Soil Association Organic Horticulture Symposium
June 2005

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PLANT HEALTH SOLUTIONS / HDRA

EC Regulations

- EC Regulation 2092/91
  - organic growers must use organically produced seed where available
- EC Regulation 1452/2003
  - prohibits the use of treated conventional seed
  - no derogations on the grounds of seed quality if the variety is registered in the organicxseeds database

Rationale

- Many plant pathogens are seed borne
- Use of disease-free (clean) seed is important for their management / control
- Especially important for organic production where there are few options for control in the field
- Seed health standards should be more stringent for seed used in organic production

Achieving Clean seed

Options:

1. Test the seed for presence of pathogens and only use clean seed lots
2. Treat the seed (and/or mother plants) to eliminate the pathogens
3. Combine the two – test and treat only if necessary

Seed testing

- Can never guarantee that a seed lot is completely healthy
  - zero disease tolerance is not possible
- Can only test a sample
  - detection limit = minimum % inf. seed which can be reliably detected (depends on sample size)
  - analytical sensitivity = minimum numbers of the pathogen which can be reliably detected (depends on assay design)

Design of Seed Health Assays

- Detection limits should be derived from tolerance standards which minimise disease risk and are based on an understanding of disease epidemiology
- Mostly lacking or arbitrarily implied as a result of the sample size
- Onions / neck rot
  - Epidemiological studies → 0.1 %
  - Most tests done on 400 seeds → 0.75 %

Conventional seed

- Relies on the use of fungicides for disease management both during seed production and treatment of the harvested seed
- Rare to find un-treated conventional seed
  - easier to treat all seed than to test and treat on the basis of need
  - lack of tolerance standards or treatment thresholds

'Official' Seed health standards

- There are no specific seed health standards/requirements for vegetables:

The Vegetable Seed (England) Regulations (2002)

"Diseases ….. shall be at the lowest possible level that can be achieved."

STOVE project

Seed **T**reatments for **O**rganic **VE**getable production

- EC co-funded project
  - QLK5-2002-02239
- Three years: Mar 2003 to Feb 2006
- Web-site: www.stove-project.net

STOVE - aim

- To improve and develop organically-acceptable methods for control of seed-borne pathogens of vegetable crops

STOVE - partners

- BBA, Germany (co-ordinator)
- PRI, Netherlands
- HDRA, UK
- Gothenburg University, Sweden
- Nunhems (Hild), Germany
- University of Turin, Italy
- Findus, Sweden

STOVE – hosts/pathogens

- Lamb's lettuce - *Phoma valerianellae*
- Carrot - *Alternaria dauci* (leaf blight), *A. radicina* (black root rot)
- Brassicas - *Xanthomonas campestris* pv. *campestris* (bacterial black rot)
- Carrot - *Xanthomonas hortorum* pv. *carotae* (bacterial blight)
- Brassicas - *Alternaria* sp. (dark leaf spot)
- Parsley - *Septoria petroselina*
- Bean - *Colletotrichum lindemuthianum* (anthracnose)
- Pea – *Ascochyta pisi* (leaf, pod spot)

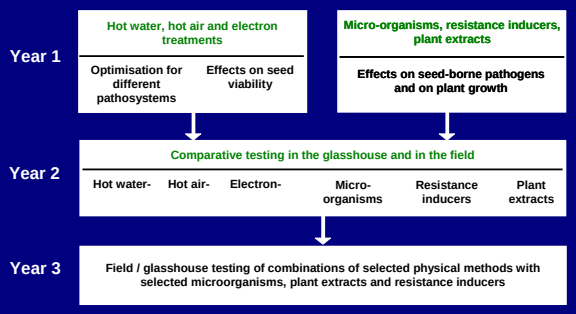
Treatments

Physical treatments	Commercial micro-organisms	Other commercial
Hot water	MSMX (*Streptomyces griseoviris*)	Milsana
Hot air	Cedomon / BA 2552 (*Pseudomonas chlororaphis*)	Tillecur
Electron bombardment	Serenade (*Bacillus subtilis*)	Chitoplant
	MBI 600 (*Bacillus subtilis*)	Kendal
	FZB 24 (*Bacillus subtilis*)	ComCat
	Tri 002 (*T. harzianum T22*)	

