: all additional inputs and management practices applied together.

Preliminary Results and Discussion

The 2022 research yield and profitability results from Indiana are presented in Table 1 and include the average treatment cost per acre, grain yield average, and net profit average. Preliminary yield results from Indiana showed the intensive management treatment out yielded the control at 3 of 5 locations by an average of 16 bushels (bu) per acre (Table 1 and 3). In addition, despite the added cost, the intensive treatments increased net profit compared to the control treatment at 2 of 5 locations, yet also decreased net profit compared to the control at 2 of 5 locations. The inputs with the largest yield responses at all three locations included sulfur (+9 bu at 2 of 5 locations), starter fungicide (+6 bu at 1 of 5 locations), V10 nitrogen application (+16 bu at 2 of 5 locations), and R1 fungicide (+17 bu at 3 of 5 locations). All three research locations exhibited visual foliar disease (e.g., tar spot, gray leaf spot, northern corn leaf blight) which was significantly reduced by both the starter fungicide (Xyway LFR) and the R1 fungicide application (Delaro Complete), likely driving the observed yield responses. In addition, late-season N application responses were likely due to increased plant N uptake and N use efficiency due to more timely rainfall following the V10-12 N application as compared to observed June drought conditions driving visual N deficiency symptoms and limited plant uptake following the V5 sidedress N only. This response is further explained by the Lexington, KY location which was irrigated and did not observe a response to the V10-12 N application applied alone and within the intensive treatment. Visual sulfur fertilizer responses and sulfur deficiency symptoms were also observed at three of five locations. Furthermore, the intensive treatment which contained all applied inputs exhibited greater plant health and stay-green potential at the R6 growth stage as compared to the control treatment.

In addition to the observed yield and economic results, starter fungicide (Xyway LFR) and R1 fungicide (Delaro Complete) increased overall kernel number in 2 of 3 and 3 of 3 Indiana locations, respectively. In addition, the R1 fungicide increased harvest kernel dry weight at 1 of 3 Indiana locations. When examining grain fill duration and maximum kernel dry weight achieved during the grain fill period, starter fungicide, R1 fungicide, and the intensive treatments (starter + R1 fungicide) increased grain fill duration by 4, 5, and 4 days, respectively when compared to the control. Furthermore, starter fungicide, R1 fungicide, and the intensive treatments increased maximum dry kernel weight achieved by 5, 5, and 10%, respectively. Preliminary data suggests through improved disease control and improved stay-green potential, the application of a starter fungicide application and/or an R1 fungicide application have the ability to extend grain fill duration, increase kernel number, increase maximum kernel weight achieved, and increase harvest kernel dry weight.

Overall, the preliminary results from this research study highlight the potential for additional inputs and intensive management practices to improve corn yield and profitability when conditions are conducive for responses (e.g., foliar disease, nutrient deficiencies). In addition, soil and tissue test results are still currently being analyzed to help further understand the observed results.

Table 1. Research trial average treatment costs, observed corn grain yields, and calculated net profits across three locations in Indiana, 2022. Green highlighted numbers indicate a statistical increase from the control, red highlighted numbers indicate a statistical decrease from the control.

Location	Treatment	Treatment Cost†	Grain Yield	Net Profit†
		$ per acre	Bu per acre	$ per acre
Columbia City, IN (NEPAC)	Control	253.40	222.1 d*	1226.15 b
Field L6	C + 2x2 Fungicide	274.33	228.1 bcd	1244.99 b
	C + 36K seed rate	272.72	230.3 bcd	1260.83 ab
	C + Sulfur	270.65	**233.5 b**	1284.52 ab
	C + Foliar Micro	274.14	231.3 bcd	1266.36 ab
	C + V10 N	261.06	222.9 d	1223.59 b
	C + R1 Fungicide	277.89	**231.9 bc**	1266.75 ab
	Intensive	356.12	**249.2 a**	**1303.73 a**
West Lafayette, IN (ACRE)	Control	253.40	206.1 c	1119.34 bc
Field 10c	C + 2x2 Fungicide	274.33	206.3 c	1099.40 c
	C + 36K seed rate	272.72	213.2 bc	1146.90 bc
	C + Sulfur	270.65	210.1 c	1128.24 bc
	C + Foliar Micro	274.14	213.9 bc	1150.16 abc
	C + V10 N	261.06	**232.4 ab**	**1286.65 a**
	C + R1 Fungicide	277.89	**226.5 ab**	**1230.83 a**
	Intensive	356.12	**243.3 a**	**1264.51 a**
Butlerville, IN (SEPAC)§	Control	253.40	261.4 d	1487.82 bc
Field C5 and D9	C + 2x2 Fungicide	274.33	**267.9 ab**	1509.63 abc
	C + 36K seed rate	272.72	261.6 d	1469.83 de
	C + Sulfur	270.65	**266.5 bc**	1504.12 abcd
	C + Foliar Micro	274.14	263.1 cd	1478.01 cde
	C + V10 N	261.06	**267.5 ab**	1520.36 ab
	C + R1 Fungicide	277.89	**271.3 a**	**1528.70 a**
	Intensive	356.12	**270.9 a**	**1448.25 e**

* Average corn grain yield and net profit values that contain the same corresponding letter and are within the same location are not statistically different from each other ($P > 0.1$).

