AGROVIVE™

2018 Farm Evaluations

Introduction

Agrovive has developed and tested microbial based products for use with all types of crops to improve yield and quality. The concept for development of such products is not new, but Agrovive uses state-of-the-art technology and expertise to identify and evaluate beneficial microbes for this application. Field trials have been underway for the past 2 years. Agrovive products are currently registered and approved for sale in many major agricultural markets in the US. Canadian registration is in the works and should be available in the fall of 2018. Agrovive has began commercial scale production of the products that have shown the greatest promise for improving crop production and acceptance into the marketplace.

Introduction

In 2017, three products, IONfx, AlfaJoule, and HydraVal, were introduced, registered and approved for sale to farmers for use on several crops, most notably, wheat, soybeans, corn, and alfalfa.

In 2018, these products were introduced and sold to growers for real-world commercial application. IONfx, and AlfaJoule were sold directly to farmers in South Dakota, North Dakota and Minnesota. In Kansas and Idaho, they were marketed through local retailers to farmers. Hydraval was sold on a limited basis for use on sunflowers in South Dakota.

Crops

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2018 Solutions

Agrovive desires to increase the sustainability and productivity of farms, and profitability to farmers. This is not only for the United States and Canada, but worldwide. Demand for food globally is ever increasing. Innovative approaches to food production are needed to keep up with an expanding global population. Microbial technology applied to food production provides an opportunity to bring agriculture to a simpler, but more effective approach to food production and rebuilding soil health and sustainability.

2018 Solutions

Agrovive products are being evaluated during the 2018 growing season on the following crops:

Wheat	Flax	Corn
Alfalfa	Canola	-Silage
Soybeans	Chickpeas	-Grain

Crop Specific Evaluations

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Crop production considerations related to product evaluation

1) Evaluation of production application methods – Seed and foliar application
2) Soil Conditions – productivity, soil amendments, drainage, tilth, chemistry, etc.
3) Crop rotation programs from year to year
4) Planting methods
5) Soil fertilization programs and nutrient levels
6) Pesticide programs – and effects on product microbial populations and viability

Application Specific Evaluations

The earlier in the growth cycle of the crop the greater the observed response in all crops evaluated. Thus, seed coat application was the most effective and efficient in application of inoculum. This was most evident with IONfx which was applied to corn, wheat, and soybean seeds. Practical seed application methods to apply Agrovive products to crops such as canola, sugar beets, and cotton seed need to be developed to gain the greatest benefits from the use of Agrovive products. This is one area of research that Agrovive intends to invest significant effort. This should provide benefit to the producers, and to increase the market share of Agrovive products.

Plant Strength Observations

Decrease in Crop Fungal Disease

An overall decrease in fungal diseases was observed in all crops that were treated with Agrovive products. It is not assumed that Agrovive products have pesticidal properties, but that the decrease in disease is attributed to the overall health and robust growth of the plants treated with Agrovive products.

Peas

Without and With disease

Wheat

Without and With Disease

Wheat

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In-Field Sample Collection

Three (3) treatments were evaluated – 1) Seed Treated, 2) Foliar Treated, 3) Untreated Control.

From the fields each treatment present was sampled five (5) times by using a matched pair block design procedure.

Each sample consisted of five (5) wheat plant extractions with root mass intact. These samples were separated to allow each crown / plant to be analyzed independently.

From each of these five (5) plants (crowns), four (4) were randomly selected for data collection. Thus, each replication of each treatment consisted of twenty (20) crowns.

Data Collection

Each 20 crown sample was photographed and total number of heads were counted.

Heads were defined as any beard bearing structure whether it had emerged from the leaf sheath or not.

Note: The inclusion of heads not fully developed was to provide consistency across all treatments, even if many untreated plants had heads that were unlikely to develop fully.

Foliar Treatment

Number of heads per 20 crowns

Field Number	Control	Foliar	% Change	Notes
1	29	40	40%	
5	65	75	15%	
6	60	99	65%	
7	39	62	57%	
8	55	75	36%	
9	42	50	19%	
10	56	76	35%	
Mean			38%	

Results of Initial In-Field Head Count for Foliar Treated Spring Wheat

Patterns emerged showing a greater than 30% increase in total head count in Foliar Treated Spring Wheat Versus untreated Control within the same field

Fields were between 40 and several hundred acres in size.

