Grower Summary

AHDB Spinach damping-off

seed treatment trials

FV 464b

Final report 2021

Project title:	AHDB Spinach damping-off seed treatment trials
Project number:	FV 464b
Project leader:	Dave Kaye, ADAS RSK Ltd., Horticulture
Report:	Final Report November 2021
Previous report:	N/A
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Location of project:	Various growers
Industry Representative:	Liz Johnson, L J Technical Consultancy Ltd.
Date project commenced:	01/06/2021

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The results and conclusions in this report are based on an investigation conducted over a one-year period. The conditions under which the experiments were carried out and the results have been reported in detail and with accuracy. However, because of the biological nature of the work it must be borne in mind that different circumstances and conditions could produce different results. Moreover, it should be noted that because of the unreplicated nature of the field trials in this project, observations and discussion of possible treatment effects relate to trends in the data rather than outputs from statistical analysis. Therefore, care must be taken with interpretation of the results, especially if they are used as the basis for commercial product recommendations.

This project incorporated grower-led field trials. Products evaluated for their effects on crop performance included biostimulants as well as plant protection products (authorised and in development). No endorsement or recommendation of named products is intended nor is any criticism implied of alternative, untested products.

The products listed in this report are not necessarily authorised as plant protection products in UK and mention of a product does not constitute a recommendation for its use against specific plant pathogens. Plant protection products must only be used in accordance with the authorised conditions of use.

Any product marketed for use specifically against Pythium species or any other plant pest/disease would require an authorisation under the Plant Protection Products Regulations/Regulation (EC) 1107/2009 before they are placed on the market for this use.

Regular changes occur in the authorisation status of biocides and plant protection products. For the most up to date information, please check with your professional supplier, BASIS registered adviser or the Chemical Regulation Division (CRD) of HSE (https://www.hse.gov.uk/crd/).

AUTHENTICATION

We declare that this work was done under our supervision according to the procedures described herein and that the report represents a true and accurate record of the results obtained.

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GROWER SUMMARY

Headline

Grower-led field trials provided a useful comparison of the effects of available and future seed treatments on spinach crop performance. The results (not statistically analysed) could help to guide growers and agronomists when considering management options for spinach damping-off.

Background

Increasing issues of damping-off diseases have been identified by the leafy salads industry since the loss of thiram as a seed treatment and metalaxyl-M as a seed treatment for outdoor drilled crops. Pathogens included in the damping-off complex for spinach are known to include *Pythium*, *Fusarium* and *Rhizoctonia* species and can devastate crops. There was a high incidence of damping-off in spinach fields in 2020. This grower-led demonstration trial was requested by spinach growers to investigate the use of a range of seed treatments to minimise crop losses. Conventional and biological plant protection products in the pipeline for approval as well as commercially available products and biostimulants were tested alongside each other for their effect on crop performance in the field. The trial considered the suitability and efficacy of the seed treatments for use in the near future.

The aim of the demonstration trials was to compare the different seed treatments for effects on spinach emergence, crop establishment, quality, yield and damping-off.

Summary

Methods

Two sets of trials were conducted:

1) Field demonstration plot trials – on grower's farms, coordinated by RSK ADAS Ltd.
2) Bioassays – conducted by Tim Pettitt at Eden Project Learning.

1) Field demonstration plot trials in 2021

Site locations

- Ten sites were provided by nine growers across England.
- Demonstration plots were placed in areas with a known history of damping-off or in conditions conducive to disease development i.e. wet or shady.

Seed treatments

- Conducted by Elsoms Seeds Ltd. using film coating process.
- Seeds delivered directly to growers when treated.

Table 1. Treatments used in trial with AHDB codes where required.

