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How Could Maize Genes Move the Needle on Nitrogen Cycling?

Ed Buckler

USDA-ARS/Cornell University

Synthetic nitrogen fertilizer has driven incredible gains in crop productivity, yet only 12% of applied nitrogen reaches consumers as protein. Today, with a systems-level understanding of soils, plant and animal physiology, manure, synthetic biology, and metagenomics, we can design nitrogen flows for both greater efficiency and lower environmental impact. The Nitrogen 2.0 framework outlines pathways to triple system-level nitrogen use efficiency, increase yields, and cut inputs—by integrating alternative nitrogen sources for livestock, improving manure recycling, and creating cropping systems that retain and reuse more nitrogen on-farm. As part of this effort, the Circular Economy that Reimagines Corn Agriculture (CERCA), which focuses on making maize extremely productive and efficient for feed, starch, and fuel uses (60% of the global crop). In temperate climates, maize faces two inefficiencies: it grows poorly in spring when light and nitrogen are available, and it allocates excessive nitrogen to low-value storage proteins in the grain. CERCA addresses this by designing a cold-tolerant maize, shifting nitrogen away from grain protein, and enhancing soil nitrogen recycling and in soil stability through biological nitrification inhibition. Together, these strategies lay the groundwork for a resilient, nitrogen-efficient agricultural system—maximizing productivity while reducing fertilizer input costs and environmental impact.

Making Corn More Cold Tolerant

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Increasing cold tolerance in hybrid corn is necessary to capitalize on early seeding in warm regions, ensure successful emergence and growth in cold regions, and expand the northern frontier of corn adaptation. Selection for cold germination began in 2014 by germinating seedlings at 9 °C. Hybrids created from the most tolerant lines were selected in the field from 2015 to 2017. Growth cabinet selection of hybrids and inbred lines was recurrent from 2018 to 2023 and involved growing corn from seed in cone-tainers at a 7 to 13 °C diurnal fluctuation and creating hybrids or inbred lines in the field from the superior lines. In 2025, early planting of 37 of the best hybrid lines at Ottawa and Carman, MB revealed that 5 hybrids in Ottawa and 9 in Manitoba yielded more than the mean of five commercial checks when planted early.

Interaction of Soil Temperature and Water Content on Corn Seedling Emergence

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The growing season throughout the Midwest has been lengthening, with the frost-free period (days above -2.2°C) extending by one week in the spring, and up to two weeks in the fall. Farmers are looking to capitalize on the lengthening season due to the yield benefits associated with early plantings and longer growing seasons. Reductions in days suitable for fieldwork may increase the likelihood that farmers will plant into marginal conditions or ahead of a cold front. Cooler soils may slow early season growth and emergence, but resilience to waterlogging may be greater under cooler temperature conditions. It is unclear how these conditions impact corn germination and emergence.

To better understand how temperatures and water conditions within the soil impact early season growth, two research trials were conducted in 2025. The first trial was conducted in controlled environment cabinets using corn planted into field soil. Soil was held at 5, 12.5, 20, 27.5, or 35°C for the first four days after planting. Trays were flooded within each temperature for 0, 1, or 3 days. After the initial four-day period, trays were relocated to a 25°C greenhouse for 14 days and assessed for daily emergence and seedling growth. Emergence decreased to 80-92% when flooded for up to 3 days at temperatures of 12.5°C or lower, but emergence totals were reduced to 35-55% at 20°C and was 0-8 % at temperatures of 27.5 or greater. Despite maintaining high emergence totals when waterlogged at lower temperatures (≤ 12.5 °C), root biomass was reduced by 20-60% compared to plants grown at the same temperatures that did not experience waterlogging. In contrast, shoot growth was similar in all cases. This suggests that plants experiencing waterlogging immediately after planting should be monitored for root growth and development to identify potential issues after emergence.

A field trial was initiated to assess whether volume of water (0.6 or 1.2 cm) and timing of application (2 hrs or 24 hrs after planting) influenced corn germination and emergence. In addition to water applications, agronomic factors of hybrid selection and planting depth were assessed to determine if management decisions could lessen the adverse impacts from cold water shortly after planting. In general, soil temperatures remained above 12.8°C and minimal instances of seed death were observed in the field. Gaps in planted rows were due to seedlings being unable to emerge through the soil crust that formed on the closed row as opposed to dead seeds from imbibitional chilling. Interactions with hybrid and planting depth were minimal, and emergence exceeded 83% in all treatments. These results were generated after a single field season and will be repeated in 2026 and 2027. Leveraging planting dates in April may help facilitate cooler soil conditions to further assess these agronomic decisions to affect resilience. The authors would like to acknowledge that funding support for this research was provided in part by the USDA-NIFA Foundational Program, as well as Corteva Agriscience Crop Management Research Award Program.

