PEWAS
Innovative chemistry since 1992

AQUAHOLDER

Seed applied soil conditioner for enhanced drought resistance

Drought resilient seeds
Better start, support for high yields

Healthier plants
Improved germination and emergence

Environmentally friendly
Microplastic free, biodegradable and biobased

Industrially applicable
Proven industrial process

Standard handling
Easy logistic, storage and sowing

Food security
Increased seed resistance, more food

Why to use Aquaholder?

What is the active substance of Aquaholder and how does it work?

PATENT GRANTED - WIPO PCT APPLICATION: PCT/SK2018/050015

PATENT PENDING - WIPO PCT APPLICATION: PCT/SK2024/000002

What is AQUAHOLDER ?

Aquaholder is a product designed to mitigate abiotic stress, provide drought relief and support better start. Aquaholder seed coat attracts available moisture around the seed even under low moisture conditions.

The hydrogel layer created around each seed serves as a reservoir of water for the germinating seed and allows the seed to germinate and grow normally even under drier than usual soil conditions. This better start supported by Aquaholder coat creates predisposition for higher yields also in favorable conditions or even in high moisture conditions.

For more information visit **www.aquaholder.com**

Primary benefits:

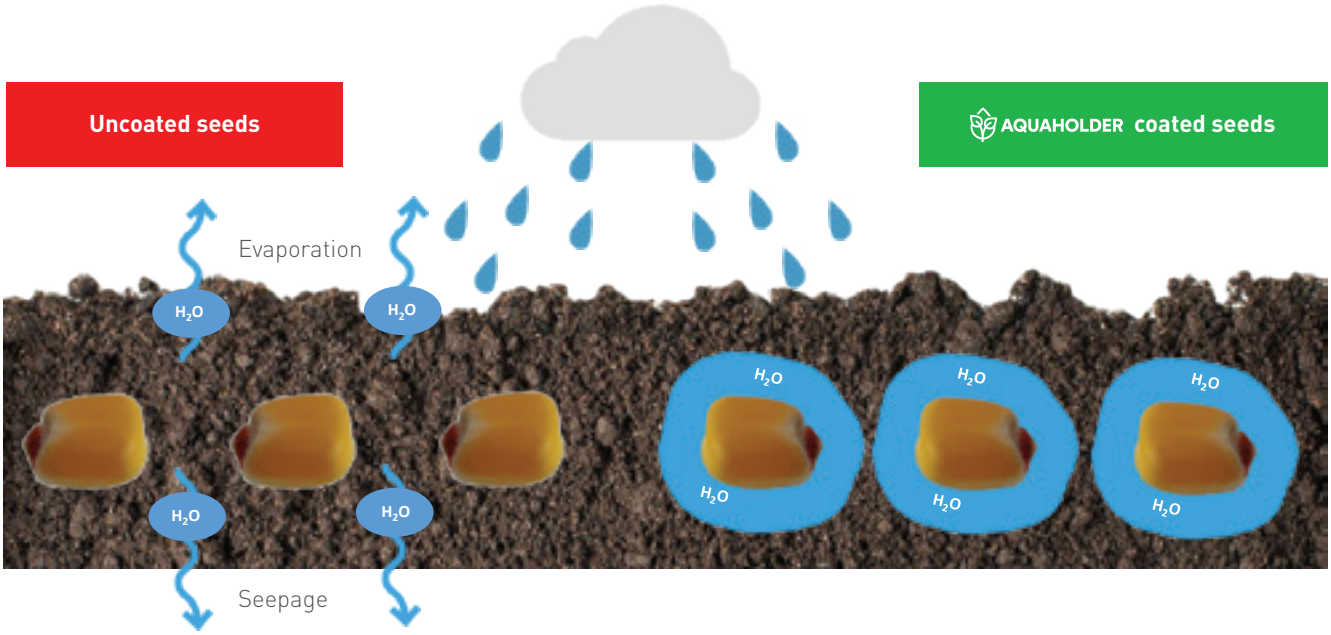
- Enhanced speed of germination and emergence
- Improved plant uniformity
- Increased root & shoot biomass
- Increased plant resilience

Secondary benefits:

- Carrier for nutrients and microbes
- Improved uptake of low water soluble actives
- Reduced leaching of actives into the soil
- Support microbial regrowth

Product characteristics:

- Microplastic free
- Plantability
- Application
- Seed safety
- Efficacy
- Regulatory



Effect proven on the following crops:

Field crops

Corn, Oilseed rape, Barley, Sunflower, Wheat, Sorghum, Soya, Sugar beet, Cotton

Vegetable crops

Carrot, Onion, Red beet, Lettuce, Radish

Grasses, turfs, forage and cover crops

Grasses, Alfalfa, Clover

...and others
(according to customer request)

CERTIFIED TECHNOLOGY **Certificate no. 1604 issued by The Central Agricultural Inspection and Testing Institute in Slovakia, E.U.**

Microscopic view of AQUAHOLDER layer

Activated superabsorbent

Proven in lab and field conditions

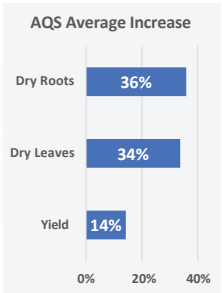
Microplots trials 2022 (dry season)