No.	Treatment	Active ingredient	Type
1	Untreated	-	Control
2	Maxim 480FS	Fludioxonil	Conventional fungicide (seed treatment)
3	Integral Pro	Bacillus amyloquefaciens	Biological fungicide (bacterial seed treatment)
4	AHDB 9763		Biostimulant: bacterial species (liquid microbial fertilizer)
5	AHDB 9733		Biostimulant: mycorrhizal, bacterial and fungal species (seed treatment)
6	AHDB 9848		Conventional fungicide (seed treatment)
7	AHDB 9732		Biostimulant: Mineral + biostimulant (biostimulant seed treatment)
8	AHDB 9734		Biological fungicide (bacterial seed treatment)
9	Priming		Physical

Germination test on seed conducted by Elsoms Seeds Ltd.

- 100 seeds, incubated in moist chamber for 28 days and assessed weekly.
- Scored as germinated/ungerminated (counts)

Trial design

- One row per treatment (nine rows total).
- Treatments positioned in random order (single replicate/site sowing).
- Growers asked to sow up to three successive trials.
- 16 trials across all sites and growers were conducted.

Field assessments

- Assessments timed to coincide with approximately 50% emergence, 100 % emergence, 10-15 days after full emergence (100%+10-15 days) and at harvest.
- Assessments conducted:

1. % Healthy plants – Quadrat counts x3
2. % Damping-off – Quadrat counts x 3
3. Cover - %, whole plot
4. Vigour – whole plot, 0-10 scale (5 was average vigour)
5. Phytotoxicity – whole plot, 0-10 scale. 0 = 100% crop kill, 10 = no damage (Table 4)
6. Yield at harvest, if possible.
7. Comments – grower comments on treatment performance

Crop destruction

- Treatment with AHDB 9848 and AHDB 9734 required the crop to be destroyed.

Data analysis

- Percentage health and damped-off calculated to account for variable quadrat sizes.
- Results grouped by closest emergence category (50%/100%/100%+10-15 days/harvest).
- Grower comments given traffic light colour based on whether negative (red)/intermediate (amber)/positive (green).

2) Bioassay

Isolate

- A field site soil sample was used for isolation of potential pathogens.
- Isolates were screened for pathogenicity on spinach seedling leaves.
- One pathogenic isolate was tentatively identified as *Pythium ultimum* based on morphology.
- Bulk inoculum was prepared in oatmeal/sand mixture to a concentration of 1.6×10^3 CFU $^{g-1}$ for the first bioassay trial and 2.2×10^3 CFU $^{g-1}$ for the second

Seed sowing

- Oatmeal/sand inoculum was placed into sterilised mushroom punnets (250 g inoculum per punnet).

- There were five seeds per cell, sown at 10 mm depth in Levington Advance F1 seed and modular growing medium into cell plug trays with 3x4 cells.
- Three replicate inoculated and 3 replicate uninoculated control trays/punnets were set up for each treatment.
- Trays were arranged in 3 randomised blocks.

Assessments

- Number of seeds germinated (count).
- Number of seeds surviving to emergence of first true leaves (count).

Results

1) Field demonstration plot trials

Germination test *in vitro*

- Most treatments had comparable germination rates to the untreated control (range 95-97%).
- Germination rates for AHDB 9848 (conventional fungicide) and AHDB 9763 (biostimulant) were slightly lower at 93% and 94%, respectively.

Percentage damping-off (Figure 1)

- Damping-off incidence was generally very low (<10% plants affected) across all trial sites, and the causal pathogens were not determined.
- Lowest damping-off incidence was observed for AHDB 9848 (conventional fungicide), AHDB 9763 (biostimulant) and seed that was primed.

