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Purdue Corn Team Research Update

(Betsy Bower, Narciso Zapata, & Daniel Quinn)

Can In-furrow Plant Nutrition Impact Yield?

Corn growers have relied on starter fertilizer for several years, but recently new starter fertilizer equipment has really started to take off. While the traditional 2x2 setup (placing fertilizer two inches below and two inches beside the seed) still delivers a strong return on investment, pop-up or in-furrow systems has become more popular as an alternative or addition.

In-furrow fertilizer, is a low-dose application placed directly in the seed furrow, right below or beside the seed (typically within about an inch). Some of the newer starter systems even allow fertilizer to be streamed directly on the seed and on both sides of the furrow, applying a total of 3 to 6 gallons on and around the seed zone.

This close placement gives young corn plants quick access to essential nutrients right after germination, which can be especially helpful in cool, wet springs when roots are slow to explore the soil. But be careful, with that proximity also comes the need to watch fertilizer rates and formulations. Since most fertilizers are salts, too much of it or the wrong mix can hurt germination and stands.

What nutrients are typically delivered through starter or pop-up systems?
Common nutrients applied through starter or in-furrow systems include nitrogen (N), phosphorus (P), potassium (K), and zinc (Zn). However, it is important to remember that not all starter N and K products are created equal. Products like UAN, ATS (ammonium thiosulfate), and KTS (potassium thiosulfate) have high salt loads, which means only small amounts can be safely placed near the seed in medium-textured soils (like silt loams and silty clay loams), and even smaller amounts should be used in sandy soils to avoid seed injury.

Why are starter fertilizers used?
Starter fertilizers supply readily available nutrients right where young corn plants need them, close to the seed. Phosphorus (P) is especially important during the critical early growth stages, when root systems are still

small and soils are often somewhat cool. Here's what starter fertilizers can do for your crop:

1. **Improve early-season growth**, particularly in cool, wet soils that often occur with early planting, unpredictable spring weather, and no-till or reduced-till systems. Nitrogen (N) and phosphorus (P) are key players here.
2. **Increase nutrient availability in low-testing soils**: placing bands of phosphorus (P) and potassium (K) near the seed helps plants access nutrients more efficiently.
3. **Boost early root development**: nitrogen (N), phosphorus (P), and zinc (Zn) support strong root growth and early vigor.
4. **Provide insurance against early stress**: giving corn a small, concentrated supply of nutrients near the seed may help the plant power through early-season challenges.

So, what are the differences between the two systems?

Because it is applied farther from the seed, a 2x2 starter system offers a lot more flexibility in what and how much fertilizer you can apply. The extra distance allows for higher rates of UAN and the addition of ATS or KTS without risking seed injury. Even so, it is still recommended to limit total fertilizer salts in sandy soils.

The University of Nebraska has an excellent guide "Using Starter Fertilizers for Corn, Grain Sorghum, and Soybeans" that goes into more detail on fertilizer use across different soil types and crops and can be found here https://extensionpubs.unl.edu/publication/g361/2012/html/view.

A 2x2 setup can carry much of the early-season fertilizer needed to get the crop to sidedress timing. The trade-off? Because application rates are higher than pop-up systems, you will likely need to refill more often during planting.

Pop-up fertilizer systems, on the other hand, apply fertilizer right next to or directly on the seed, which means smaller quantities and less total material are used. Pop-up systems typically deliver just enough nutrients to get the corn plant started, and because the fertilizer is placed so close to the seed, they are also one of the best ways to deliver micronutrients like zinc. And since there is less product applied overall, there are fewer starter fill-ups needed during planting.

Can planters be set up with both 2x2 and pop-up starter systems?

Yes, some planters come equipped with both systems. This setup gives you a little fertilizer right with the seed to help the plant get off to a good start, followed by a heavier dose placed farther away to carry it through to sidedress timing.

Purdue Research

The Kernel Team at Purdue has been working with **BRANDT Consolidated Inc.** since 2023 on research trials using starter fertilizer products like Enz UP P DS, Enz UP K DS, Enz UP Zn, and others. These have been tested alone and in combination with ammonium polyphosphate (APP, 10-34-0) in pop-up systems at ACRE in West Lafayette and PPAC near Wanatah, IN. Results from 2023 and 2024 are shown below.