Treatments

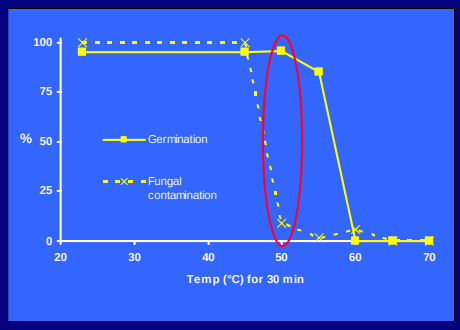
Non-commercial res. inducers	Experimental natural compounds	Experimental micro-organisms
Bion	**Essential oils:** e.g. oregano, peppermint, basil, clove, thyme, manuka, cinnamon	**IK 726** (*Clonostachys rosea*)
Jasmonic acid	**Organic acids:** lactic-, acetic-, citric, propionic- and ascorbic acid	**SLU 5** (*Pseudomonas* sp.)
Salicylic acid		**MSA 35** (*Fusarium* sp.)
		Other unidentified strains

Project outline



Physical treatment

- Principle



Hot water

- Used for ca. 100 yrs
- Simple, relatively 'low tech'
- Big disadvantage that seed needs drying after treatment
- Problem of variation in sensitivity

Hot air - *ThermoSeed®*

- Treatment with hot, humid air for a short time with precise control of:
  - *Temperature*
  - *Air humidity*
  - *Treatment time*

- Developed in Sweden by *Acanova* for cereals (www.acanova.se)
- Now being applied as an alternative to chemical treatments for conventional production – 1000 t/week plant under construction

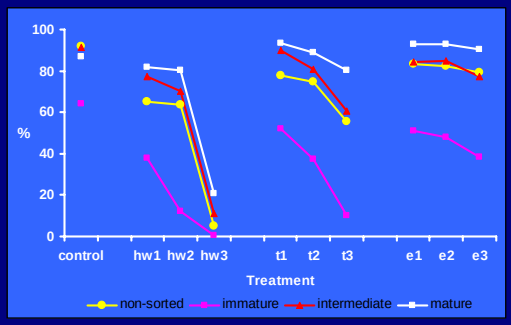
Electron treatment

- Mobile system
- Based on TV technology
- Seed falls past a beam of electrons
- Voltage and dose adjusted to penetrate only the seed coat

Physical treatments

- Problem with all physical treatments: variation in sensitivity
  - between cultivars of same species
  - between lots/batches of same cultivar
- Investigated at PRI using seed sorting based on chlorophyll fluorescence
  - high chlorophyll → immature
  - low chlorophyll → mature

Effect of seed sorting on sensitivity to hot water, Thermoseed®, electron treatments in *Brassica oleracea*



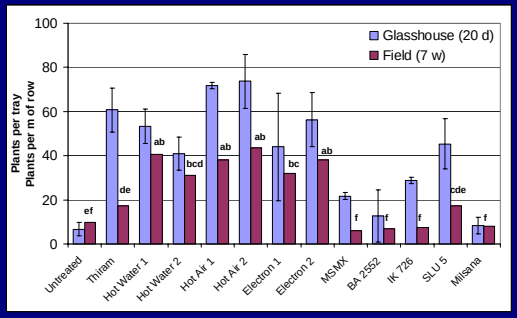
Examples of results
for selected crops / pathogens

