CIBO

4 Ways CIBO Uses Science to Forecast Crop Yield in a Better, Brand-New Way

A unique, science-based approach empowers anyone to predict the productivity of any parcel in the U.S.

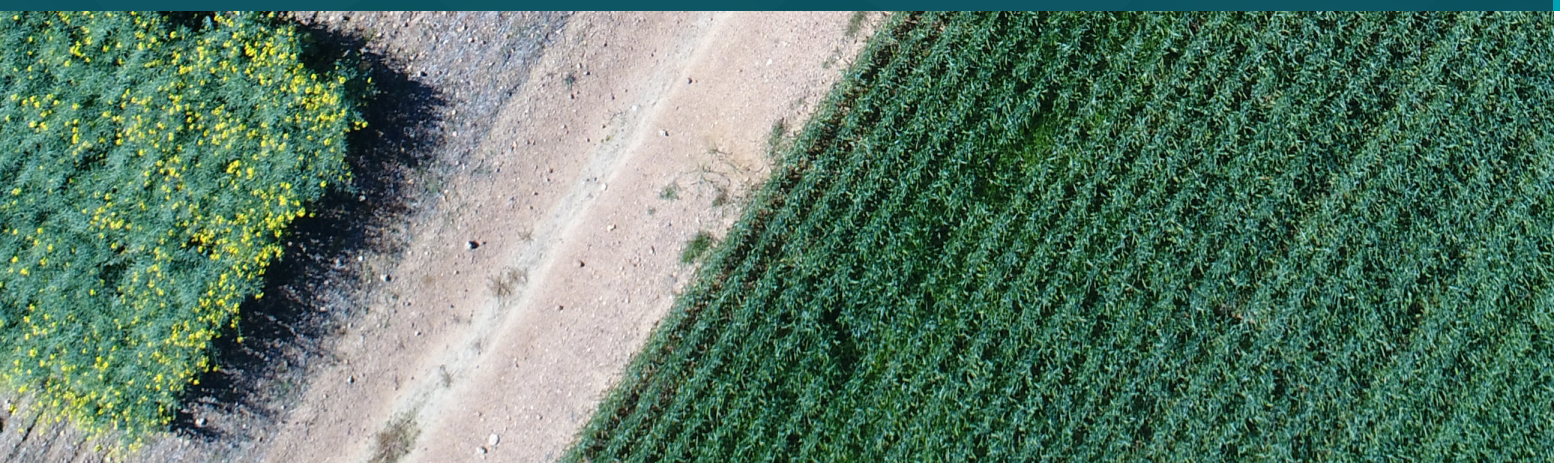


Table of Contents

Introduction

Before now, to understand the crop yield for a particular parcel for a given year, you might physically travel to that parcel and conduct a field experiment where you grow a crop, then measure the yield when the crop matures. This approach would work—but it's a long, manual process that would cost too much money and prove impossible to manage in order to achieve that same level of insight for all of the parcels across the U.S., for all years of interest.

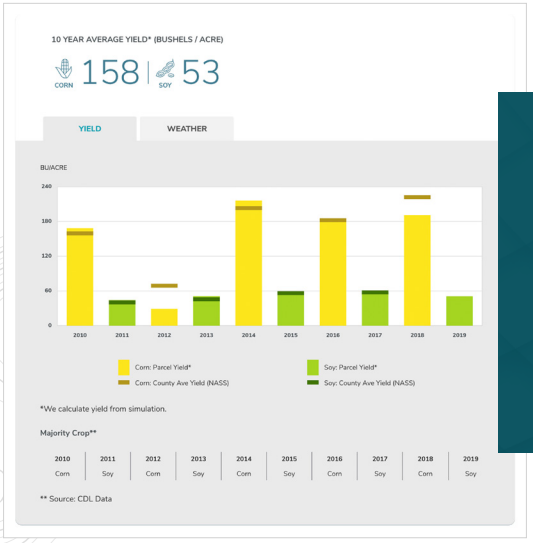
That's where CIBO's unique, science-based crop-yield forecasting technology comes in.

