

ELECTRON TREATMENT OF SEEDS

ENVIRONMENTALLY FRIENDLY, EFFICIENT, SUSTAINABLE







ELECTRON TREATMENT

ENVIRONMENTALLY FRIENDLY, EFFICIENT AND FLEXIBLE

The treatment of seeds with accelerated electrons is a modern, environmentally friendly method that works without any chemical ingredients. Pathogens are effectively and completely destroyed without harming the endosperm and the embryo in the seed.

The method has won a DLG award and was described by the state entity »Biologische Bundesanstalt ^[1]« as an »alternative method for chemical dressing«.

The use of this modern technology offers consumer protection at its highest level and is also suitable and approved for organic farming.

The electron treatment works against all pathogens that are in and on the seed shell. This means that not only seed-borne

pathogens are destroyed, but lasting protection is also achieved by interrupting the chain of infection by eliminating harmful microorganisms such as bacteria (for example: pseudomonas) and viruses.

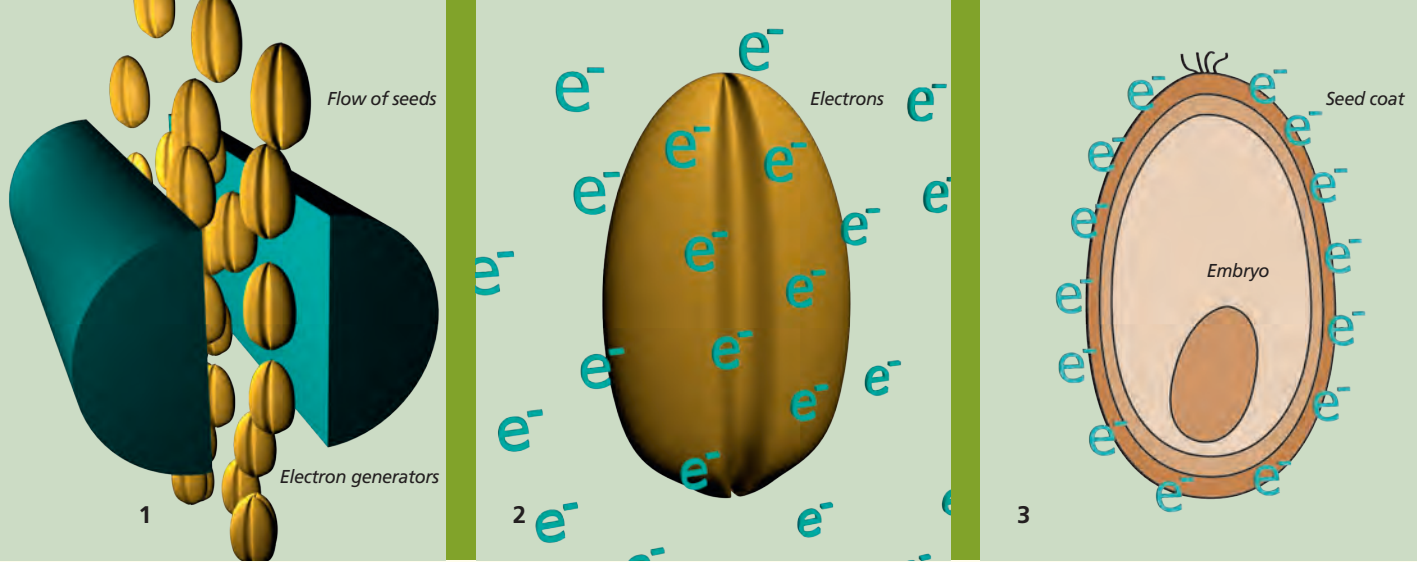
Because this method leaves no residues on the seeds, it is particularly suitable in combination with biological plant strengtheners.