Table 1. 2023 Purdue University Agronomy Center for Research and Education (ACRE). West Lafayette, IN.

Treatment Description	Grain Moisture	Grain Yield
	-- % --	-- bu/ac --
Untreated Check	22.9 a*	288.6 d
Ammonium Polyphosphate (APP; 10-34-0)	23.7 a	298.2 bcd
EnzUP P DS	23.7 a	297.4 bcd
APP + EnzUP P DS	23.2 a	294.2 cd
APP + EnzUP K DS	23.5 a	305.8 a
APP + EnzUP Zn	23.4 a	311.8 a
APP + EnzUP SeedFlow Zn	21.8 b	299.8 bc

* Mean values which do not contain the same letter and are in the same column are determined statistically different from each other (P<0.1).

Table 2. 2023 Pinney Purdue Agricultural Center (PPAC). Wanatah, IN.

Treatment Description	Grain Moisture	Grain Yield
	-- % --	-- bu/ac --
Untreated Check	22.5 a*	272.4 bc
Ammonium Polyphosphate (APP; 10-34-0)	22.5 a	268.1 c
EnzUP P DS	22.6 a	273.2 abc
APP + EnzUP P DS	22.5 a	272.6 bc
APP + EnzUP K DS	22.7 a	271.6 bc
APP + EnzUP Zn	22.7 a	278.7 a
APP + EnzUP SeedFlow Zn	22.7 a	276.3 ab

* Mean values which do not contain the same letter and are in the same column are determined statistically different from each other (P<0.1).

Table 3. 2024 Purdue University Agronomy Center for Research and Education (ACRE). West Lafayette, IN.

Treatment Description	Grain Moisture	Grain Yield
	-- % --	-- bu/ac --
Untreated Check	23.8 a*	288.5 ab
Ammonium Polyphosphate (10-34-0, 5 gal/ac)	23.8 a	281.3 c
EnzUP P DS (5 lbs/ac)	23.6 a	288.6 ab
APP (2.5 gal/ac) + EnzUP P DS (2.5 lb/ac)	23.4 a	291.9 a
APP (5 gal/ac) + EnzUP Zn (1 qt/ac)	23.1 a	292.1 a
APP (5 gal/ac) + EnzUP SeedFlow Zn (1.3 oz/unit)	23.7 a	288.8 ab
EnzUP P DS (2.5 lb/ac)	23.8 a	285.6 bc

* Mean values which do not contain the same letter and are in the same column are determined statistically different from each other (P<0.1).

Table 4. 2024 Pinney Purdue Agricultural Center (PPAC). Wanatah, IN.

Treatment Description	Grain Moisture	Grain Yield
	-- % --	-- bu/ac --
Untreated Check	18.9 a*	216.3 a
Ammonium Polyphosphate (10-34-0, 5 gal/ac)	19.1 a	223.3 a
EnzUP P DS (5 lbs/ac)	19.4 a	226.9 a
APP (2.5 gal/ac) + EnzUP P DS (2.5 lb/ac)	18.9 a	219.9 a
APP (5 gal/ac) + EnzUP Zn (1 qt/ac)	18.9 a	220.8 a
APP (5 gal/ac) + EnzUP SeedFlow Zn (1.3 oz/unit)	19.3 a	220.0 a
EnzUP P DS (2.5 lb/ac)	18.9 a	220.4 a

* Mean values which do not contain the same letter and are in the same column are determined statistically different from each other (P<0.1).

In 2025, the trial included APP, APP plus Enz UP P, APP plus Enz UP Zn, and Reaction P DS for comparison. Reaction P DS (12-58-0) serves as a high-phosphorus starter, while Enz UP P and Enz UP Zn contain enzymes aimed at improving plant health and stress tolerance. Please, stay tuned for updates on the results and conclusions from this year's trials.

Take Home Points:

1. In **3 of the 4 trials**, several of the **BRANDT Enz UP** products statistically increased yield when added to APP, compared to APP alone; with **APP plus Enz UP Zn** being consistently the top performer.
2. At **PPAC in 2024**, overall yields were about **50 bushels lower** than in 2023, with **no significant** differences among treatments. It is likely another yield-limiting factor, outside of starter fertilizer, played a role that year.