Optimizing Corn Hybrid Maturity based on Planting Date

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Climate change has allowed corn (*Zea mays* L.) growers in northern regions to achieve early planting dates (PD) but increase in extreme spring precipitations can cause significant delays. Current corn hybrid relative maturity (RM) decisions are mostly based on typical PD. It is important to understand how hybrid RM should be adjusted based on PD to ensure optimal utilization of the growing season. Field trials were conducted in Lansing, MI from 2021-2023 to evaluate the impact of multiple PDs (late April to early June) and hybrid RMs (89-109 RM) on grain yield, partial returns, phenology, and kernel dry down. Grain yield responded significantly to hybrid RM adjustment at day of year (DOY) 120, 130, and 150 with an average yield gain of 1.10, 0.75, and 0.55 Mg ha⁻¹ for every 5-unit increase in hybrid RM, with 62% of the gains explained by greater kernel m⁻². At DOY 120, 130, and 150, partial returns increased by \$229, \$118, and \$91.5 ha⁻¹ for every 5-unit increase in hybrid RM, respectively. With delayed planting, hybrid RMs matured quicker by compressing growing degree days (GDD) between 2.1-4.4 GDD per day of planting delay. Under typical PD, daily dry down averaged 0.88, 0.64, and 0.54% per day for 89, 99, and 109 RM hybrids, respectively, while rates averaged 0.60, 0.62, and 0.59% under delayed PD. Overall, growers in northern regions can benefit by using hybrids 5-10 RM longer than the optimal under early planting. For late May and early June planting, maintaining the optimal or switching to 5 RM shorter hybrids, respectively is necessary to maximize profit and reduce risk of frost damage. We recommend growers in this region to plant late-maturity hybrids first on fields suitable for early planting, and switch to mid- and early-maturity hybrids with planting delays.

Bt Resistance and the Resurgence of European Corn Borer in Canada

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European corn borer (ECB), *Ostrinia nubilalis*, once a dominant yield-limiting pest in North American corn production, was effectively suppressed for nearly two decades following the adoption of high-dose *Bacillus thuringiensis* (Bt) maize hybrids beginning in the mid-1990s. However, recent discoveries of practical resistance, first documented in Nova Scotia in 2018, with subsequent confirmations in Quebec, Manitoba, New Brunswick, and Connecticut, USA, signal a re-emergence of ECB as a serious threat. Field injury to high-dose events, including Cry1F and Cry1A.105, has been repeatedly observed, and bioassays have confirmed resistance ratios to Cry1F exceeding 30-fold in some populations. The return of ECB poses multilayered risks: increased yield loss, heightened stalk and ear damage, greater mycotoxin contamination, and renewed reliance on foliar insecticides. Ongoing surveillance and coordinated resistance monitoring across provinces have played a critical role in mapping the spread of resistant populations, revealing expansion across thousands of kilometres and highlighting the urgency of strengthened stewardship. Management strategies emphasized in the presentation include early detection of injury in single-toxin hybrids, reporting suspected resistance, and implementing cultural control practices such as removal of overwintering habitat through stalk destruction and targeted tillage, which can reduce ECB survival. Continued genetic characterization, ecotype differentiation, fitness-cost assessment, and evaluation of next-generation control proteins will be essential to building durable resistance-management frameworks. Together, these efforts aim to mitigate the spread of Bt-resistant ECB and preserve the long-term viability of this cornerstone technology in North American corn production.

Keywords: Bt corn, resistance, European corn borer, Canada

Pathogenic Oomycetes Dynamics under Tillage and Soybean, Corn, and Wheat Rotation Regimes

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Soil-borne oomycetes include destructive plant pathogens that cause major agricultural losses, yet their responses to common management practices remain poorly understood. To evaluate how tillage and crop rotation shape these pathogen communities, we used a long-term split-plot field experiment with tillage as the main factor (conventional tillage vs. no-till) and four rotation regimes (monocultures of corn, soybean, or wheat, and a corn–soybean–wheat rotation with different current crops for a given sampling year). Post-harvest soil oomycete communities were profiled over three consecutive years (2016–2018) by metabarcoding the Internal Transcribed Spacer (ITS) 1 region. Soybean monoculture supported higher confirmed species richness (34 species) than corn monoculture (21 species), reflecting a consistently more diverse oomycete community. In contrast, the three-crop rotation had limited influence on dominant species or overall community structure, suggesting that rotations including soybean and wheat may not sufficiently disrupt the life cycles of the most abundant oomycete pathogens. Tillage altered community composition and, in some cases, reduced diversity in corn monoculture, but had minimal effects on dominant taxa. Microbiome interaction networks highlighted several bacterial genera, including *Massilia*, *Agromyces_B_382064*, and *Variovorax*, as potential antagonists of oomycetes, offering promising targets for isolation and development of biological control agents. Together, these findings indicate that current rotation schemes may be inadequate for managing key oomycete pathogens and underscore the need for improved rotation design and integrated biological strategies.

Battling Corn Diseases: “The Ontario Experience”

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Corn diseases have become an increasing challenge across Ontario, driven by shifting weather patterns, tighter crop rotations, economics, and evolving pathogen pressures. Issues such as Gibberella ear rot and associated DON contamination, Northern Corn Leaf Blight, Tar Spot, and other endemic and emerging diseases continue to test the resilience and management capacity of growers and advisors. Ontario’s experience offers practical insight into coordinated, science-based disease management in a high-production corn environment.

Ag retailers, consultants, grower organizations, and extension specialists play a critical role in helping producers recognize disease risks early, interpret local field conditions, and make timely, economically sound decisions. Provincial and University research programs and multi-location field trials continue to refine hybrid resistance ratings, fungicide efficacy and timing, disease forecasting and prediction models, and our understanding of environmental factors influencing disease development, along with the contribution of cultural practices such as residue management and crop rotation.

