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extension for the vegetable industries

HAL project VG07070 (Benchmarking Predictive Models)

Update Report on white blister of brassicas and downy mildew of lettuce, IPM, fungicide alternatives, irrigation and disease predictive modelling.

Research supported by your Vegetable Industry Levy, Horticulture Australia, and DPI-Victoria

Where: Amstel Golf Club, Cranbourne
1000 Frankston-Cranbourne Road, Cranbourne 3977
Melways Map 133 D5 (03 9788 8222)

When: Friday 21st November 2008: 2.00pm-4.00pm

Speakers:

Dr Liz Minchinton, Des Auer & Joanna Petkowski – DPI Vic

Afternoon tea provided

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Acknowledgments
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Chemical Use
The chemical use reported in the publication is off label information; consequently the DPI does not recommend it for use. All off label use is at the growers own risk.

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Definitions used throughout notes and graphs

Incidence is the % of plants showing white blister disease.

Severity on foliage: is the amount of white blister on plants on a scale of 0 to 5, where 0 = no blister, 1 = 1 or 2 blisters on one or two leaves, 2 = Two or blisters on more than one leaf, 3 = multiple blisters on upper or lower leaf, 4 = blisters on leaf stalk, 5 = systemic symptoms (distorted foliage).

Severity on heads: on head is the amount of white blister on heads on a scale of 0 to 2, where 0 = no blisters, 1 = less than 10 blisters on a head and marketable and 2 = more than 10 blisters on a head and not marketable.

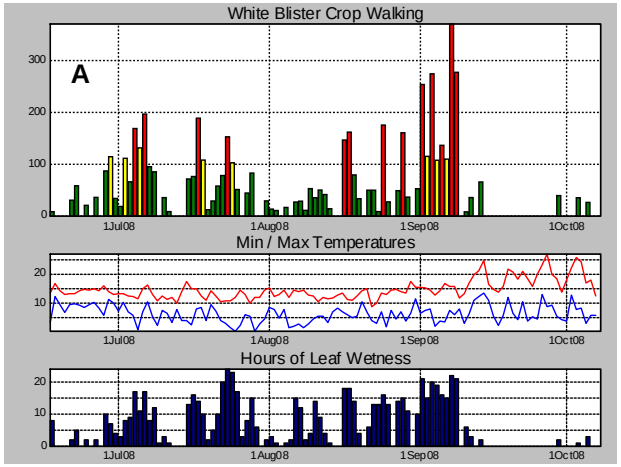
Project VG07070: Benchmarking predictive models

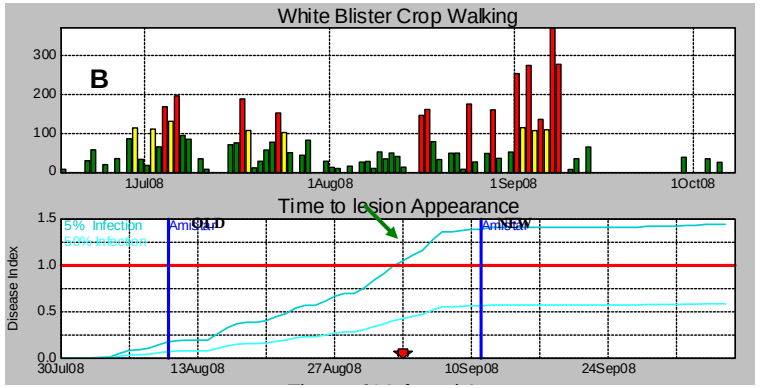
Field trials for White Blister

Introduction

Three field trials for VG07070 in 2008 are concerned with the evaluation of the new Brassica$_{spot}$ model provided by HRI Warwick UK. In all trials, the new model was compared with the old model using data obtained from the in-crop weather station and inputting the date of the appearance of white blister in the crop into the model program. A sample comparison between the two models is shown below (Fig. 1).

Fig. 1 Comparison between old model and new model. Morph™ outputs (A) Old Model; (B) New Model





A: old model. Top to bottom: *disease risk* (no bar, no disease risk; green bar, low disease risk; red bar, high disease risk); *daily minimum* (red) and *maximum temperatures* (blue); *hours of leaf wetness*

B: new model. Top to bottom: *disease risk* (as for A); *infection track*; red line disease index level of 1; blue tracks, infection trace with chemical application at intersection (green arrow); solid blue vertical lines, chemical applications (old model, new model)

Irrigation trial in Dairy Road, Werribee

Aim

This trial compared:

- irrigation times (morning, evening) to white blister incidence;
- tolerant (Tyson) and susceptible cultivars (Ironman);
- the new Brassica$_{spot}$ model to the old model and;
- model sprays to weekly copper sprays