† Treatment costs were calculated as the combined cost of corn seed, fertilizer cost, chemical input cost, and application cost. Prices were calculated as an average from various local retailers. Net profit was calculated based on average harvest corn grain cash price ($6.66) + average grain yield – treatment costs.

§ The research trial in Butlerville, IN was performed in two separate fields, yield data was combined from those two fields due to similar responses at that location.

References:

Nielsen, R.L., D. Quinn, and J. Camberato. 2022. Optimum Plant Populations for Corn in Indiana. Corny News Network. Purdue Univ. Ext. https://www.agry.purdue.edu/ext/corn/news/timeless/PlantPopulations.html

Camberato, J., R.L. Nielsen, and D. Quinn. 2022. Nitrogen Management Guidelines for Corn in Indiana. Applied Research Update. Purdue Univ. Ext. https://www.agry.purdue.edu/ext/corn/news/timeless/nitrogenmgmt.pdf

Assessing various N sources and water excess on corn growth and yield

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Waterlogging is expected to increase in the Midwest during the cropping season, causing environmental nitrogen losses and corn yield penalties. Current N management does not consider N sources during waterlogging, so it is crucial to understand if N sources improve N uptake by plants and yield in areas prone to flooding. This research aimed to assess N sources and waterlogging on corn growth and yield. A split-plot randomized complete block design was implemented in Custar, Ohio, in 2021 and 2022. The whole-plot factor was waterlogging duration (WD): zero or four days. The subplot factor was N sources: a non-fertilized control, urea (46-0-0), urea or UAN (28-0-0) alone or combined with nitrapyrin or N-(n-butyl) thiophosphoric triamide (NBPT), polymer-coated urea (PCU, 44-0-0), and a biological source (manure + urea). Corn biomass was analyzed at pre- and post-waterlogging and yield was analyzed using a mixed model effects model. Biomass was higher in 2021 compared to 2022 at zero days across WD and N sources. For biomass at eight days of W, Synthetic, enhanced, and biological N sources performed similarly across WD in 2021 and 2022 (data not shown). Initial and final stand populations were higher in 2021 (74469 plants ha^{-1}) compared to (42021 plants ha^{-1}) across treatments (data not shown). Enhanced fertilizers did not improve yield under waterlogging conditions compared to untreated urea or UAN. Still, the yield was higher than the biological or no N source (Fig. 1 and Fig. 2). There is a reduction in yield comparing the two years, which can be attributed to the lower stand in 2022. The results indicate that EEF did not increase yield and the biological source is the most affected by waterlogging.

