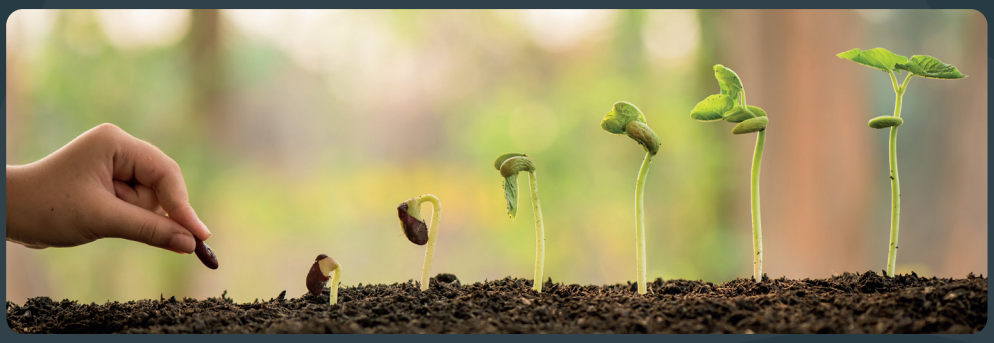
E-VITA

Technology that protects

E-VITA® - Electron treatment

The advantages at a glance



- Excellent effect against seed-borne diseases
- Effective against fungi, viruses and bacteria
- Pathogens cannot develop resistance
- Non-hazardous to drinking water
- Excellent in combination with biological active ingredients
- Improved CO2 footprint
- No handling of hazardous substances and no hazardous substance requirements
- Independence from approval requirements for chemical disinfectants and mordants
- Independent from suppliers of chemical seed treatment
- Unused seed suitable for animal feed
- Better flowability in the seed drill / planter
- Sowing independent of wind conditions
- No ingestion of chemical agents by users, animals and insects

"E-VITA® - electron treatment of seeds is the combination of state-of-the-art technology with proven environmental and user protection at the highest technical level!"

The use of electron-treated seed advances environmentally friendly crop production and thus contributes to the image promotion and acceptance of agriculture!

The **E-VITA** active principle

The E-VITA procedure and how it works

Electrons are energy in its purest form. They do their work by breaking down chemical bonds and destroying viruses, bacteria, and fungi.

VIDEO-ANIMATION

E-VITA® - Electron treatment of seed

The cleaning effect of electrons is used on an industrial scale, for example, in the disinfection of food packaging, the sterilization of medical products such as implants and in the production of vaccines. Electron treatment processes are used in many different ways and are offered for various applications.

E-VITA is the transfer of this resource-saving, high throughput and non-selective disinfection method to plant technology for bulk material disinfection. In tests carried out by independent bodies, it was shown that the energy dose required for seed treatment to ensure safe disinfection is 12 kGy.

The E-VITA process refers to the technical application of this energy to seeds in free fall. In the E-VITA process, the required flow of electrons is applied evenly to the entire product surface in such a way that the pathogens die within fractions of a second and without the possibility of resistance forming.

How does it work?

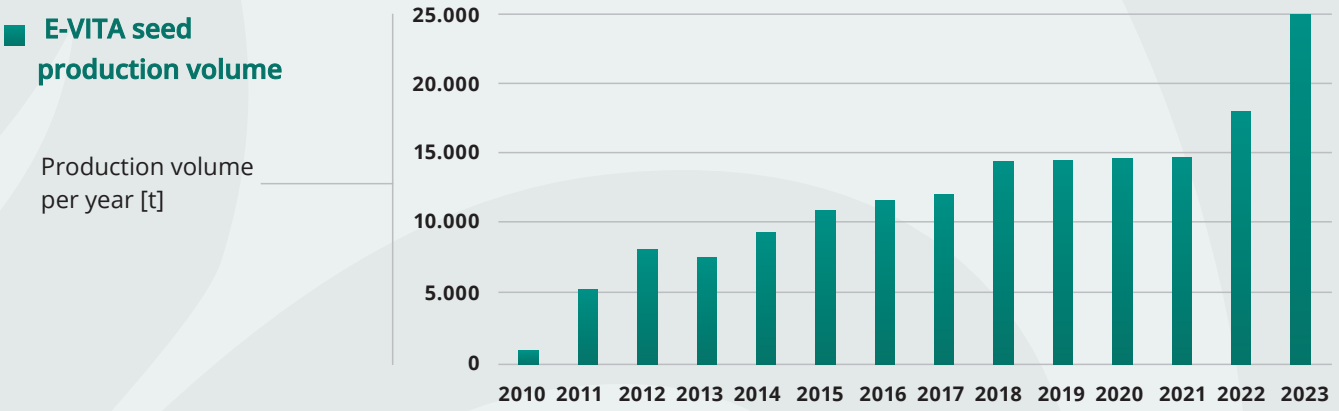
The current and voltage parameters, which can be set in the system, are important for the treatment of seeds: The current determines the amount of electrons released (dosage). The voltage regulates the penetration depth of the electrons in the seed coat.