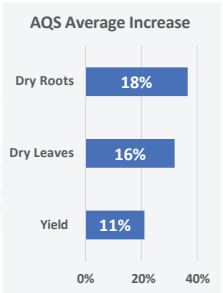
34x
Field Trials

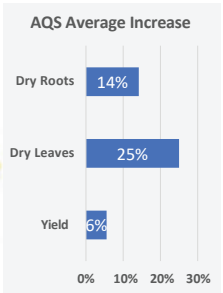
13x
Countries

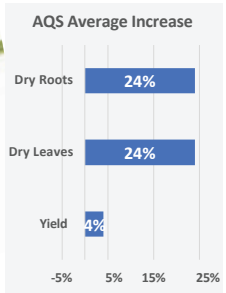
4x
Crops

23%
Root increase

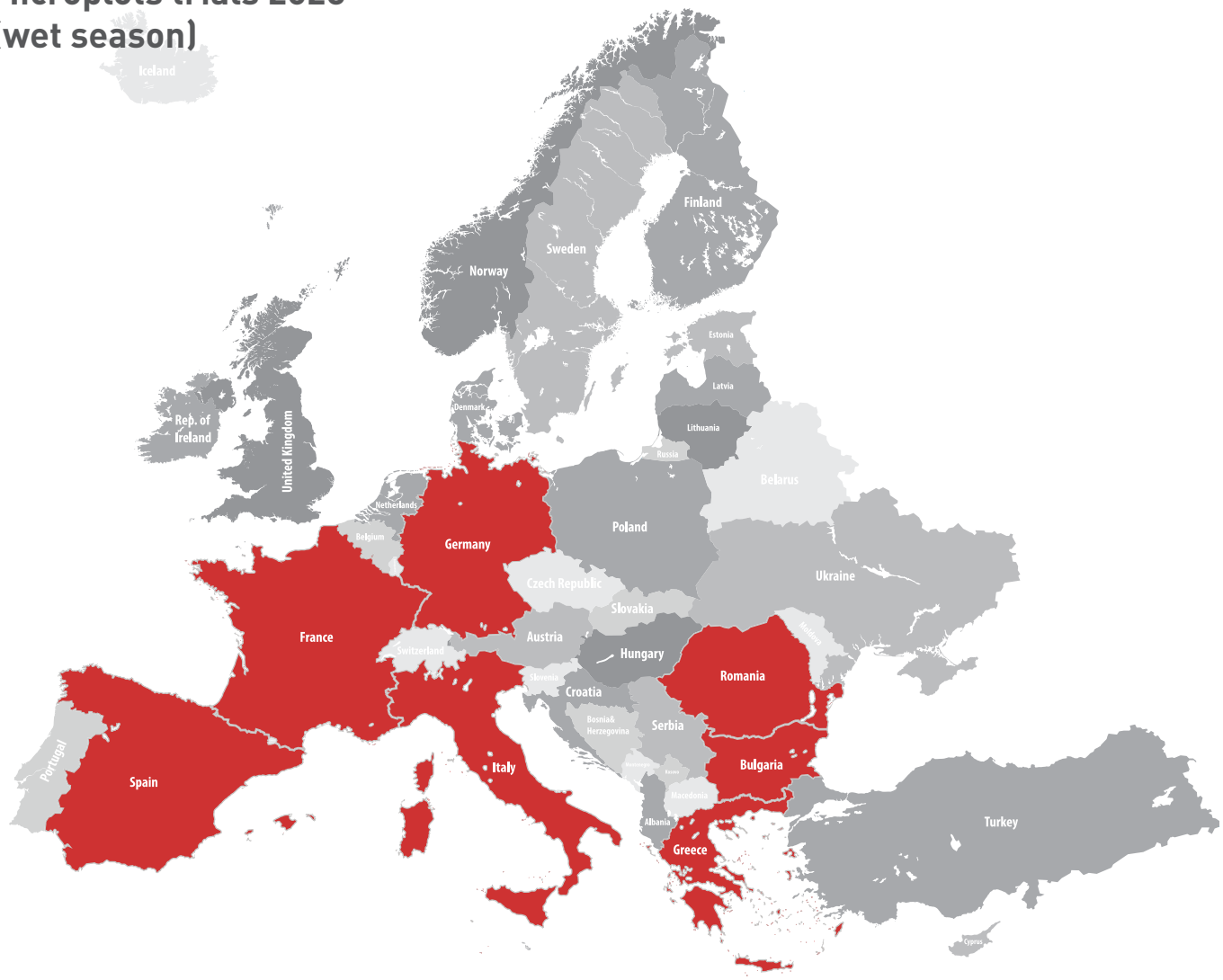








Microplots trials 2023 (wet season)

