



GRO REPORT

2022 Performance Report on Gro Yield Forecast Models and Acreage Models

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Executive Summary

Gro Intelligence is an AI-driven data and analytics company helping businesses, financial institutions, and governments make better decisions on food security and climate risk.

Gro has over 2 million unique, proprietary data series that address a range of questions across crop yield and production, supply and demand, growing conditions, and climate scenarios. Gro's data series are built by our team of 50+ domain experts and scaled through artificial intelligence, generating predictive models and real-time applications. Our products provide accurate forecasts and holistic views into the most pressing challenges across climate, agriculture, and the economy.

In this report, we focus on the performance of our Global Yield Forecast Models across corn, soy, and wheat, as well as our US Planting Intentions Model and US Prevent Plant Model for corn, soy, wheat, and cotton. **This is the only report currently available in the marketplace that compares model performance against ground truth data in a comprehensive, transparent way.** Gro has always believed in transparency and access to knowledge as key pillars to moving the world towards food and climate security. **Our team of domain experts is available 24/7** to ensure that our users successfully answer their questions and access the knowledge they require.

Gro's Yield and Acreage Models are especially significant because they offer a holistic view of global food supply, a key indicator for prices and global food security. **Gro's suite of machine-learning models currently cover 80% of global production for corn, soy, and wheat. They provide an unprecedented combination of accuracy, global coverage, granularity down to the district level, and daily in-season updates.** They can be used to forecast supply and assess farmer profitability to make decisions around product pricing, sourcing, trading, or policymaking.

Gro's first predictive yield model, the US Corn Yield Forecast Model, was launched in 2016. Gro now offers 14 Yield Forecast Models for different crop/country pairings. Each yield model has been running for at least two years, meaning this performance analysis is based on years of actual, live-updating data in addition to back-tested data, a level of proven performance that is unique in the marketplace.

Our 2022 performance analysis shows that Gro's models accurately predicted yields and planted acreage, averaging within 95%-98% of final government reporting up to 10 months in advance.¹ This remains consistent with our models' performance in 2021. This report also includes historical performance data.

Key takeaways of this 2022 report include:

¹ For this report, in countries where final government reporting has not yet been published, Gro compares our model estimates to the USDA's yield estimates for those countries, current as of January 12, 2023.

- Historically, for the past seven years, Gro’s US Corn Yield Forecast Model has been on average within 98.3% of the USDA final January report by September (i.e., four months in advance). Our US Soybean Yield Forecast Model has been on average within 99% of the USDA’s final number by September (i.e., four months in advance) for the last four years.
- This remained true during the 2022 US growing season. **By September, Gro’s forecasts for corn and soy were already within 98% of the USDA’s final January reporting.** Gro’s models thus provided an earlier view of final numbers, allowing customers to move ahead of the market.

Gro Corn Yield Model vs USDA, 2022



Source: Gro Intelligence, USDA

During the 2022 growing season, Gro’s US Corn Yield Forecast Model was showing yields consistently below USDA estimates starting in June, providing early insight into lower-than-expected production and potentially lower exports. The model dropped mid-season due to extreme high temperatures, recovering a bit in August as conditions improved. The forecasts stabilized in September and were already within 98% of USDA final January reporting.

- In critical global regions, where the current marketplace does not have many machine learning-based predictive models, such as Ukraine, Brazil, and China, **Gro’s 2022 Global Yield Forecast Models were on average 95% accurate up to 10 months ahead of final government reporting.**

- Gro's **US Planting Intentions Model** for corn and soybeans did not initially account for the surge in fertilizer prices in early 2022. As a result, our model's estimates, published early February, were higher than the USDA's Prospective Plantings report, published March 31, 2022. After we substantially improved our Planting Intentions Model to incorporate fertilizer prices, our **estimates for corn and soybeans planting intentions showed significant improvement and were within 98% of the USDA's March 31 report.**

Gro's Global Yield Forecast Models leverage high-resolution satellite data that captures every field in every district or province, not just random fields as with traditional crop survey methods, making the data more precise. Our Yield Forecast and Acreage Models are significantly more accurate and available earlier because:

- **Research and data science** - Our team of 50+ experienced data scientists and research analysts, who have backgrounds in commodity trading, crop science, climate science, agronomy, and more, have worked together to develop the best possible models. We leverage human intelligence, which is then scaled through artificial intelligence.
- **Comprehensive global data sources and variables** - Our forecasts incorporate a combination of Gro's extensive suite of climate, environmental, and crop condition data alongside other variables. Gro has spent the past nine years building up the world's largest platform dedicated to food security, agriculture, and the economy.
- **Geospatial expertise** - Gro's geospatial team creates proprietary crop covers² for each yield model to enhance the explanatory power of climate variables.
- **Machine and human learning** - Our machine-learning models constantly improve as additional ground truth data comes in, and our in-house domain experts examine this data to create new predictive features.

² A crop cover is a crop-specific land cover data layer showing what parts (or %) of a specific area are growing a specific crop.

Accurate Yield and Acreage Forecasts Months Before Government Reports Are Released

Gro Intelligence’s predictive models help inform a customer’s view of global grain and oilseed supply, demand, and revenue months ahead of final government reporting.

Gro’s suite of machine-learning models currently cover 80% of global production for corn, soy, and wheat. Our forecast models provide in-season yield estimates at the district, province, and/or national levels on a daily basis. Gro’s models incorporate satellite-based data and near real-time environmental and growing conditions, including vegetative health, soil moisture levels, and GFS 7-day forecasts. This unique methodology enables Gro to forecast final government reporting, such as final USDA estimates, months in advance.

Customers use our models to monitor crop production in the world’s top-producing countries. They help users track in-season crop yields, gauge crop availability and crop prices, and understand how weather is impacting yields on the ground at the district level. This information can be used to assess farmer profitability and forecast supply to make pricing, sourcing, or trading decisions.

Gro’s Yield Forecast Model and Acreage Model estimates are accurate – which Gro defines as within 90%-99.9% of final government reporting – 1-10 months in advance, depending on the crop/country pairing.

As opposed to waiting for final government reporting, Gro’s customers can get an earlier, accurate understanding of crop availability. This enables our customers to “see around the corner” and make confident, informed decisions much sooner.

Final government reporting is released at various points during the calendar year, depending on the country and crop (see a chart of release dates in the appendix).

Yield Forecast Models: Up to 10 Months Ahead of Final Government Reporting

Available Models Include (Year Launched):

- **US:** Corn (2016), Soy (2018), Hard Red Winter (HRW) Wheat (2019)
- **Argentina:** Corn (2020), Soy (2020)
- **Australia:** Wheat (2021)
- **Brazil:** Corn (2020), Soy (2020)

- **Canada:** Wheat (2020)
- **China:** Corn (2019), Wheat (2021)
- **India:** Wheat (2018)
- **Russia:** Winter Wheat (2019)
- **Ukraine:** Wheat (2019)

Country	Crop	# of Months Gro Accurately Predicts Ahead of Government Estimate ³
Argentina	Corn	5-6
Argentina	Soybean	5-6
Brazil	Corn	6
Brazil	Soybean	6
Canada	Spring Wheat	1-2
China	Corn	3
China	Winter Wheat	N/A ⁴
India	Wheat	5
Russia	Winter Wheat	8
Ukraine	Wheat	10
US	Corn	4
US	Soybean	4
US	HRW Wheat	6

Acreage Models: 2-6 Months Ahead of Final Government Reporting

Gro's US Planting Intentions and Prevent Plant Models estimate planted area for the

³ The number of months can vary year to year due to irregular reporting dates by a government source. Gro accuracy is 90-99% on an average absolute basis across models.

⁴ The National Bureau of Statistics of China (NBS) has not released winter wheat yield since 2018.

upcoming US season. Our acreage models provide county- or state-level forecasts that can be used to gain a regional view.

- **Our US Planting Intentions Model** for corn, soybeans, wheat, and cotton projects how much land will be devoted to major crops in the coming year based on farm-level economics. The model considers a complex set of price relationships to predict farmer behavior.
- **Our US Prevent Plant Model** estimates the number of acres that have been prevented from being planted at the county and national levels well ahead of the USDA’s FSA Crop Acreage Data report. These estimates allow our customers to measure the impact of lost acreage on demand for seeds and inputs. The model uses spatially explicit environmental data to predict the amount of acreage the farmers will be unable to plant.