Due to the varying thickness of the seed coat, the voltage and dosage are readjusted for each type of fruit. In numerous tests, the optimum settings were determined for each type of fruit, which on the one hand enable the greatest possible effect against the pathogens on and in the seed coat and on the other hand prevent damage to the embryo and thus protecting the germination capacity.

In order to ensure the success of the treatment, the number of electrons released is constantly measured by numerous sensors in the system. If there is a risk of underdosing, the system switches off automatically.

The E-VITA safety of action

Tested by experts, established over decades.



The start of E-VITA technology was marked by extensive scientific trials under the auspices of the German Federal Biological Research Institute (BBA). The results of numerous experiments in the laboratory and in the field were compiled and published in BBA booklet 399 in 2005.

The conclusion of the study is:

As a modern alternative method, electron treatment offers good conditions for combating seed-borne pests effectively and economically. Around 500 field trials have shown that electron treatment can be used as an alternative method to chemical dressing.

The level of seedling emergence, crop development and yields from electron-treated seed were comparable with crops grown from chemically treated seed. No increased infestation with soil-borne pathogens was detected after electron treatment during the entire study period.

These initial trials were supplemented by a long-term trial conducted by various farmers and seed companies over 13 years (2001 to 2013) at four locations with four winter wheat varieties.

In all trials, electron treatment was found to be equivalent to chemical dressing in terms of yield. In the meantime (as of Feb. 23), over 200,000 tons of seed have been treated with electrons in Germany. This corresponds to a cultivated area of around 4 million acres. Year after year, E-VITA seed is added to the portfolios of farmers, seed breeders, producers and traders.

E-VITA technology is the innovative solution for chemical-free control of pests on seeds and other bulk goods such as animal feed, herbs and spices.

E-VITA | PLUS

Physics and biology

Strong together with E-VITA | PLUS.

E-VITA | PLUS is the combination of a safe treatment method to eliminate seed-borne diseases with the use of innovative products to increase yields and stress resistance. Beneficial organisms so-called "biologicals" - are applied to the seed surface, which has been cleaned by electrons and thus optimally prepared.

Why is the combination with electrons so important?

The biologicals can only develop their effect if they colonize the radicle. To do this, the bacteria must prevail against other opponents (fungi, harmful bacteria, etc.) in the battle for the "best places" on the root. This takes time and energy. Electron treatment eliminates all opponents at the seed.

This allows the bacteria to begin their work "without competition" from other microorganisms. Incidentally, it is very important to eliminate not only fungi but also harmful bacteria in this competition between micro-organisms at the germination root. This is not possible with chemical seed dressing agents, which only have an effect on fungi!

This is what E-VITA | PLUS does:

- **The applied bacteria envelop the entire root and prevent the attack of harmfl soil-borne pathogens**
- **The formation of plant hormone-like substances by the applied biologicals visibly and measurably promotes root growth**
- **The absorption of nutrients from the soil (especially phosphate) is improved**
- **The E-VITA | PLUS seed treatment protects against the weather risk such as drought and temperature, at a manageable additional cost**
- **The process is associated with additional economic benefits for the farmer like reduced fertilization**
- **Higher and faster field emergence**
- **Healthy radicles with better water and nutrient uptake**
- **Better overwintering**

Biologicals used

win-win situation thanks to spore-forming bacteria.

Uniform spread of Bacillus cultures on root surfaces

It has been proven that the uptake of nutrients from the soil (especially phosphate) by the roots could be improved.