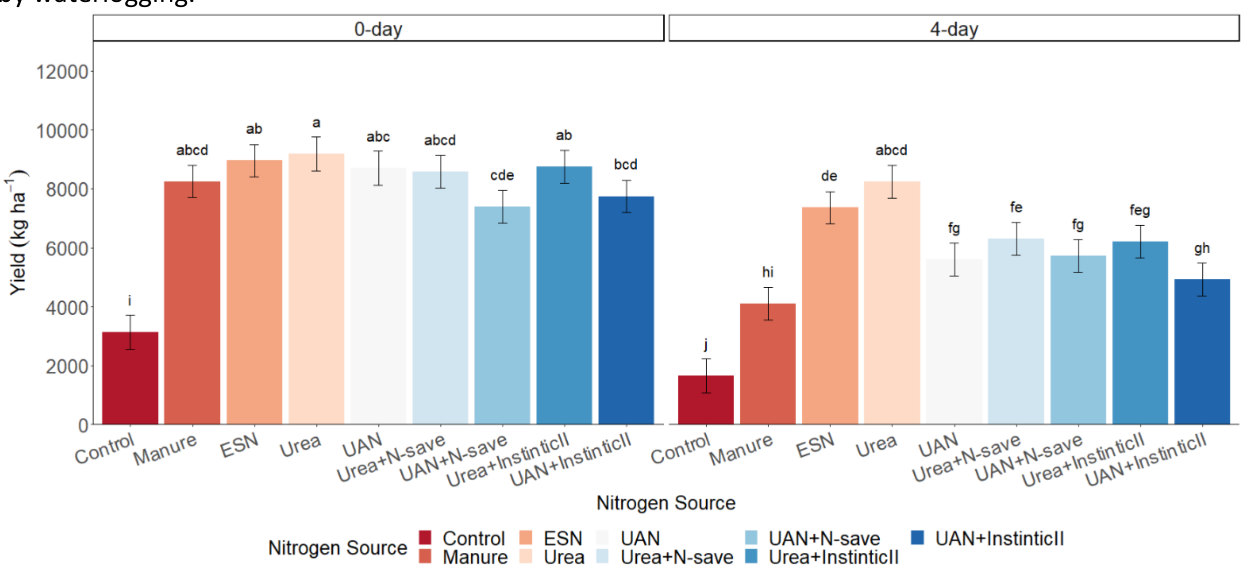

Figure 1. Interaction of N sources and waterlogging duration for yield in kg ha^{-1} across years. Different letters are significant at $p<0.05$.

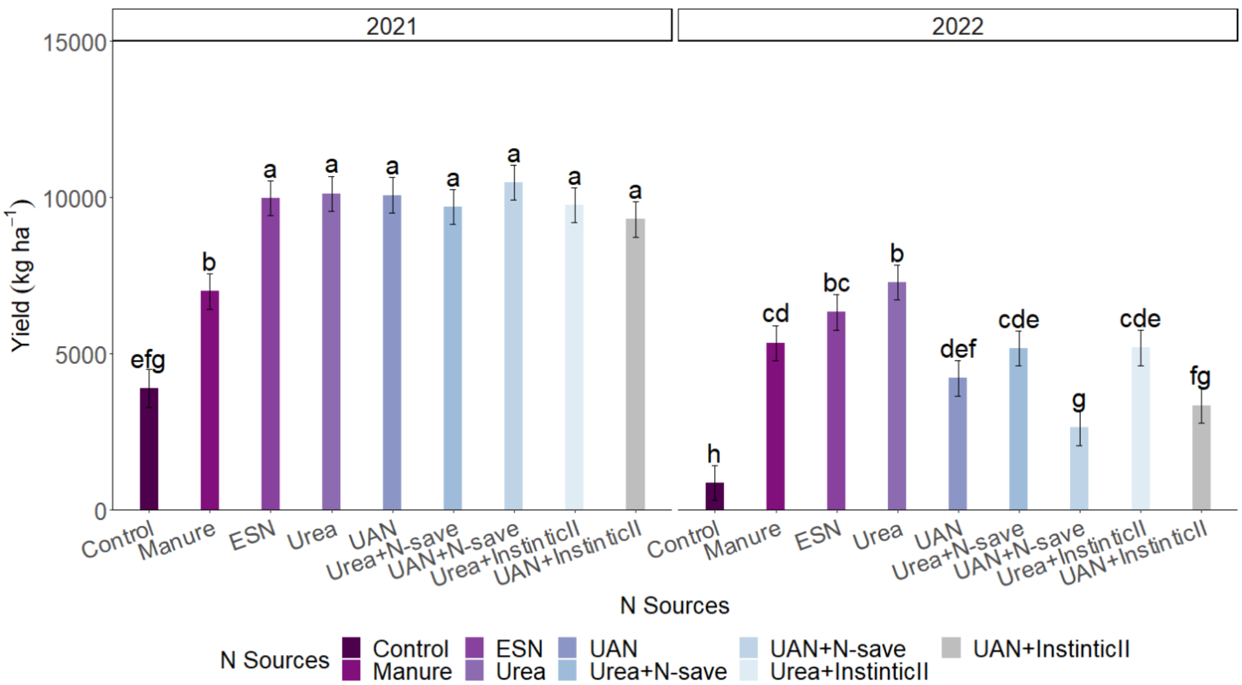

Figure 2. Interaction of N sources and years for yield in kg ha^{-1} across waterlogging duration. Different letters are significant at $p<0.05$.

Using aerial imagery to quantify root lodging damage in corn

A.J. Lindsey[1], B. Allred[2], L.R. Martinez[2], P.R. Thomison[1], and G. Rouse[3]*
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Root lodging can cause substantial yield losses in corn, especially if incurred during the pollination or grain fill growth stages. Accurate quantification of lodging is important to determine potential yield losses, issues with grain quality, and provide insight into potential management options to address the lodged field. Aside from traditional scouting, use of uncrewed aerial vehicles (UAVs) may provide an option for rapid assessment of damaged fields. The data contained in imagery from these fields could be used to correlate to crop condition, height, yield, and potentially grain quality. However, it is important to assess multiple indices to determine if one type or wavelength reflectance is superior to others.