For full layout and trial key see Fig. 3

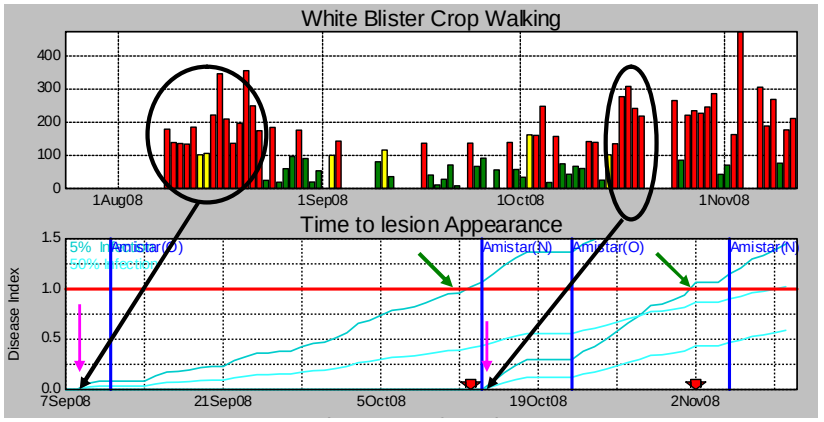
The Trial

- Planted in Dairy Rd on 23 July and assessed on 29 October, 10 November & 14 November.
- Plots treated according to the old model were sprayed with Amistar on 12/9 and 23/10.
- Plots treated according to the new model were sprayed on 15/10 and 6/11 with Amistar.

Brassica$_{spot}$ Model

- Weather station data for the entire trial were collected and this data were run through the Brassica$_{spot}$ model in the program MORPH to generate the following outputs (Fig. 2).

Fig. 2 MORPH interpretation of irrigation site weatherstation data



Old Model vs New model

Briefly, with the old model, if there was an infection event, indicated by 3 or more red bars in tandem (***black circle***), the crop was inspected at weekly intervals. In this case, white blister was observed in the crop after 14 days (***black arrows***). With white blister present in the crop, the ***'old model'*** plots were sprayed as indicated by the ***vertical blue lines*** (O).

In the case of the new model, the presence of white blister was noted and entered into the model as a data point (**pink arrows**). As the historical data from the weather station progressed, the infection was tracked within the model program.

The 'new model' plots were sprayed with Amistar ***only*** when the ***blue line*** has intersected the ***red line*** as indicated by ***green arrows*** (Fig. 2).

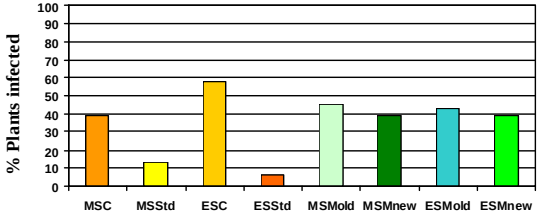
Note the presence of a **second data** point on the 12th of October, with a second infection event tracked in the model.

Results: Foliage

- ***No white blister was evident in the tolerant cultivar plots (TYSON) throughout trial,*** so the relevant model treatments (ERMold, MRMold, ERMnew, MRMnew) were ***not*** sprayed (however, the weekly std sprays ***were*** applied)
- Difference evident in incidence (Fig. 4) with evening-irrigated plot and morning-irrigated plot (MSC, 40%; ESC, 58%) for susceptible cv. Ironman.
- This difference not evident with weekly Cu regime, indicating spray program adequate for disease control (MSStd, ESStd).
- No difference evident between old and new models (MSMold, MSMnew, ESMold, ESMnew).

- ***However, std spray program had 15 applications of Tribase blue (Cu), whereas model spray program only had only 2 sprays each.***

Fig. 4 Average white blister incidence on foliage



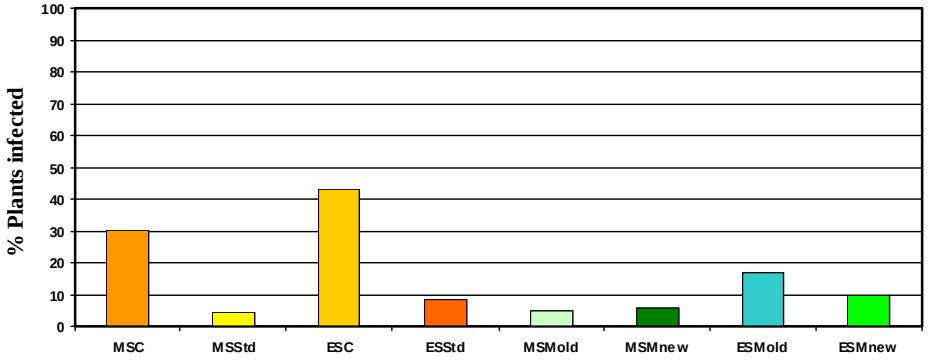
Note: disease severity on leaves in all cases was less than one, indicating it was very low (i.e. less than one blister present on foliage per plant)