3. In 2023, the **APP plus Enz UP K** treatment also yielded significantly higher than APP alone or APP combined with other Enz UP products. We do not always think of **potassium (K)** as a big player in starter fertilizers, but its impact can depend on crop needs. Stay tuned, in a couple of weeks we will share some **Enz UP K** farm-scale trial results from several Purdue Ag Centers.
4. Overall, these results suggest that certain **pop-up fertilizer combinations** may help push yield to the next level.

References

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Smother, Suppress, Succeed: Using Cover Crops for Weed Control

(Tommy Butts)

Weeds continue to be increasingly challenging each year with herbicide resistance concerns on the rise, persistent challenging environmental conditions, and further spreading across the state (particularly with waterhemp). As a result, it is not viable to rely solely on herbicides for successful weed management anymore. Rather, we need to use multiple, diverse strategies that can be found in our “Weed Management Toolbox” (Fig. 1).

Fig. 1. Weed management toolbox. Image generated using Google Gemini A.I.

Right now (beginning of October) is an ideal time to start initiating our 2026 weed management plan and using a diverse strategy by drilling cover crops following crop harvest. Cover crops can be beneficial for numerous reasons, but from a weed management standpoint, they can reduce weed seedling emergence, slow weed growth, reduce weed biomass, and limit seed production—especially for small-seeded annual weeds (Fig. 2). For example, research has shown **approximately a 30 to 50% reduction in waterhemp emergence with a 75% reduction in waterhemp biomass when competing with a cereal rye cover crop**. This beneficial effect is often directly linked to the amount of cover crop biomass. Meaning, a successful fall planting (drilling is typically better than broadcast) a few weeks before the first frost is critical to giving the cover crop the best chance for success. Additionally, allowing the cover crop to grow as close as possible to the cash crop planting date the following spring will make sure to take the greatest advantage of shading, competition, and physical suppression of weed emergence. However, careful consideration and advanced planning for cover crop termination should be made so as to not allow the cover crop to end up being a problematic weed in the cash crop. For recommendations on cover crop termination, check out this previous Purdue Fact Sheet: “Successful Cover Crop Termination with Herbicides.”

There are a variety of cover crop seed options that can aid in weed management efforts. However, cereal rye is typically the standard recommendation due to its biomass capabilities, termination ease, and sourceability. The publication, “Post Corn, Going to Soybean: Use Cereal Rye,” provides more in-depth information regarding this cover crop option. Despite cereal rye typically being an all-around good option, there have been instances where it has negatively impacted corn growth and yield. As a result, if planning to plant corn, it is recommended to either terminate cereal rye 2 to 3 weeks prior to planting or use an alternative cover crop mixture such as oats and tillage radish. Additional tips for this cover crop practice can be found in the following publication: “Post Soybean, Going to Corn: Use Oats/Radish.”

As I started out this article, weed management should be thought of as a toolbox. Just like doing repairs around the home or farm: a single hammer can do a lot of jobs, but if that's all you use, eventually you end up smashing your thumb or destroying the thing you're trying to fix (not that I'm speaking from experience). So, using some of the other tools in that toolbox will make the job more successful overall. The same holds true for using cover crops in our weed management efforts in conjunction with other strategies such as herbicides, crop rotation, precision equipment, etc. None of these should be considered standalone weed control practices, but rather used together in an integrated weed management strategy.

Fig. 2. Demonstration of cereal rye (left) suppressing summer annual weeds compared to a bare soil surface (right).

I hope your 2025 harvest is going smoothly, and that y'all consider initiating your 2026 weed management efforts by planting cover crops in the near future. If you have any questions, please don't hesitate to reach out! Additionally, If you're interested in even more resources that discuss the weed suppression capabilities of cover crops and recommendations for their use, check out the following:

- GROW Cover Crops Webpage,
- "Herbicide Rotation Restrictions for Cover Crops and Fall Forages,"
- "Residual Herbicides and Fall Cover Crop Establishment."