When selecting the bacteria, a distinction must be made between spore-forming and living bacteria. When using live bacteria, which only have a limited lifespan on the seed, it is necessary to sow promptly after seed treatment. However, numerous trials have shown that various strains of live bacteria have a very high performance. They therefore continue to be of great interest for seed treatment.

For practical reasons, spore-forming bacteria (primarily from the genus Bacillus) are currently preferred for seed treatment. These bacteria survive for many years on the seed without losing their effectiveness. The Bacillus species are bacteria that occur naturally in every soil worldwide and have a positive effect on the plant through a symbiosis with the plant root.

It is a classic win-win situation:

The Bacillus receives carbon hydrates from the plant root and in return supplies hormones that stimulate root growth as well as nutrients (especially phosphorus) obtained from the soil solution. There are numerous strains of Bacillus that can differ in their environmental requirements (temperature, pH value in the soil, nutrient supply).

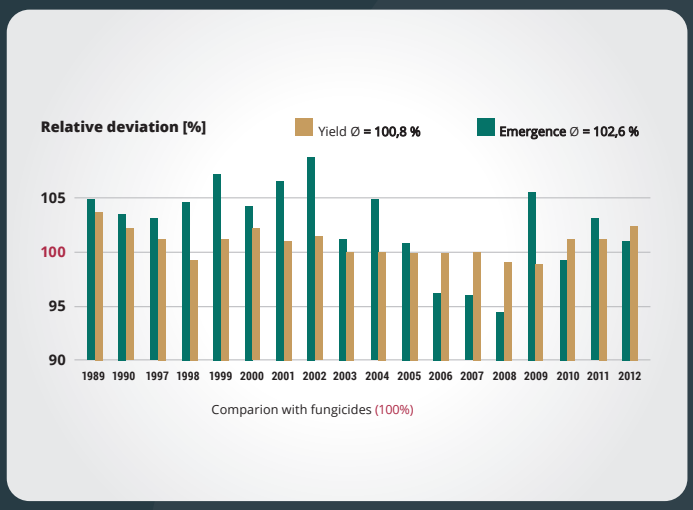
In extensive steps, individual strains were specially selected for seed treatment and tested in field trials. Conclusion: Bacillus is not just Bacillus!

Effect:

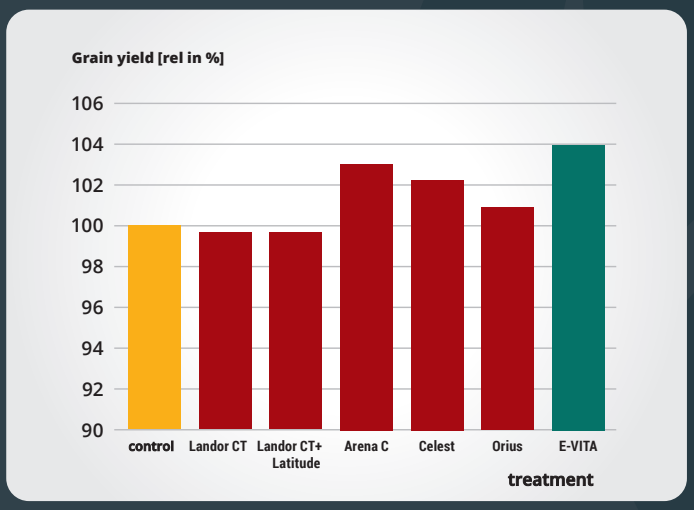
The Bacillus bacteria multiply via spores. Reproduction begins just 24 to 36 hours after sowing. Spore formation is stimulated during germination by messenger substances produced by the seed. With the beginning of visible germination (emergence of the radicle tip from the seed), the bacteria colonize the radicles and envelop them. This prevents harmful soil-borne pathogens from "docking" onto the roots. The space on the radicle is occupied, so to speak, by the "desired" beneficial bacteria.

The symbiosis of the bacteria with the radicles not only prevents infection by harmful microorganisms present in the soil. It also provides the seedling with further advantages. The production of plant hormone-like substances by the Bacillus visibly and measurably promotes root growth.

