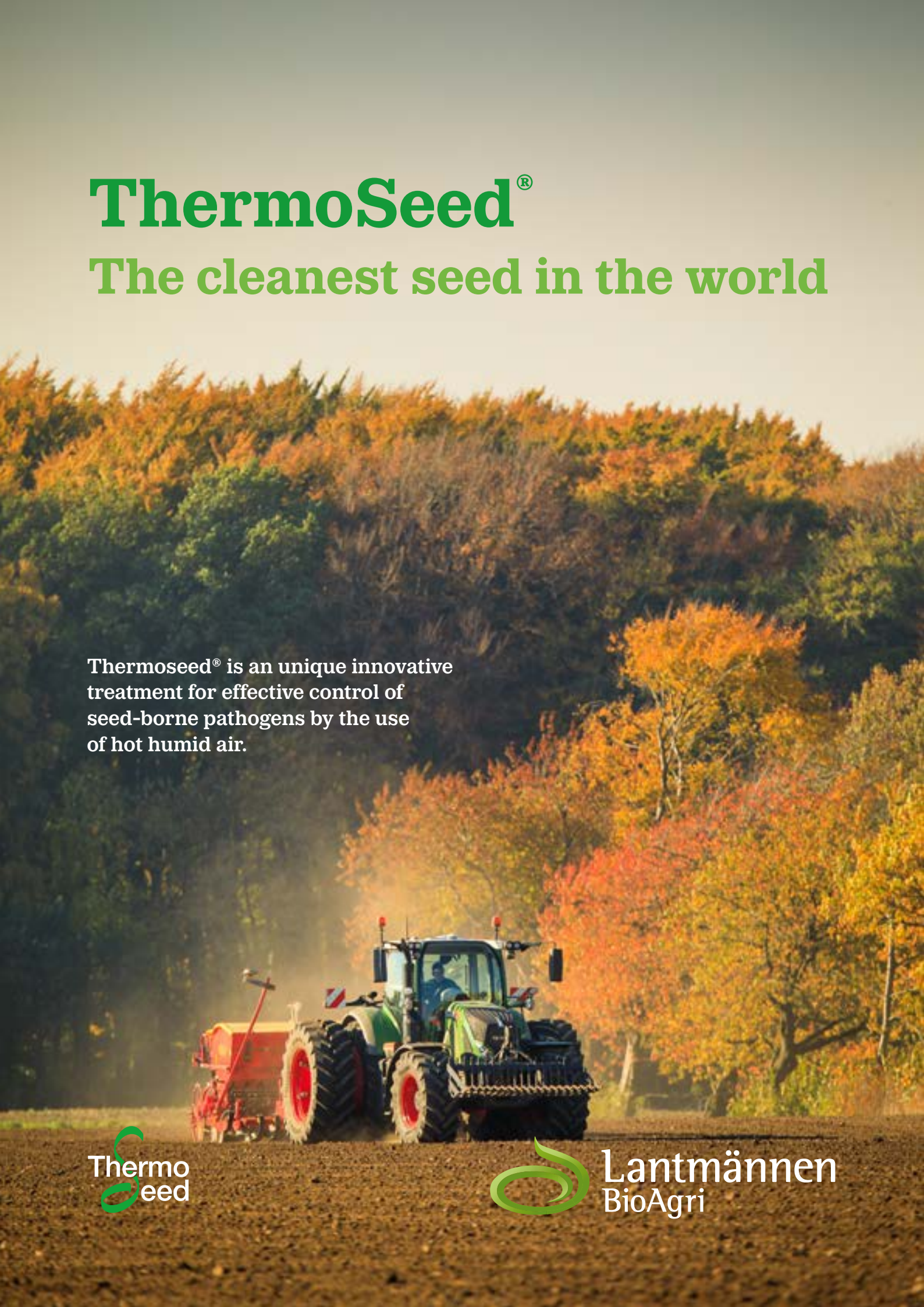
ThermoSeed®

The cleanest seed in the world



Thermoseed® is an unique innovative treatment for effective control of seed-borne pathogens by the use of hot humid air.

Thermo Seed

Lantmännen BioAgri

ThermoSeed®
For natural growth

Globally there is an increasing demand for sustainable crop production processes. ThermoSeed® offers an innovative, highly efficient and environmental friendly seed treatment technology with great added value to seed processors and farmers.

ThermoSeed® was developed in Sweden in the nineties and has undergone rigorous testing in a wide range of crops under various climatic conditions worldwide with remarkable and consistent results. Nowadays 60.000 tons of seeds are treated annually with a strong increase of volume and users globally.