By combining proprietary machine learning and artificial intelligence (AI) technologies with subject matter expertise in soil, weather and agronomics, only CIBO can:

- simulate and provide a range of accurate outcomes for crop development—from planting to harvest—based upon a wide variety of different, potential scenarios;
- predict yields for current and future growing seasons, on scales from a sub-field to the entire continental U.S.; and
- become more accurate as the growing season progresses.

It's in this way—by realistically simulating a future that does not yet exist—that land stakeholders become able to accurately, effectively and objectively understand and compare the past or future yield of a parcel, field, county, state or the entire Grain Belt—and even estimate the yield for a growing season that's only just begun.

Here are four key ways CIBO uses science to forecast crop yield in a better, brand-new way.



A CIBO Parcel Report

This parcel report shows a parcel's 10-year average yield for corn and soybeans as simulated by CIBO's proprietary crop model.

1. CIBO Uses Mathematical Models to Simulate Yield

At the heart of the CIBO forecasting engine is a comprehensive crop modeling system that simulates plant growth and grain yield for a known, single field in a known growing season.

These yield forecasts culminate from a journey that encompasses:

- the **very real** (e.g., what is the soil composition of a particular field in Iowa?);
- the **speculative** (e.g., what will the weather be like this year?); and
- the **theoretical** (e.g., how will plants grow in this environment?).

But it's the "theoretical" method that differentiates CIBO's crop forecasting approach from all others.

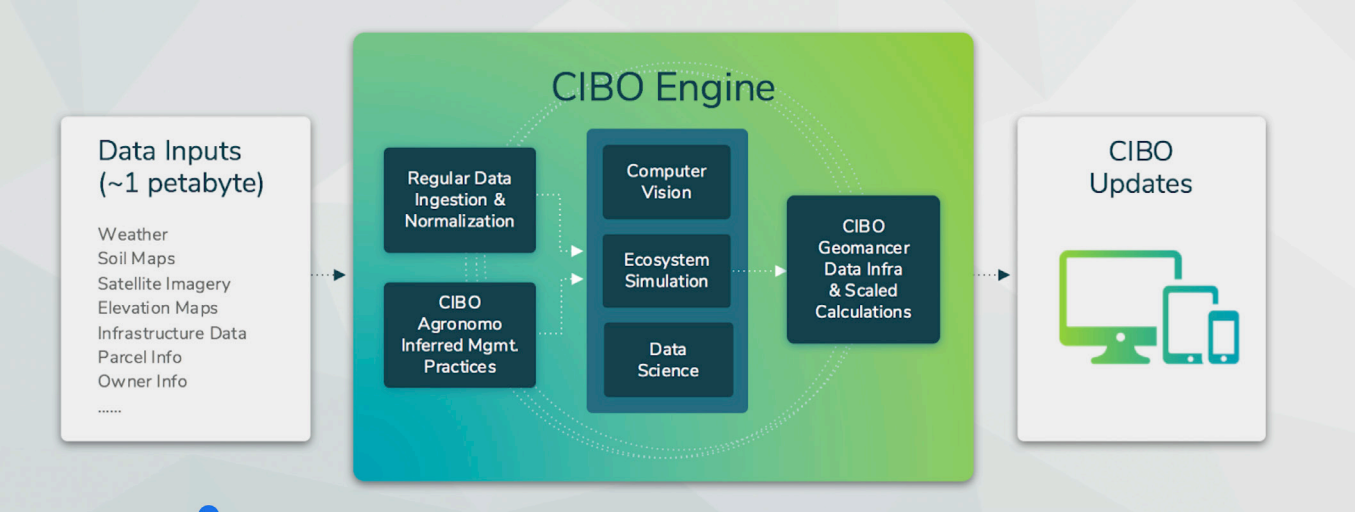
To understand how plants will grow in any given environment, CIBO builds a massive mathematical model of a plant:

1. **First, CIBO creates a "model-plant."** This model-plant is an abstract, simplified representation—*not a physical model*—of a real plant that possesses the plant's main characteristics (roots, leaves, flowers, grains, etc.).