Treatment in cereals



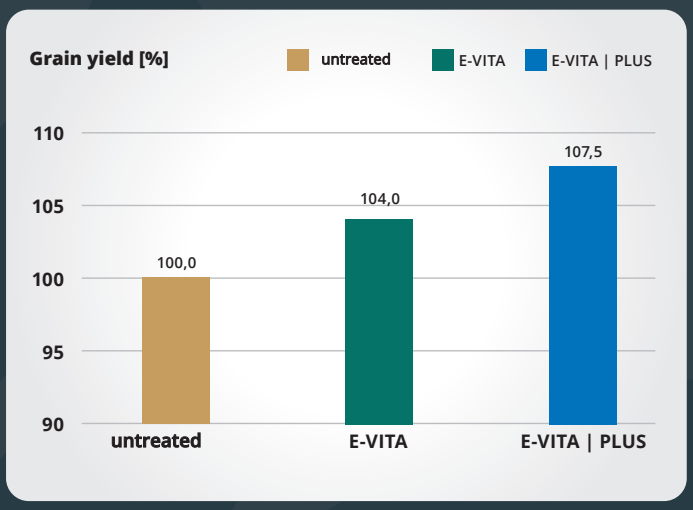
Crop: winter wheat
trial: long-term trial series Federal Biological Institute



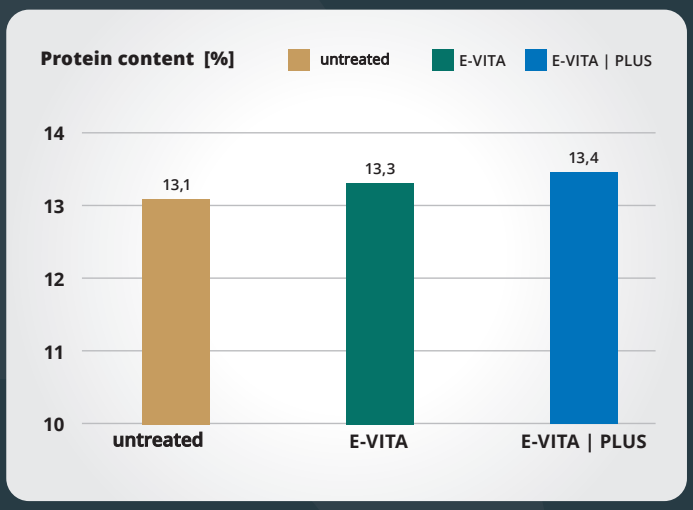
Crop: winter wheat, trial: self-follow-up trial 4 years
Schleswig-Holstein Chamber of Agriculture, Ceravis AG

Crop: Winter barley, trial: Vessel trial winter barley - 3 week after sowing
Source / Implementation: Ceravis AG, Feb. 2021

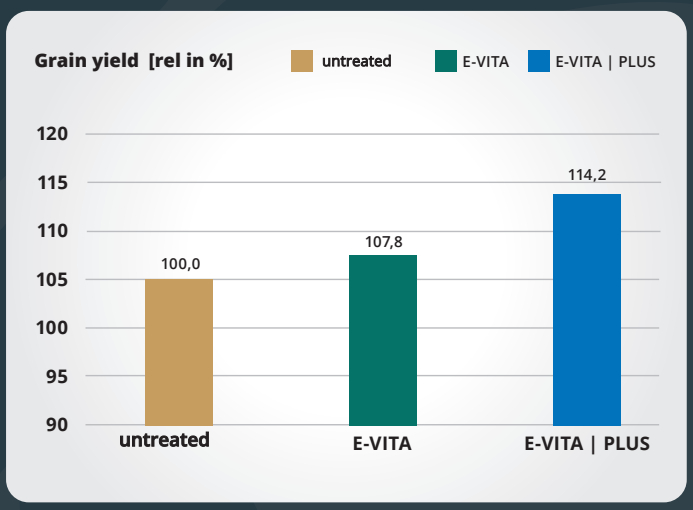
Available species: Wheat, barley, oats, rye, triticale