For highly productive and sustainable agriculture

- Thermal seed disinfection by steam pasteurization
- Effective control of seed-borne pahogens without chemicals
- Proven effectiveness on large scale commercial level and confirmed by numerous official trial results
- Profitability
- Suitable for a wide range of crops

Innovation with long experience

Today ThermoSeed® is divided in two organizations. Lantmännen BioAgri AB, owned by Lantmännen Group, markets ThermoSeed® in Northern Europe, while ThermoSeed Global AB operates in the rest of the world, both companies work closely together for expanding ThermoSeed®.

Kenneth Alness

1993 The ThermoSeed® technology is initiated and developed by research projects at the Swedish University of Agricultural Science in Uppsala (SLU)

1998 Company is founded in Uppsala and first patent is filed.

2003 First demonstration machine (1 ton/h) is installed.

2005 Development of a first large-scale ThermoSeed® equipment (15 ton/h)

2007 Lantmännen acquires the rights for Scandinavia and Baltics and integrates ThermoSeed® activities into Lantmännen BioAgri AB. A joint venture with Incotec International B.V. coveres activities in the rest of the world

2008 Lantmännen installs a 15 ton/h ThermoSeed® equipment in Skara and starts commercial production on large scale

2010 Incotec aquires 100% of their joint venture

2012 The Norwegian cooperative Felleskjøpet installs two ThermoSeed® machines with a capacity of 15 ton/h each

2013 Incotec provides a mobile 2 ton/h ThermoSeed® machine for vegetable seeds and demonstration

2014 Lantmännen installs in Eslöv a second 15 ton/h machine. RiceTec Inc. starts treating rice seeds with a 2 ton/h ThermoSeed® equipment in the USA.

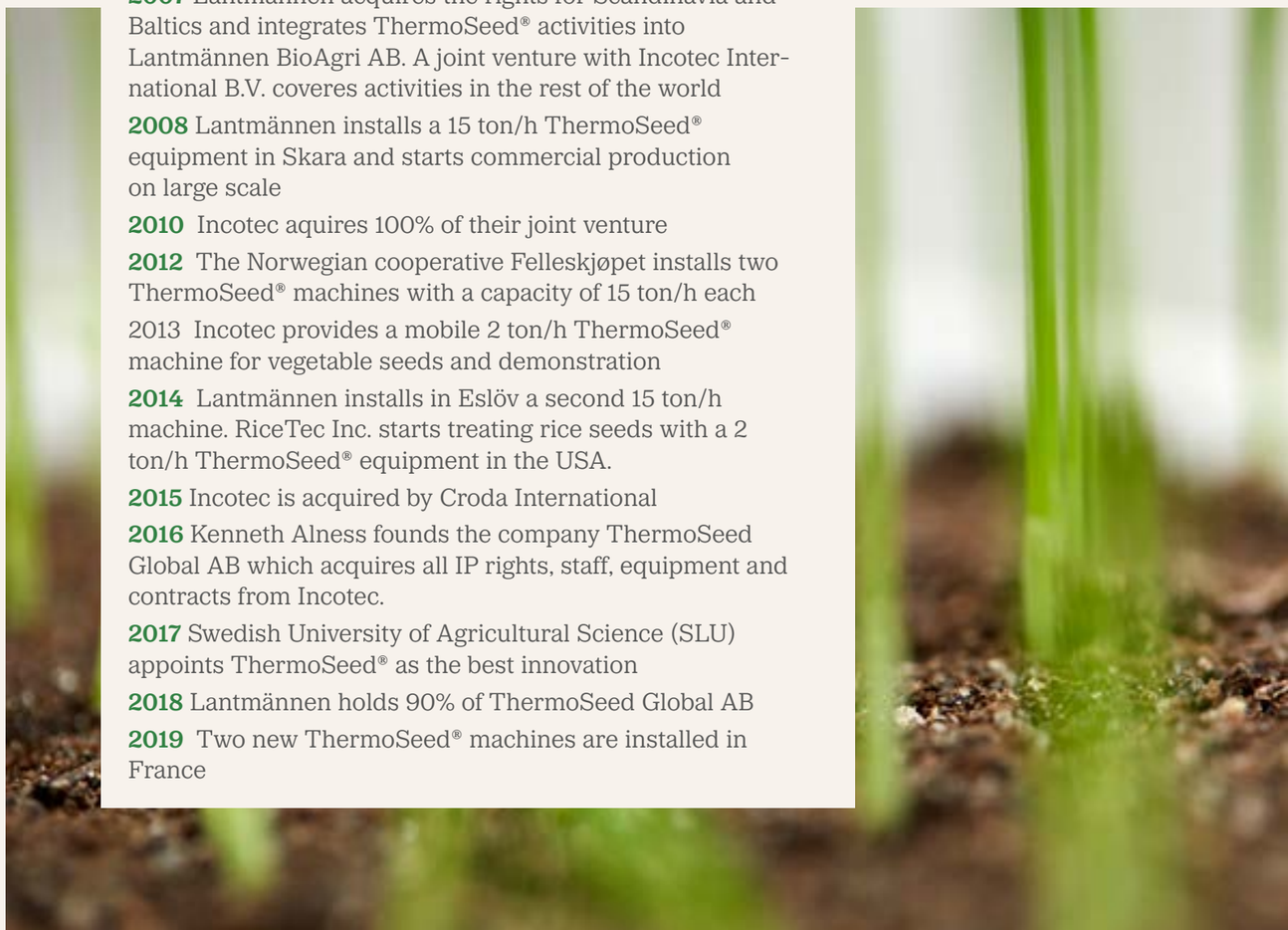
2015 Incotec is acquired by Croda International