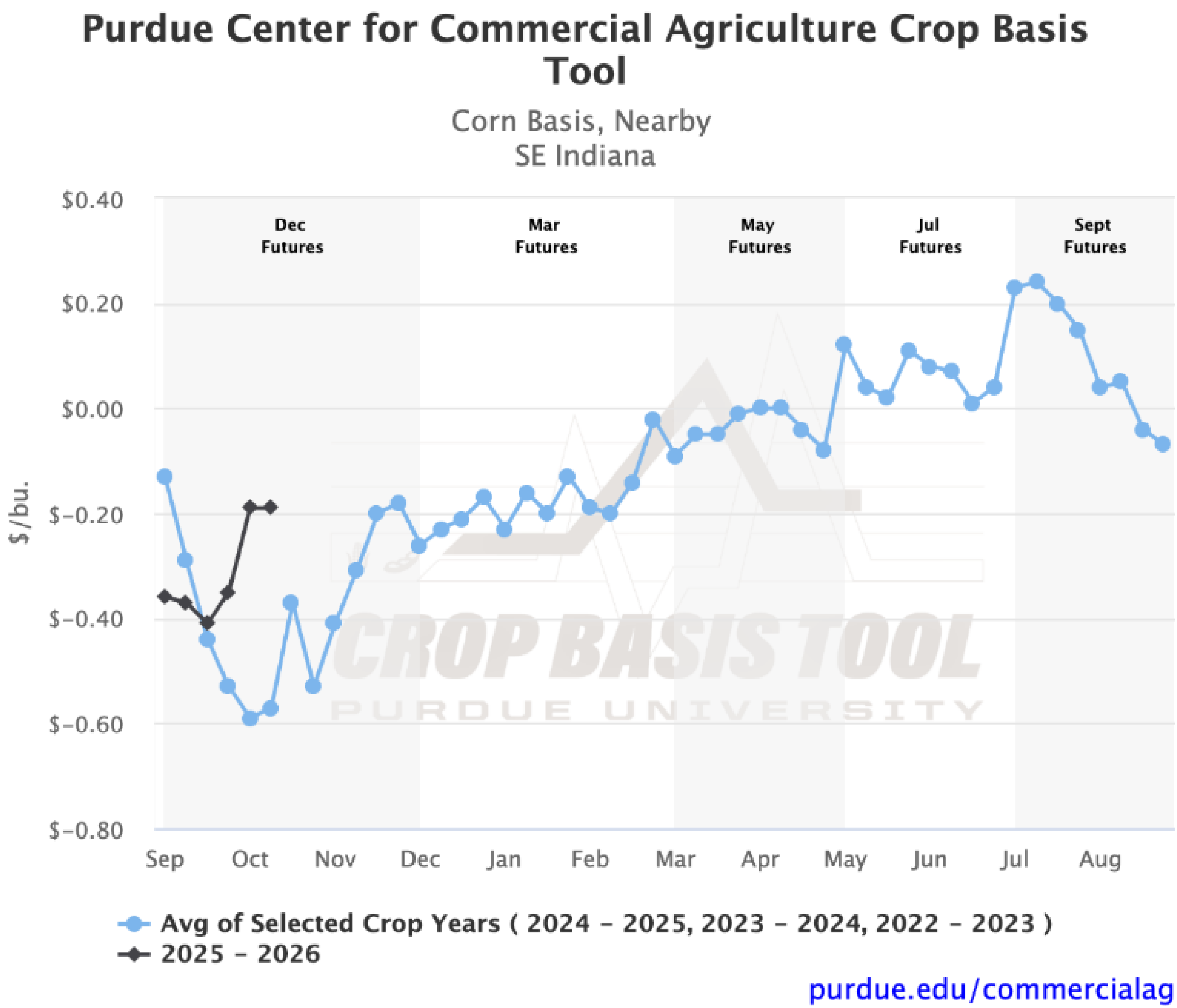
🌽 💰 Indiana Corn Basis Begins Strengthening Earlier than Previous Years