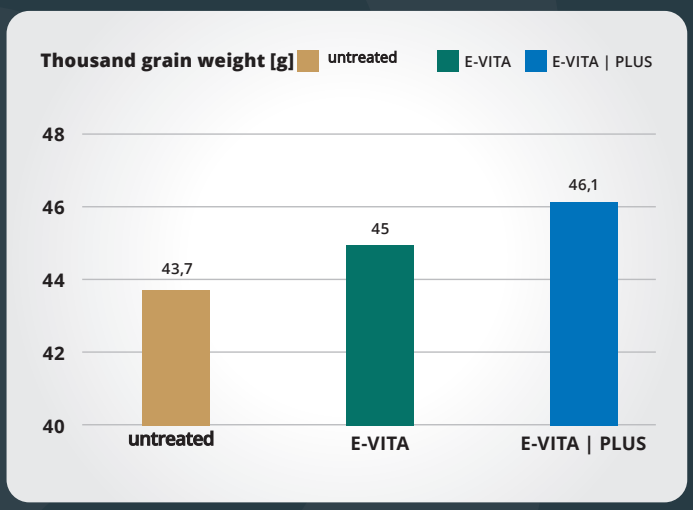
Crop: Wheat, 2021
Implementation Funds for the Barkow and Ivenack sites



Crop: Wheat, 2021
Implementation Funds for the Barkow and Ivenack sites



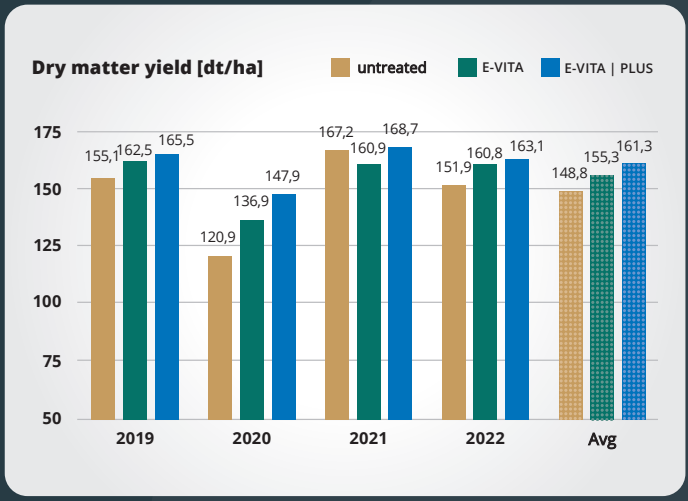
Crop: Barley, 2021
Implementation Funds for the Barkow and Ivenack sites



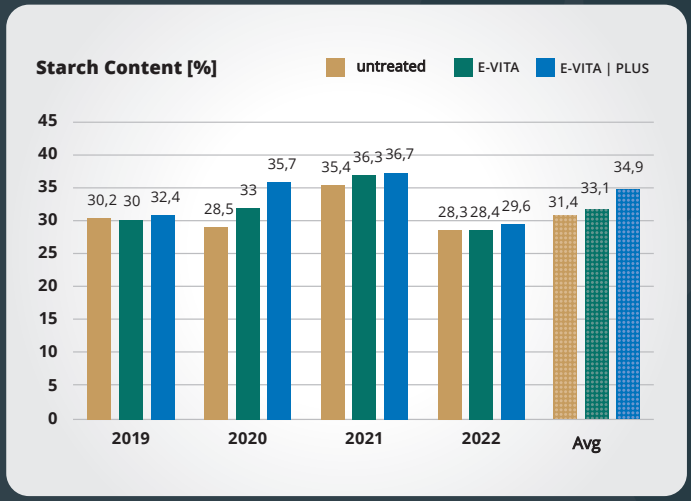
Crop: Barley, 2021
Implementation Funds for the Barkow and Ivenack sites