2. **Then CIBO identifies the key parcel characteristics most likely to impact the model-plant's yield.** These determinants include things like:
   - **soil properties** (i.e., soil pH, soil texture, soil organic matter, etc.);
   - **weather** (i.e., temperature, radiation, precipitation, etc.);
   - **management practices** (i.e., planting date, planting density, amount of nitrogen applied during the season, etc.); and
   - the **characteristics of the specific crop variety that's grown** (e.g., for corn, these include its relative maturity and the number of leaves the plant produces).

3. **CIBO then builds a computer experiment.** The experiment defines the crop parameters—which crop to grow, when to grow it, where to grow it, etc.

4. **CIBO's computer experiment creates the crop model.** This mathematical model links the model-plant's characteristics to environmental variables and management practices in order to simulate yield for that parcel.

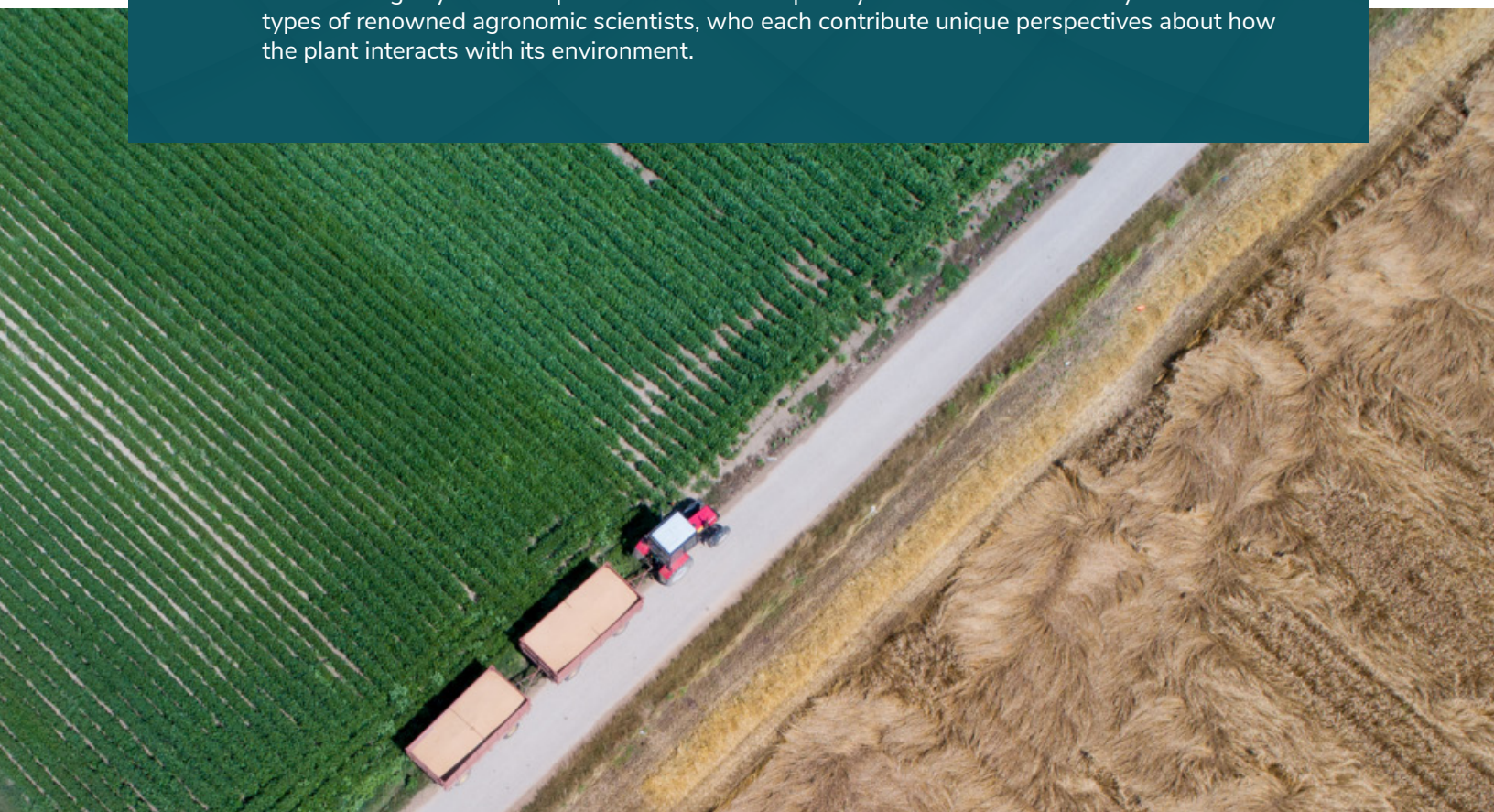


CIBO's unique, science-based approach to simulating crop yield.

A Sophisticated Simulation Process Demands Sophisticated Thinking

That's why CIBO:

- links complex plant characteristics to environmental variables and management practices in a mathematically valid way; and
- utilizes a large system of equations and interdisciplinary collaboration with many different types of renowned agronomic scientists, who each contribute unique perspectives about how the plant interacts with its environment.



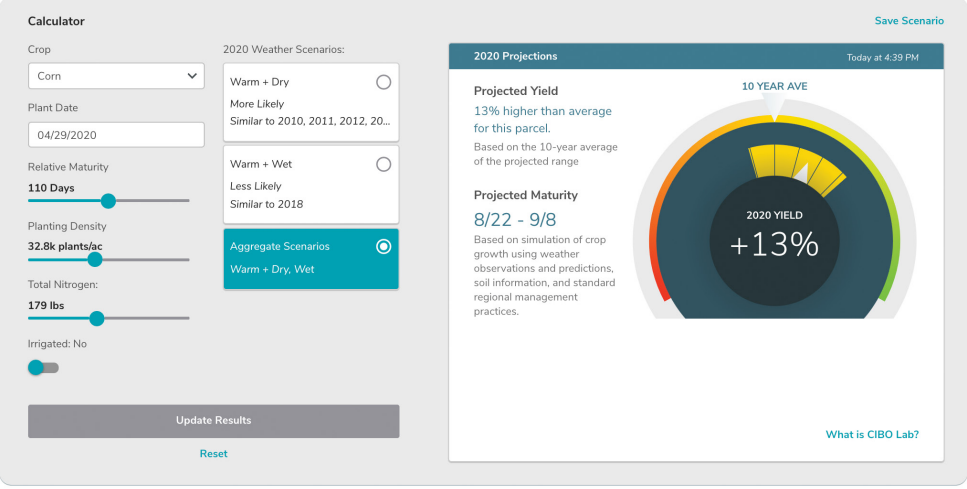
2. CIBO Predicts How Weather Will Affect Crop Yield

Accurately predicting how weather will affect individual parcels of land in an upcoming planting season is no easy task, especially when there are so many different variables at play—things like soil quality, drainage ability, and type of crop, among others.

Yet that's exactly what CIBO Lab's Yield Simulator is designed to do. By blending observed weather data with state-of-the-art seasonal predictions, CIBO Lab lets anyone simulate a range of possible weather scenarios for the new planting season.

Let's look at an example.

For this parcel of land where corn is to be planted, CIBO Lab predicts a yield that's 13% higher than the 10-year average and maturity projected to occur from Aug. 22 to Sept. 8 based upon aggregated simulations of the impact of different weather scenarios.