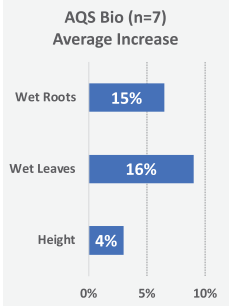


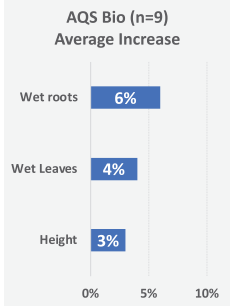
20x Field Trials

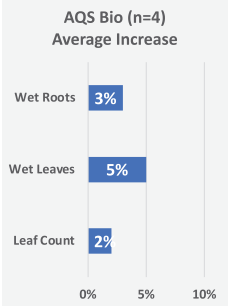
9x Countries

3x Crops

6% Root increase







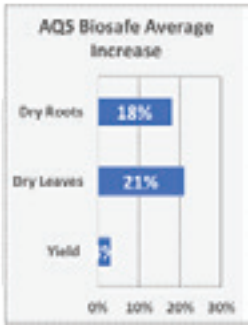
Microplots trials 2024

6x
Field Trials

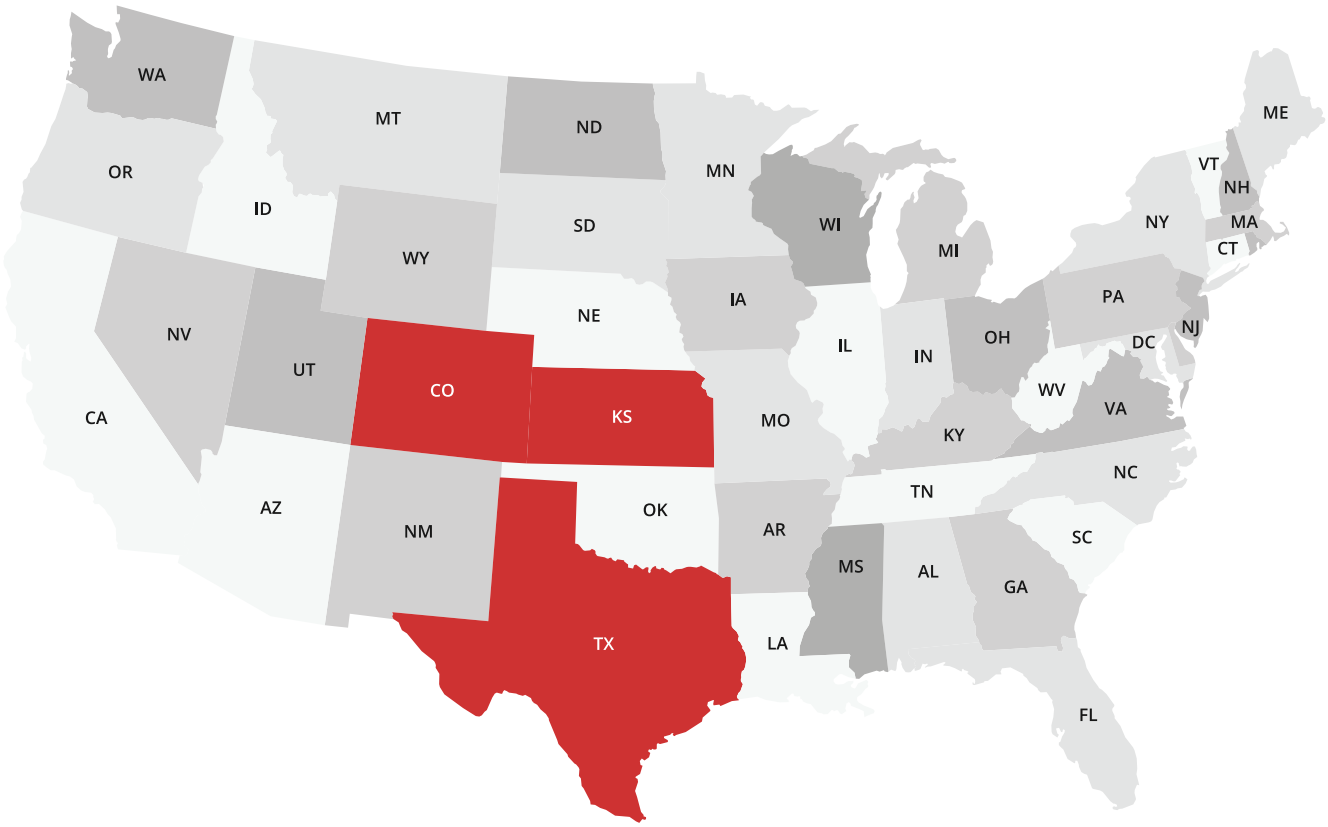
4x
Countries

2x
Crops

22%
Root increase



Microplots trials 2023 in US

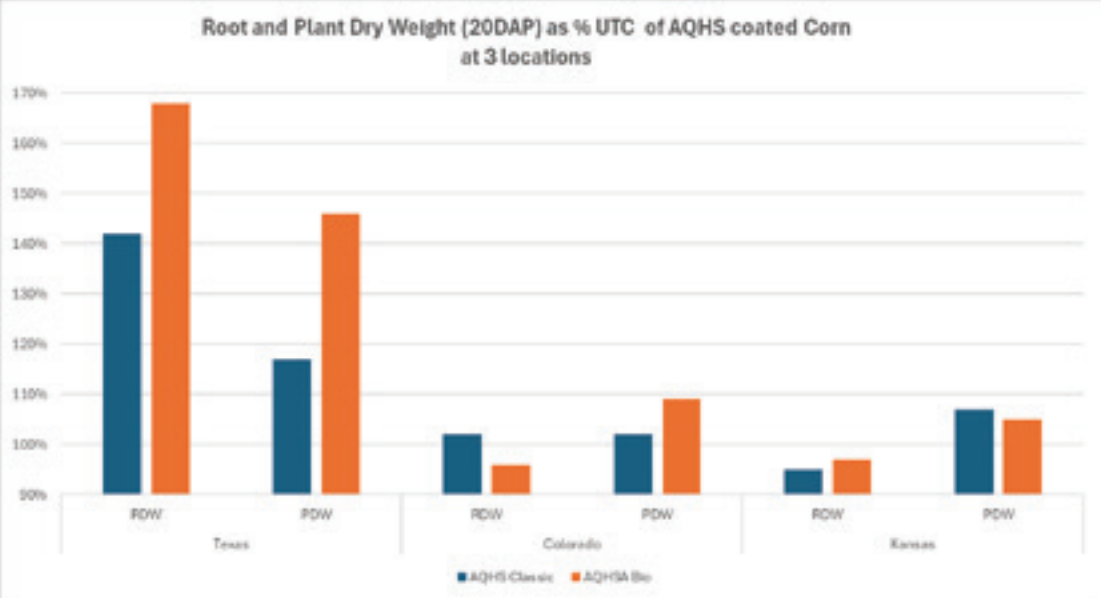


34x Field Trials

13x Countries

4x Crops

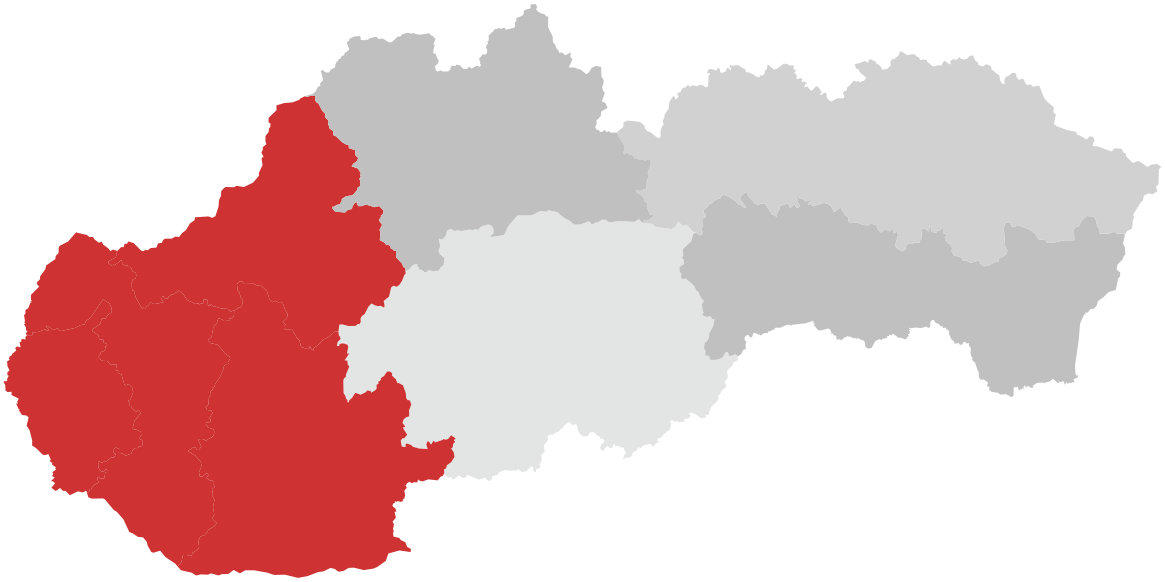
23% Root increase



Location	Texas		Colorado		Kansas		Average	
Parameter	RDW	PDW	RDW	PDW	RDW	PDW	RDW	PDW
AQHS Classic	142%	117%	102%	102%	95%	107%	113%	109%
AQHSA Bio	168%	146%	96%	109%	97%	105%	120%	120%

RDW - Root Dry weight 20DAP / PDW - Plant Dry weight 20DAP

Farmers' experiences – large-scale production trials



Location: western Slovakia
Crop: WOSR
Year: 2021/2022

Area
Control 32,0 ha
AQ 8,0 ha

Yield
Control 3,87 t/ha
AQ 4,9 t/ha

Overproduction
+ 1,03 t/ha

Profit
+483,8 €/ha

Location: western Slovakia
Crop: Corn
Year: 2023

Area
Control 24,27 ha
AQ 42,29 ha

Yield
Control 9,01 t/ha
AQ 9,42 t/ha

Overproduction
+ 0,41 t/ha

Profit
+84,46 t/ha

Location: western Slovakia
Crop: Corn
Year: 2024

Area
Control 10,3 ha
AQ 19,7 ha

Yield
Control 8,49 t/ha
AQ 9,39 t/ha

Overproduction
+ 0,9 t/ha

Profit
+185,4 €/ha

Location: western Slovakia
Crop: WOSR
Year: 2024/2025
dry season

Area
Control 10 ha
AQ 22 ha

Yield
Control 4,4 t/ha
AQ 5,0 t/ha

Overproduction
+0,6 t/ha

Profit
+282 €/ha

Production site - pilot line for AQUAHOLDER coating

In order to demonstrate industrial applicability and scalability, a pilot line for treating seeds with Aquaholder has been constructed. It is set up in the Pewasu production hall in Sered and its projected capacity is 6 tons of seeds per day.