Versatility

This high-quality method destroys all kinds of pathogens in the effective range, amongst other, on the following products:

Grain seeds	wheat, barley, triticale, rye, oats
Vegetable seeds	basil, beans, peas, lamb's lettuce, garlic, cabbage, leek, carrot, bell pepper, parsley, arugula, lettuce, tomato, onion
Herbs	aniseed, chili, pepper, marjoram
Other seeds	maize, grass, flower seeds, rape, poppy, seed potatoes

^[1] Today's name: Julius-Kühn-Institut



HOW THE ELECTRON TREATMENT WORKS

Technology in detail

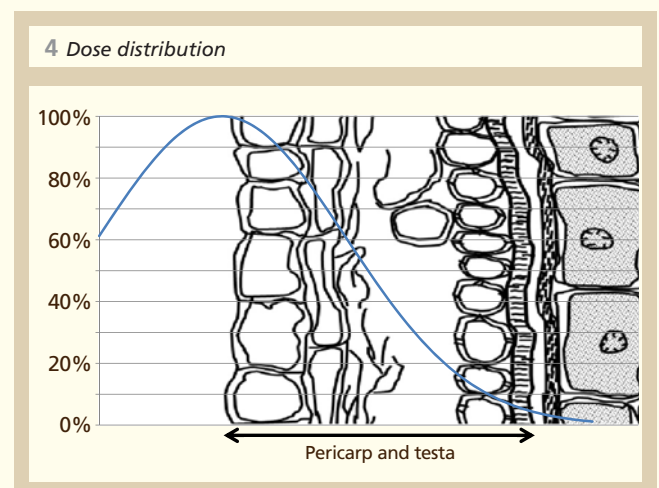
The electron treatment of seeds is based on the biocidal effect of low-energy electrons. The accelerated electrons are generated according to the principle of the Braun tubes. When high electrical voltages are applied between a cathode and anode, electrons are emitted from the cathode and are accelerated in the direction of the electron exit window by the difference in the electrical charge. The exit window separates the vacuum in which the electrons are generated from the process area, where an ambient pressure prevails (Fig. 1).

When treating seeds, the applied dose, which can be determined by regulating the current strength, and the electron energy, which can be adjusted with the acceleration voltage, are important. The dose is the electron energy that is absorbed in the seed coat. During the electron treatment of seeds, the lethal dose is crucial to combat the existing pathogens.

The electron energy is a measure of the kinetic motivity of electrons. When electrons penetrate matter, they lose their energy through collision processes. Once the energy is spent, they do not penetrate further into the material. This fact is used to precisely control the sphere of action during electron treatment (Fig. 4). The method can be used to apply an even dose (Fig. 2) on all sides of the individual seeds that only penetrates the coat far enough to guarantee that it has no effect on the embryo and the endosperm (Fig. 3). Harmful

organisms hit by accelerated electrons in the effective range are destroyed.

A splitting of molecular chains in microorganisms guarantees the complete destruction of these pathogens, irrespective of their nature. The method is effective against various fungal spores, bacteria and viruses, as proved in numerous laboratory and practical tests. At the same time, the purely physical action of the method rules out the possibility of the formation of resistant pathogens, which is not the case with chemical-systemic active agents.





ADVANTAGES

Advantages for users, producers and the environment

- Treatment of seeds without chemical active agents and without loss of the biological efficacy and without crop losses
- Excellent effect against seed-borne pathogens with no development of resistance
- No threat to the environment through chemically-synthetic active agents and formulation agents
- User-friendly because no dressing dusts, vapors or solutions are released
- Low-cost operation
- Faster field emergence
- Advanced storage properties
- Waste-free technology
- Approved for organic farming

