Thermo Seed

SeedGard AB

Lantmännen

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- **Cerall**
- **Cedomon**

- **ThermoSeed – SeedGard**

Thermo Seed

Gustaf Forsberg

Sales

R & D

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The modern solution

Free from chemicals

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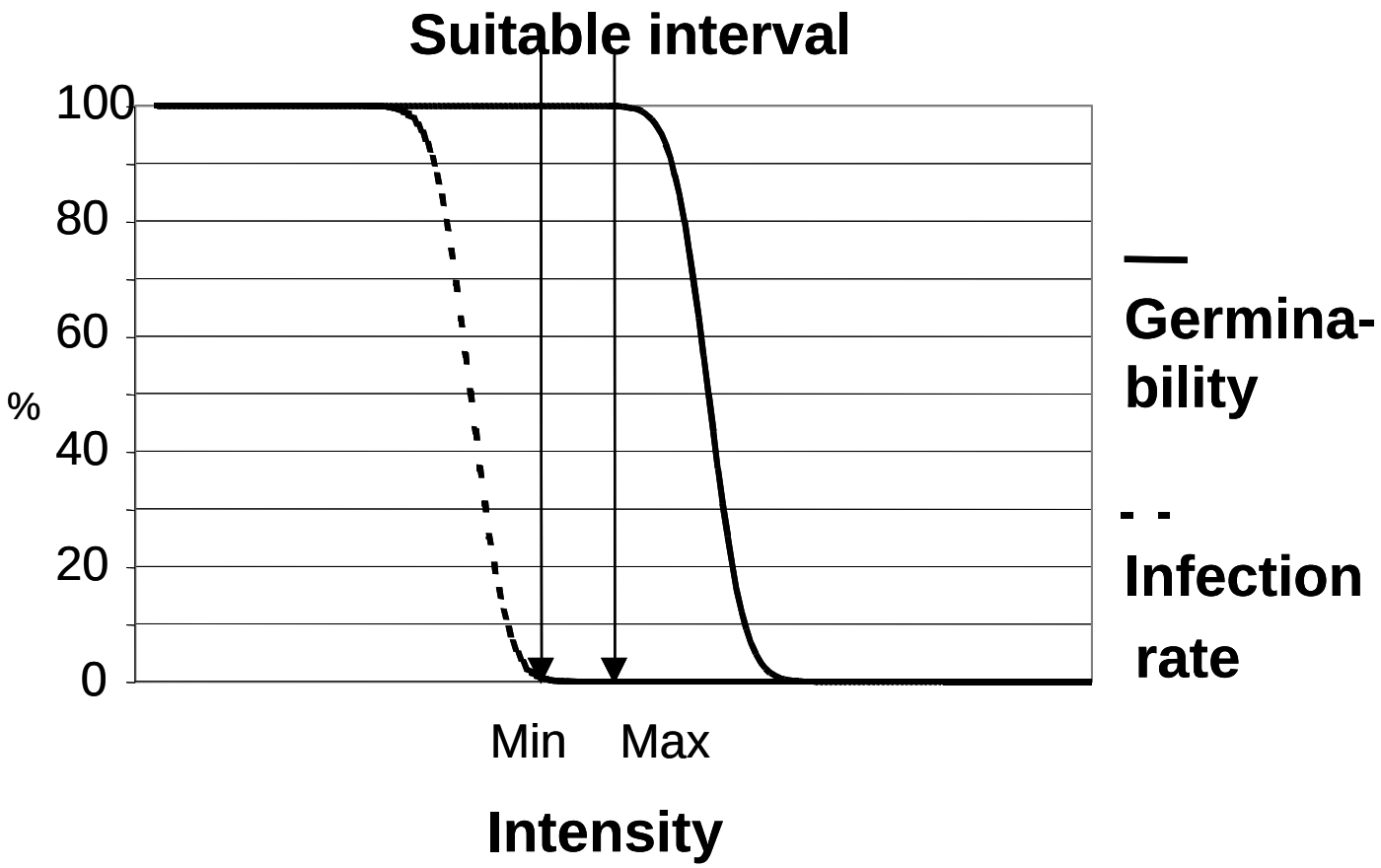
Commercial status

- In use on Swedish farms since 2002
- First full-scale system sold and licensed to Svenska Lantmännen for use on cereal seed
- More contracts under negotiation
- Several evaluations have shown very good potential for use on vegetable seed