In 2018 and 2019, a field trial containing three hybrids was lodged at four different growth stages (V10, V13-14, VT/R1, and R3). At the R4 growth stage, the field was flown using a UAV to collect imagery data. Data from flights were stitched to produce elevation maps from which Digital Surface Models (DSM) data were generated to quantify canopy height. Other indices of NDVI and NDRE were calculated using reflectance of the Red and Far Red wavebands in conjunction with the Near Infrared band reflectance. Approximately 15 points were extracted from the imagery data and averaged for comparison to ground-truth data of plant height, vertical height recovery (percent of plants exhibiting upright growth), yield, and grain quality parameters.

The height data from DSM data was well correlated to actual measured height, though was consistently lower than measured height. This may have been due to actual height being quantified on the uppermost collared leaf, though the area of that leaf was usually small (less than 15 cm^2) (Figure 1). Correlations between NDVI and NDRE with measured plant height and recovery were strong (r>.67), though correlations to yield and kernel weight were lower (r = .51-.56). Both vegetative indices were negatively correlated with vivipary (r=.71-.73).

In conclusion, aerial imagery was a good predictor of post-lodging height. In general, NDVI was a slightly better predictor of crop metrics than NDRE, though both were still strong. Future work should look to replicate this practice in naturally-occurring conditions, as well as with other iterations of wind damage to ensure its applicability in the field moving forward.

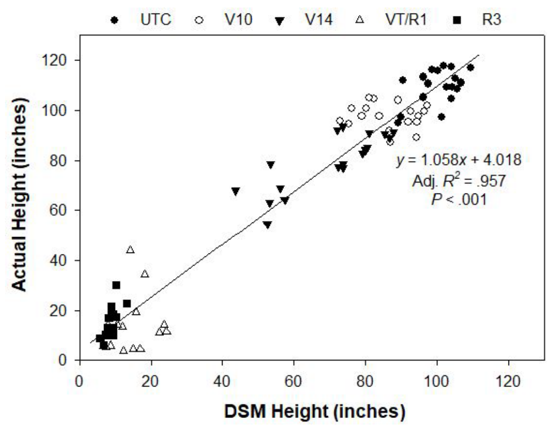

Figure 1. Height from Digital Surface Model (DSM) file plotted against actual measured plant height. Image used with permission.

Lactational performance of dairy cows fed diets based on corn silage with varying organic matter digestibility

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Penn State's Organic Matter Digestibility Index (OMDI) is a quality measure for corn silage (CS) based on laboratory analyses of rumen degradability of its major nutrients. An experiment was conducted to evaluate the effects of diets formulated using CS varying in OMDI on the productive performance and enteric gas emissions of dairy cows. Following a 2-wk covariate period, 48 Holstein cows averaging (± SD): 129 ± 53 days-in-milk (DIM), and 44 ± 7 kg/d milk yield (MY) were assigned to 1 of 4 treatments in a 10-week randomized complete block design experiment. Cows were blocked based on lactation number, DIM and MY. Treatments were diets based on CS included at 50% of diet dry matter (DM); inclusion rate of all other feed ingredients was similar among diets. Corn silages A, B, C and D were, respectively, 44.3, 43.3, 44.1 and 44.9% DM and had (% of DM): neutral-detergent fiber, 32.9, 33.8, 31.9, and 29.5; starch, 38.7, 38.6, 39.7 and 41.2; and OMDI 59.0, 62.7, 65.6 and 60.6. Feed intake and milk production were recorded daily and milk samples for component analysis were collected every other week during the experimental period. Enteric CH_4 emission was measured using the GreenFeed system. Data were analyzed using the PROC MIXED of SAS and an orthogonal polynomial contrast to evaluate a linear effect of CS OMDI. Block and block × treatment were random effects. Treatment did not affect MY or energy-corrected MY (ECM). Dry matter intake (DMI) decreased numerically (P = 0.11) but feed efficiency tended to increase linearly (P = 0.08) with increasing CS OMDI. There was no effect of increasing CS OMDI on milk components concentration or yields. There was also no effect of increasing CS OMDI on bodyweight (BW) or BW change. Treatment did not affect daily CH_4 emission (338 g/d; SEM = 14.0) or emission yield (per kg DMI) and intensity (per kg MY or ECM yield). When CS makes up 50% of dietary dry matter, differences of 2.9 to 6.6% in its OMDI had no effect on MY, ECM, and enteric CH_4 emission, but feed efficiency tended to increase linearly with increasing CS OMDI.