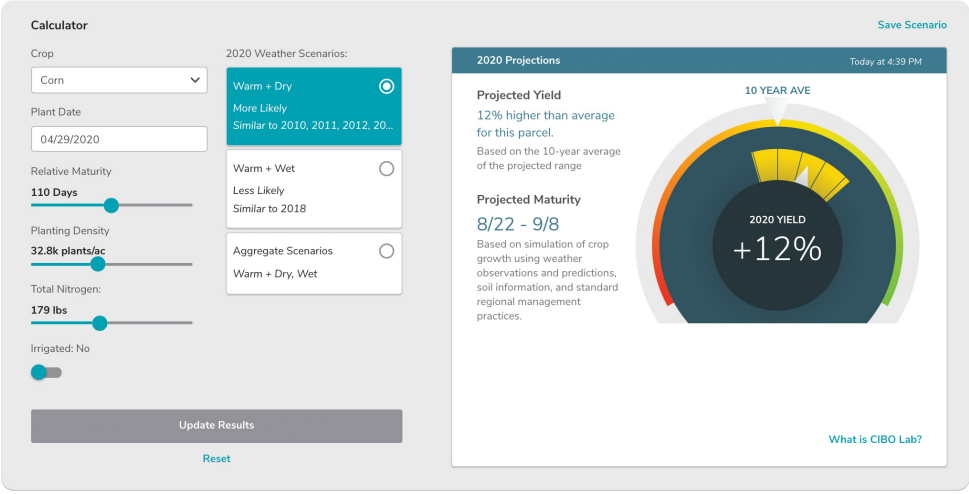
CIBO Lab's yield simulation for a parcel of land where corn is to be planted.

Using CIBO Lab's Yield Simulator, we can understand the impact two different types of weather would have on the predicted yield and maturity date.

Weather Scenario 1: Warm and Dry

The most likely scenario for this particular parcel is “Warm and Dry,” meaning weather predictions are warmer and drier than the 30-year climatology for this particular parcel.

As a result, yield is predicted to be 12% higher than the 10-year average—an estimate slightly lower than the aggregate prediction of 13%. The predicted maturity range, however, is the same as the aggregated simulations, which means most of the possible weather conditions are trending toward Warm and Dry.



CIBO Lab’s yield simulator for a parcel of land where corn is to be planted for “Warm and Dry” conditions.

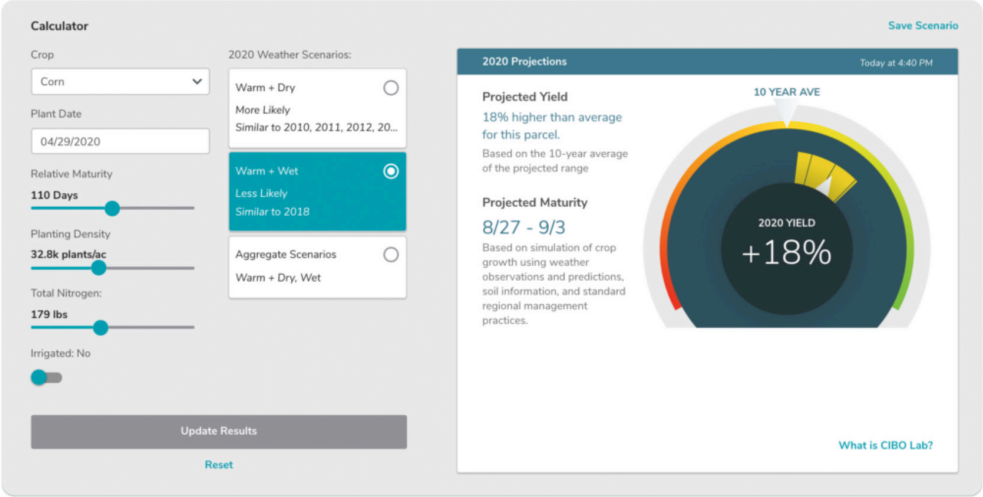
Weather as a Corn-Yield Determinant

The time it takes a corn plant to reach maturity strongly depends upon the temperature of its growing environment. Therefore, to calculate corn yield, the CIBO model would use some function of temperature to calculate the corn’s time to maturity.

Weather Scenario 2: Warm and Wet

The less likely scenario for this particular parcel is "Warm and Wet," which means the weather predictions are warmer and wetter than the parcel's 30-year climatology.