The technology has been successfully launched in 2023. Pilot line has proved that Aquaholder is scalable solution for all types of crops.

Benefits:

- Scalability proven
- Product validation and processability
- Real production for business purposes
- Client Onboarding & Training

Aquaholder product now available

INNOVEINS
SEED SOLUTIONS

Aquaholder seed treatment additive trial program at Innoveins seed solutions

Innoveins seed solutions has carrier out a complete testing program with Pewas to test their Aquaholder product as seed treatment for compatibility, germination effects, efficacy against fungal diseases and control of active ingredient leakage . Based on this trial program Innoveins could draw the following key conclusions:

Compatibility

Compatibility was tested on the effect of application and the effect of the additive on germination rates. In general there can be concluded that there is no negative interaction between active ingredients and Aquaholder when applied as a double application sequentially from a chemical standpoint. In corn, sugarbeet, wheat, OSR, no negative effects on germination were observed. The application of Aquaholder is applied as a dual application starting with a base treatment of the standard slurry including the PPP's followed by a final dressing with Aquaholder which is a mixture of alcohol and SAP particles, during the application process the alcohol will evaporate. Since a solvent is used as carrier there is a risk that there is an additional loss of active ingredient during the second application process. The active ingredient Fludioxonil did not show a reduction of active around the seed when applied together with Aquaholder while the active ingredient Ipconazole did show a reduction in active ingredient around the seed. When testing Aquaholder as seed treatment additive this need to be determined before scaling up hence that the selection of binder type in the base slurry while be a basic solution to solve this potential issue.

Data example (Figure 1):

Wheat seeds were treated with 1) polymer only 2) Aquaholder only 3) Systeva and 4) Systeva and Aquaholder. Based on the graph you clearly see that seed treated with Aquaholder shows no negative effect on germination and specifically in wheat a slight positive effect on germination has been observed, theoretically a higher Prescence of water around the seed due to Aquaholder results in this earlier emergence.

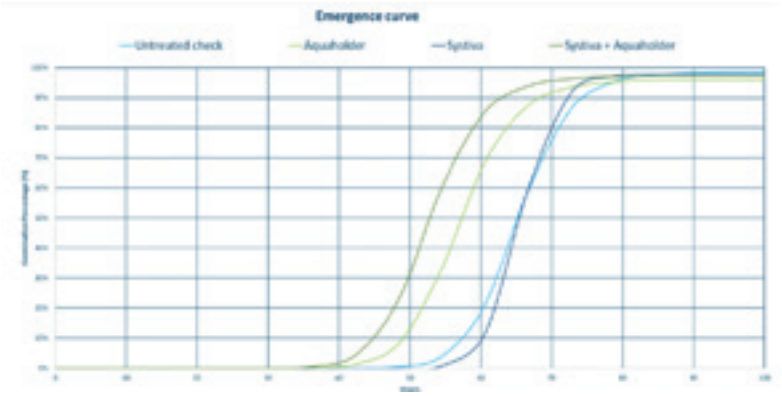


Figure 1 Graph systeva seed treatment

Efficacy

Fungicides

Efficacy of multiple active ingredient/ Aquaholder combinations were made within the trial program and tested against Fusarium graminearum, Phoma linquisti and Rhizoctonia solani. In general no strong differences were observed between treated with the active ingredients only compared to the active ingredients together with Aquaholder. Under laboratory screening we could observe in some cases that Aquaholder can form a barrier effect in between the pathogen and seed, when screening diseases in planta more research is needed individually per crop or active ingredient. In general plant stand and vigor of plant treated with Aquaholder looks slightly better compared to plants which were not treated with Aquaholder.

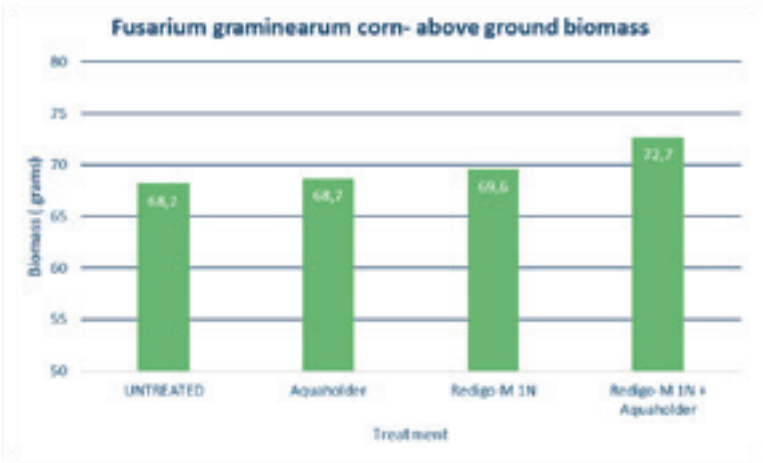


Figure 2 Redigo-M seed treatment

Data example (figure 2):

Corn seeds were treated with 1) polymer only, 2) Aquaholder only 3) Redigo M and 4) Redigo-M + Aquaholder. We clearly see in the graph that biomass of Redigo-M combined with Aquaholder showed increased biomass compared to Redigo-M solo. Based on visual observation if looks like that plants have established better and therefore we see a clear added value. With a ½ dosage ofRedigo-M we did not see that effect anymore, out from this we can conclude that Aquaholder has no disease control activity but only supporting the products with enhanced plant establishment. We don't see this as clear in each crop we have tested based on data acquired.