Seed Treatment

Number of heads per 20 crowns

Results of Initial In-Field Head Count Protocols for Seed Treated Spring Wheat

Patterns emerged showing a greater than 80% increase in total head count in Seed Treated Spring Wheat Versus untreated Control within the same field

Fields were between 40 and several hundred acres in size.

Field Number	Control	Seed	% Change	Notes
1	29	61	110%	
2	52	75	44%	
3	47	109	132%	
12	85	118	38%	
Mean			81%	

In-Field Observations

- Findings validate our bacterial inoculant increases stem production early in lifecycle of the wheat plant.
- The effect of our bacterial inoculant is greater the earlier the plant is inoculated.
- This validates the use of our product as a seed inoculant.
- The inoculant causes a dramatic increase in the overall size and surface area of the flag leaf. This allows for an increase in sugars within the plant.

Harvest Observations

Protein and test weights:

Protein content of the wheat grain was observed to be consistently higher from Kansas to North Dakota with the use of the product, regardless of application method. Even application of the foliar product after setting of the flag leaf caused a significant increase in protein levels in Kansas.

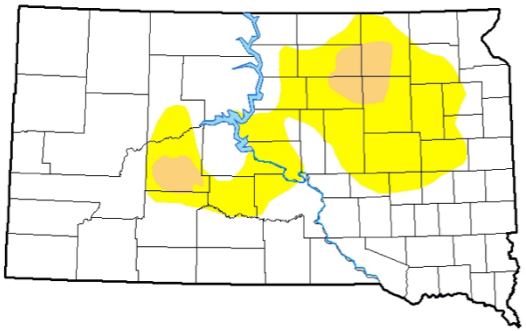
Because of drought conditions, South Dakota wheat protein averages were higher than normal. Even so, with Agrovive product use, protein content increased by an additional 0.8% to >2%. In Kansas, this protein content increase was 2.2%

Test weights for wheat grown in the drought of South Dakota were seen to increase even in poor land. Test weights in excess of 61 lb/bu were seen in areas of central South Dakota much to the excitement of producers.

Field Moisture Conditions

U.S. Drought Monitor
South Dakota

August 7, 2018
(Released Thursday, Aug. 9, 2018)
Valid 8 a.m. EDT



Intensity:
- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

Author:
Richard Tinker
CPC/NOAA/NWS/NCEP

http://droughtmonitor.unl.edu/

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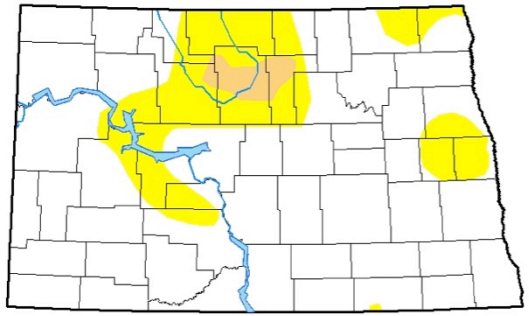

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Constraints to Wheat Yields and Product Performance.

It is very obvious that the product had a positive impact to improve crop growth and improved wheat quality. However, environmental and cultural practices do influence the overall performance of the product. Based on the field observations in 2018, here are issues that were demonstrated to limit the benefits of the product.

1) Drought – During the period of grain fill for wheat, the farm locations in South Dakota and in other areas where trials were set up, suffered severe long term drought. During this critical plant growth development stage, the crops received virtually no rainfall for up to 5 consecutive weeks. Moisture became the limiting factor in grain production. The net result in these tests is that drought caused many of the youngest seeds to either not develop properly, or to abort. The straw in the field that was baled yielded an increase of 46% more bales per acre. This is consistent with the number of heads observed in the in-field tests.

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2) Pesticides – Agrovive products are living organisms. It was determined in these trials that one fungicide / antibacterial in particular suppressed the activity of the applied organisms. At this time, only one such pesticide, Propiconazole, has been identified that causes a loss of efficacy of the product. Because of this effect, Dr. Robert Kremer, retired USDA-ARS microbiologist, has been retained to conduct an evaluation of the compatibility of commonly used pesticides on target crops with the products. With this information as well as confirmation in field trials. The product labels and advertising materials will include notification to product users not to use these chemicals in conjunction with the products in crop production

Alfalfa

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Harvest Observations

- Alfalfa producers in Central South Dakota reported a 27% increase in bale yield with the use of the product using existing production programs. They also reported higher yields and higher quality in their subsequent cutting without additional product application. The product was applied as a foliar spray after the first cutting of established alfalfa fields.