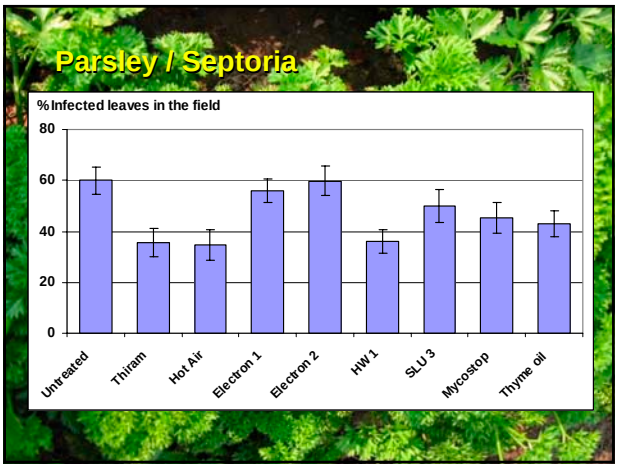
Carrots / *Alternaria*

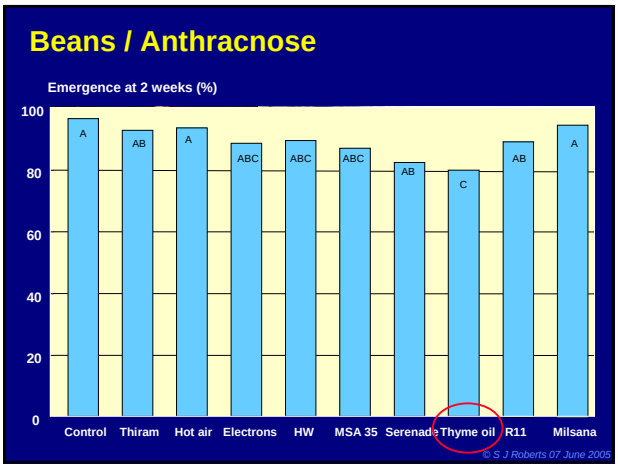
A. dauci – poor emergence, leaf blight

A. radicina – poor emergence, black root rot

Carrots / *Alternaria* emergence




Parsley / Septoria
% Infected leaves in the field
80
60
40
20
0
Untreated
Thiram
Hot Air
Electron 1
Electron 2
HW1
SLU 3
Mycostop
Thyme oil