Insecticides (figure 3)

Aquaholder potentially could enhance the active ingredient uptake, due to the water attraction and water holding capacity of Aquaholder more active could potentially be available for the plant for an enlarged period. A test was carried out with the active ingredient Cyantraniliprole as seed treatment and combined with Aquaholder. In one of our tests we observed a double uptake of cyantraniliprole compared to the treatment without Aquaholder, this substantiates the theory that Aquaholder keeps the active ingredient for a longer term closer to the seed.

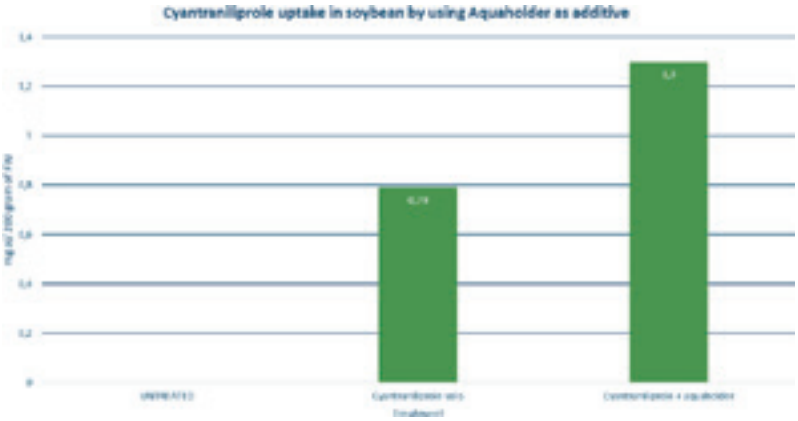


Figure 3 Cyantraniliprole seed treatment

Active ingredient distribution in the soil

Since Aquaholder causes more water availability and keeps active more close to the seed an assymption has been made that Aquaholder causes a reduced active ingredient leakage in the soil and ground water after sowing. A laboratory trial was carried out while seeds were treated with an overdosage of active to be able to measure small volumes in the soil. In figure 4 is clearly explained that treatments including Aquaholder show much lower leakage into the soil compared to treatments without.

Biostimulation effect

No specific research on the biostimulation effect has been carried out, although in the trials including corn an increase in plant vigor was observed. More research needs to be done to further clearify the potential biostimulation effect of aquaholder.

Quality of results

The trial was conducted by independent seed technology trial station Innoveins seed solutions. Data presented in this sheet are part of the complete reports and dataset send to Pewas sro but give a representative view on important findings in the reports for the Aquaholder product.

		maxim 480FS + Apron XL			
unit	Soil compartment	Metalaxyl	metalaxyl + Aquaholder	Fludioxanile	Fludioxanile + Aquaholder
Values in mg ai per kg soil	Seeds				
	5cm soil	14,00	2,00	4,00	0,75
	10 cm soil	2,30	0,40	1,30	0,63
	15 cm soil	1,30	0,16	0,26	0,16
	20 cm soil	1,10	0,20	0,65	0,12
	25 cm soil	1,50	0,64	0,18	0,09
	Ground water	0,13	0,43	0,00	0,03
	Total leakage in soil	20,3	3,8	6,4	1,8

Figure 4 Soil and ground wate

11-9-2023
Niels Peeters
Director and seed specialist
Innoveins seed solutions B.V.

Testing report

“Successful one-step application process on the FDM Rotary Dryer-Coater”

Prepared in collaboration between Seed Processing Holland (FDM) and Pewas (Aquaholder)

Key findings

The testing yielded positive results, with the quality of coatings during overcoat testing matching standards achieved at Pewas. The one-step coating technique proved effective across al crops, leading to high-quality coatings. Notably, the super-absorbent polymer in Aquaholder remained inactive during the coating process. Its presence was confirmed through FSC measurements conducted at Pewas laboratories. Microscopic analyses revealed distinct characteristics in seed coating quality for each crop.

Dry Seeds

Seeds coated with Aquaholder and finishing powder on the FDM Rotary Dryer Coater were found completely dry after testing, with specific conditions established for each type of test (overcoat or one-step) and crop. No hydrogel creeation was observed during coating process.

Coating Quality Evaluation:

Seeds coated with Aquaholder and finishing powder on the FDM Rotary Dryer Coater fulfill requests on coating quality standards, resulting in uniform distribution of Aquaholder layer and effective moisture retention.

Conclusion

The successful integration of Aquaholder into existing seed treatment processes underline its potential for widespread use in agricultural practices aimed at enhancing seed germination and improving crop yields under variable environmental conditions. Further evaluations, including external tests for germination rates and dust-off, are recommended

Aquaholder testing conducted by the Pewas team at Seed Processing Holland was highly successful, providing significant insights into its future applications.

In Enkhuizen/Bratislava on March 6, 2025

Arjan Kunst, CEO
Seed Processing Holland

Ivo Krpelan, CEO
Pewas

Date: June 28th 2022
Location: Testing center Hoopman equipment & engineering b.v., Dinxperlosoestraatweg 145, 7122 JP AALTEN (NL)

Subject
Report on testing day - the application of the Aquaholder seed coating product was carried out.