Governments, financial institutions, and companies can leverage these models to predict planted acreage for corn, soybeans, cotton, and wheat, to forecast state and regional seed and crop protection demand and to understand US production of important global crops.

Model	Country	Crop	# of Months Gro Accurately Predicts Ahead of Final January Government Estimate
Prevent Plant	US	Corn	6 ⁵
Prevent Plant	US	Soybean	6

Model	Country	Crop	# of Months Gro Accurately Predicts Ahead of Final March Government Estimate
Planting Intentions	US	Corn	2
Planting Intentions	US	Soybean	2
Planting Intentions	US	Wheat	2
Planting Intentions	US	Cotton	2

⁵ USDA Farm Service Agency (FSA) publishes final reporting in January.

Yield Forecast Model Performance: Final Numbers

Gro's US Yield Forecast Models Are Historically Within 98% of Final Government Reporting

On average, our US Yield Forecast Models for corn and soy are **within 98% of the USDA's final January numbers four months before** those final numbers are released. Final numbers show the official government record for the season's crop yield. Comparing this to Gro's final model number shows how accurate our models are and also indicates which models need to be improved. It also allows us to see how far in advance Gro's model began forecasting the final number.

Historically, for the past seven years, Gro's US Corn Yield Forecast Model has been on average within 98.3% of the USDA final January report by September (i.e., four months in advance). Our US Soybean Yield Forecast Model has been on average within 99% of the USDA's final number by September (i.e., four months in advance) for the past four years.

In September 2022, we were within 98% of the agency's final January numbers for soybeans and corn. Gro's forecasts clearly indicated early in the season that crop conditions were well below trend three months before the USDA started cutting its yield estimates in August.

Globally, our Yield Forecast Models are within 90%-99% of final government reporting up to 10 months before official figures are released. Final government reporting is released at various points during the calendar year, depending on the country and crop (see a chart of release dates in the appendix).

The following sections compare the performance of Gro's Yield Forecast Models against final government reporting for each respective crop/country combination. We show US 2022 growing season performance, as well as final, end-of-year yield forecasts.

Forecasts at early stages of the growing season are preliminary. As the season progresses, and changes in growing conditions alter crop prospects, Gro's Yield Forecast Models become more accurate. The models update daily.

Gro US Yield Forecast Model Performance, 2022 | **US GROWING SEASON**

During the US corn and soybean growing season, Gro compares our Yield Forecast Model estimates to the USDA's monthly WASDE report. As the USDA's September WASDE report is the first US government report to incorporate data from the agency's objective yield plots, it is an especially pivotal report.