An innovative example of cross-sector coordination is Ontario’s DON hybrid screening program. Conducted through partnerships among public researchers, seed companies, grain industry stakeholders, and grower organizations, the initiative provides independent, replicated data on hybrid response to Gibberella ear rot and DON accumulation. These results equip farmers, retailers, and industry with transparent information to support hybrid selection and risk management decisions.

Disease pressure is unlikely to diminish, but through collaboration across research, retail, industry, and grower, Ontario’s corn sector continues to work together to battle corn diseases and protect yield, quality, profitability and market access.

Keywords: Corn diseases and management, Ontario agriculture, DON hybrid screening

The Expanding Footprint of Tar Spot in Canada

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Tar spot, a tropical corn disease caused by obligate fungus *Phyllachora maydis*, was confirmed in USA in 2015 in Illinois and Indiana, spread to 20 USA states in 2024. It was first found in 5 counties in Southern Ontario in 2020, 20 counties in Southern and West Ontario in 2021, 8 counties in 2022. Tar spot was confirmed in Québec in 2023 and in Eastern Ontario in 2024. Tar spot was detected in 8 counties in Southern Ontario, 5 counties in Western Ontario, 2 counties in Eastern Ontario, and 12 counties in Québec in 2025. Daily radar map can confirm air-borne is the most important epidemic method. The climatic data, southern west or west wind, raining time great than 7 hours and rainfall great than 7 mm could be used to explain tar spot severity in Ontario and Quebec. There were two long periods of rainfall on July 17-18, August 10-11 in 2021, one long period of rainfall on July 17-18 in 2022, three long periods of rainfall on August 7, 12, and 15 in 2023, one long period of rainfall on August 28-29 in 2025. It explained that tar spot spread wider in Ontario in 2021, disease symptoms mostly appeared in lower leaves in 2022, heavy symptoms on husk and leaves above ears in 2023 in Southern and Western Ontario, and light symptoms in 2025 in Québec and Eastern Ontario, respectively. Tar spot appeared in Southern and Western Ontario, but not in Central Ontario and most East Ontario, again appeared in Quebec, which indicated that two pathways exist for tar spot epidemics. The main path is from tropic to central USA, then to Southern and Western Ontario by mainly southwest wind; Another path is from the valley between New York and Vermont, along Lake Champlain to Québec.

Key words: Air-borne, epidemic pathway, radar map, rainfall, *Phyllachora maydis*, tar spot, wind direction.

Lessons Learned from 50+ Years of Corn Performance Test: Trends, Changes, & Yields

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Corn production in Ohio accounts for about 3.5M acres annually, primarily for grain production. Corn is a critical agricultural contributor to the state's economy. The Ohio Corn Performance Test (OCPT) was established at Ohio State in 1972, and it evaluates corn hybrids for grain yield and other important agronomic characteristics.

For more than 50 years, the OCPT has evaluated the agronomic performance of commercially available corn hybrids across the state. The program has been planted annually at about 10 distinct sites grouped in three regions: Southwest/West Central Region, Northwest Region, and North Central/Northeast Region.

Part 1 - Trends over 50 years: The objective of this study was to highlight overall trends as they relate to crop management, agronomic performance, and grain yields. Over the last 50 years, more than 53,000 hybrid combinations (i.e., hybrids × environments × years) were tested in the OCPT. From 1972 to 2021, seeding rates increased from 68,259 to 89,239 seeds per ha, seedling emergence increased from 86.2% to 94.9%, and final plant stands increased from 58,559 to 84,649 plants per ha. From these trends, the number of days from planting to harvest decreased by 11.5 days (slightly later planting dates, variable harvest dates), grain moisture at harvest decreased by 48 g per kg, and average volumetric grain weight increased by 83 kg per m⁻³. The same period had a grain yield gain of 0.135 Mg per ha per year, with 9.09 Mg per ha in 1972 and 16.97 Mg per ha in 2021 (an 87% increase).

Part 2 - Historical Changes: This work aimed at identifying historical changes in agronomic characteristics, environmental factors, crop management, and their association with crop productivity and gross income over 50 years. Yield improvements were observed, from 9.34 (1972–1981) to 14.78 (2012–2021) Mg per ha. Adopting management practices such as crop rotation and soil conservation practices (e.g., minimum till, no-till, and stale seedbed) accompanied production improvements. Our results showed that seeding rate, seedling emergence, and final stands had strong correlations with yield (81%, 64%, and 82%). Regions with better weather conditions (i.e., more precipitation, higher average temperatures, lower wind speed) also had strong correlations with yield; the central region had the highest average yield.

Overall, these results indicate that yield improvements in the corn performance test have been achieved through synergistic changes in new hybrids, improved management practices, and coupled with suitable growing environments. Our work reaffirms that selecting hybrids that are best adapted to specific growing environments is a primary factor in achieving high yields and profits at the farm level. Corn hybrids differ considerably in yield potential, standability, maturity, and other agronomic characteristics that affect profitable crop production. Hybrid selection should be based on proven performance from multiple test locations and years.