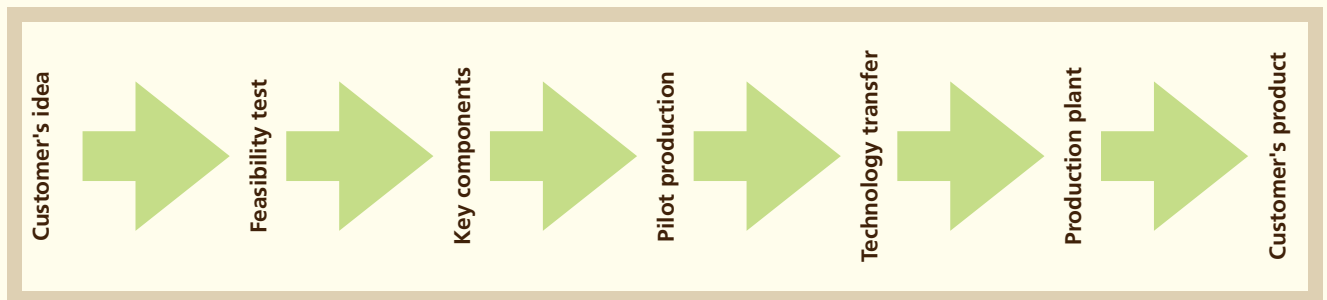
An excerpt from the spectrum of efficacy

- *Common burnt of wheat – Tilletia caries*
- *Smut fungus on rye – Urocystis occulta*
- *Brown spelt of grain – Septoria nodorum*
- *Snow mould – Microdochium nivale*
- *Stripe disease – Drechslera graminea*
- *Leaf blotch – Septoria spp.*
- *Alternaria leaf spot and stem blight – Alternaria spp.*
- *Gray mould rot – Botrytis aclada*
- *Fusariosis*
- *Bacteriosis – Pseudomonas spp.*
- *Bacteriosis – Xanthomonas spp.*



THE RIGHT SYSTEM FOR EVERY APPLICATION

DEVELOPMENT COMPETENCE MADE BY FRAUNHOFER



Experimental equipment

The universal experimental equipment REAMODE can be used for the discontinuous electron treatment of small amounts of all kinds of seeds. Specifically modified product feed systems and packaging solutions guarantee an electron treatment on all sides of the samples under a single batwing radiator. The treatment of new types and varieties of seeds can also be accompanied by on-site analyses. Microscopes to measure the coat thickness, various dosimetry systems to diagnose the penetration depth, an electron spin resonance measuring device to investigate various seed depths for free electron pairs to check the penetration depth and also climate chambers are available locally. These control systems are used to assess the status of the treatment and are used at the same time, as a basis for a subsequent scale-up to a pilot or production scale.

Throughput:	max. 1,000 grains / hour
Product size:	0.1 ... 10 cm
Treatment depth:	10 ... 170 µm

Production plants

Several stationary or container-integrated mobile systems for the electron treatment of seeds have been developed and delivered by Fraunhofer FEP over the past decades. Various companies produce and sell electron-treated seeds, such as, e.g., BayWa AG under the brand name E-PURA®. Currently, more than 20,000 t of seeds are electron treated on Fraunhofer FEP's systems in Germany per year – and counting.

Throughput:	max. 30 t / h
Grain sizes:	0.5 ... 2.0 cm
Treatment depth:	20 ... 200 µm
Treatment costs:	0.03 – 0.06 ct/kg



INVESTIGATION BY INDEPENDENT EXPERTS

Independent, competent partners are available to investigate the germinability and germination rate and to inoculate seeds with pathogens as well as investigate the pathogenic load after treatment.

Germinability tests

Germination tests can be carried out at independent institutes and testing authorities to examine the germination behavior and thus the vitality of seeds. These are performed according to the ISTA rules for the various types and varieties. This means that seeds can be tested not only routinely but also scientifically modified according to corresponding treatment methods.

Greenhouse tests

Pot experiments under controlled environmental conditions in small greenhouses can be carried out at the Institute of General Ecology and Environmental Protection at the Technical University Dresden in addition to germination tests. Different atmospheric gas concentrations can be simulated, soil-specific parameters, such as the soil moisture, can be modified in these experiments. These can be used to examine the fertility of plants from seeds treated with electron beams.