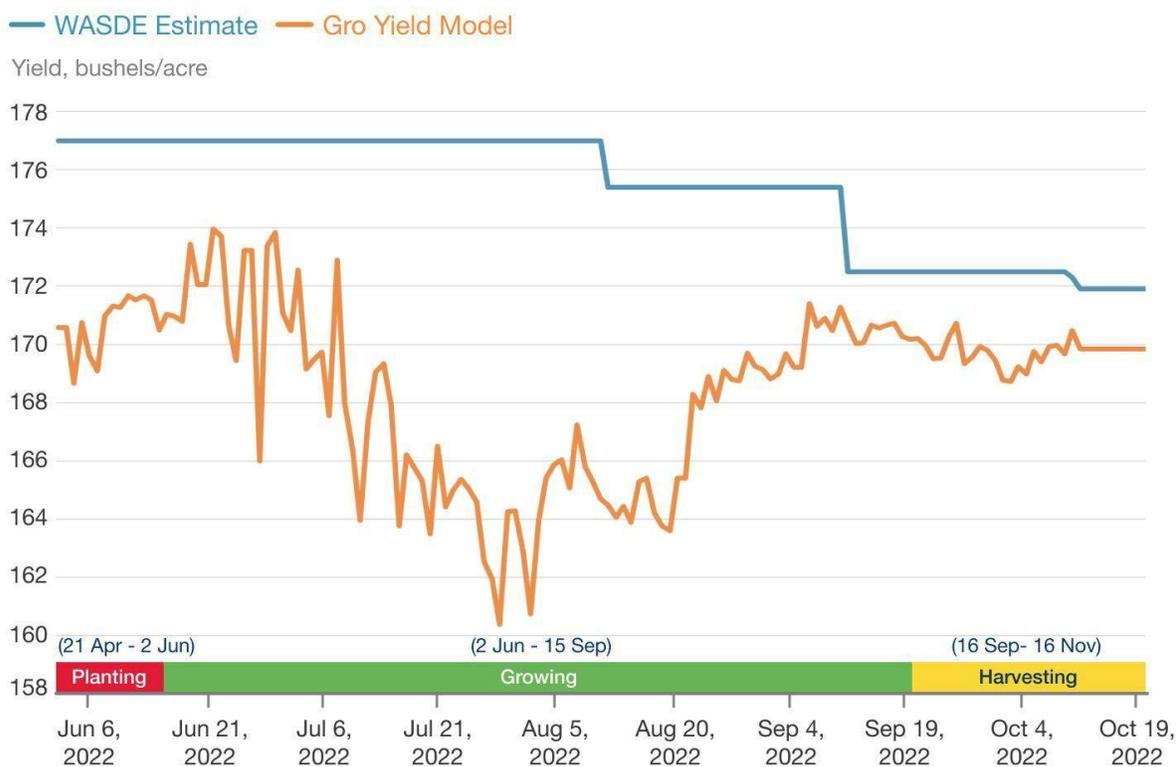
This year, in its September WASDE, the USDA cut its corn yield estimate to 172.5 bushels per acre and its soybean yield to 50.5 bu/acre, bringing both crops' yield forecasts closer to projections that Gro's US corn and US soybean models were making all season.

Then, ahead of the USDA's October WASDE, our in-season US corn and soybean models predicted that the USDA would lower its US corn and US soybean yield estimates. When the WASDE was released on October 12, the USDA cut its national corn yield forecast by 0.3% and its soybean yield forecast by 1.4%, compared with its September forecast.

This adjustment in October brought the USDA's estimate even closer to forecasts by Gro's machine-learning yield models, which use satellite-based data and near real-time environmental and growing conditions to generate yield forecasts for each county and state, as well as a national yield forecast, each day.

When Gro's forecasts for corn and soybeans stabilized in September, they were already within 98% of the USDA's final January reporting.

Gro Corn Yield Model vs USDA, 2022



Source: Gro Intelligence, USDA

During the 2022 growing season, Gro's US Corn Yield Forecast Model was showing yields consistently below USDA estimates starting in June, providing early insight into lower-than-expected production and potentially lower exports. The model dropped mid-season due to extreme high temperatures, recovering a bit

in August as conditions improved. The forecasts stabilized in September and were already within 98% of final reporting.

Gro Yield Forecast Performance, 2018-2022 | **US SOYBEAN**

Gro's model provides forecasts within 99% of the USDA's final reporting.

Country	Crop	Harvest Year	Gro Final Forecast bu/acre	Final (January) Number WASDE
US	Soybean	2018	50.61	50.60
US	Soybean	2019	46.65	47.40
US	Soybean	2020	51.45	51.00
US	Soybean	2021	51.12	51.20
US	Soybean	2022	48.87	49.5

Gro Yield Forecast Performance, 2018-2022 | **BRAZIL SOYBEAN**

Gro's model provides forecasts within 98% of the Brazilian Institute of Geography and Statistics' (IBGE) final reporting.

Country	Crop	Harvest Year	Gro Final Forecast t/ha	Final October Number IBGE
Brazil	Soybean	2020	3.23	3.28
Brazil	Soybean	2021	3.37	3.45
Brazil	Soybean	2022	2.98	2.92

Gro Yield Forecast Performance, 2016-2022 | **US CORN**

Gro's model provides forecasts within 98% of the USDA's final reporting.