Corn on the rise: Research Priorities to Improve Corn Production in Manitoba

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Corn production in Manitoba has expanded rapidly over the past decade, with recent estimates indicating approximately a 22% increase in production over the last five years. Agronomic recommendations used by Manitoba producers are largely based on research conducted in Ontario and the United States, regions characterized by longer growing seasons and more favorable heat accumulation. Manitoba's production environment differs considerably, with a cooler climate and shorter frost-free period ranging from approximately 117 to 141 days. These differences highlight the need for regionally relevant research to optimize management practices and support the continued expansion of corn production in the province.

To address these challenges, a series of research projects aimed at identifying key agronomic strategies to improve corn productivity under Manitoba conditions has been initiated by Manitoba Crop Alliance. Current research priorities include optimizing hybrid maturity and seeding dates, improving early-season weed management, exploring strategies to mitigate nitrous oxide emissions, and investigating residue management approaches to support soil health and crop establishment.

A major component of this work focuses on determining the critical weed-free period in corn across multiple Manitoba environments to identify the periods during which weed competition most strongly affects crop yield. The goal is to develop Manitoba-specific guidelines that help producers protect yield potential while reducing unnecessary herbicide applications and limiting the risk of herbicide resistance.

Complementary studies are evaluating the agronomic performance of different corn hybrids across multiple seeding windows to better define optimal planting timing under Manitoba's climatic constraints. Collectively, this research program aims to generate locally adapted management recommendations and strengthen the sustainability and profitability of corn production in Manitoba.

Short Corn for Silage in Wisconsin Production Systems

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Wisconsin is a leading producer for silage corn in United States. Therefore, exploring the suitability of short corn which represents an emerging innovation with potential to revolutionize silage corn production in dairy systems is critical. Developed using brachytic genetics, short corn hybrids are designed to be 25-40% shorter than the full stature or conventional tall hybrids while maintaining the yield potential and feed quality. The modified architecture is aimed at improving standability, reducing lodging risk, and enhancing late-season field access, creating new management opportunities for dairy producers. Our research explores how the reduced stature of short corn influence silage yield, and forage quality. Preliminary results from research trials comparing short and tall hybrids suggest that short corn produces comparable biomass and nutritive value to conventional hybrids. In year 1 of the study, short corn hybrids had 8-10 % higher fiber digestibility than conventional hybrids, however, in year 2 these differences were not significant. We also tested the performance of short corn for silage in systems of interseeded alfalfa. The preliminary results show that short corn hybrids relatively had a lower yield loss than the conventional hybrids. It remains to be seen how these hybrids behave in terms of forage nutritive value under these systems. Moving forward, we aim to explore management decisions such as hybrid selection, planting population, nutrient management, and harvest considerations in short corn hybrids that specific to dairy operations. Overall, the aim is to view short corn as a systems-based tool and integrate it with sound agronomic and nutritional management to support more consistent forage supply and improved milk production efficiency.

Can We Reduce Corn Irrigation and Maintain Yield?

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Farmers are searching for answers to keep corn profitable. Corn plays a key role in crop rotation, but corn has a significant water use requirement. Multiple irrigation applications are an integral but expensive component to profitable corn production in South Georgia. Farmers want to know if there are options to continue growing corn by reducing irrigation amounts while maintaining yield yet reducing overall costs. To address these concerns, a study was conducted at the UGA Southwest Research Education Center (SWREC) in Plains, Georgia to assess various reductions in irrigation application amounts and its impact on yield, test weight, and moisture. Four corn hybrids were planted in six row plots under the 4-tower pivot (Pivot #4) at the SWREC. Three of the quadrants received a decreasing amount of irrigation (100%, 70%, and 50%). The 100% treatment followed UGA irrigation recommendations for corn. Irrigation events were triggered based on the soil moisture data provided by an AquaSpy soil moisture sensor that was installed by the UGA Ag Water Team in the 100% treatment. Each hybrid was replicated four times under each treatment and was harvested separately then weighed. The yield and test weight were recorded. Aflatoxin samples were pulled and submitted. Results from the trial identified little reduction in yield with irrigation amounts reduced by as much as 50%. The potential to reduce irrigation amounts could reduce costs and keep corn profitable. The SWREC Field Day highlighted this corn trial. Details from this trial will be presented at the Georgia Corn Growers Short Course, and the Annual Corn Improvement Conference.

Mid-Season Application of Nitrogen and Sulfur for Corn

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Many farmers apply all their nitrogen (N) and sulfur (S) for corn preplant (PP), which can result in late-season deficiencies of N and S. The 360 Y-DROP® system on a high-clearance sprayer allows liquid fertilizers to be applied mid-season for greater synchrony with corn uptake. Experiments were conducted in continuous corn from 2022–2024 on Normania loam soil at Lamberton, MN (3.8–5.6% organic matter (OM)) and on Nicollet clay loam soil at Waseca, MN (4.5–5.7% OM). Corn response to mid-season application of N and S fertilizers was evaluated through five treatments. They had the same total N rate, except for the non-N-fertilized control, and all nutrients except N and S were managed uniformly. Fertilizer treatments included (1) 240 lb N ac⁻¹ plus 25 lb S ac⁻¹ applied PP, (2) 200 lb N ac⁻¹ plus 25 lb S ac⁻¹ applied PP and 40 lb N ac⁻¹ applied at V14, (3) 200 lb N ac⁻¹ plus 25 lb S ac⁻¹ applied PP and 40 lb N ac⁻¹ plus 10 lb S ac⁻¹ applied at V14, (4) 240 lb N ac⁻¹ plus no S applied PP, and (5) no N plus 25 lb S ac⁻¹ applied PP. Broadcast PP fertilizers were urea and gypsum. Fertilizers applied at V14 were urea-ammonium nitrate and ammonium thiosulfate and were placed on the soil surface near both sides of corn rows with a urease inhibitor using the 360 Y-DROP® system. There was one trial with high yields, one trial with low yields, and four trials with intermediate yields. Yield was reduced for the non-S-fertilized control in two of six trials, split-N application increased yield in one of six trials when there was 19.6 inches of rainfall in May plus June, and there was never an advantage to including additional S with split-N application.