Field tests

The suitability of the treated seeds for practical use is proven in exact trials and large-scale field tests. Farmers with many years of experience in conventional and organic farming from various regions throughout Germany as well as professional testing authorities help Fraunhofer FEP to investigate the germinability, yield, field emergence and crop development.

Investigation of the pathogen infestation

Seed samples are tested for infestation with bacteria, viruses and microspores by state research institutes such as the Julius-Kühn-Institut, amongst others. It allows not only an analysis of the bacterial load after treatment through laboratory-analyzed tests, but also the selective inoculation of seeds with pathogens.

A cell and microbiology laboratory unit for fast, on-the-spot analyses is also available at the Fraunhofer FEP. This means that the pathogen infestation can be analysed directly on site by determining the total number and the number of viable cells, for example.





SPECTRUM OF EFFICACY

Grain

Culture	Pathogen	Effect
Winter wheat	<i>Tilletia caries</i> (common burnt of wheat)	very good
	<i>Septoria nodorum</i> (Brown spelt of grain)	good
	<i>Fusarium spp.</i> (moulds)	good
	<i>Microdochium nivale</i> (snow mould)	moderate to good
	<i>Septoria spp.</i> (leaf blotch)	good to very good
Winter barley	<i>Drechslera graminea</i> (stripe disease)	good
Summer barley	<i>Drechslera graminea</i> (stripe disease)	good
Winter rye	<i>Urocystis occulta</i> (smut fungus)	very good
	<i>Fusarium spp.</i> (moulds)	good
Triticale	<i>Fusarium spp.</i> (moulds)	good
	<i>Microdochium nivale</i> (snow mould)	moderate to good

Herbs

Culture	Pathogen	Effect
Caraway	<i>Alternaria spp.</i>	very good
Fennel	<i>Alternaria spp.</i>	very good
Coriander	<i>Pseudomonas spp.</i>	very good
Aniseed	<i>Alternaria spp.</i>	very good