Fig. 6 Trial site on field day

Results: Heads

- Results for head incidence and severity mirror that of foliage results above (Fig. 5). There was a higher incidence with those plants irrigated in the evening (8 p.m) as opposed to early morning (4 a.m).
- There is some indication of white blister in heads of the tolerant cultivar Tyson, but again, severity in all cases, including Ironman was low.

Fig. 5 Average white blister incidence on heads



Variety Trial at Dairy Road, Werribee

Aim

This trial evaluated six Broccoli varieties and two Cauliflower varieties for susceptibility to white blister.

The Trial

- Planted on July 28th, 2008.
- Broccoli cultivars: Agassi, 'BROC', a new variety, Grevillea, Ironman, Prophet and Tyson.
- Cauliflower cultivars: Discovery and Skywalker.
- Assessed on November 10th and 14th, 2008 for incidence and severity of white blister.

Results Foliage

- Little white blister was observed on the foliage of either the 'new' broccoli variety or Tyson (Figs. 7 & 8).
- The varieties Grevillea and Agassi had the highest levels (incidence) of white blister on foliage.
- Of the Cauliflower varieties, Skywalker was more susceptible to white blister than Discovery, but infection was very minor
-

Results Heads:

- Trace levels of white blister occurred on the heads on both the 'new' variety of broccoli and Tyson (Figs. 9 & 10).
- Grevillea and Agassi were the most susceptible varieties to white blister.

Conclusion

- Disease pressure from white blister has been low in this trial.
- The 'new' broccoli variety and Tyson showed strong tolerance to white blister symptoms on heads.
- Skywalker is more tolerant than Discovery, but white blister infection was very minor in cauliflower.

Fig. 7 Average white blister incidence on foliage

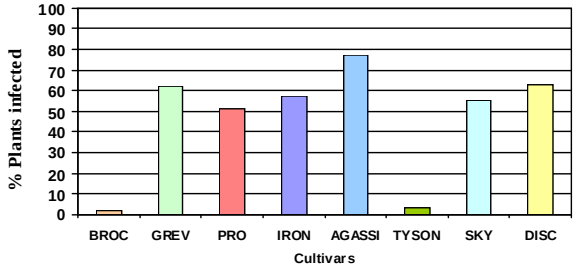


Fig. 8 Average severity of white blister on foliage (scale 0-5)

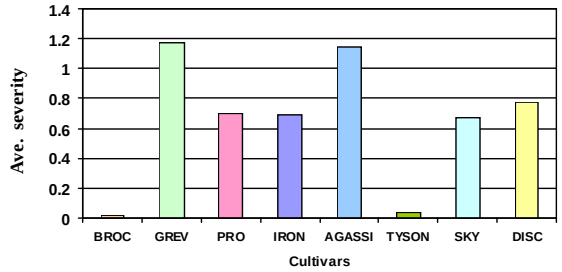


Fig. 9 Average white blister incidence on heads

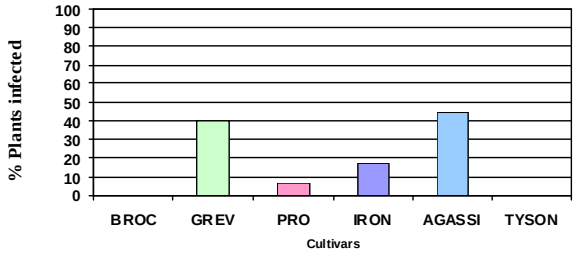
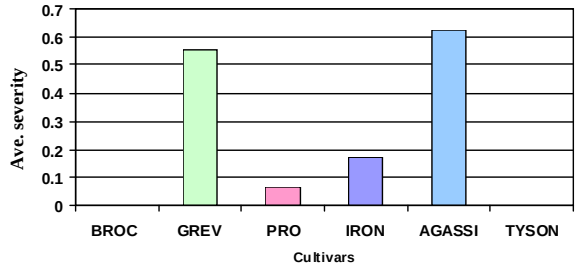


Fig. 10 Average severity of white blister infection on heads (scale 0-2)



White Blister Trial Werribee South

Aim

This trial compared the old Brassica$_{spot}$ model, the new Brassica$_{spot}$ model, standard weekly sprays (STD) and unsprayed plants for timing of applications of fungicide sprays for white blister control on broccoli variety Bridge.