2016 Kenneth Alness founds the company ThermoSeed Global AB which acquires all IP rights, staff, equipment and contracts from Incotec.

2017 Swedish University of Agricultural Science (SLU) appoints ThermoSeed® as the best innovation

2018 Lantmännen holds 90% of ThermoSeed Global AB

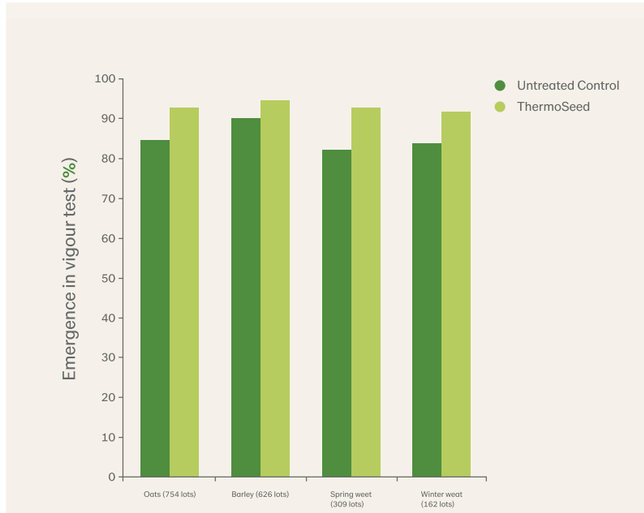
2019 Two new ThermoSeed® machines are installed in France

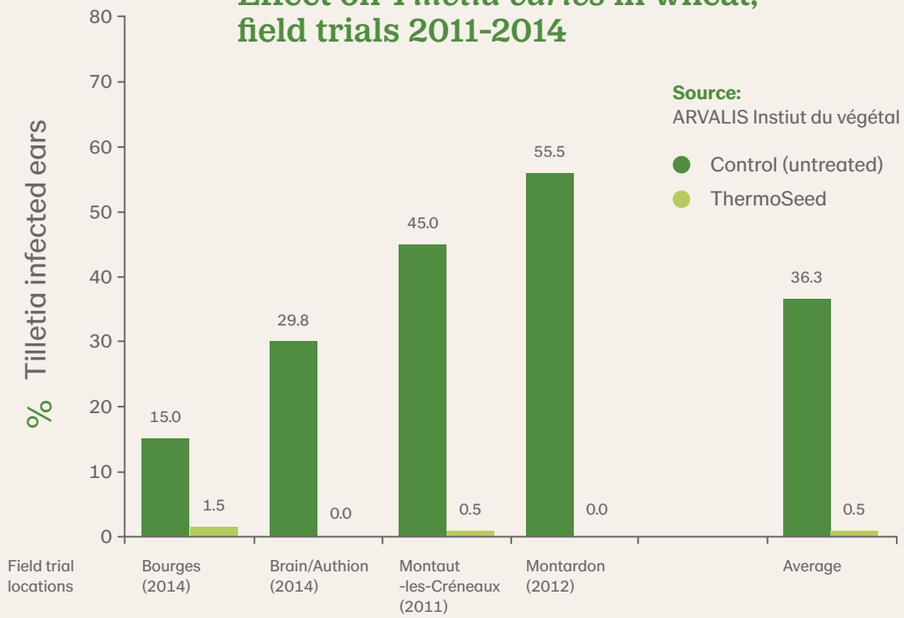


High field emergence and yield

Assets on field

- Competitive alternative to chemical seed treatment in conventional agriculture
- Very high efficiency against seedborne pathogens
- Crop yield levels equivalent to chemical seed treatments
- Full compliance with organic farming rules
- Outstanding vigor of germinating plants





The responsible choice of seed disinfection

“ThermoSeed is a very powerful tool for high-quality sustainable seeds, responding to our high industrial and agronomic demands. We started with two production lines with ThermoSeed in 2012 and completed our strategy by adding the third one in 2017. It’s a very concrete way of reducing the environmental impact and adding product value also in conventional agriculture, without compromising farmers’ productivity and profits”.