Test plots

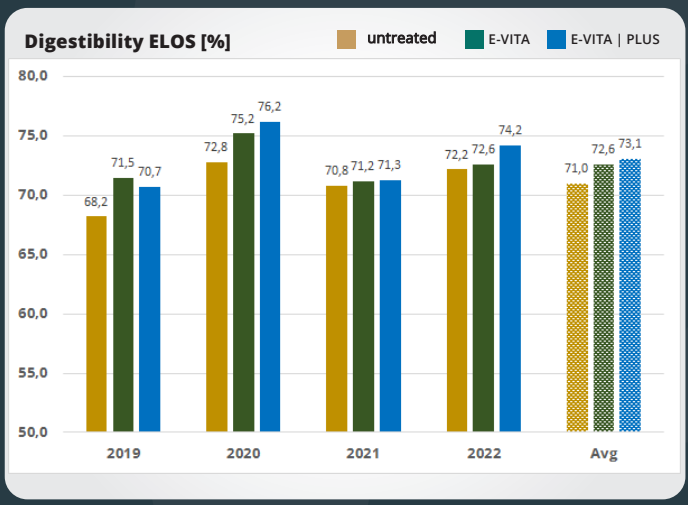
Treatment in corn and grain legumes



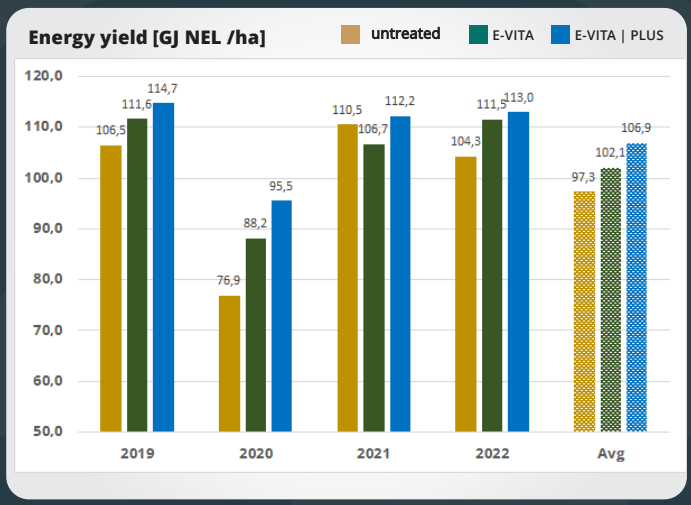
Crop: Corn
Long-term trial (3 years), 12 locations, source Ceravis AG



Crop: Corn
Long-term trial (3 years), 12 locations, source Ceravis AG



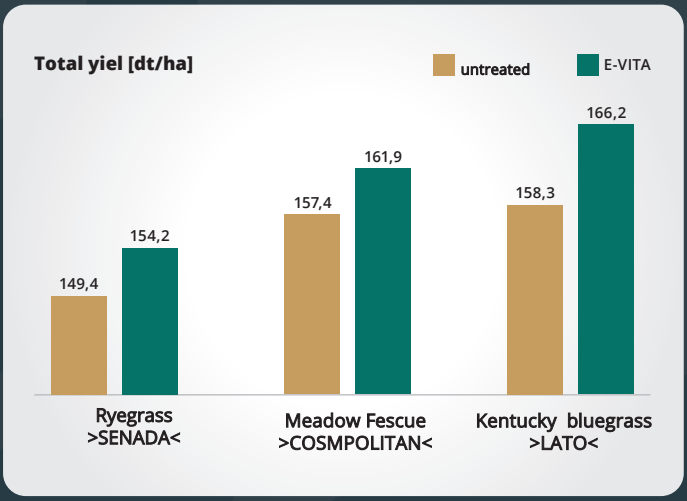
Crop: Corn
Long-term trial (3 years), 12 locations, source Ceravis AG



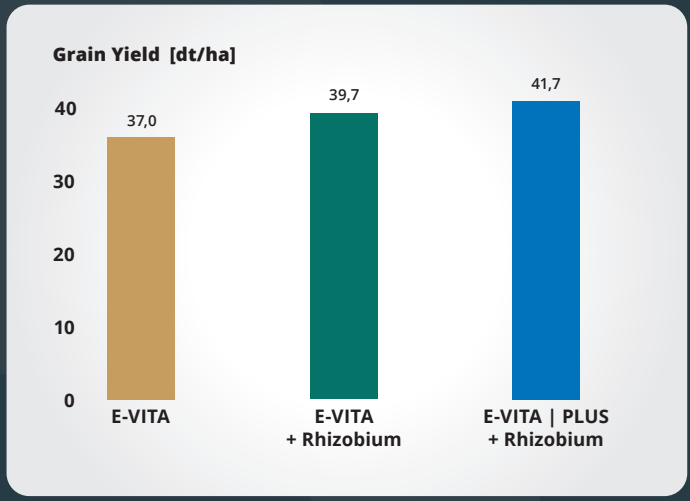
Crop: Corn
Long-term trial (3 years), 12 locations, source Ceravis AG