Optimizing Georgia Corn Performance When Faced with Future Uncertainty

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Corn (*Zea mays* L.) production in Georgia exceeded 500,000 harvested acres in 2025, representing a 33% increase relative to 2024 acreage. Expansion of corn within existing production systems necessitates strategic integration with dominant regional crops, including peanut (*Arachis hypogaea* L.) and cotton (*Gossypium hirsutum* L.), to mitigate biotic and abiotic stressors that constrain yield potential. Diversified rotations remain foundational for suppressing pest complexes, improving soil structure, and enhancing nutrient cycling efficiency. However, limitations in grain handling and storage infrastructure present logistical and economic constraints under expanded production scenarios. Georgia's agroecological conditions characterized by high temperature regimes, variable precipitation patterns, and episodic drought stress require intensive input management to sustain yield and grain quality targets when compared to other corn producing states. Elevated production costs, coupled with commodity price volatility, increase financial risk and compress profit margins. Consequently, management frameworks must prioritize return on investment (ROI) alongside agronomic optimization. The objective of this outline was to disseminate integrated corn management strategies tailored to Georgia production systems for the 2026 growing season. Field-level recommendations emphasized hybrid selection informed by University of Georgia on-farm variety trials, optimization of planter and fertilizer application efficiency to improve spatial seed and nutrient placement without capital investment in new machinery, and adaptive in-season management guided by predictive modeling of heat and drought stress. These decision-support tools facilitate proactive pest management and fertility adjustments to mitigate stress during critical phenological stages. The mission of University of Georgia Extension is to continuously evaluate prevailing production protocols and refine recommendations to ensure operational viability across diverse farm scales while accounting for evolving commodity market dynamics. The Georgia Grains Team's strategic framework for corn production integrates three core pillars: (i) maximizing early-season stand establishment and seedling vigor, (ii) protecting biomass accumulation and reproductive investment during vegetative and reproductive phases, and (iii) expanding educational programming to enhance producer decision-making capacity. Collectively, this systems-based approach is designed to enhance productivity, economic resilience, and long-term sustainability of corn production in Georgia for the 2026 production cycle.

Reducing Cover Crop Effect on Nutrient Availability in No-Till Corn

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Cover crops are reported to have long-term soil health improvements, one of which is reducing erosion. However, popular cereal cover crops, such as rye (*Secale cereale* L.), have the potential to cause a yield penalty in the following corn (*Zea mays* L.) crop due to a reduction in available nitrogen. Legumes, such as Austrian winter pea (*Pisum sativum* L. var. *arvense*), are thought to reduce this yield penalty due to their capacity to fix nitrogen. The main objective of this study is to determine how management of a cover crop, through species selection and termination timing, can reduce its effect on the next corn crop. Cover crop treatments include no cover crop control, barley (*Hordeum vulgare* L.) alone as well as in a mixture with Austrian winter pea. Cover crops were terminated at either five or two weeks before corn planting was anticipated. Five nitrogen rates ranging from 45 to 391 kg N ha⁻¹ were applied to corn. Early termination of the cover crops led to less above ground biomass and lower C:N of the cover crop. However, cover crop termination did not significantly impact corn grain yields. A second study observing the effect of sulfur applied as gypsum following the same cover crop treatments was also conducted. Sulfur was found to increase corn grain yields for one of four site-years. No yield penalty was observed in either study following any cover crop.

Digital Agronomy - Digging into the Data

Kelsey Banks, Owner and Agronomist - Banks Agro

Digital Agronomy is a tool that can be used to increase yield, improve crop quality and support the agriculture industry. From crop planning through to harvest there is a place for digital agronomy tools. However, as the digital agronomy platforms and tools continue to improve, one of the top challenges is the large amount of platforms available and many of them cannot communicate and produce a continually positive outcome. This results in a negative experience financially and optimizing experience leading to overall confusion for the grower and their agronomist.

Assessing Corn Nutritional Status and Grain Yield Using CropScan Derived NDVI

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Accurate assessment of crop nutritional status is essential for optimizing nitrogen (N) management and improving corn productivity while minimizing environmental impacts. This study evaluated the potential of CropScan-derived vegetation indices (including NDVI, normalized difference vegetation index) to quantify corn yield and plant nutrient status under varying N management strategies. Field experiments were conducted at the Ottawa Central Experimental Farm using a randomized complete block design in split-plot arrangement, to assess the effects of multiple N treatments (0–250 kg N ha⁻¹) including mineral fertilizer and manure sources applied to Bt and non-Bt corn hybrids. Measurements included grain yield, biomass, plant nutrient concentrations (N, Cu, Mg, Fe, and K), spectral reflectance (460–1480nm), and weather variables. Results showed that the red-edge vegetation index (CI_{red-edge}) was moderately correlated with grain yield ($R^2 = 0.65$), indicating that spectral indicators can capture yield variability across treatments. Machine learning models (SVM, Random Forest, and CNN) integrating multiple vegetation indices improved predictions of grain yield ($R^2 = 0.8$) and early-season plant N status ($R^2 = 0.6$) compared with single-index approaches. Vegetation-index-based N recommendations derived from the models were comparable to field-calculated recommendations, demonstrating the potential of sensor-based approaches to support climate-smart and data-driven nutrient management in corn production. These results highlight the value of integrating spectral sensing and machine learning to improve N use efficiency and precision nutrient management in modern cropping systems.