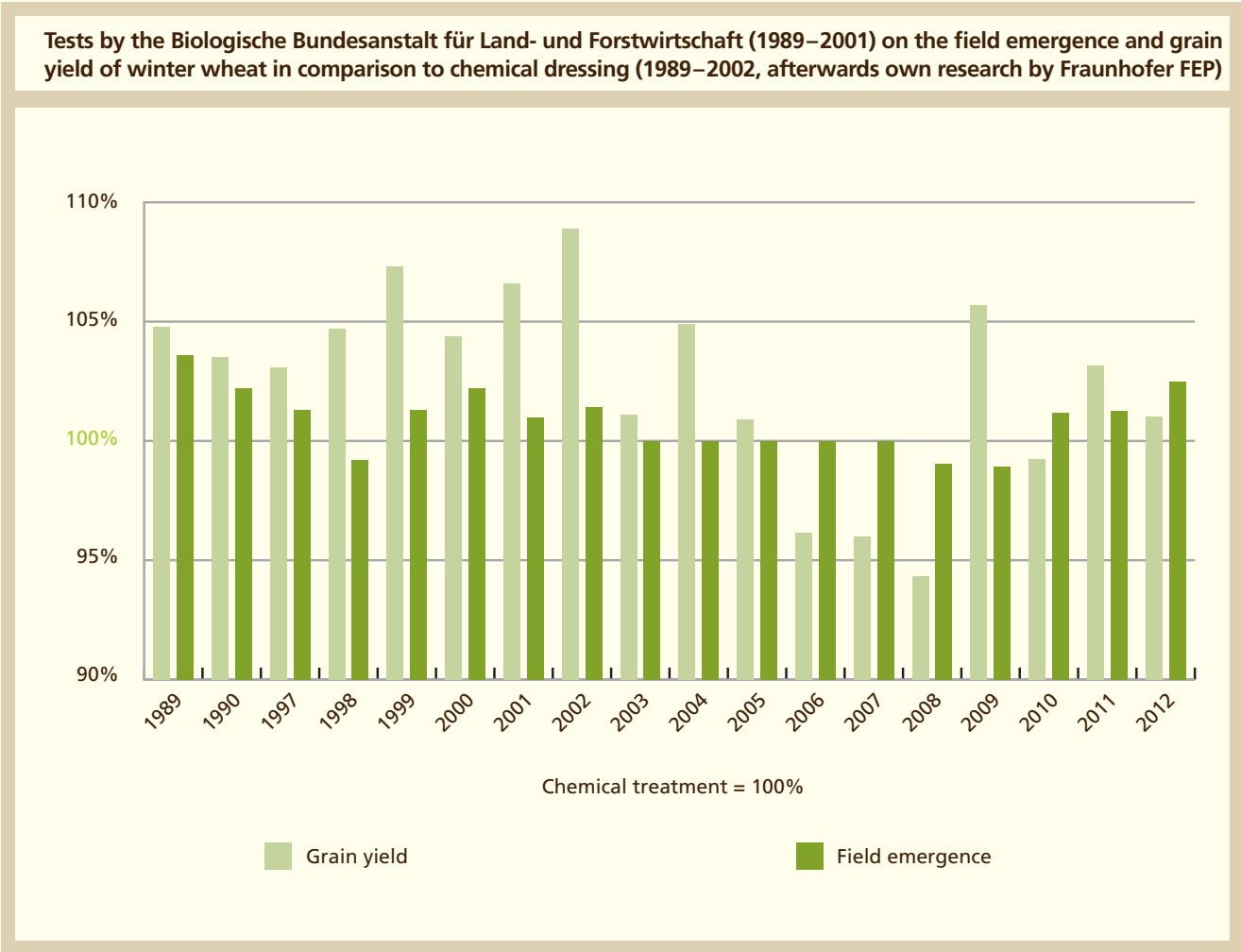


Vegetables

Culture	Pathogen	Effect
Parsley	<i>Alternaria spp.</i> <i>Septoria spp.</i> <i>Alternaria spp.</i>	very good moderate very good
Carrots	<i>Xanthomnas spp.</i> <i>Alternaria spp.</i> <i>Phoma spp.</i>	very good very good very good
Cabbage	<i>Xanthomnas spp.</i>	good
Lamb's lettuce	<i>Phoma spp.</i>	very good
Beans	<i>Pseudomonas spp.</i>	very good
Celery	<i>Septoria spp.</i>	moderate
Onions	<i>Alternaria spp.</i> <i>Xanthomnas spp.</i>	very good very good