Bjørn Stabbetorp,
Felleskjøpet Agri, Norway

Assets for environment

- No drift of fungicide-laden dust and convenient handling
- No negative impact on the environment
- Contributes to sustainable agriculture and food production
- Complies with the EU directive of integrated pest management (IPM)
- A good working environment without exposure to chemicals
- Increases food safety, no risk for residues

Customization

Assets for seed management

- Effective control of various storage pest insects
- Treated leftover seeds can still be used for consumption and feed
- Leftover seeds are not chemical waste
- Convenient handling of treated seeds in bulk
- Efficiency of biological seed treatments can be increased when combined with ThermoSeed® disinfected seeds
- ThermoSeed® processing equipment can be delivered with capacities ranging from 10 kg up to 35.000 kg per hour
- Flexible implementation in existing seed processing lines and seed plants

To the right:

ThermoSeed® machine at the *Terre de Lin* plant for flax seeds in France with a capacity of 8 tons per hour.

Below:

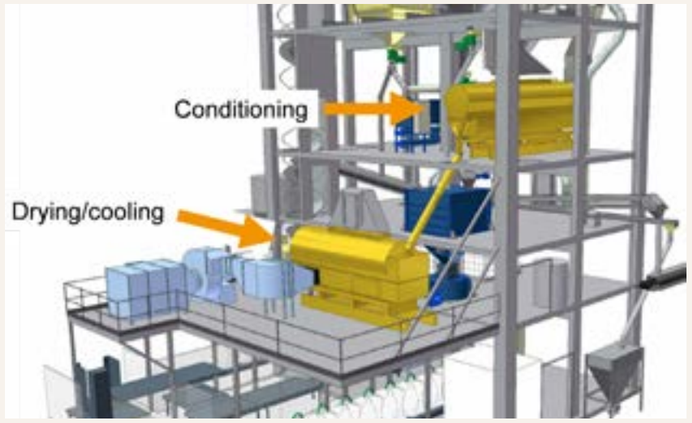
The new ThermoSeed® machine of Epilor Semences launched in 2019 at the seed plant in Dieulouard, France with a capacity of 12 tons per hour.

Added value for the harvested product

- High product value in the food chain due to reduced impact on the environment
- Can contribute to reduced DON level of harvested grain from crops established with ThermoSeed® treated seeds
- Efficient post-harvest treatment against storage pest insects such as Sitophilus granarius
- Can easily be used to support various sustainable food brands

To the right:

A 15 tons per hour machine operating in Sweden. The drawing shows the two-step, continuous process. The treatment phase followed by the drying and cooling phase just in front of a big-bag packing line.

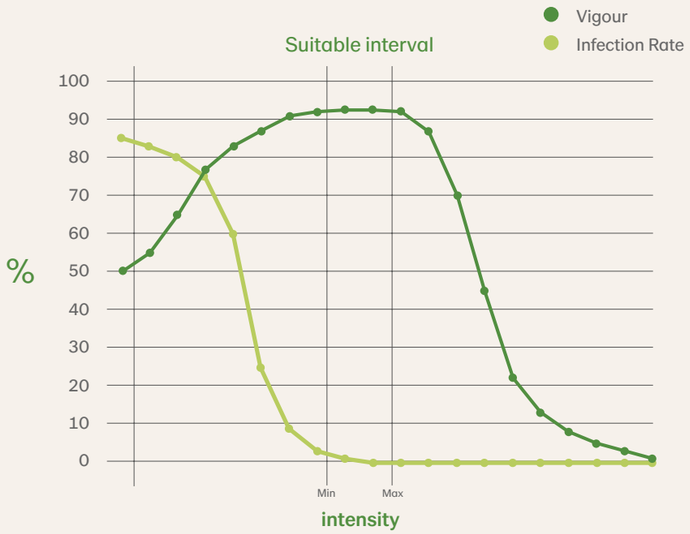


Optimum Quality

Thorough pre-testing is issued routinely to identify characteristics of each seed lot and optimize the process for the individual seed lot. These pre-treatment analyses and resulting calibrations of parameters are performed with exceptional precision. This enables maximal efficacy and grants full quality control.