As a result, yield is predicted to be 18% higher than the 10-year average—an estimate well above the aggregate prediction of 13%. The predicted maturity range of Aug. 27 to Sept. 3 shows a slightly delayed start date but a condensed time frame compared to the aggregate simulations.

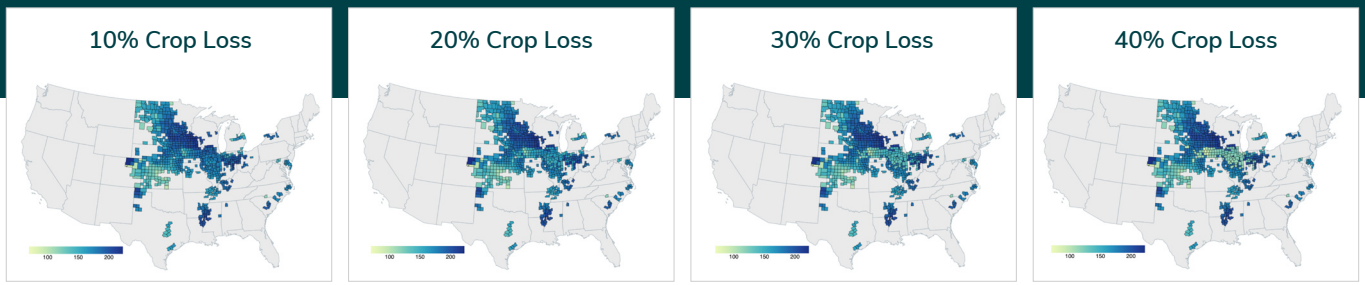


CIBO Lab's yield simulator for a parcel of land where corn is to be planted for "Warm and Wet" conditions.

CASE STUDY:

How CIBO Calculated the Derecho's Destructive Impact on Crop Yield

To understand the Aug. 10, 2020 derecho's potential impact on corn yields, CIBO Lab's Yield Simulator analyzed preliminary National Weather Service Storm Reports and used NOAA data to identify the counties—located primarily in Iowa, Illinois and Indiana—that may have sustained crop damage, then modeled four different damage scenarios that compare CIBO's original August 2020 yield predictions against different levels of crop loss in these counties. Here are the results:



**Calculations are based upon yields for counties that typically plant at least 25,000 acres of corn based upon the past 10 years of crop acreage data from the USDA Farm Service Agency.*

3. CIBO Forecasts Yield for an Entire Region

To extend yield forecasts across an entire region—for example, across the entire Corn Belt—CIBO uses an intricate, multi-step process.

1. **First, CIBO builds a profile of a "typical" farming scenario for each field.**
   1. We identify every county in the U.S. that has a significant acreage of a particular crop.
   2. We then sample fields within each county where that crop has been grown.
   3. We use publicly available data to gain insight into a field's soil composition based upon its location.
   4. We infer which crop rotations, planting dates, cultivars/maturity groups, fertilizer regimes, irrigation and other management practices are typically used in this location.

2. **Then, CIBO blends observed weather data with state-of-the-art seasonal predictions to simulate a range of possible weather scenarios for the upcoming year's growing season.**
   1. For each field, we combine the range of weather forecasts with the typical farming scenario.
   2. We feed that information into the CIBO Lab simulation system.
   3. CIBO Lab calculates a collection of possible outcomes for that field.
   4. We combine these possible outcomes across the sample of fields in a county to obtain a composite prediction for the whole county (this composite prediction can be averaged to produce a single yield, but it's often more helpful to consider the composite range of likely yields).
   5. We repeat this process for each county and for each crop in order to produce the national maps of CIBO forecasts.

Millions of Simulations

To create each of CIBO's crop yield maps, more than 15 million individual-scenario simulations of an entire growing season for a field are run. Then, each time the forecast map updates, 15 million more simulations are run/compiled.

3.

Then we repeat the process again and again.

1. As time passes, we replace weather forecasts with actual weather observations, and we create new weather forecasts.
2. As the growing season progresses, and we know more about the actual weather situation, our overall level of uncertainty about our yield forecast narrows.