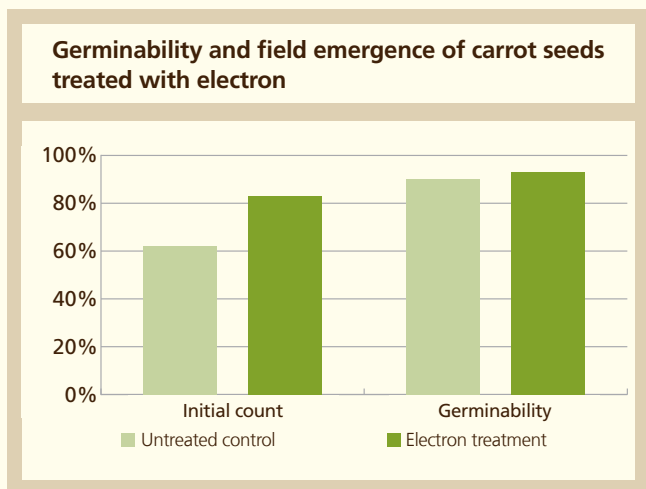
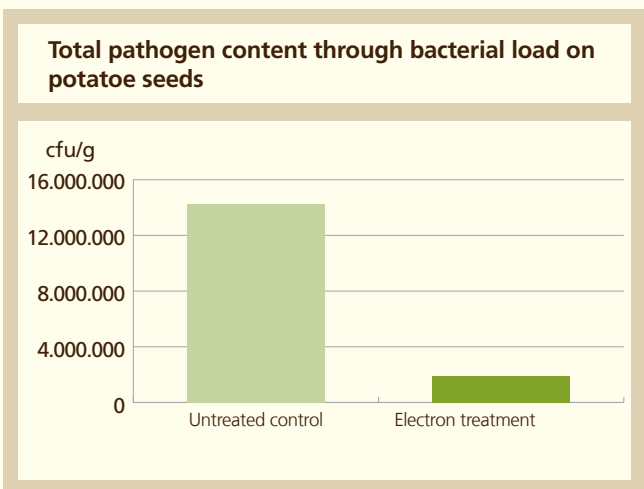
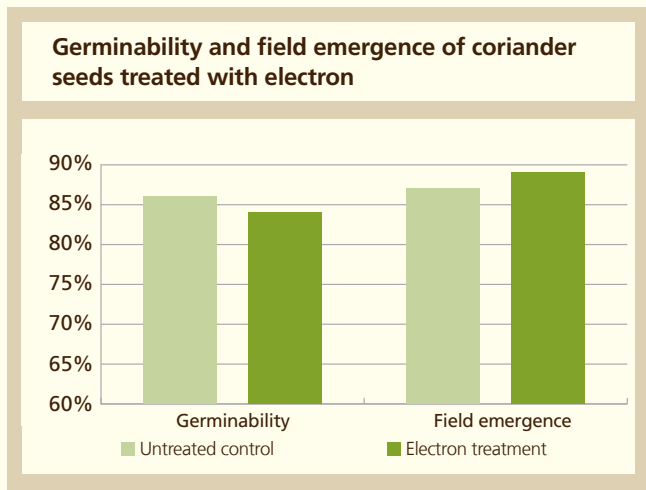
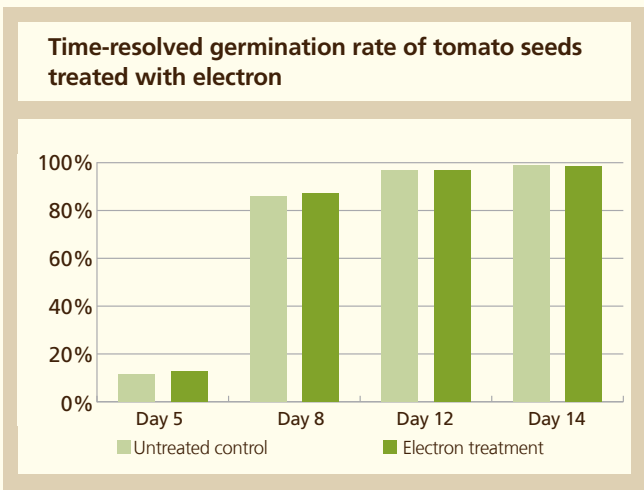
TEST RESULTS

PHYSIOLOGICAL AND ECONOMIC SUCCESS OF CROP IN FIGURES





PHYSIOLOGICAL AND ECONOMIC SUCCESS OF CROP IN FIGURES



COMPETENCE AND WHAT WE OFFER

WE AND OUR PARTNERS CAN OFFER YOU

- feasibility studies for the treatment of all kinds of grain and fine seeds
- development, construction and commissioning of customized plants for seed treatment
- customer service for the treatment of seeds with electron
- parameterization of electron treatment systems based on laboratory tests
- inoculation with target bacteria and laboratory tests for bacterial load
- germinability tests in climate chambers and greenhouses
- feasibility studies on the adaptation of the systems for the treatment of animal feedstuffs, pharmaceutical products and other granular products such as polymers and fine chemicals

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and the ISO 9001.*