The principle of ThermoSeed®

ThermoSeed® characteristic with germination inhibiting seed-borne pathogens



Excellent control of fungal pathogens

Crop	Pathogen	Disease	Effect TS
Wheat	Tilletia caries	common bunt	+
	Stagonospora nodorum	leaf and glume blotch	+
	Ustilago tritici	loose smut	-
	Fusarium spp.		+
	Fusarium culmorum		+
	Microdochium nivale	snow mold	+
	Claviceps purpurea	ergot	+
Barley	Drechslera graminea	leaf stripe	+
	Drechslera teres	net blotch	+
	Bipolaris sorokiniana		+
	Fusarium spp.		+
	Ustilago nuda	loose smut	-
	Ustilago hordei	covered smut	+*
Rye	Fusarium spp.		(+)
	Michrodochium nivale	snow mold	(+)
	Urocytis occulta	stem smut	+*
Triticale	Fusarium spp.		(+)
	Michrodochium nivale	snow mold	(+)
	Stagonospora (Septoria)		(+)
Oats	Drechslera avenae	leaf spot	+
	Fusarium spp.		+
	Fusarium graminearum		+
	Ustilago avenae	loose smut	+
Rice	Magnaporthe grisea		+
	Cochliobolus miyabeanus		+
	Gibberella fujikuroi		+
	Aphelenchoïdes besseyi	white tip nematode	+

Fungal infected wheat

Read the table

+ = Effects equivalent to, or better than, conventional seed treatment
(+) = Positive effects but not always fully equivalent with the best conventional seed treatment
- = Limited effect
* = Limited experience

Suitable for many types of crops

Crop	Pathogen	Effect of ThermoSeed® [1]
Alfalfa	Ditylenchus dipsaci	III
Bean	Colletotrichum lindemuthianum	III
Cabbage/ brassicas	Alternaria brassicicola	II
	Xanthomonas campestris	III [2]
Chicory	Alternaria spp.	III
Chickpeas	Botrytis cinerea	III
	Ascochyta spp.	II
Carrot	Alternaria spp.	II - III
	Xanthomonas campestris wpv. carotae	II [2]
Chinese Chive	Fusarium oxysporum	III
Corn	Fusarium spp.	II
Flax	Alternaria spp.	II - III
	Botrytis spp.	II - III
	Fusarium spp.	II - III
Hemp	Botrytis spp.	II
Lamb's lettuce (corn salad)	Phoma valerianellae	II
Oilseed rape	Phoma lingam	III
Onion	Botrytis aclada	III
	Stemphylium	II
Parsley	Septoria petroselini	II - III
Pea	Ascochyta pisi	II
	Fusarium spp.	II
Red Clover	Phoma medicaginis	II
Soybean	Alternaria spp.	II
Spinach	Alternaria	II
	Cladosporium	II - III
	Colletotrichum	II - III
	Fusarium	II - III
	Phoma	II
	Stemphylium	II - III
	Verticillium	II - III
Sugar beet	Fusarium spp.	II
	Phoma spp.	II
Sunflower	Sclerotinia sclerotiorum	III
Tomato	General M.O (fungi)	II

Read the table

II = Good effect
III= Full suppression (no pathogens detected)
[1] with no negative effect on germination or emergence
[2] with a modified variant of ThermoSeed®

Photos: Mårten Svensson, Gustaf Forsberg, Helena Holmkrantz, Incotec international s.v. and ThermoSeed Global.

Very clean starting material

Above: The picture presents the efficiency of ThermoSeed® in cleaning and removal of associated fungi in barley. On the left agar plate the untreated reference and on the right petri dish the ThermoSeed® treated barley seeds. The treatment results to healthy, clean and viable seeds.

ThermoSeed® treated carrot seed.

Untreated carrot seed reference with Alternaria spp.

Below: Chick pea plants. On the right ThermoSeed® treated and on the left a untreated reference showing lesions caused by Ascochyta.

After several years of plot and large-scale trials, we were able to prove that this innovative and eco-responsible process allows us to skip the fungicide seed treatment and still guarantee the farmers' revenues. The installation of the process ThermoSem® in our factory is important in order to be proactive regarding the evolution of the EU regulations and in relation to the need for sustainable development. The advantages of this investment are beneficial for all involved parties

Céline Canet,
Epilor Semences, France

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