- These results are promising, but additional field trials are planned. In upcoming trials, the product will be applied prior to first cutting. A second application, likely after a second cutting will be evaluated to determine if there is an economic benefit to do so. In new alfalfa plantings, the product will be applied to the seed at planting to evaluate the impact on stand establishment, and the quality of cuttings from new fields.

- Another issue with alfalfa growers is that fields are not managed for maximum yields or quality. Nutritional issues are a concern. Growers in this region often depend on manure as the primary source of alfalfa nutrients. The growers seldom do soil testing or tissue analysis for either macronutrients or micronutrients. Thus their true nutritional status is largely unknown. Micronutrients are particularly important for alfalfa. Alfalfa is a legume and in combination with Rhizobium bacteria can “fix” usable nitrogen from the air. This process, called nitrogen fixation, requires iron and molybdenum. Both are micronutrients. Nitrate nitrogen taken up from the soil also requires molybdenum to convert the nitrogen to protein. Zinc and Molybdenum are involved in the production of IndoleAcetic Acid (IAA), which is a growth regulator that influences the growth and quality of alfalfa cuttings.

- Dr. David Sasseville, retired Missouri State Extension Specialist and a plant nutritionist, is working with Agrovive to develop a nutritional program for use with alfalfa (and other crops) to enhance overall yield and to gain the greatest benefits of Agrovive products. Dr. Sasseville is a co-author of Plant Analysis Handbook III, the international standard reference in tissue analysis, and is also on the Board of Directors for Agrovive. The combinations for Agrovive microbial and biostimulant products and proper crop nutrition are expected to dramatically improve the profitability and quality of alfalfa (and other crops) that use Agrovive products.

Treated Untreated

Treated Untreated

Canola

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Harvest Observations

Canola has yet to be harvested, so no yield data is currently available. This will be done over the next few weeks.

Field observations of the crop have shown a dramatic increase in branching in the lower third of the plant, that is, when the plant was young. The formation of more branches results in more locations for pods to be formed, which is what is being observed. During the early growth prior to bolting, the plant is observed to produce a more extensive leaf system. Canola is in the cabbage family, so these are called “cabbage” leaves. These leaves are responsible for photosynthesis which produces the carbohydrates used to promote overall growth, and increase pod and seed production. Historically, growers have applied growth regulators to stimulate growth. With the use of Agrovive products, the application of these growth regulators is not needed, thus saving the cost of those products. Because Agrovive products provide several other benefits to canola that far exceed growth regulators alone, using Agrovive products will readily replace growth regulators in canola production programs. It was also observed that growth regulators had a negative effect on the use of Agrovive products, another reason for eliminating growth regulator application to canola. This information will be added to the product label for canola.

Treated Untreated

Treated Untreated

Treated **Untreated** **Treated, another product and Untreated**

Treated Untreated

Treated Untreated

Treated Untreated

Treated Untreated

Flax

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Harvest Observations

Flax has yet to be harvested

Early observations include a dramatic increase in branching.

This early branching has lead to the formation of significantly more pods.

The increase in yield is expected and should only be limited by the lack of water.

Treated Untreated

Untreated Treated

Treated Untreated

Treated Untreated

Soybeans

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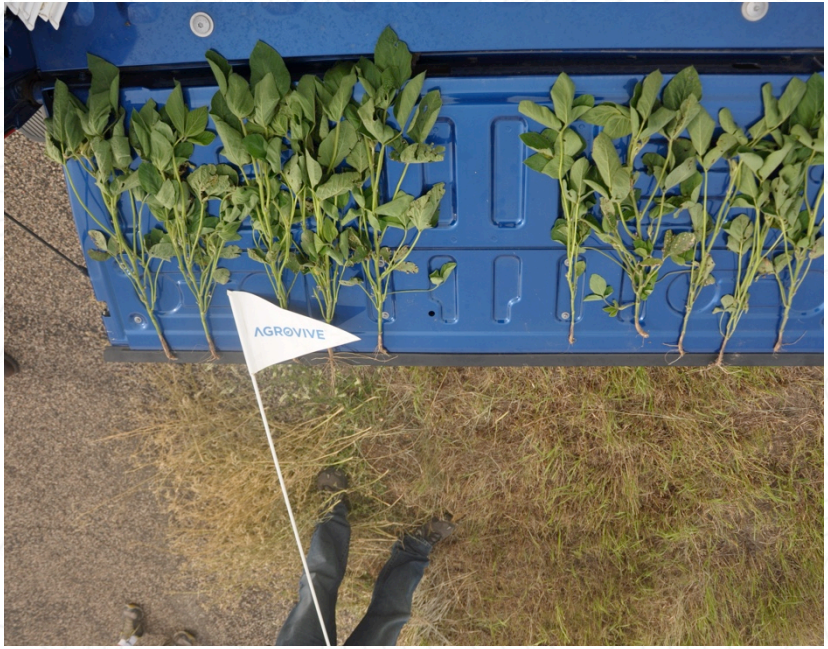
Harvest Observations