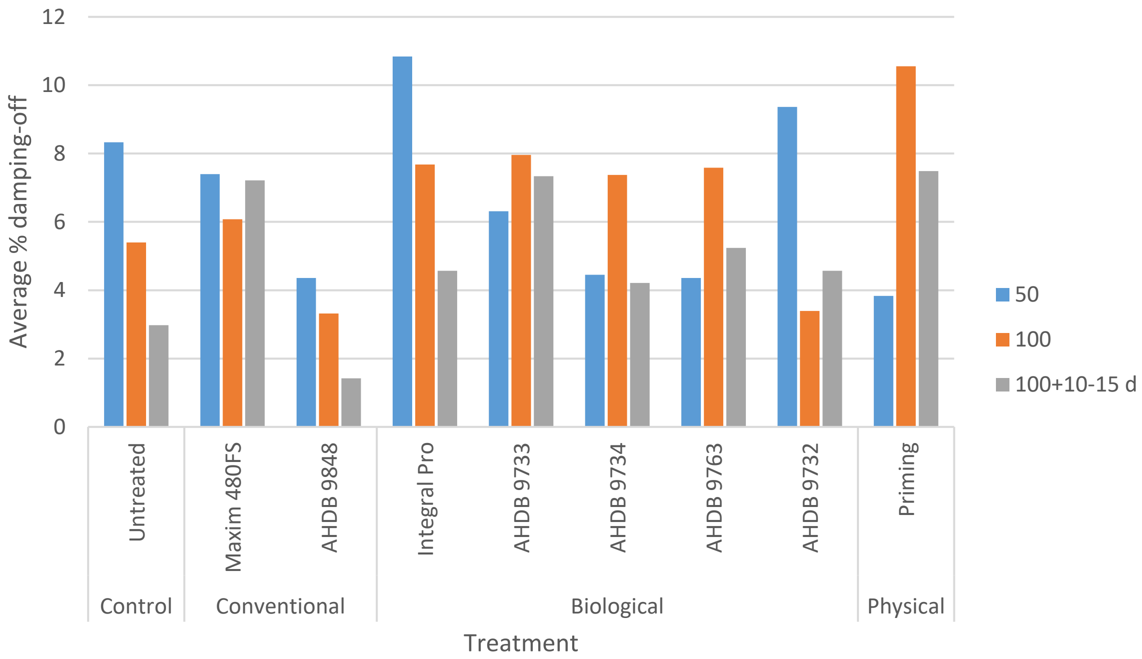

Figure 1. Effect of seed treatment on average percentage damping-off when assessed at different percentage emergence and development timepoints (50% emergence, 100% emergence, 100% emergence + 10-15days + Harvest).

Vigour

Under low damping-off risk conditions of 2021:

- Vigour scores did not vary widely between treatments, ranging between scores of 4.3 to 6.9.
- Highest vigour scores were obtained from plots with seed treated with AHDB 9732 biostimulant), while vigour in Maxim-treated plots was consistently the lowest.
- AHDB 9848 (conventional fungicide), AHDB 9763 (biostimulant) and AHDB 9734 (biofungicide) were as good as the untreated control.

Percentage ground cover (Table 2)

The conventional treatment AHDB 9848 gave slightly higher ground cover than the untreated control.

- Out of the biostimulants, the highest % ground cover was obtained with AHDB 9732.
- Biofungicide AHDB 9734 was the better performer of the two biofungicides, but below that of the untreated.

- Primed seed plots had marginally better cover than the untreated control by harvest.

Table 2. Effect of treatment on average cover, scored as percentage of whole plot at emergence assessment timepoints across all trials.

	Treatment	% ground cover at different assessment time points (% emergence)
		Harvest
Control	Untreated	91.4
Conventional fungicides	Maxim 480FS	60.8
	AHDB 9848	95
Biological fungicides	Integral Pro	67.5
	AHDB 9734	79.2
Biostimulants	AHDB 9732	83.3
	AHDB 9733	65
	AHDB 9763	75
Physical	Priming	93.3

Phytotoxicity

- Classic scorching symptoms were not observed from any treatments but there was some impact on growth. This metric was open to interpretation by grower-assessors so should be treated with caution.
- AHDB 9848 plants had the best appearance over the assessment period to harvest.
- Maxim 480 FS had the poorest appearance throughout.

Yield

- Data from only one grower trial was considered as the others were too sparse to be harvested
- AHDB 9732 (biostimulant), AHDB 9848 (conventional fungicide) and AHDB 9763 (biostimulant) had the best yields.

Grower comments on treatment performance (Table 3)

- Conventional fungicide AHDB 9848, biostimulant AHDB 9732 and priming were all reported to perform well, while two products were clearly poor (Table 2).

Table 3. Comments from growers. For individual comments see Appendix A.