(Joshua Strine – Purdue Agricultural Economics**)**

As Indiana's corn harvest progresses, recent basis movements have pushed nearby basis levels above historical averages across much of the state. Typically, basis weakens during harvest, with nearby basis levels bottoming out between October and November. This marketing year, however, corn basis has strengthened earlier than usual in many of the USDA's Indiana crop reporting districts

Figure 1 presents nearby corn basis in Southeast Indiana as an example of the difference between the 2025 – 2026 market year and the three-year average. Historically, basis has reached its lowest point in October. In contrast, the district's basis began increasing between the third and fourth week of September this year. As a result of this earlier strengthening, the -$0.19/bu basis observed during the second week of October represents a five-year high for nearby basis in October. One possible factor driving this basis strengthening is increased export demand. Corn basis along the Ohio River is also at a five-year high for October.

Historical trends would suggest that corn basis in Indiana and across the Eastern Corn Belt should continue to increase through November. However, future gains may be limited where basis levels are above their three-year averages. Additionally, the last time corn basis was above -$0.19/bu in October for Southeast Indiana, it had fallen below the three-year average by mid-November. To see where your local corn basis may be heading, check out the Purdue Center for Commercial Agriculture Crop Basis Tool.



🌽 From Simulation to Real-World Implementation: Leveraging Crop Models for Agricultural Decisions in Corn

(Jorge Jola, German Mandrini, Pedro Cisdeli, Gustavo Santiago, and Ignacio Ciampitti, Department of Agronomy and IDAAS, Purdue University)

In recent years, farmers have been facing increasingly complex challenges. Irregular rainfall, longer dry spells, floods, and the return of certain pests and diseases are making it harder to plan and maintain stable production. On top of that, population growth in some regions is increasing the demand for food, putting pressure on agriculture to produce more without expanding farmland and losing valuable natural areas.

These changes raise important questions: what crops should we grow, where, and how can we make the most of each acre? To provide an answer to these questions, farmers and researchers need tools that can help anticipate different situations and guide better decisions in the field.

Crop models are one such tool. They allow us to simulate how crops might grow under different weather conditions, soils, and management practices. By using these models, we can better understand our production systems and test different strategies before applying them in the real world—saving time, resources, and reducing risks.

A crop model is like having a virtual version of a field on a computer. To run a simulation, the model needs information about the soil, such as how much water it can hold, how deep it is, and how much organic matter it contains, as well as data on weather, like temperature and rainfall during the crop growing season. Then the model plants a crop that starts growing on a given date.

As the crop emerges, it begins to take up water from the soil, capture sunlight, and grow. The model uses mathematical equations to represent these processes day by day. For example, if a day is sunny and warm, the model calculates how much sunlight the crop captures and converts that into growth, producing larger leaves and roots. This means that the next day the simulated crop can capture even more sunlight and continue to grow faster, if resources (for example, water and nutrients are not limited).

The model repeats this process throughout the season. Depending on the growth stage, different plant organs such as stalks, leaves, or grains develop at different