Facts

- In commercial operation at 15 tons/h
- Effects equivalent to chemicals
- Cost-competitive with chemicals
- Approved by the Swedish Seed Testing and Certification Institute, SUK
- Up-scaled to over 200 tons per day

The principle



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Characteristics

- **Outstanding precision**
- **High throughput process**
- **Low cost**

  competes with chemical treatment

- **“Pasteurization”**

  treatment using hot, humid air

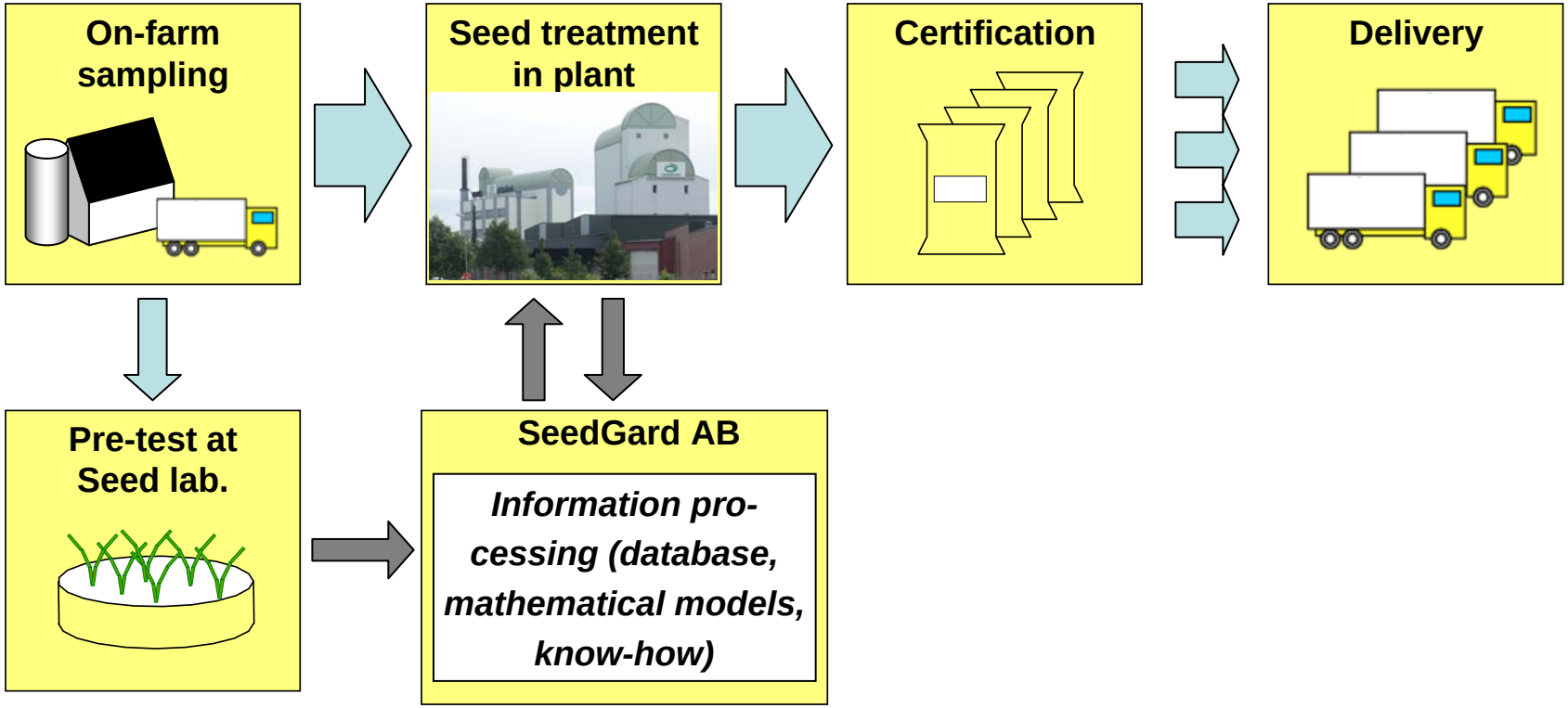
- **Advanced**

  process control technology

- **Reliable**

  highest quality control

The quality system



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Evaluation

+UK

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Evaluation methods

Highly infected seed

Field tests

- plant emergence
- pathogenic symptoms
- yield

Covering climatic and geographic variations

Laboratory and greenhouse tests

Effects

1: Non-cereal crops

Effects non-cereals, summary

Crop	Pathogen	Disease control[1)]	Yield effect	Kind of test
Cabbage	*Alternaria brassicicola*	II		Greenhouse
		II		Field
	Xanthomonas campestris	III		Laboratory
		III		Greenhouse
Carrot	*Alternaria radicina*	II		Laboratory
	Alternaria dauci	II		-"-
	Alternaria spp.	C+		Field
	Xanthomonas campestris pv. *carotae*	II		Greenhouse
Lamb's lettuce	*Phoma valerianellae*	II		-"-
Onion	*Botrytis aclada*	III		Laboratory
	Stemphylium	II		-"-
Parsley	*Septoria petroselini*	C+	C+	Field
Spinach	*Verticillium spp.*	II		Laboratory
	Cladosporium	II		-"-
	Stemphylium	II		-"-
	Alternaria	II		-"-
	Fusarium	II		-"-
Tomato	*Pseudomonas syringae* pv. *tomato*	III[2)]		Greenhouse
	Xanthomonas campestris pv. *vesicatoria*	III[2)]		-"-
Pea	*Ascochyta pisi*	II		Laboratory
Bean	*Colletotrichum lindemuthianum*	III		Field