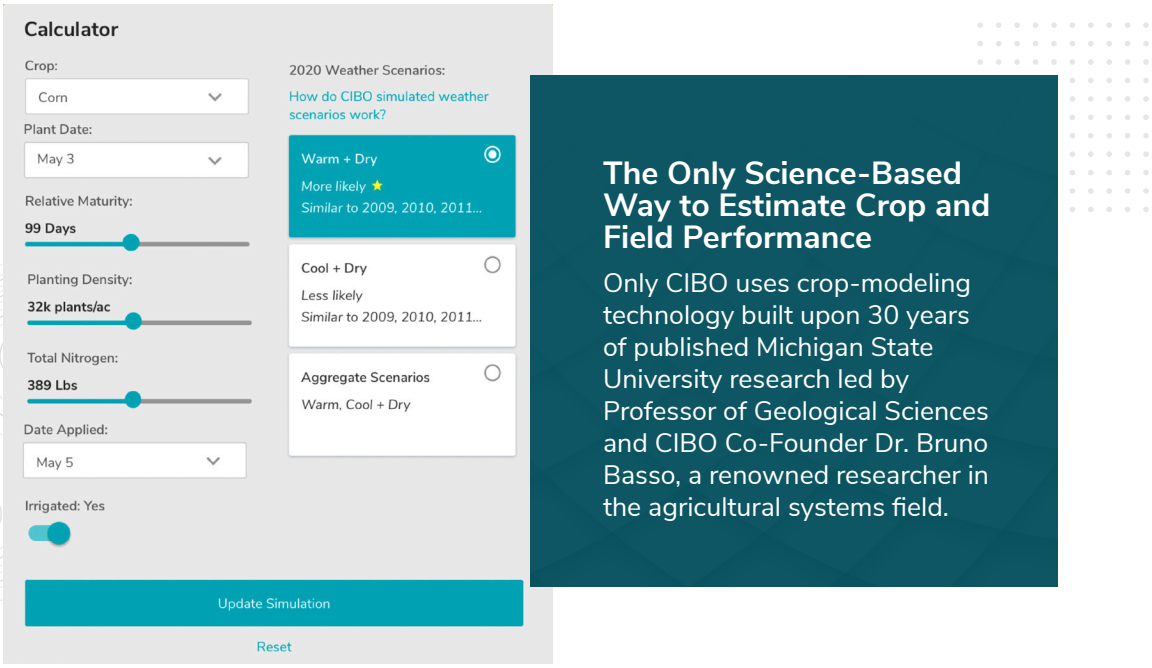
4. CIBO Empowers Any Stakeholder to Run Custom Yield Simulations

By simulating crop development—from planting to harvest—under a variety of forecast weather scenarios and management strategies, CIBO Lab delivers accurate, up-to-date yield reports unattainable anywhere else.

Even more powerfully, CIBO Lab empowers land stakeholders to accurately track and predict crop growth at each critical moment in a growing season based upon their own custom inputs.

With CIBO Lab, users can run and save an unlimited number of online simulations, easily inputting their own, specific data in order to see the predicted impact of different factors on any given parcel's yield and maturity date. Custom simulations like these help stakeholders answer important field performance questions like:

- "How is this year's weather likely to affect the yield?"
- "How will a field perform relative to its historical performance?"
- "Based upon a variety of different scenarios, when will the crops mature?"
- "How does this field compare to other fields in the county?"



Users can run custom simulations by editing the inputs in the calculator or using default values based upon regionally common farming practices.

CIBO

Conclusion

Only CIBO's unique, science-based crop growth simulation technology empowers anyone to easily and accurately forecast crop yield against multiple scenarios.

With CIBO, you can estimate yield for any corn or soybean field—at any time, at scale—by taking into consideration various management practices; weather forecasts; and actual, observed weather conditions.

Easily simulate yield for any U.S. parcel, using your own custom inputs, **FREE!**

SIGN UP FOR CIBO TODAY!