Conclusion
From an application point of view, no remarkable problems were observed in the application of the Aquaholder on seed during testing. The mixing of the product, the passage of the product through the pump, the process of applying of the product on the seed, the drying process, the clogging of the coating and drying equipment with product residues were within the norm and did not show any process abnormalities preventing further tests on industrial scale equipment.

All in all a perfect and effective day for Pewas and Hoopman e&e, demonstrating easy handling while application of Aquaholder

Name, signature
for Hoopman equipment & engineering b.v.

Hoopman
equipment & engineering b.v.
Dinxperlosestraatweg 145
7122 JP Aalten – NL
Phone +31 (0)543 470 496
Stamp

BIOSAFE suspension testing using a CC50 rotary coater and JCD 625 drying device

Date: 7th August 2024
Location: Laboratory, Cimbria Heid GmbH, Heid-Werkstrasse 4, 2000 Stockerau, Austria

Aquaholder is a product designed for hydrostimulation seed treatment, where the active substance is a superabsorbent polymer. During a testing day, the Aquaholder seed coating product called BIOSAFE suspension was being tested using a rotary coater CC50 and a drying device JCD 625. The testing involved PEWAS personnel, including Mr. Viktor Gelinger, Dr. Lukáš Petra, and Dr. Halyna Bodnár Yankovich.

Five batches of maize seeds were prepared, with varying parameters to achieve the best possible seed coating:

- Time of suspension dosing
- Time of mixing seeds with the suspension
- Amount of added finishing powder
- Time of mixing powder with suspension-coated seeds
- Temperature of drying the coated seeds.

After each batch, a quick test was conducted by placing the coated seeds in a container, adding deionized water, and observing the formation of hydrogel around the seeds, confirming the presence of the active substance in the coating. Further analysis in PEWAS laboratories led to the following conclusions:

- The coating quality achieved at the CC50 was comparable to PEWAS standards.
- The amount of superabsorbent polymer in the coating was slightly lower due to longer dosing and mixing times
- The seeds were completely dried in the JCD625 dryer, considered the best result.
- The dried seeds were sticky, making the addition of finishing powder an absolute necessity.
- Effective drying of coated seeds can reduce the amount of finishing powder required.

The overall testing was successful, and the setup present at CIMBRIA`s laboratory was the best tested so far. The coated seeds were examined using optical microscopy, which verifies the formation of solid particles upon drying the suspension.

Bratislava, October 5, 2023

Endorsement Letter

Cimbria is one of the world's leading companies within industrial processing, handling and storage of grain and seed, as well as animal feed, foodstuffs and other bulk products.

Company cooperates with the company Pewas s.r.o. since 2016 through official distributor for Slovak Republic, company INGOTTO, spol. s r. o.

The company Cimbria/INGOTTO was asked for cooperation in the Aquaholder Seed project from the very beginning of the research. Due to the constantly intensifying climate changes and their impact on agriculture, the project was characterized by high potential for the seed industry and subsequently for agriculture and farmers. That's why we decided to support Pewas with both technical equipment as well as technological mentoring. Cimbria/INGOTTO supplied 3 CC LAB devices to Pewas for research purposes.

These facilitieswere primarily used for research and development of product and were sufficient for seed preparation for lab and field trials. Numerous trials have confirmed the potential of the Aquaholder Seed product as an insurance against drought during the emergence period.

Based on the excellent field results of the Aquaholder seed product, Pewas decided to build a pilot line to prove the industrial application of Aquaholder. INGOTTO was contacted to be the project's dominant technology partner. The company was the supplier of the entire documention and equipment with the exception of the drying machine. Pewas also started preparations for the construction of a large-capacity seed coating line. The new high-capacity line will use the concept of Cimbria's existing container technology, while it will be implemented with specific modifica ons enabling the effective application of Aquaholder. For this purpose, the Cimbria company carried out technological engineering and developed complete documentation.

We believe that all these steps already proved and will lead to an effective demonstration of the applicability of the Aquaholder Seed product, which we believe will help increase the productivity of agricultural production in constantly deteriorating climatic conditions.

O. Straka - CEO
INGOTTO, spol. s r. o.

ÚKSÚP

ÚSTREDNÝ KONTROLNÝ A SKÚŠOBNÝ ÚSTAV
POĽNOHOSPODÁRSKY V BRATISLAVE

Ústredný kontrolný a skúšobný ústav poľnohospodársky v Bratislave (ďalej len „kontrolný ústav") ako príslušný orgán štátnej správy podľa § 13a ods. 1 písm. b) a ods. 3 písm. a) zákona č. 136/2000 Z. z. o hnojivách v znení neskorších predpisov (ďalej len „zákon") a v súlade s § 65 a nasl. § 46 a 47 zákona č.71/1967 Zb. o správnom konaní (správny poriadok) v znení neskorších predpisov (ďalej len „správny poriadok") a § 5 zákona v súlade so záverečným protokolom hnojiva vydáva

CERTIFIKÁT
HNOJIVA

č. 1604

pre

1. Obchodný názov hnojiva	**AQUAHOLDER BIOSAFE BASIC**
2. Číselný kód colného sadzobníka (HS/CN)	3906 90
3. Žiadateľ (výrobca/dovozca) (obchodný názov a sídlo)	P e W a S s.r.o. Vansovej 2, 811 03 Bratislava Slovenská republika IČO: 31332013
4. Výrobca (obchodný názov a sídlo)	P e W a S s.r.o. Vansovej 2, 811 03 Bratislava Slovenská republika

5. Obmedzenia pri uvádzaní hnojiva do obehu a pri jeho používaní

Dátum vydania: 14.02.2025
Doba platnosti: Certifikát platí 5 rokov od nadobudnutia právoplatnosti.