Product type	Treatment	Comment summary
Control	Untreated	Mostly positive
Conventional	Maxim 480 FS	All poor
	AHDB 9848	Mostly positive
Biological fungicide	Integral Pro	Mostly poor, some positive
	AHDB 9733	All poor
	AHDB 9734	Mostly poor, some positive
	AHDB 9763	Mostly poor, some positive
Biostimulant	AHDB 9732	Mostly positive
Physical	Priming	Mostly positive

2) **Bioassay trials**

- Very little damping-off was recorded in the first trial, which had low inoculum levels. . The second trial with a higher inoculum level had higher disease incidences.
- At higher inoculum levels, priming and AHDB 9848 gave better emergence than the other treatments and the untreated control.
- At higher inoculum levels, AHDB 9848 and AHDB 9733 had the best seedling survival, albeit low (Figure 2).

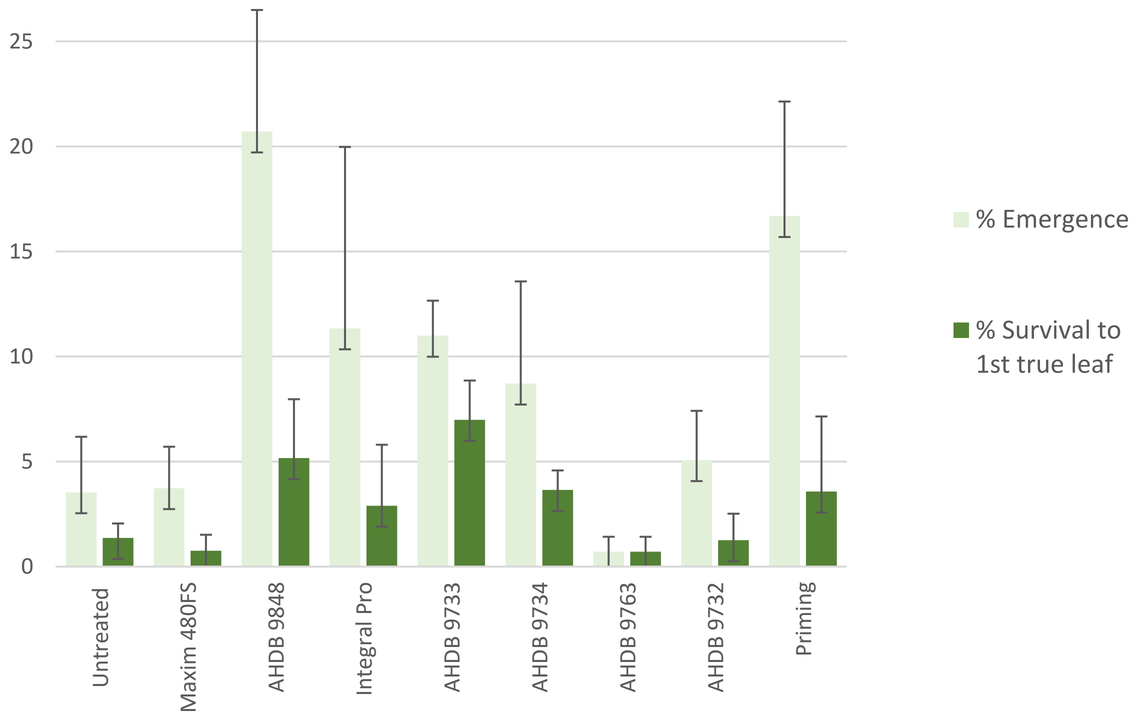

Figure 2. Experiment 2 comparisons between seed treatments of % emergence and of germination (survival to emergence of first true leaves) of inoculated treatments as a percentage of uninoculated controls (bars are standard errors of the means of three counts).

Conclusions

In terms of overall crop performance, AHDB 9848 was the better conventional fungicide treatment in both field trial and bioassay.

AHDB 9732 was the best of the biostimulants and the increase in vigour it seemed to induce may have helped seedling survival.

Grower comments aligned well with the field data collected.

A replicated trial would be valuable to determine if the differences between treatments are statistically significant and real effects seen.