Country	Crop	Harvest Year	Gro Final Forecast bu/acre	Final January Number WASDE
US	Corn	2016	171.02	174.60
US	Corn	2017	176.86	176.60
US	Corn	2018	177.48	176.40
US	Corn	2019	170.02	167.50
US	Corn	2020	180.64	171.40
US	Corn	2021	177.36	177.00
US	Corn	2022	169.83	173.3

Gro Yield Forecast Performance, 2021-2022 | **BRAZIL CORN**

Gro's model provides forecasts within 99.6% of the IBGE December report's final number.

Country	Crop	Harvest Year	Gro Final Forecast t/ha	Final December Number IBGE
Brazil	Corn	2021	5.02	4.65
Brazil	Corn	2022	5.34	5.32⁶

⁶ The IBGE final number has not yet been released. Instead, we compare to the USDA's yield estimates, current as of January 12, 2023.

Gro Yield Forecast Performance, 2018-2022 | ARGENTINA CORN & SOYBEAN

Gro's model provides forecasts within 97% of the Ministry of Agriculture's (MAGyP) final number.

Country	Crop	Harvest Year	Gro Final Forecast t/ha	Final Sep-Dec Number Ministry of Agriculture
Argentina	Soybean	2018	2.30	2.32
Argentina	Soybean	2019	3.21	3.33
Argentina	Soybean	2020	2.90	2.92
Argentina	Soybean	2021	2.88	2.81
Argentina	Soybean	2022	2.84	2.76

Gro's model provides forecasts within 97% of the Ministry of Agriculture's (MAGyP) final number.

Country	Crop	Harvest Year	Gro Final Forecast t/ha	Final October Number Ministry of Agriculture
Argentina	Corn	2021	7.02	7.43
Argentina	Corn	2022	6.53	6.73

Gro Yield Forecast Performance, 2019-2022 | CHINA CORN AND WHEAT

Gro's model provides forecasts within 96% of China's National Bureau of Statistics' (NBS) final number.

Country	Crop	Harvest Year	Gro Final Forecast t/ha	Final December Number China NBS
China	Corn	2019	6.22	6.32
China	Corn	2020	6.29	6.32
China	Corn	2021	6.57	6.29
China	Corn	2022	6.68	6.44

China NBS has not released final yield numbers for wheat since 2018.

Country	Crop	Harvest Year	Gro Final Forecast t/ha	Final Number China NBS
China	Winter Wheat	2020	5.67	N/A
China	Winter Wheat	2021	5.99	N/A
China	Winter Wheat	2022	6.18	N/A

Gro Yield Forecast Performance, 2019-2022 | US HARD RED WINTER WHEAT

Gro's model provides forecasts within 90% of the USDA's final January Annual Production Report.

Country	Crop	Harvest Year	Gro Final Forecast bu/acre	Final January Number USDA ERS - Wheat Yearbook
US	Hard Red Winter Wheat	2019	44.24	48.18
US	Hard Red Winter Wheat	2020	42.83	42.22
US	Hard Red Winter Wheat	2021	45.02	43.62
US	Hard Red Winter Wheat	2022	38.49	34.82

Gro Yield Forecast Performance, 2019-2022 | UKRAINE WHEAT

Gro's model provides forecasts within 97% of the UkrStat's final number.

Country	Crop	Harvest Year	Gro Final Forecast t/ha	Final April Number UkrStat
Ukraine	Wheat	2019	4.34	4.16
Ukraine	Wheat	2020	3.91	3.71
Ukraine	Wheat	2021	4.20	4.46
Ukraine	Wheat	2022	4.04	3.9⁷

⁷ The UkrStat final number has not yet been released. Instead, we compare to the USDA's yield estimates, current as of January 12, 2023.

Gro Yield Forecast Performance, 2018-2022 | INDIA WHEAT

Gro's model provides forecasts within 93% of the USDA Production, Supply, and Distribution's (PS&D) final number.

Country	Crop	Harvest Year	Gro Final Forecast t/ha	Final September Number USDA PS&D
India	Wheat	2018	3.10	3.37
India	Wheat	2019	3.22	3.53
India	Wheat	2020	3.23	3.44
India	Wheat	2021	3.57	3.46
India	Wheat	2022	3.61	3.37

Gro Yield Forecast Performance, 2019-2022 | RUSSIA WHEAT

Gro's model provides forecasts within 91% of the final number from EMISS (Russian Official Estimates).