Red clover	*Phoma medicaginis* var. *pinodella*	C+	C+	-"-
Rice	*Magnaporthe grisea*	C	C	-"-
	Cochliobolus miyabeanus	C	C	-"-
	Gibberella fujikuroi	C	C	-"-

I Better than untreated
II Good effect
III Complete eradication

When compared with chemical treatment:
C Equivalent with chemical treatment
C+ Better than chemical treatment

[1)] With no negative effect on germination or emergence
[2)] Very low control infection

STOVE project

"Seed Treatment for Organic Vegetable Production"

- Evaluations in lab, greenhouse and field 2003-2006
- Evaluated methods:
  - » ***ThermoSeed***
  - » ***Chemicals (Thiram and more)***
  - » ***Hot water***
  - » ***Electron beam "E-Ventus"***
  - » ***Various bacteria***
  - » ***Plant extracts***

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STOVE project

Outline of the conclusions:

"Aerated steam* appeared to be the most effective method, but hot water and electron seed treatment may still be similarly effective if they are more optimised".

*ThermoSeed label in the project

Effects

2: Cereal crops

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Effects in cereals, summary

Crop	Pathogen		Effects	
Wheat (spring winter)	*Tilletia caries*	(common bunt)	+	
	Stagonospora nodorum	(leaf and glume blotch)	+	
	Ustilago tritici	(loose smut)		-
	Fusarium spp.		+	
	Fusarium nivale	(snow mold)	+	
	Fusarium culmorum		+	
Barley	*Drechslera graminea*	(leaf stripe)	+	
	Drechslera teres	(net blotch)	+	
	Bipolaris sorokiniana		+	
	Fusarium spp.		+	
	Ustilago nuda	(loose smut)		-
	Ustilago hordei	(covered smut)	+	
Oats	*Drechslera avenae*	(leaf spot)	+	
	Ustilago avenae	(loose smut)	+	
Rice	*Magnaporthe grisea*		+	
	Cochliobolus miyabeanus		+	
	Gibberella fujikuroi		+	

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Example: Fusarium spp.