QTL Discovery for GER Disease Severity and DON Accumulation in Maize

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Maize is a major staple crop for human consumption and animal feed, but its production is limited by *Gibberella* ear rot (GER), particularly in temperate regions worldwide. GER, also known as red fusariosis, is caused by *Fusarium graminearum* and its sexual stage *Gibberella zeae*. GER was first reported in Canada in 1923, and has since been prevalent in many geographical areas, including North and South America, Central Europe, and China. GER causes an average global maize yield loss of approximately 2.38%, reduces kernel quality, and contaminates grain with mycotoxins such as deoxynivalenol (DON), which pose serious health risks to humans and animals. Agronomic and chemical control strategies have generally proven ineffective in preventing GER infection. Therefore, breeding for host resistance remains the most sustainable strategy for mitigating GER disease and reducing mycotoxin contamination in maize production. This study aimed to identify quantitative trait loci (QTLs) and candidate genes associated with GER resistance and DON accumulation using a panel of 500 historical maize inbred lines provided by Agriculture and Agri-Food Canada. The panel was genotyped using genotyping-by-sequencing to generate a genome-wide SNP dataset. Phenotypic evaluations were conducted in Ottawa and Ridgeway, and across combined environments, to estimate the heritability of GER severity and DON content. The results indicated that resistance to GER and DON accumulation is governed by several minor QTLs with additive effects. A significant moderate correlation was observed between GER severity and DON content within the diversity panel. Heritability estimates for both traits ranged from moderate to high across environments. These findings suggest that genomic selection may be a more effective breeding strategy than marker-assisted recurrent selection for developing maize genotypes with improved resistance to GER and reduced DON contamination.

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New York State Report and Upcoming Cornell Inbred Releases

Margaret E. Smith

Plant Breeding and Genetics, Cornell University

Over the past 100 years, field corn area in New York has doubled, from a low of 450,000 acres (22% grain) in 1928 to 1,015,000 acres (56% grain) in 2024. Current acreage is down from a peak of 1.4 million acres (60% grain) in the 1981 growing season. The shift towards a greater share of grain acres undoubtedly reflects successful long-term breeding to develop early maturing hybrids that also possess good yield potential. Over the past 50 years, New York's grain corn yields have risen from roughly 80 bu/acre to around 140 bu/acre, while silage yields also have grown from 12 tons/acre to nearly 20 tons/acre.

In contrast to the long-term upward trends, yields were down in 2025 due to excessive early season rainfall before and during planting season, followed by limited, erratic rainfall during the main portion of the growing season. State average yields of 140 bu/acre grain and 17 tons/acre silage were the lowest since 2016. Dry conditions during the heart of the growing season limited presence of foliar diseases. Regarding recently introduced diseases, Gary Bergstrom notes that tar spot came in late and was not severe, but progressed as far east as Otsego County. Corn stunt spiroplasma was confirmed for the second year in a row in Erie County and Monroe County (western New York) but the corn leafhopper vector was not found in 2025 despite an extensive trapping effort.

Margaret is officially resting on her laurels and today completes her second week of retirement! Based on Cornell's corn breeding efforts, keep an eye out for inbred releases, including lines with resistance to multiple leaf diseases, anthracnose stalk rot, and European corn borer. The work of many people – field technicians, graduate students, and collaborators from among the Corn Improvement Conference and beyond – is very gratefully acknowledged.

Comparison of Short Statured Corn and Tall Corn Hybrids at Differing Nitrogen Rates

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Short statured corn hybrids (SC) are hybrids that are selectively bred to express the Brachytic 2 (br2) mutation and is 0.5 m shorter than tall hybrids (TC). These SC hybrids offer reduced lodging risk, increased accessibility for late season fungicide or nutrient applications, and potentially improved nutrient efficiencies. However, there are numerous knowledge gaps that need to be explored for profitable adoption of SC hybrids in the system. Therefore, we conducted a field study to evaluate yield, NDVI, NDRE, and plant and ear height differences across statures at different nitrogen rates. Three SC and two TC hybrids were tested at three nitrogen rates (Low: 168 kg/ha; Current Recommendation: 213 kg/ha; and High 269 kg/ha) in Arlington, WI. The trial was set in a RCBD with four replications per treatment. Row spacing was 76 cm and plots were 7.62 m long x 3.05 m wide, planted at 86,450 seeds/ha. Plant heights were measured every 14 to 20 d from V7 to R1. Ear heights were measured from the ground to the base of the ear shank. Plots were combined at 19% moisture content with a Kincaid 8XP plot combine with a HarvestMaster Classic GrainGage. Data was analyzed using Proc Mixed in SAS (v9.4) with stature, nitrogen rate, and stature x nitrogen rate as fixed effects and replication as random effect with alpha of 0.05. Grain yields were similar between SC and TC hybrids (13.3 and 13.1 Mg/ha, respectively). With the N rate treatments, Low N yielded less than Current and High N treatments (12.4 vs 13.4, 13.8 Mg/ha, respectively; $p < 0.01$). There were no Stature x N Rate interactions. There may be potential canopy structure differences affecting NDVI and NDRE measures between statures. This trial will be evaluated in 2026 and 2027 with an additional location and parameters.