Country	Crop	Harvest Year	Gro Final Forecast t/ha	Final March Number EMISS
Russia	Winter Wheat	2019	3.44	3.41
Russia	Winter Wheat	2020	3.76	3.77
Russia	Winter Wheat	2021	3.62	3.43
Russia	Winter Wheat	2022	3.82	4.17⁸

⁸ The EMISS final number has not yet been released. Instead, we compare to the USDA's yield estimates, current as of January 12, 2023.

Gro Yield Forecast Performance, 2020-2022 | CANADA WHEAT

Gro’s model provides forecasts within 97% of StatCan’s final number.

Country	Crop	Harvest Year	Gro Final Forecast t/ha	Final November Number StatCan
Canada	Spring Wheat	2020	3.56	3.60
Canada	Spring Wheat	2021	3.37	2.53
Canada	Spring Wheat	2022	3.71	3.61

Acreage Model Performance: Final Numbers

Gro’s US Planting Intentions Model Within 98% of USDA’s March 31 Report

Gro’s **US Planting Intentions Model** for corn and soybeans did not initially account for the surge in fertilizer prices in early 2022. As a result, our model’s estimates, published in early February, were higher than the USDA’s Prospective Plantings report, published March 31, 2022.

After we substantially improved our Planting Intentions Model to incorporate fertilizer prices, our **estimates for corn and soybeans planting intentions showed significant improvement and were within 98% of the USDA’s March 31 report.** For this report, we show the initial model forecast, prior to the improvements.

For wheat and cotton, our 2022 US Planting Intentions Model estimates were within 98% of the report published March 31.

The following chart displays final numbers across Gro’s model forecast, the USDA’s March 31 report, and the final USDA report released in January.

Gro Planting Intentions Performance, 2021-2022 | US CORN, SOYBEANS, WHEAT, & COTTON

Country	Crop	Harvest Year	Gro Forecast Million acres	USDA NASS March Prospective Plantings million acres	Final Acreage January USDA NASS million acres
US	Corn	2021	93.14	91.14	93.30
US	Soybeans	2021	88.56	87.60	87.20
US	Wheat	2021	44.33	46.36	46.74
US	Cotton	2021	15.11	12.04	11.22
US	Corn	2022	94.96⁹	89.49	88.58
US	Soybeans	2022	84.80	90.96	87.45
US	Wheat	2022	48.31	47.35	45.74
US	Cotton	2022	12.45	12.23	13.76

Gro’s US Prevent Plant Model Within 99% of USDA’s Farm Service Agency (FSA) Report

Flooding in the Red River Valley coupled with delayed planting pushed year-over-year prevent plant acres higher in 2022. Gro’s US Prevent Plant Model estimates from June were within 99% of the USDA’s final reported number in January.

⁹ Gro’s 2022 US Corn & Soybeans planting intentions estimates did not factor in the skyrocketing fertilizer prices seen earlier in the year. The model now incorporates fertilizer prices.

Gro Prevent Plant Performance, 2019-2022 | US CORN & SOYBEANS

Country	Crop	Harvest Year	Gro Forecast As of End June million acres	January Final Number USDA FSA million acres
US Corn Belt ¹⁰	Yellow Corn & Common Soybeans, non-irrigated	2019	10.30	11.13
US Corn Belt	Corn & Soybeans	2020	3.34	5.26
US Corn Belt	Corn & Soybeans	2021	0.54	0.38
US Corn Belt	Corn & Soybeans	2022	3.18	3.22

Accessing Yield Model Forecasts and Acreage Models

Gro’s yield and acreage models update daily in-season in a variety of formats.

- **API access** allows teams to incorporate all of the inputs included in our yield and acreage models into their own workflows.
- **Global Yield Forecast Models** - available with a Premium subscription.
- **US Planting Intentions Model** - available with a Premium subscription.
- **US Prevent Plant Model** - available with a Premium subscription.