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Method approval

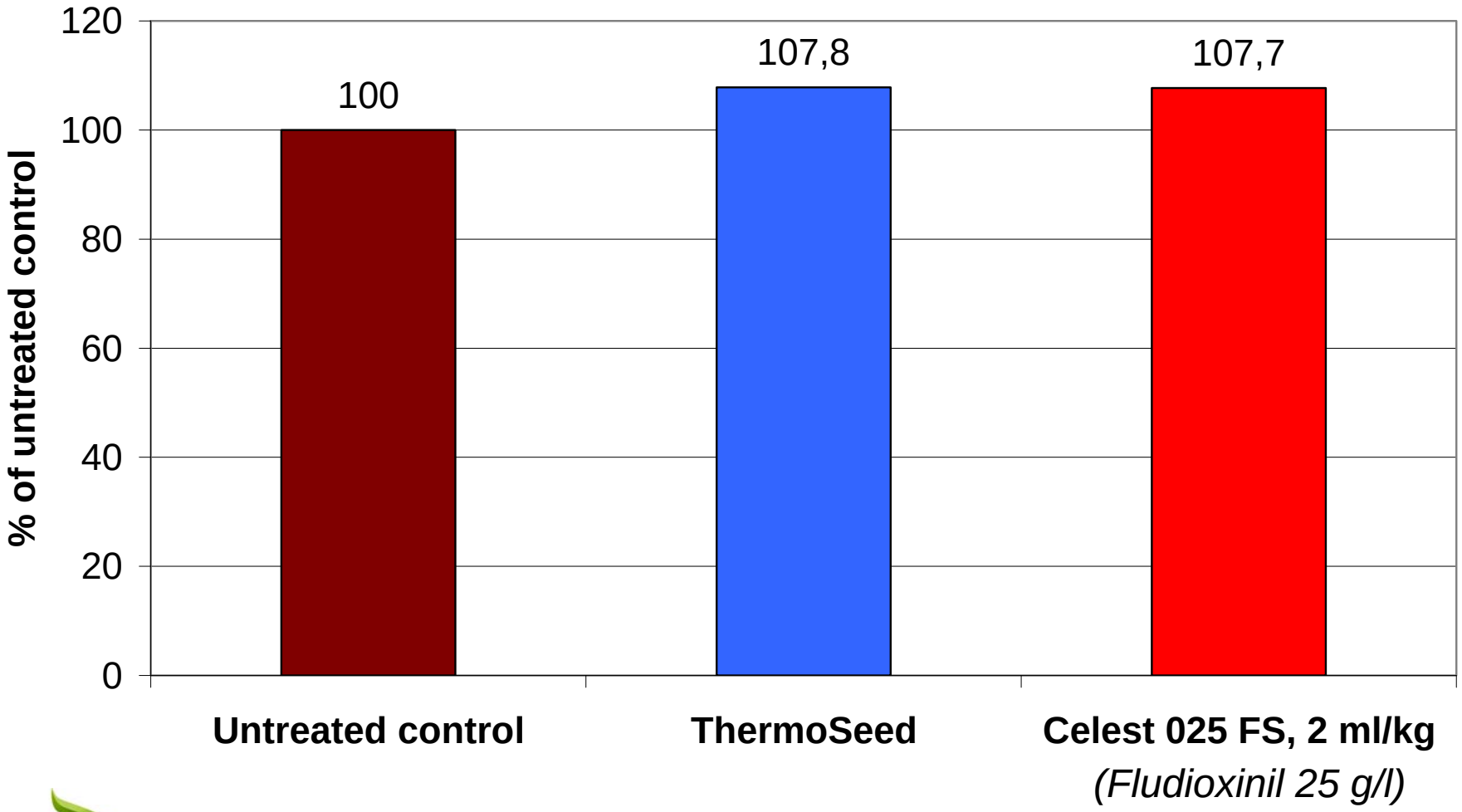
Evaluation by SUK

- the Swedish Seed Testing and Certification Institute (part of the Board of Agriculture