Planting date and hybrid maturity selection considerations for optimizing corn yield and dry down

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Timely planting of corn is critical for maximizing grain yield in the northern Corn Belt. Early planting dates (late-April to mid-May) have mostly shown higher yield and gross returns than late planting dates (end-May or later). Kernel moisture dry down also occurs at a faster rate in early planted (around 0.8% day^{-1}) than late planted corn (around 0.4% day^{-1}) as it reaches maturity earlier (late-August) than late planted corn (mid- to late-September). Rising propane prices makes it extremely necessary for corn to dry down faster, achieve low harvest moisture, and reduce drying cost. The expansion in the growing season (due to first fall freeze occurring later and last spring freeze occurring earlier than normal) offers an opportunity to plant earlier in the growing season and use late-maturing hybrids. However, extreme spring precipitation often delays planting, resulting in extended planting window and may necessitate switch of hybrid maturities. It is therefore important to evaluate how effectively hybrid maturity can be matched based on planting dates in order to optimize yield, field dry down, and overall profitability.

Field trials were conducted in Lansing, MI during 2021 and 2022 to evaluate the impact of four planting dates (end-April to early-June) and five hybrid comparative relative maturities (CRM, 89 to 109 in 5 CRM increments) on corn growing degree unit (GDU) accumulation to physiological maturity, yield, moisture, test weight, and dry down. Dry down was estimated only for two planting dates (mid -May and end-May) and three hybrid CRM (89, 99, and 109). Growing degree unit accumulation (GDU) was estimated in degree Fahrenheit using the Baskerville-Emin method. Dry down was monitored three days per week (starting at physiological maturity) by pulling five ears from each plot and oven drying a sub-sample of kernels. Yield, moisture, and test weight was estimated at harvest using Kincaid 8-XP plot combine. Data was analyzed in R and involved fitting a response surface model for yield, moisture, and test weight and a linear plateau model for dry down.

All late planted hybrids reached maturity quicker than earlier planted hybrids, due to GDU compression. Growing degree unit compression averaged 5.6 GDU and 7.2 GDU per day delay in planting in 2021 and 2022, respectively. Rate of compression was greater in late- than early-maturity hybrids. Yield, moisture, and test weight response was consistent in both years with significant interaction between planting date and hybrid maturity. Under early planting (end-April), late-maturity hybrids (104-109 CRM) provided a significant yield gain compared to other hybrid maturities. Under late planting (end-May), use of late-maturity hybrids showed some yield advantage over early-maturity hybrids. Yield response to hybrid selection was neutral with mid-June planting, however kernel moisture was high (> 23%) among late maturity hybrids in 2021. Dry down rate was similar among hybrid maturities when planted at the same time but declined slightly with delayed planting. Daily dry down rate averaged 0.6 and 0.5% day^{-1} in 2021 and 0.8 and 0.7% day^{-1} for mid-May and end-May planting dates in 2022, respectively. Moisture plateaued around the same date across planting dates and hybrid maturities in both years, however, plateau moisture content was higher (~23%) in 2021 than 2022 (< 20%), probably due to frequent rainfall during dry down in 2021. Results showed that benefits from early-season planting can be enhanced by using late-maturity hybrids, while switching to an early-maturity hybrid can be delayed until end-May due to GDU compression. Overall, this research can help growers choose hybrid maturities that maximizes yield and profits.

Managing today's corn hybrids

*E.D. Nafziger**
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From 1999 through 2022, Illinois corn yield rose at the rate of 2.58 bushels per acre per year, to a trendline yield of 200 bushels per acre in 2022. Over that same time period, the average yield of the ten top-yielding hybrids in the highest-yielding University of Illinois hybrid trial in central Illinois increased by 2.87 bu/ac/year, to a trendline yield of 300 bu/acre in 2022. If we take the tep-ten yields as an indicator of yield potential, all of the statewide yield increase in recent years can be explained by the increase in genetic potential, and current statewide yields are about 100 bushels per acre less than current yield potential.

Hybrids: The increase in genetic yield potential has brought hybrids with faster growth rates—higher canopy photosynthetic rates—and faster growth of both tops and roots convey better ability to extract nutrients and water from the soil. Better root systems also mean improved stress tolerance, including from late planting and periods of dryness during the season, which may be connected. They have shorter anthesis-silking intervals (ASI), which has nearly eliminated the concern about asynchrony of pollen shed and silking, and kernel set has become much more consistent, even under dry conditions. Given the nature of these improvements, current hybrids may well respond less to high levels of management factors such as plant populations and soil nutrient concentrations.

The need for rapid early growth may, however, make hybrids today more sensitive to low soil temperatures or low soil nitrogen concentrations early in the season, and this may sometimes lower yield potential. Current hybrids may also have less foliar disease resistance than some older hybrids had. With the emphasis on high yield potential, which is necessary for high-volume hybrids, many popular hybrids may not be very well-suited to marginal soils or to poor growing conditions. Still, the ongoing rise in state yields indicates that overall, hybrids are doing well under a wide range of conditions.