Odôvodnenie: Hnojivo vyhovelo podmienkam certifikácie podľa ustanovenia § 5 ods. 5 zákona. Neoddeliteľnou súčasťou tohto certifikátu je Záverečný protokol č. z. 6887/2025 podľa vyhlášky č. 245/2005 Z. z. Ministerstva pôdohospodárstva Slovenskej republiky, ktorou sa ustanovujú podrobnosti o certifikácii hnojív a uznávaní výsledkov laboratórnych a vegetačných skúšok hnojív a schválená etiketa resp. príbalový leták hnojiva AQUAHOLDER BIOSAFE BASIC.

Poučenie: Proti tomuto rozhodnutiu možno podať odvolanie podľa § 68 ods. 2, § 53 a 54 správneho poriadku, na Ústredný kontrolný a skúšobný ústav poľnohospodársky v Bratislave, Matúškova 21, 833 16 Bratislava, do 15 dní odo dňa jeho doručenia. Odvolanie možno podať aj do elektronickej schránky kontrolného ústavu v zmysle zákona č. 305/2013 Z. z. o elektronickej podobe výkonu pôsobnosti orgánov verejnej moci a o zmene a doplnení niektorých zákonov (zákon o e-Governmente) v znení neskorších predpisov. Rozhodnutie je podľa § 47 ods. 4 správneho poriadku preskúmateľné súdom až po využití riadneho opravného prostriedku (odvolania).

ÚSTREDNÝ KONTROLNÝ A SKÚŠOBNÝ ÚSTAV POĽNOHOSPODÁRSKY V BRATISLAVE SLOVENSKÁ REPUBLIKA

Ing. Vladimír Urmanič
generálny riaditeľ

102536

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPÄISCHES PATENT | EUROPEAN PATENT
BREVET EUROPÉEN

Hiermit wird bescheinigt, dass für die in der Patentschrift beschriebene Erfindung ein europäisches Patent für die in der Patentschrift bezeichneten Vertragsstaaten erteilt worden ist.

It is hereby certified that a European patent has been granted in respect of the invention described in the patent specification for the Contracting States designated in the specification.

Il est certifié par la présente qu'un brevet européen a été délivré pour l'invention décrite dans le fascicule de brevet, pour les États contractants désignés dans le fascicule.

Europäisches Patent Nr. European patent No. Brevet européen n°	Tag der Bekanntmachung des Hinweises auf die Erteilung des europäischen Patents Date of publication of the mention of the grant of the European patent Date de la publication de la mention de la délivrance du brevet européen

Patentinhaber | Proprietor(s) of the patent | Titulaire(s) du brevet

António Campinos

Präsident des Europäischen Patentamts | President of the European Patent Office | Président de l'Office européen des brevets

München, den | Munich, | Munich, le

URKUNDE | CERTIFICATE | CERTIFICAT

Alternative use of superabsorbents – application of powder

Aquaholder Agro Powder

- Crystal form mixed with the substrate during planting
- Works as a soil conditioner that enhances the soil properties and renders the use of irrigation water more efficient

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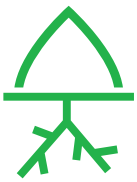
Aquaholder Hydrogel

- Crystal form mixed with water is used for soaking root balls prior to planting
- Increases the survival ratio of young plants and accelerates their growth.
- Enables to plant in dry periods



Aquaholder injection

- special type of hydrogel, which is afterwards injected using special injector directly to the root system of trees and plants
- it is not necessary to interfere to already established vegetation

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Aquaholder Fertilizer

- absorbing polymer able to keep certain amount of nutrients coming from the melted fertilizer inside its structures and continuously released: „slow release fertilizer"
- more nutrients stay in the root system of the plant and are not washed away into the subsoil and sub water.

Home and Garden portfolio

Products designed for hobby segment as well as professional use based on superabsorbents. Soil conditioners with different compositions that enrich the soil with organic matter, mineral nutrients, trace elements and improves its overall quality.
In the soil, it creates a moisture-retaining system. The product helps develop plant resistance to pathogens.

Aquaholder AGRO
Absorbent

Aquaholder ALGI
Absorbent + Algae nutrients

Aquaholder ZEO
Absorbent + Zeolite

Aquaholder PLANT
Absorbent + Chitosan + Zeolite
+Algae nutrients

Microgreens
Special set containing items needed for growing of microgreens (absorbent as a substrate + seeds of chosen vegetables)

The Aquaholder project is realized by PEWAS

Pewas is a research organization focused on the research of alternative use of superbasorbent polymers in various industries. Pewas has analytical and production laboratory facilities, a team of laboratory researchers and more than 10 years of research of the effect of superabsorbent polymers and hydrogels on seeds and agricultural substrates.

Why to use Aquaholder?

What is the active substance of Aquaholder and how does it work?

PEWAS
Innovative chemistry since 1992

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