ThermoSeed approved

- as an equivalently effective alternative to chemical seed treatment

Yield wheat, 41 field tests 2003-04



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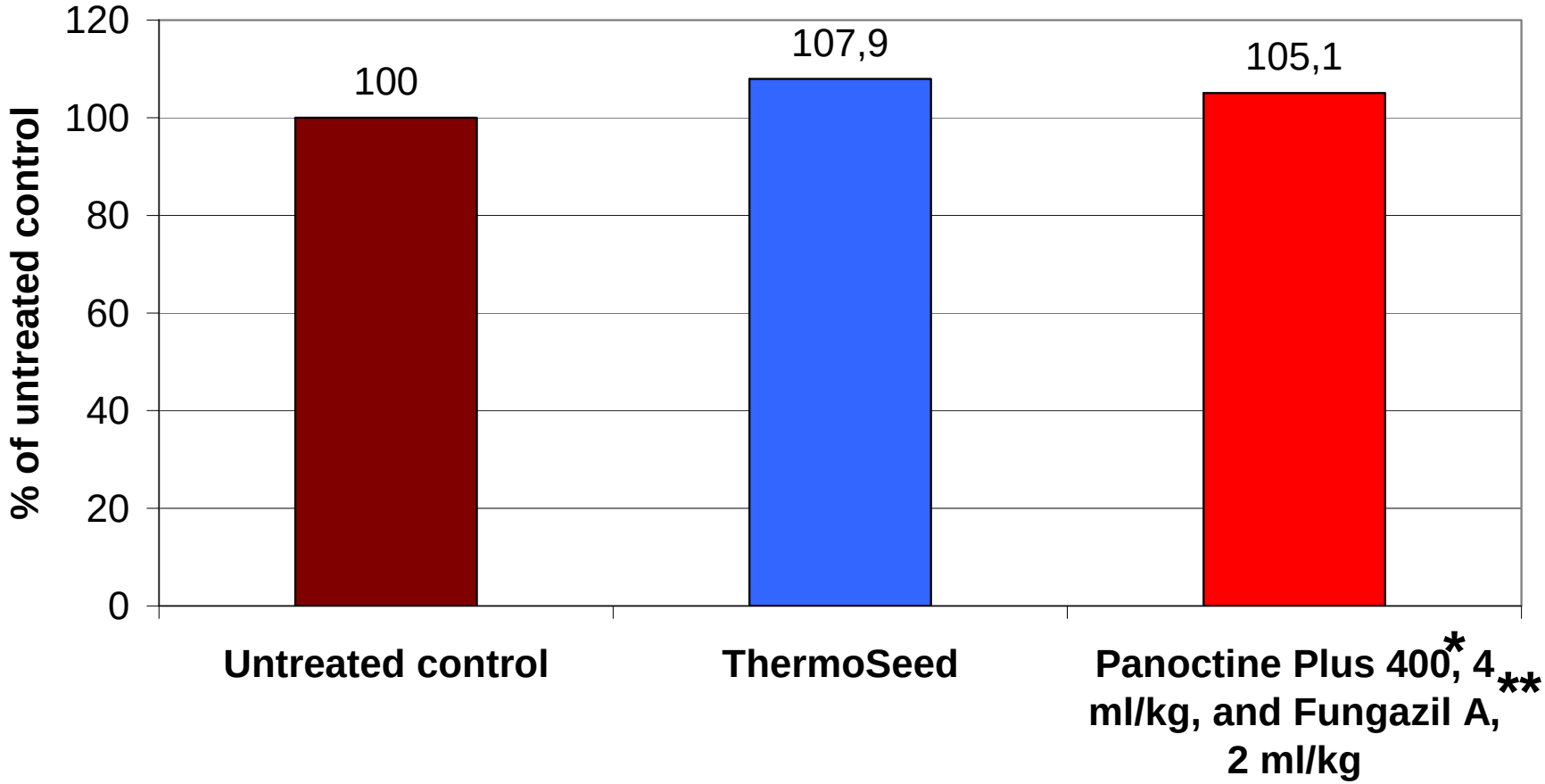
Yield barley, 24 field trials 2003-04



Imazalil 10 g/l, guazatine 150 g/l

***Imazalil 25 g/l*

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SLU:s seed treatment evaluation

Lars Wik, SLU

- Field tests at four locations 2005-07
- Comparisons between different products
- Wheat and barley