Keywords: Short Corn, Nitrogen Rate

Evaluating Growth Stimulant Products in Corn Production

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Growers have expressed interest in using biological products in row crop production. In 2023, a field experiment was initiated at the Sunbelt Ag Expo to evaluate the effects of four biological products on corn yield. The three treatments included Ensoil Algae, Activ8 + Unleash, and Utrisha-N. Each treatment was replicated 3 times, and each plot was 6 rows wide and ran the length of the field. The Ensoil Algae was applied in-furrow at planting and V3 and V7. The Activ8 + Unleash was applied in furrow at planting and the Utrisha was applied at V7. No significant differences in treatments during stand counts at V2. Tissue samples were taken at brown silk. No significant differences in N content among treatments. P content was significantly higher in the Utrisha plots compared to the other treatments. All biological treatments had a significant increase in K levels when compared to the untreated check. Yield data showed no significant differences among treatments.

Kernel Number and Kernel Weight Stability Can Vary Across Corn Hybrids

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The stability of a trait refers to the extent to which its expression in a given genotype varies across environments. The more stable a trait, the less variable its expression. Grain yield stability is a central consideration in corn production to ensure that hybrids perform consistently across environments and is frequently quantified given its importance. Little attention has been paid to the stability of corn yield components, kernel number per m² (KN), and kernel weight (KW). Our hypothesis is that while previous research suggests that yield stability of commercial corn hybrids is generally consistent, the stabilities of KN and KW may exhibit significant differences, even when overall yield stability remains constant. This study evaluated the yield and yield component stabilities of 23 commercial corn hybrids conducted on-farm at five location-years in Ontario, Canada, using Finlay–Wilkinson regression. Most (61%) hybrids exhibited average yield stability with β_1 -values close to 1.0. But seven hybrids displaying average yield stability had KN and/or KW stabilities significantly different than average. While in absolute terms, KW was always more stable than KN across environments, the data indicate that hybrids have different mechanisms to achieve stable yields in terms of relative yield component adjustments. Overall, 14 hybrids had yield component β_1 -values significantly more or less stable than average. The instances where yield component β_1 -values differed significantly from 1.0 were almost equally divided between KN and KW. These findings support the potential for hybrid-specific corn management, that is, tailoring management practices to take advantage of hybrid variation in yield component stabilities.

Corn production with strip-tillage in the northern Great Plains

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Department of Agronomy, Horticulture, and Plant Science - South Dakota State University

Conventional tillage is still the dominant tillage practice in the eastern third of South Dakota (USA). Producers are often facing wind and water soil erosion in this part of the state. Strip-tillage can offer an alternative production option that could lower erosion potential between cash crops, while maintaining the yield potential. In addition, strip-tillage allows a same-pass nutrient placement. The research objectives were to compare tillage and fertilizer placement methods in a corn (*Zea mays* L.) - soybean [*Glycine max* (Merr) L.] production system. Field trials were established in two locations in a randomized complete block design with split-plot arrangement (both crop phase present in each year) with four replications. Tillage system and fertilizer placement were the main plots (conventional tillage with fall broadcast fertilizer placement, fall strip-tillage with banded fertilizer, fall strip-tillage with broadcasted fertilizer, spring strip-tillage with banded fertilizer placement, and spring strip-tillage with broadcast fertilizer application). Fertilizer rates [full rate ($80 \text{ kg ha}^{-1} \text{ P}_2\text{O}_5$, $60 \text{ kg ha}^{-1} \text{ K}_2\text{O}$), 75% of full rate, and control] and starter fertilizer (applied or not) were sub-plots for corn.

In the first two years yield and nutrient uptake were similar in strip-till banded system compared to the conventional tillage practices.

Georgia Farmers Increase Adoption Rate of Soil Moisture Sensor Technology for Irrigation Scheduling Through the Master Irrigator Program

Edwards,* P.¹, Anderson, H.², Beasley, S.⁵, Bennett, J.², Bowen, D.², Brown, W.², Carlson, S.², Carter, B.², Cloud, C.², Collins, C.², Crews, B.², Dowdy, M.², Edenfield, J.², Frye, M.², Green, R.², Hall, D.⁴, Hayes, B.², Kalina, J.², Kichler, J.², Mallard, J.³, McAllister, S.², Miller, J.², Porter, W.⁶, Powell, S.², Royal, C.², Sapp, P.², Sapp, P.², Smith, A.², Shirley, A.², Stanley, L.², Tanner, R.², Tanner, S.², Tyson, B.², Wilson, T.²