¹⁰ US Corn Belt includes IA, IL, IN, OH, KS, NE, MO, MN, SD, ND, and WI

Conclusion

Gro has over 2 million unique, proprietary data series that address a range of questions across yield and production, supply and demand, growing conditions, and climate scenarios. Gro's data series are built by our team of 50+ domain experts and scaled through artificial intelligence to generate predictive models and real-time applications. Our products provide accurate forecasts and holistic views into the most pressing challenges across climate, agriculture, and economy.

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- In critical global regions, where the current marketplace does not have many machine learning-based predictive models, such as Ukraine, Brazil, and China, **Gro's 2022 Global Yield Forecast Models were on average 95% accurate up to 10 months ahead of final government reporting.**
- Gro's **US Planting Intentions Model** for corn and soybeans did not initially account for the surge in fertilizer prices in early 2022. As a result, our model's estimates, published in early February, were higher than the USDA's Prospective Plantings report, published March 31, 2022. After we substantially improved our Planting Intentions

Model to incorporate fertilizer prices, our **estimates for corn and soybeans planting intentions showed significant improvement and were within 98% of the USDA's March 31 report.**

Gro has spent the past nine years building up the world's largest platform dedicated to food security, agriculture, and the economy. Gro's predictive models provide unparalleled forecasting accuracy because they leverage unique skill sets across domain expertise, machine-learning capabilities, and data science. Our forecasts incorporate a combination of Gro's extensive suite of climate, environmental, and crop condition data alongside other variables.

| About Gro

Gro Intelligence illuminates the interrelationships between the earth's ecology and human economy. Our system is curated by human intelligence and scaled through artificial intelligence, enabling companies and countries to both see the big picture and act on the small details.

Gro's globally comprehensive data and forecast models cover a variety of subjects, geographies, and environmental conditions. By examining and translating the intersectional effects of supply, demand, price, climate, pests, and disease, the Gro platform provides meaningful, actionable insights. Our mission is to help customers make decisions with confidence.

[Schedule a demonstration](#) to learn more about our models.

NEW YORK

505 Park Avenue, 12th Floor

New York, NY 10022 USA

+1 718 935 0100

NAIROBI

Eldama Park, Block A, 2nd Floor

Eldama Ravine Rd., Westlands

Nairobi, Kenya, P.O. Box
14410-00800

+254 788 448 678

+254 202 186 996

SINGAPORE

71 Robinson Road, #14-01
Singapore, 068895

Appendix

When Do Government Agencies Typically Release Their Final Yield Estimates?

Country	Crop	Source	Month the government issues its final yield estimates
Argentina	Corn	The Ministry of Agriculture, Forestry, and Fisheries (MAGyP)	September-October
Argentina	Soybean	The Ministry of Agriculture, Forestry, and Fisheries (MAGyP)	September-October
Brazil	Corn	Instituto Brasileiro de Geografia e Estatística (IBGE)	October-December
Brazil	Soybean	Instituto Brasileiro de Geografia e Estatística (IBGE)	October-December
Canada	Spring Wheat	Statistics Canada's (StatCan)	November
China	Corn	The National Bureau of Statistics of China (NBS)	December
China	Winter Wheat	The National Bureau of Statistics of China (NBS)	N/A ¹¹
India	Wheat	The Department of Agriculture and Farmers Welfare	August
Russia	Winter Wheat	Russia United Interdepartmental Information and Statistical System (EMISS)	March
Ukraine	Wheat	State Statistics Service of Ukraine (Ukrstat)	April
US	Corn	USDA Annual Crop Production Summary	January
US	Soybean	USDA Annual Crop Production Summary	January

¹¹The National Bureau of Statistics of China (NBS) has not released winter wheat yield since 2018.

US HRW Wheat USDA Annual Crop
Production Summary January

When Does The USDA Issue Its Final Planted Acreage Estimates?

Model	Country	Crop	Month the USDA releases initial prevent plant estimates	Month the USDA releases final prevent plant estimates
Prevent Plant	US	Corn	August	January
Prevent Plant	US	Soybean	August	January

Model	Country	Crop	Date the USDA releases planting intentions estimates
Planting Intentions	US	Corn	March 31
Planting Intentions	US	Soybean	March 31
Planting Intentions	US	Wheat	March 31
Planting Intentions	US	Cotton	March 31

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