⇒***ThermoSeed is in the top***

both concerning effect and yield

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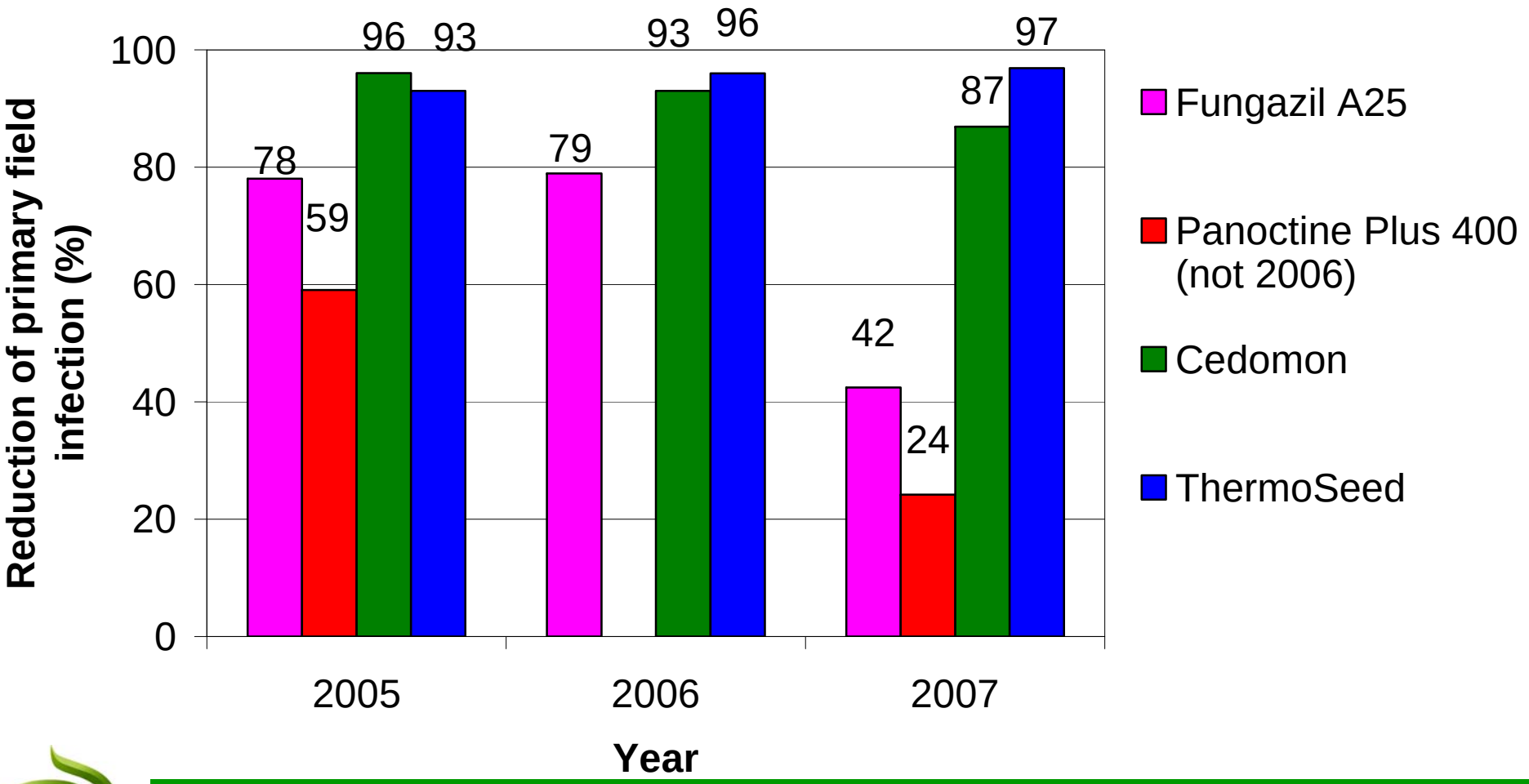
Seed Treatment against net blotch in barley

Official field trials during 3 years (SLU R11-4010)



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Treatment effects in commercial operation 2006-07

- *Barley*
- *Wheat*
- *Rye*
- *Triticale*

⇒*Effects confirmed*

⇒*Farmers very satisfied*

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The Lantmännen plant in Skara