- Soybeans have yet to be harvested
- Early observations include a dramatic increase in branching in the lower third of the plant.
- This early branching has lead to the formation of significantly more pods.
- The increase in yield is expected and should only be limited by the lack of water. It has been observed that the earlier canopy of the plant has lead to a retention of water in the soil and a reduction of weeds. This should lead to the plants surviving short periods of drought more efficiently than untreated plants.
- Root mass shows a longer root systems as well as a greater mass of secondary roots. It has been observed that the treated roots have a greater number of nodules and the nodules present are larger.
- Earlier maturation of plant has been observed this year on several of the fields.
- It is observed that seed coating is having a significant advantage in growth over foliar.

Treated Untreated Untreated Treated



Treated **Untreated** **Treated** **Untreated**

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Corn

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Harvest Observations

Corn is not yet harvested.

Silage harvest is anticipated to begin approximately August 20. Grain harvest is anticipate in October.

Corn treated with Agrovive products have ears that are observed to be filled to the tip, likely to increase yields with additional filled kernels. Treated corn plants often have secondary ears that are filling. Even partially filled second ears can contribute greatly to over grain yield.

Early plant growth of treated corn plants show secondary stem grown from the main stalk, which are in some varieties absorbed back into the plant after V7. These secondary stems (branching) have growth potential, which can contribute to the biomass tonnage for silage.

Larger vascular tubes were observed in the stems of treated plants through V7. Increased vascular tissue allows for more rapid nutrient accumulation inside the plant and greater water flow within the plant stems themselves.

Greater leaf surface area and plant height were also observed in treated tissues. These increase yields of biomass tonnage and increased production of carbohydrates that can lead to larger corn kernels, and higher yields.

It is also observed that ear formation occurred one full node higher on the treated plants. Enhanced secondary brace roots are also prevalent on the treated stems. Larger and stronger root systems parallel increased biomass on the stalk.

Treated **Untreated**

Treated **Untreated**
(Displays the length of fill)

Treated with Second Cob

Treated Untreated
(Note the cob set height)

Untreated Treated

Untreated Treated

Treated **Untreated**

(Note the second stalk set on treated)

Treated **Untreated**

Treated Untreated

Treated Untreated

Treated Untreated

Treated Untreated

Rye

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Harvest Observations

Rye was harvested green for feed in South Dakota near Huron.

The crop showed a 25% increase in biomass tonnage.

This tonnage increase was derived with the foliar application being made after jointing. The increase in tonnage is likely to be attributed to maturing grain and increased size and thickening of the stem tissues. While these are fantastic results from foliar treatment, further research is planned to make earlier application of Agrovive products to determine if even greater potential in biomass tonnage is possible. This would be achieved by stimulating increases in tiller and head numbers as shown in spring wheat.

Treated and Untreated
(Treated 2 weeks prior)

Treated and Untreated

Vegetable Evaluations

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There were significant changes to the yield and yield bearing structures of green bean plants.

Discussions are underway to begin testing the commercial viability with one of the largest vegetable growers in the world.

Plant profiles are displayed below

Treated

Untreated

Organic Certifications

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Organic Certification

Applications are being submitted to both OMRI and Washington State organic certification authorities.

Canadian OMRI certification will be sought as well in the same application process.

It is anticipated that we will have certification based on discussions with the certifying authorities by the end of the year.

International Opportunities

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Foreign Opportunities

Foreign patent applications have been filed to provide us the protections necessary to enter many foreign markets. This is a patent filing in a group of 30 countries that have joined a patent cooperation treaty to make it easier for inventors and companies to file for broad geographic patent protections. As well as countries deemed important but not part of the treaty organization.

We have identified potential manufacturer and marketers in Canada, which are necessary to enter the Canadian market. We are currently seeking registration of labels which is required for marketing in Canada.

Have also begun negotiations to open an office and manufacturing site in Scotland. Registration and regulatory processes are being initiated. A similar arrangement is being sought with the United Kingdom.

THANK YOU

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