Treatment in other crops

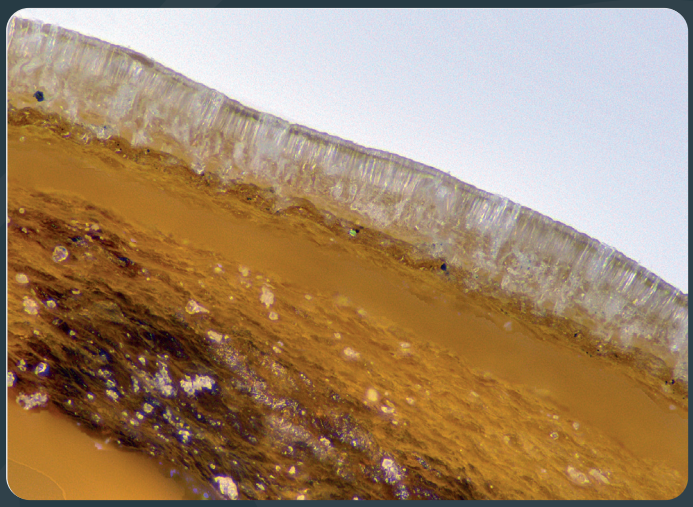
Available species: White lupin, blue lupin, field bean, peas, gras



Crop: ryegrass, meadow fescue, meadow grass Averaged sites: Lüssow and Steinach (GER)



Crop: grain peas
Trial: 2020, Ceravis AG



Do you have questions about E-VITA and E-VITA | PLUS?

Here you will find answers.

1. How does electron treatment work?

Electrons are generated and accelerated in a cathode and directed specifically at the seeds to be treated. The energy of these accelerated electrons effectively destroys microorganisms of all kinds, i.e. viruses, bacteria and fungi. The required amount of energy of 12 kGy determined by the German Federal Biological Institute to guarantee the safe destruction of pathogens is guaranteed.

2. What do E-VITA seeds and E-VITA PLUS seeds look like?

The seed is externally unchanged. The electron treatment leaves no visible traces on the seed. Detection is possible using laboratory analytical methods such as electron spin resonance (ESR or EPR), photoluminescence or thermoluminescence.

3. For which types of seed can electron treatment be used?

Electron treatment has been extensivelyinvestigated and tested for cereals, grain legumes, oilseeds and corn. Furthermore, initial test results show that the process is also suitable for treating various vegetable seeds and grasses.

4. Is electron treatment recommended for early and late sowing in winter wheat?

Electron-treated seed can be used for all sowing dates. Faster field emergence is a significant advantage for late sowing dates.

5. Does electron treatment only work against fungal pathogens?

Electron treatment leads to the complete elimination of all microorganisms adhering to the seed. The full range of positive effects of killing bacteria and viruses on the seedling are difficult to assess today as more studies are needed.

However, it is a fact that there is a gradual increase in bacterial and viral infections, which can also come via the seed (e.g. Pseudomonas, wheat streak, mosaic virus, etc.) and there are no chemical agents against these pathogens. However, it is good to know that preventive interruption of the chain of infection via the seed is already possible today with electron treatment.

6. How does electron treatment work against soil-borne pathogens?

Electron treatment of seeds creates germ-free seeds with high vitality. This enables the seed to withstand the possible infection pressure of soil-borne pathogens very well.

In its comprehensive investigation report, the German Federal Biological Research Center estimates: "Over the entire study period after electron treatment no increased infestation with soil-borne pathogens was detected."

This assessment is supported by extensive practical experience on over 4 million acres of cereal land. The option of additionally treating the seed with bacteria (E-VITA | PLUS) provides the radicle with additional protection against possible infection by soil-borne pathogens. This also eliminates the need for chemical treatment against blackleg.

7. Is there an official evaluation of the procedure?

The German Federal Biological Research Center for Agriculture and Forestry has extensively tested the process in numerous studies. The results are published in issue 399 of 2005. Among other things, it states: "Over a period of 20 years, it was shown in approx. 500 field trials that electron treatment can be used as an alternative method to chemical treatment". In addition, extensive tests have been carried out in recent years in the German states of Schleswig-Holstein, Mecklenburg-Vorpommern and Saxony by the relevant state research institutes, which confirm the results of the German Federal Biological Research Institute.