Annual production 32 000 tons

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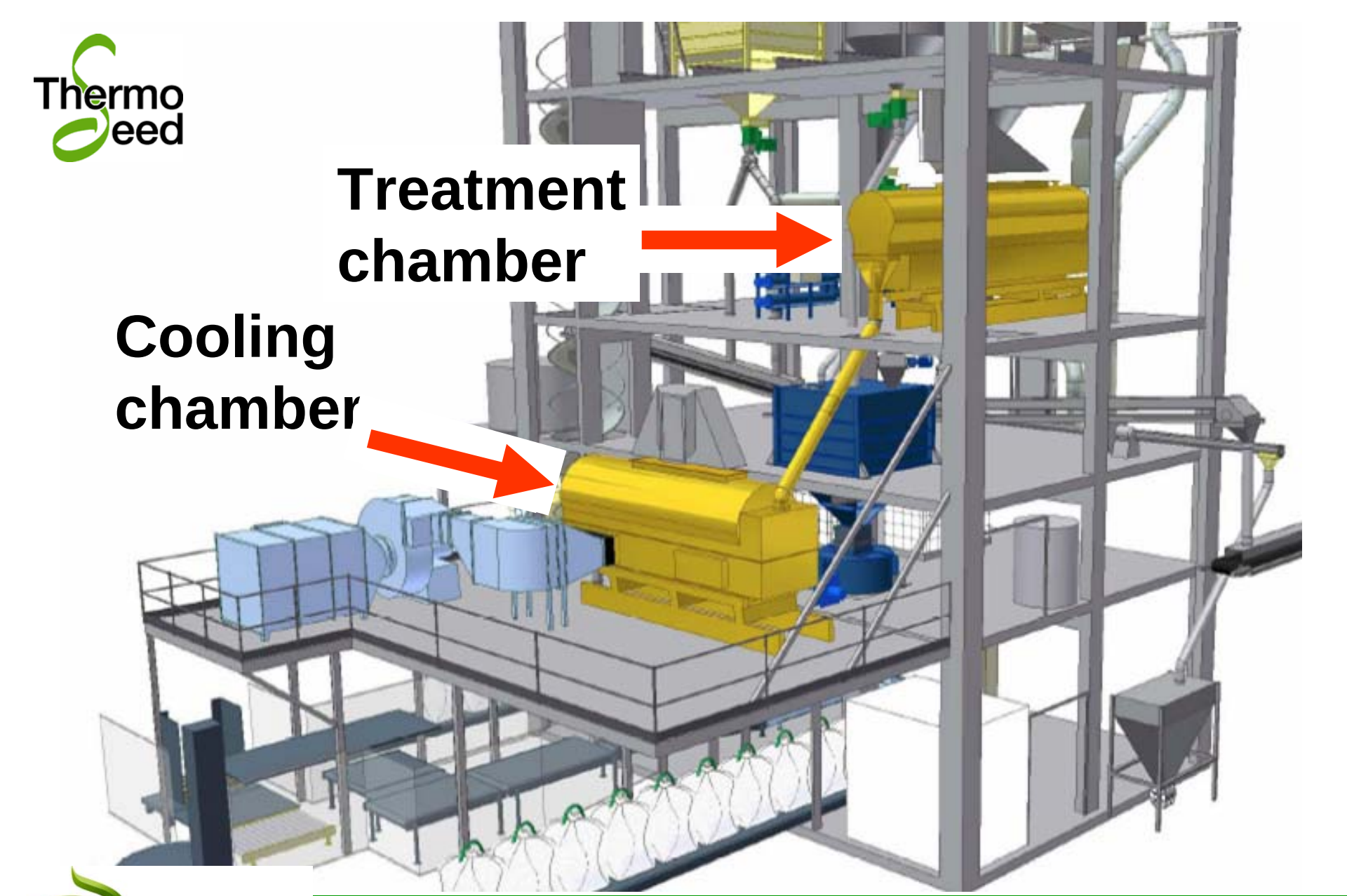

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LIFE environment award to ThermoSeed, by the EU Commission:

”Best of the Best”

of the over 100 projects finished during 2005-06

Lantmännen´s choice:

- *Create a new focus on seeds*
- *Use the unique technology advantages to win market shares*

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ThermoSeed benefits

Powerful and practical

Effects

- equivalent to chemical seed dressing

Broad spectrum

Conventional farming

- alternative to chemical seed treatment

Organic farming

- seed pathogens can now be controlled

No additives

– leftover seed has an alternative value

Economic

ThermoSeed competes with chemicals ***also by a low treatment cost***

Promoting environment and health

Environmentally friendly

Working environment improvement

- considerable for farmers and seed industry workers

No risks with treated seeds

- groundwater
- eco-systems
- humans
- animals
- etc.

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Supporting consumers concern

Environmental awareness increasing among consumers

Mercury treatment experience, the fear remains

Goodwill is gained from reduction of pesticides

Legislation

Facilitated establishment on new markets - no tests required to prove harmlessness

Lists with risk chemicals are implemented by National/EU authorities

Increased costs for development and use of chemicals due to new legislation policies

Other advantages

- ***Seed dormancy*** breaking
- ***Leftover seed*** good as food or feed
- ***Leftover seed*** no costs for destruction
- ***Grain storage insects*** effective control
- ***Bulk seed facilitated*** for low logistics costs

Conclusion

ThermoSeed

is an ***attractive alternative*** to chemical seed treatment

Next step?

- **<u>International expansion</u>** on field crop markets

- Now evaluating the potential for **<u>horticultural market introduction</u>**

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-For natural growth