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In 2018, only 11 percent of Georgia producers reported through NASS that they were using soil moisture sensors. The UGA Extension Ag Water team received a seed grant to begin the Master Irrigator Developmental Program in Georgia, which has led to fifty-seven farmers completing training in thirty-one counties during years 2023-2025. The Master Irrigator Developmental Program was designed to train irrigation managers and agents on advanced irrigation scheduling methods through multiple avenues including indoor seminars, in field one-on-one training, and guidance by texts and phone calls throughout the growing season. Producers being trained through the Master Irrigator Program are gaining valuable information and experience in managing irrigation applications on their farms and therefore, changing the way they decide to manage irrigation. Irrigating without an irrigation scheduling method can have a significant impact on crop yield, irrigation water use efficiency, and water consumption. Participants were surveyed before and after participation concerning their preferred methods of irrigation scheduling. Prior to participating in the program, fifty-five percent of responses were initiating irrigation scheduling decisions on either visible plant stress or feel of soil, both of which are not reliable-scientific methods. The post survey showed a fifty-nine percent reduction in the utilization of non-scientific methods such as feel of soil and visible plant stress in plans for future irrigation scheduling procedures. Through this program's yearlong training, surveying showed after course completion ninety eight percent were most comfortable with soil moisture sensors as their chosen tool for management. With utilization of the knowledge gained and innovative technologies in the field, these producers are irrigating crops when the crops need moisture, and state water resources are being utilized more efficiently.

Can We Reduce Corn Irrigation and Maintain Yield?

Edwards, P.¹, Beasley, S.³, Collins, D.², Crews, B.², Crosson, L.², Hall, D.⁶, Lopez, C.², Lyon, D.³, Mallard, J.⁵, McAllister, S.², Porter, W.⁷, Poythress, T.⁴, Quayle, J.², Rogers, S.⁸, Sanders, H.², Starr, B.², Young, C.², Watson, W.²

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Farmers are searching for answers to keep corn profitable. Corn plays a key role in crop rotation, but corn has a significant water use requirement. Multiple irrigation applications are an integral but expensive component to profitable corn production in South Georgia. Farmers want to know if there are options to continue growing corn by reducing irrigation amounts while maintaining yield yet reducing overall costs. To address these concerns, a study was conducted at the UGA Southwest Research Education Center (SWREC) in Plains, Georgia to assess various reductions in irrigation application amounts and its impact on yield, test weight, and moisture. Four corn hybrids were planted in six row plots under the 4-tower pivot (Pivot #4) at the SWREC. Three of the quadrants received a decreasing amount of irrigation (100%, 70%, and 50%). The 100% treatment followed UGA irrigation recommendations for corn. Irrigation events were triggered based on the soil moisture data provided by an AquaSpy soil moisture sensor that was installed by the UGA Ag Water Team in the 100% treatment. Each hybrid was replicated four times under each treatment and was harvested separately then weighed. The yield and test weight were recorded. Aflatoxin samples were pulled and submitted. Results from the trial identified little reduction in yield with irrigation amounts reduced by as much as 50%. The potential to reduce irrigation amounts could reduce costs and keep corn profitable. The SWREC Field Day highlighted this corn trial. Details from this trial will be presented at the Georgia Corn Growers Short Course, and the Annual Corn Improvement Conference.

Comparing Field Corn Hybrids in Southwest Georgia-2025

McAllister, S.¹, Crews, B.², Starr, W.³, Lopez, C.⁴, Cloud, C.⁵, Hancock, K.⁶, Hayes, B.⁷, Kichler, J.⁸, Ingram, S.⁹, Shay, N.¹⁰

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In 2025 field corn was planted on 485,000 acres in Georgia. Field corn producers face many difficult decisions. Hybrid selection is one of the most important and difficult decisions for growers due to the rapid turnover in available field corn hybrids. The goal of this research was to compare 10 of the most popular corn hybrids from 5 companies across 6 locations in Southwest Georgia. This area represents the geographic region encompassing the largest field corn acreage in the state. On-farm, replicated, irrigated, hybrid trials were planted in 6 row plots in grower fields in Terrell, Sumter, Grady, Colquitt, Mitchell, and Early Counties. Plot Sizes ranged from 0.26-0.76 acres each with (2-3 replications). Plant populations ranged from 24K-36K plants per acre at the various locations. Each hybrid was harvested separately and weighed on weigh wagons to determine yield based on 15.5% moisture content. All data were subjected to ANOVA with means separated using Fishers Protected LSD test (P=0.10). Average yield ranged from 219-278 bushels per acre at each location. Dekalb 6835, Croplan 5911, and DG D60TC45 showed the most stability across the locations while Agratech 85VT2P was among the lowest yielding across the locations, despite winning the Sumter and Mitchell County locations. This proves that it is important to look at multiple years and multiple locations before ruling out a single variety.

NECC29: 77th Corn Improvement Conference

Business Meeting Minutes

13 February 2026

Ottawa, Ontario Canada

- The 2027 NECC29 meeting will be in Kentucky on 8-9 February 2027.
- Wisconsin will host in 2028.
- As in recent years, the 2026 Proceedings will be assembled by the incoming host group (University of Kentucky).
- An official report of the meeting is due to USDA in 60 days (14 April 2026). Margaret can get this uploaded to the multistate project database (NIMSS) but will need the Proceedings and the list of attendees.
- There should be a new Administrative Advisor for the NECC29 project by next year, but that person has not yet been chosen.
- One year from now, the group will need to begin planning for renewal. The current project terminates in September 2028.

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