Beans / Anthracnose
Emergence at 2 weeks (%)
100
80
60
40
20
0
A
AB
A
ABC
ABC
ABC
AB
C
AB
A
Control
Thiram
Hot air
Electrons
HW
MSA 35
Serenade
Thyme oil
R11
Milsana
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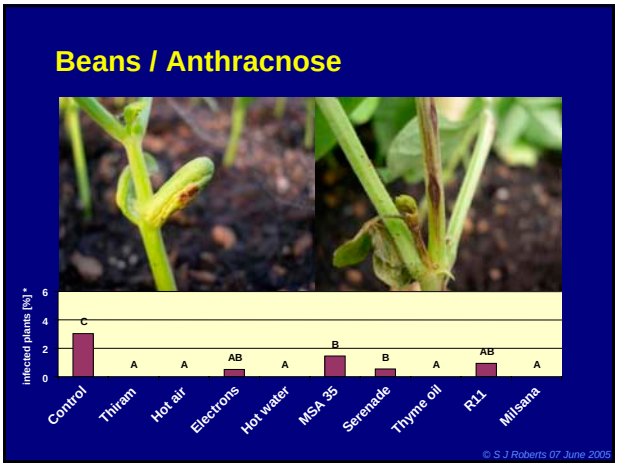
Beans / Anthracnose
infected plants [%] *
6
4
2
0
C
A
A
AB
A
B
B
A
AB
A
Control
Thiram
Hot air
Electrons
Hot water
MSA 35
Serenade
Thyme oil
R11
Milsana
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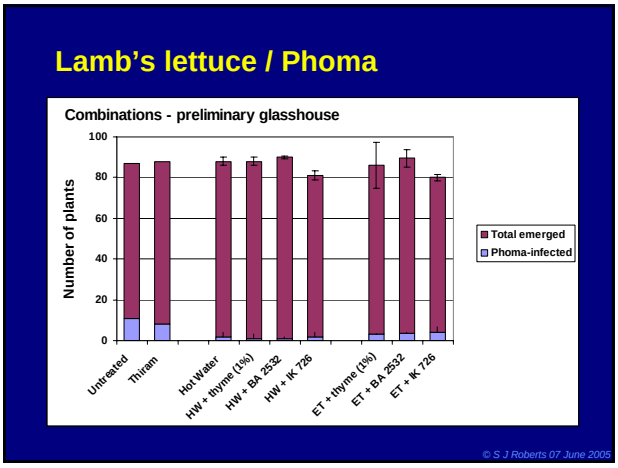
Lamb's lettuce / Phoma
Combinations - preliminary glasshouse
Number of plants
100
80
60
40
20
0
Total emerged
Phoma-infected
Untreated
Thiram
Hot Water
HW + thyme (1%)
HW + BA 2532
HW + IK 726
ET + thyme (1%)
ET + BA 2532
ET + IK 726
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Brassica / Xanthomonas
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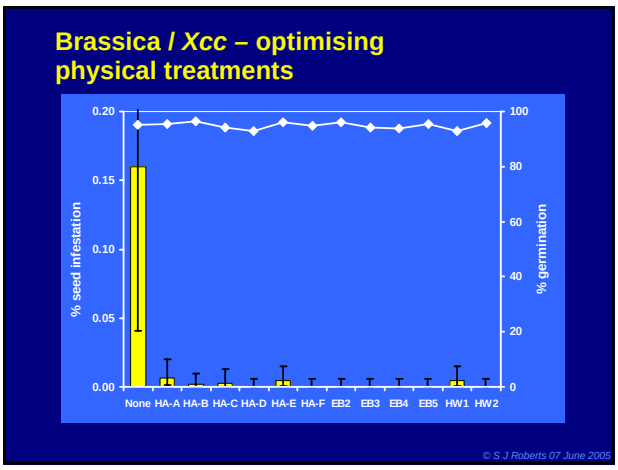
Brassica / Xcc – optimising physical treatments
% seed infestation
0.20
0.15
0.10
0.05
0.00
% germination
100
80
60
40
20
0
None
HA-A
HA-B
HA-C
HA-D
HA-E
HA-F
EB2
EB3
EB4
EB5
HW1
HW2
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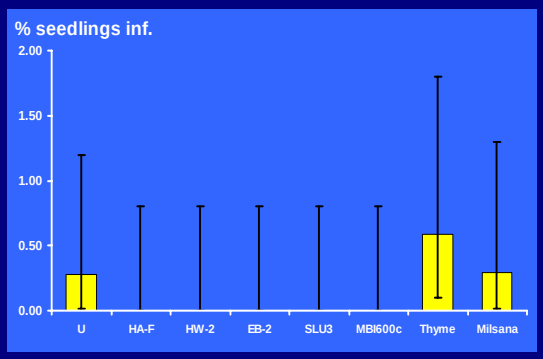
Brassica / *Xcc* - transmission



Summary

- Lack of seed health standards for vegetable seeds – a problem for effective testing programmes
- Promising physical treatments identified for many of the host/pathogen combinations
- Seed maturity (as indicated by chlorophyll fluorescence) affects sensitivity to physical treatments
- Certain plant oils (e.g. thyme, oregano) are highly inhibitory to the pathogens tested (but can be phytotoxic)

Summary

- Performance of the non-physical methods (micro-organisms, plant extracts) was generally better in the greenhouse than in the field.
- Most resistance inducing compounds (e.g. salicylic acid, jasmonic acid, Bion) were excluded in the first round of screening.
- Field and glasshouse trials on the most promising treatments and combinations are currently in progress

Acknowledgements

The data presented was obtained by the collaborative efforts of all colleagues in the STOVE project