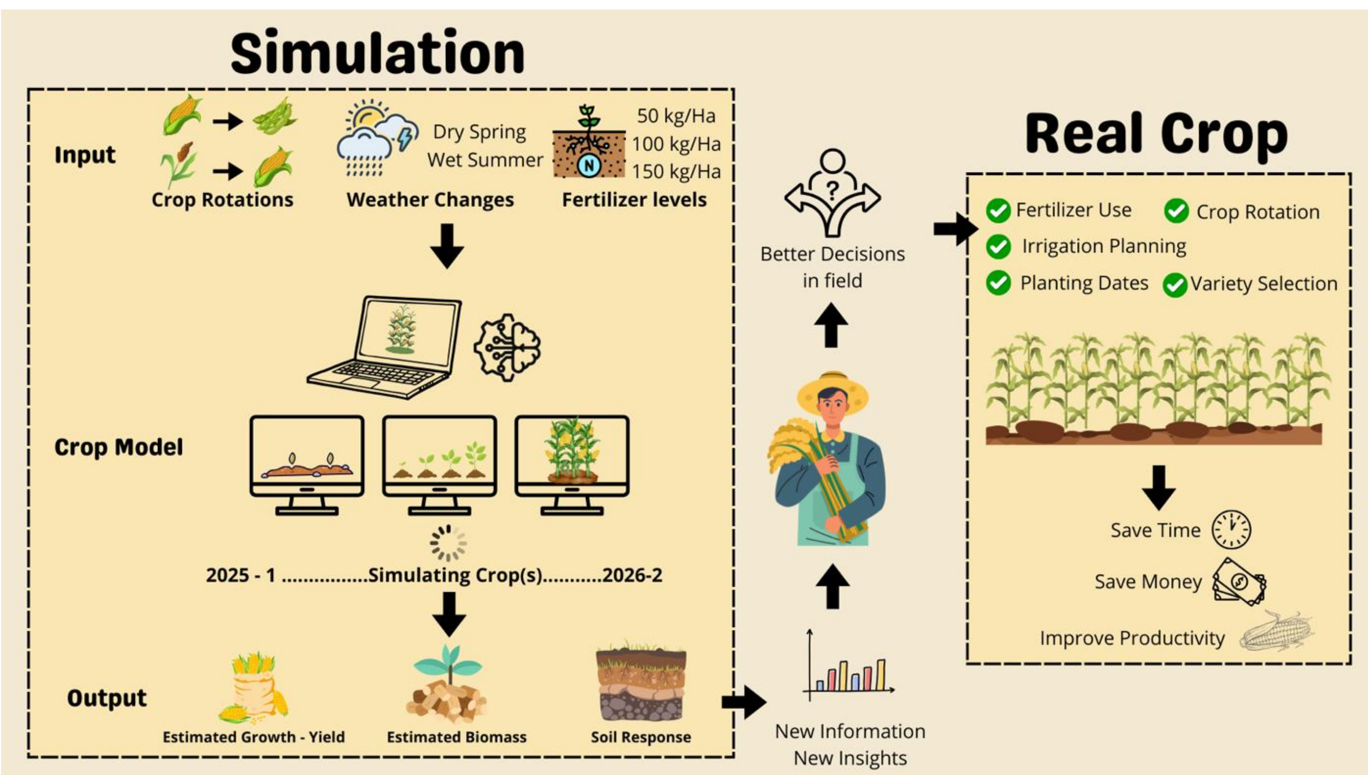


Figure 1. How a crop model helps you make smarter decisions on the farm.

rates. If a dry period occurs, the model limits crop growth according to the available soil water, reducing the growth of certain parts of the plant. In this way, the model simulates the main processes that drive crop growth through the season and ultimately estimates the attainable yield for that field and specific conditions.

These models are used to test ideas, and simulate different scenarios, without spending resources or time in the field: for example, you can see what happens if you apply more or less fertilizer, if the weather turns drier or wetter, if you change planting dates, or if you rotate crops differently. It shows which practices give the best results in a given year and long-term, and how the crop would perform before even planting it. This way, we can plan ahead and fine-tune decisions to make the most of every season.

Maize crop models have been applied for multiple purposes, providing valuable insights into which practices are implemented in both research and production, and current efforts are underway in Indiana. At Ciampitti's Lab, we are developing a workflow that will allow us to run several thousands of simulations and generate a dataset capturing how maize responds to different conditions of climate, soil, nutrition, irrigation, and more across the state of Indiana and the US Midwest region. Studies like this have already been conducted in Illinois (Mandrini G., 2022) and other states.

The insights from these simulations can help farmers make more informed decisions regarding the purchase and use of nitrogen fertilizers.

Crop models still have a long way to go. They don't always represent what happens on each farm or plot. For example, the soil data they use is often estimated, not actual measurements, and this means the results are not as accurate for each producer.

Today, areas such as artificial intelligence, satellite imagery (remote sensing), and new technologies for measuring plant growth can significantly help make them more accurate.

Similarly, we also need ground truth data. To achieve this, field experimentation must go hand in hand with computer modeling. Models can help us generate ideas for new trials, and the results will be used to improve future models.

But none of this would be possible without the support and participation of farmers, who face the real-world challenges under field conditions and have the experience we need to continue improving agriculture in this century.

References

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Mandrini G. et al. 2022. Simulated dataset of corn response to nitrogen over thousands of fields and multiple years in Illinois. *Data in Brief.*

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