Plant population: Over a set of 17 trials with several hybrids in each trial, we found that optimum yields—yields at the population where the last seed added just paid for itself in higher yield—ranged from about 30,000 to 40,000, with little effect of yield level on optimum population. Based on this, stands of 32,000 to 36,000 plants per acre are appropriate, with little to be gained from raising them to 40,000 or more. Because responses between 30 and 40 thousand are relatively flat, there is little penalty for having populations serval thousand higher or lower that the optimum.

Planting date: Data from 39 trials in Illinois show that yield begins to decline if planting is delayed past the first week of May, with yield loss approaching 10 percent of maximum with a delay to May 25 and a loss approaching 20% of maximum by about June 6. A few trials showed lower yields from very early planting—planting before April 10. A few individual trials, including one in 2022, showed no significant effect of planting date, with yield levels of about 270 bushels per acre from planting anytime between April 12 and May 31. That is not typical, but it may be that the usual causes of lower yield with late planting, such as mid-season dryness or late-season loss of canopy health, may affect current hybrids less that older hybrids.

Nitrogen: Over hundreds of N response trials in the past 15 years, we have found that high yields do not require high rates of N fertilizer. Over a set of 11 trials in 2022, about 175 lb of N pr acre produced yields averaging about 240 bushels per acre, when corn follows soybean in rotation. The rest of the N—an estimated 50% of the total N requirement in central Illinois with corn following corn—comes from mineralization of N from soil organic matter. It is difficult to predict hos much of this N a soil will provide in a given field in a given year, but it is enough to assure that not all of the N nee sot come from fertilizer.

Summary: The idea that "high yields require a lot of inputs"—that "intensive" (expensive) management usually pays, is not supported by recent studies in productive soils. We attribute much of this to genetic improvements in hybrids, that we believe has also brought improved resilience, and greater ability to access soil resources (water, nutrients) to produce high yields. The improvement of genetics has stabilized the "G x E x M" (genetics x environment x management) interaction; this has stabilized yields at high levels, and with appropriately modest input levels.

Product pipeline for Corteva Agriscience

J. Schmoll.*

Corteva Agriscience.

Below are press release information related to the information presented at the 2023 meeting:
Media Center | Corteva Agriscience (Main press release website).
Corteva Agriscience Announces Commercial Launch of Vorceed™ Enlist® Corn Products
Corteva Agriscience Announces Plant Breeding Innovation to Combat Corn Disease

Business Meeting and State Reports

Presenters: Jim Breining, Daniela Carrijo, Harkirat Kaur, Benjamin Agyei, Kelly Nelson, Margaret Smith, Osler Ortez, Alex Lindsey, Emerson Nafziger, and Daniel Quinn.

Alex Lindsey called the meeting to order at 9:00AM on Feb. 24. Alex Lindsey asked for reports from the Industry and University Representatives, and can be found below the notes from the business meeting.

Discussion of the 75th annual meeting host and location was discussed, with Daniel Quinn volunteering to host in West Lafayette, IN. Discussions from previous day's visioning sessions with all attendees included editing current NECC-29 objectives in preparation for the renewal submission of the program. Proposed a name change to "Corn Improvement Conference" to reflect sole status as remaining project group and reflect current members.

Business meeting was adjourned at 11:00AM.

Respectfully submitted,

Alex Lindsey, The Ohio State University

2022 Michigan State Corn Report

M. P. Singh and M. M. Blohm

Combination of cooler and wetter than normal weather led to significant challenges and delays in early-season field work and plantings across the state. However, extended period of sunny, warm, and rain-free weather in early-May allowed drying of topsoil and rapid progress of fieldwork and planting. By end-May, planting totals were at or ahead of long-term averages. A combination of high evapotranspiration demand and lack of rainfall in July to mid-July led to appearance of water stress symptoms. By end-June, lot of area in state was under 'abnormally dry' as categorized by the US Drought Monitor and some regions were categorized in "moderate drought" by mid-July. A widespread rainfall on July 24 brought relief to some areas in the state, however relative dryness when corn was entering pollination stage probably impacted yield potentials across most regions. Rainfall returned in mid-August again and helped minimize water stress across state. Most days in late-September and October had mild temperatures and were relatively dry, and helped with good field dry down and harvest operations.

Michigan's average corn yield was 168 bushels per acre in 2022, down 6 bushels from 2021 (USDA NASS). A total of 336 million bushels of corn were produced in 2022 from 2.00 million acres harvested, compared to 346 million bushels and 1.99 million acres in 2021.

In 2022, Michigan Corn Performance Trials (MCPT) evaluated 204 corn hybrids representing 15 commercial brands. These hybrids generated 230 entries, resulting in 2,760 plots at 12 grain trial locations and 9 silage trial locations across the State of Michigan. Corn Grain Trials were comprised of 152 entries. Corn Silage trials realized a total of 78 entries, with one of the silage locations conducted in Wood County (Ohio) in conjunction with The Ohio State University. The conventional grain trials were comprised of 20 entries.