8. Does multi-year application on the same area lead to a build-up of a pest population in the soil?

The German Federal Biological Research Center estimates that "multiple successive treatments do not pose a risk and a build-up of pathogen populations is not to be expected." Adherence to crop rotation principles makes an effective contribution to reducing the pest population in the soil.

9. Does the process influence the germination capacity and field emergence?

The germination capacity is not impaired because contact between the electrons and the seedling is excluded. Tests have shown that field emergence is often slightly higher than with chemically treated seed. In practice, it has been observed that electron-treated seed emerges 1 to 3 days earlier.

10. Does electron treatment have an influence on winter hardiness?

In the winters that were affected by winterkill, a direct comparison showed no difference in winter hardiness with regard to the seed treatment method. Much more decisive were factors such as sowing date, variety and snow cover.

11. Does electron treatment influence the yield?

In all scientifically monitored trials, no significant difference in yield was observed compared to the chemically treated variant. Even in the provocation trials with artificial infection by Fusarium and Septoria spores, there was no difference in yield between the treatment variants. Significant yield advantages were demonstrated in the E-VITA PLUS combination method compared to chemically treated variants.

12. Where can E-VITA | PLUS be used?

Bacillus is not host plant specific. This means that it can colonize the roots of many plant species. Therefore, seed treatment is not limited to certain crops.

13. Do the bacteria also have negative side effects?

The bacteria are harmless to humans and animals. Bacilus can be found on all vegetables that are contaminated with soil residues (even in very small quantities). This means that everyone has already ingested this bacterium unnoticed. Seed residues that have been treated with EVITA | PLUS can be fed without hesitation.

14. Is there a risk to the user or the environment?

By avoiding the release of dressing dust into the air and the introduction of chemical substances into the soil, the process is environmentally and user-friendly. Seed treatment also poses no risk to the environment. In contrast, chemical seed dressings can have a considerable impact on the environment if not used properly.

> ***According to our experience and investigations to date, the use of E-VITA | PLUS is recommended for cereals, grain legumes and corn.***

15. How can left over seed be used?

Seed residues can be used as animal feed without any problems. Use as human food grain is not yet permitted.

16. How long does the protection last on the seed?

There are major differences in effectiveness between the chemical method of dressing and the physical method of electron treatment. The physical process achieves complete removal (disinfection) of persistent pathogens and thus has a long-lasting preventive effect. This effect lasts far beyond the time of planting.

17. How long can electron-treated seed be stored?

The limitation of the shelf life is less due to the treatment method and more to the germination capacity. Depending on the quality of the harvest, electron-treated seed can be stored for months. Electron treatment improves the shelf life of the seed.

18. Can reinfection occur during the storage of E-VITA Seed?

Infections with pathogens only occur in the field and during the growing season. If E-VITA seed has not been planted in the current year and is stored for the following year, reinfection will not happen. However general requirements for the storage of seed (clean, dry, free from rodents) should be observed.

19. What should I bear in mind when using electron-treated seed?

There are no requirements for the use of electron-treated seed. In practice, the absence of dressing dust when filling the seed drills and planters was perceived very positively. In addition, electron-treated seed can be sown in drinking water protection areas without any restrictions.

20. Does the planting rate need to be adjusted?

The planting rate does not need to be changed. However, when adjusting the seed drill / planter, it should be noted that the flowability of the seed (especially with cereals) is higher than with chemically treated seed.

21. Does electron treatment contribute to resistance management?

Pathogens are able to adapt their metabolism and reproduction cycle to chemical agents and develop resistance to them. This is an evolutionary process that ensures the survival of living organisms through adaptation.

> ***Nature has no resistance mechanisms for physical parameters. Consequently, the use of electron-treated seeds is an active and successful resistance management method.***

22. Will the process be developed further?

The process has been proven to be suitable for use on cereals, grain legumes, maize corn and oilseeds. Its effectiveness has also been confirmed for forage seeds (grasses, small-grain legumes). More development is planned in this area. The E-VITA PLUS process including subsequent treatment with bacteria represents a major step forward.

Your E-VITA contact

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