Michigan corn grain trial locations are divided into 4 zones based upon historical growing degree days. Three sets of trials are planted across each zone. Hybrids are grouped into early and late maturities within the zone based upon the relative maturity. Relative maturities for each hybrid are supplied by the participating seed companies. Table 1 provides the zonal averages for percent moisture, bushels per acre, test weight, percent lodging and percent stand.

Similarly, the corn silage locations are divided into three zones with zones 2 and 3 combined into one trial. Again, the hybrids are grouped into early and late maturities within each zone based upon provided relative maturities. Table 2 summarizes the zonal averages for percent dry matter, green tons per acre, dry tons per acre and percent stand.

Confidence in corn performance data increases as the number of testing locations increases. One-year single-site results are less reliable than multiple year and multiple location averaged and should be interpreted with caution. Look for consistencies in hybrid performances across a range of environmental conditions when selecting a hybrid for production. Complete results of the 2022 Michigan Corn Performance Trials including MSUE bulletin E-431 can be found online at: https://varietytrials.msu.edu/.

Table 1. Zonal summaries for Early (E) and Late (L) Grain Trials in the 2022 Michigan Corn Performance Trials. Each data point represents 12 replications (3 locations per zone, 4 reps per location).

Zone	Entries	% Moisture	Bu/A	Test Weight	% Lodging	% Stand
Zone 1 E	21	18.0	218.7	54.6	0	95
Zone 1 L	29	19.9	229.2	53.7	0	96
Zone 2 E	36	16.3	197.8	55.3	0	97
Zone 2 L	24	17.4	205.2	54.0	0	97
Zone 3 E	32	21.6	173.3	50.6	0	88
Zone 3 L	26	23.8	171.2	49.3	0	96
Zone 4 E	8	19.3	155.4	53.4	0	94
Zone 4 L	11	20.8	162.2	52.3	6	95
Conv. E	10	17.4	189.1	53.5	0	96
Conv. L	10	17.9	210.5	55.4	0	98

Table 2. Zonal summaries for Early (E) and Late (L) Silage Trials in the 2022 Michigan Corn Performance Trials. Each data point represents 12 replications (3 locations per zone, 4 reps per location).

Zone	Entries	% Dry Matter	Green Tons/A	Dry Tons/A	% Stand
Zone 1 E	20	36.9	25.4	9.3	96
Zone 1 L	17	36.3	26.1	9.3	96
Zone 2/3 E	21	40.7	20.4	8.3	98
Zone 2/3 L	23	40.0	20.8	8.3	97
Zone 4 E	10	34.2	22.8	7.6	94
Zone 4 L	9	32.0	24.7	7.8	95

Ohio State Report – 2022

Osler Ortez and Rich Minyo

Growing conditions in 2022 were favorable for some areas but not across the state. One of the main challenges was a delayed start to the planting season. By May 8, only 5% of corn was planted in Ohio, according to USDA reports. By May 29, 72% of Ohio's corn was planted and 28% had yet to be planted. Some conditions that favored these delays included wet soil (surplus moisture and standing water in many areas) and below-average temperatures (April and early May). Heavy rains after planting led to high variability of results in three out of the 10 hybrid performance test sites (South Charleston in the Southwest, Hoytville in the Northwest, and Bucyrus in the North Central region), these results are not presented.

Rainfall in the 2022 growing season was variable across sites; it ranged from 13.3 inches (Columbiana in the Northeast) to 26.9 inches (Hebron in the Southwest). Heat-unit accumulation was generally greater at Ohio Corn Performance Test (OCPT) sites in the Southwestern/West Central/Central and Northwestern regions (with heat-unit accumulation ranging from 2,734 to 2,968 growing degree days or GDDs) than at sites in the North Central/Northeastern region (2,504 and 2,707 GDDs). Overall, the heat-unit accumulation was lower in 2022, relative to 2021 results. Foliar diseases, primarily gray leaf spot and northern corn leaf blight (NCLB), were present at nearly all sites, although fungicide was applied anywhere between VT/R1 and early brown silk (R2). Ear rots, primarily Gibberella (GER) and/or Diplodia, were present at most sites. The severity of the disease pressure was variable by location and hybrid differences were observed. Additionally, tar spot was observed late in the season (R4 and R5 stages) at all locations, except at Hebron. When tar spot appears late in the season, less yield impact is expected. Above normal temperatures and below average precipitation in late October and early November promoted crop maturation and dry down. Field conditions were suitable for harvest the second half of October and early November.

Yields varied across the state depending on rainfall distribution, timing, and total precipitation received. Averaged across hybrid entries in the early- and full-season tests, yields were 270 Bu/A in the Southwestern/West Central/Central region, 252 Bu/A in the Northwestern region, and 261 Bu/A in the North Central/Northeastern region. Yields at individual test sites, averaged across hybrid entries in the early- and full-season tests, ranged from 226 Bu/A at Van Wert to 278 Bu/A at Upper Sandusky. The Van Wert test site was especially dry in late June/early July and averaged lower yields than other test locations. The precipitation timing and totals were extremely variable across the state throughout the growing season. Despite fluctuating temperatures and variable precipitation, corn yields in 2022 exceeded expectations.

2022 New York State Report

Sherrie Norman, Keith Payne, Joe Lawrence, Margaret Smith

Field corn was planted on 1.03 million acres in New York in 2022. Silage was harvested from 440,000 acres with a state average yield of 17 tons/acre. This is slightly below the average silage yield over the past ten years (17.7 tons/acre). Grain was harvested on 575,000 acres in 2022. State average yield was reported at 140 bu/acre – quite a drop compared to the 157-167 bu/acre state average yields we've seen over the previous five years.

New York's 2022 corn growing season began with rather warm, dry conditions that facilitated timely planting in most parts of the state. Dry conditions continued through flowering in many areas of the state. Rainfall through the main part of the growing season was a bit more frequent and water stress less in northern New York compared to many other areas of the state. Rains picked up a bit in most areas after flowering, helping the crop to fill out and mature. Yields of both silage and grain through the central area of the state were affected by drought stress, to varying degrees depending on location.

Dry conditions at our Oakfield testing site led to mite damage on corn there. The generally dry growing season led to minimal presence of leaf diseases. We began to see some northern leaf blight late in the season, when fall rains picked up, but too late to be damaging to the crop. In early September, Gary Bergstrom confirmed the first 2022 report of tar spot, in Chatauqua County in the far southwestern corner of the state. In 2021, it had been found in two sites in Erie County (outside the Buffalo area) in October. We anticipate that this disease will spread more broadly in the state in coming years.

Illinois State Report

Emerson D. Nafziger

The 2022 corn crop in Illinois was planted beginning late but ending at the normal time; the median planting date was May 12, compared to the normal of May 1. The crop got off to a good start, but the weather in June was very dry. Rain fell in July in time to help set kernels and returned to normal in August. Dryness helped more than it hurt—stands were very good, there was no standing water damage, and foliar disease pressure was low. Canopy color was outstanding after pollination, and plants in some places remained green past maturity. This helped add some weight to kernels, but probably due to accumulation of sugars in the kernels, it also delayed harvest, with grain drying very slowly in the field. Yields were good to very good across Illinois, even in areas where June was very dry. The average yield in Illinois was reported by NASS at 214 bushels per acre, which is a new state record. The trendline yield is now at 200 bushels per acre, and is increasing at a rate of about 2.5 bushels per acre per year.

2023 Northeastern Corn Improvement Conference

Wooster, OH

PA State Report

Pennsylvania went through a tough growing season in 2022. We started our normal planting season with cold and wet soil conditions. Corn planting statewide didn't take off until the middle of May. By May 15th, only 33% of the corn acres had been planted. At the end of May, that number had reached only 69%.

We started planting our OVT Corn grain and silage trials on May 10th and ended on June 15th. Field conditions were generally good for planting and the plots had good emergence. Stand counts were recorded from late June through early July. Starting about mid-July we started experiencing hotter and drier weather. Much of the central part of the state suffered the most from the dry weather. Sporadic rain showers hit some of our 20 testing sites early in the grain fill period and those fields fared better.

Corn silage trials harvest started on August 29th. The grain moisture levels were still on the high side, but the stover was rapidly drying down due to drought stress. We continued silage harvesting through September and finished on October 7th. Our grain trials harvesting started on October 19th and finished on November 29th.

In summary, the NASS website shows our corn grain acres planted at 1,180,000 acres, a decrease of 11.3% from 2021. Corn acres harvested was 1,145,000 acres, a decrease of 13.3%, probably due to failure of some fields because of drought stress. Corn grain yield for 2022 was 140 bu/acre, a decrease of 17.2% from 2021. Corn silage yields also fell to 18 tons/acre, a decrease of 14.3% from the previous year.

The Penn State corn testing program had 10 seed companies enter 93 varieties into the corn grain OVT trials. The corn silage testing had 13 companies enter 96 varieties for testing.

PA OVT Trials	2022 YIELD	2021 YIELD
Early silage 85-100 RM	17.3	18.2
Mid Silage 101-109 RM	19.5	20.0
Late silage 110-120	21.5	23.1
Early Grain 85-100 RM	164.1	186.5
Mid Grain 101-109 RM	188.5	220.3
Late Grain 110-120 RM	231.2	237.4

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