The Trial

- This trial was planted at 300 Diggers Rd Werribee South on 26 June 2008 and assessed on 13 October 2008.
- See Table 1 for spray details.
- *Graphs: bars of different colours differ significantly, ie there is a real difference in the data not due to chance alone. Data with bars of overlapping colours do not differ.*

Table 1 Spray information

Treatment	No. of sprays	Dates
STD (Tribase Blue-Cu)	9	weekly
New Brassica$_{spot}$ model (Amistar)	2	11/8, 12/9
Old Brassica$_{spot}$ model (Amistar)	1	11/8
Control	0	N/A

Results - Foliage

Weekly (Standard) sprays of copper gave the best control of the incidence and severity of white blister on foliage (Figs. 11 & 12).

Fig. 11 Incidence of white blister on foliage (lsd=13.2)

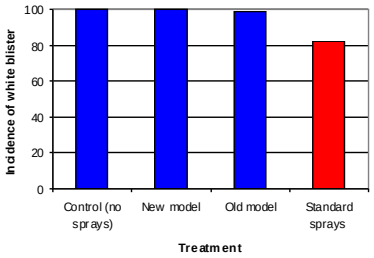
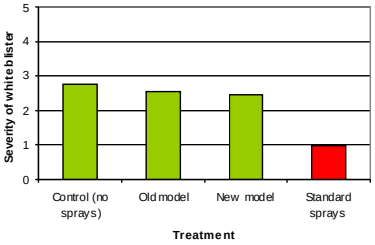


Fig. 12 Average severity of white blister on foliage (lsd= 0.314)



Results - Heads

- None of the treatments differed in controlling the incidence of white blister on heads (Fig. 13).
- Only the new model spray program reduced the severity of white blister on heads compared with the unsprayed control (Fig. 14).

Fig. 13 Average incidence of white blister on heads

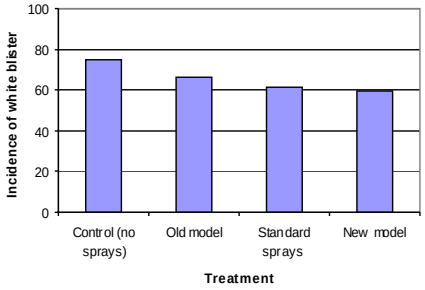
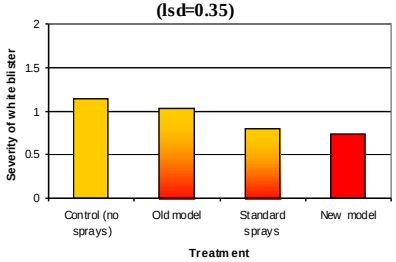


Fig. 14 Average severity of white blister on heads (lsd=0.35)



Conclusion

- Plants had very dense foliage & many auxiliary shoots, providing an ideal microclimate for white blister. (the cultivar in question was Bridge
- Standard sprays (9) produced the best control of white blister on foliage, but foliage is not marketed.
- No difference in incidence or severity between old, new or std. treatment, but the new model is significantly different from the unsprayed control in terms of severity

White Blister Trial Rosebud

Aim

This trial compared the old Brassica$_{spot}$ model, the new Brassica$_{spot}$ model, Sodium Lauryl Sulfate (SLS), *Streptomyces lyticus (S. lyticus)*, weekly sprays (STD) and unsprayed treatments (control) for timing of applications of sprays to control white blister on broccoli variety Grevillea.

The Trial

- This trial was planted at 1155 Browns Road Boneo on 2 June 2008 with cultivar Grevillea and assessed on 22 September 2008.
- See Table 2 for spray details.

Table 2 Spray information

Treatment	No. of sprays	Dates
STD (Tribase Blue-copper	13	weekly
New Brassica$_{spot}$ model (Amistar)	3	3/7,4/8,15/9
Old Brassica$_{spot}$ model (Amistar)	2	3/7, 20/8
SLS (sodium lauryl sulphate)	9	16/7 to 11/9, weekly
Streptomyces lyticus	9	16/7 to 11/9, weekly
Unsprayed control	0	N/A

Results - Foliage

- The standard or weekly sprays with copper produced the lowest incidence and severity of white blister on foliage (Figs. 15 & 16).
- The two models showed no real difference in the levels of white blister on plant foliage.
- Neither SLS nor *S. lyticus* controlled white blister on foliage as a weekly spray.

Fig. 15 Ave. incidence of white blister on foliage

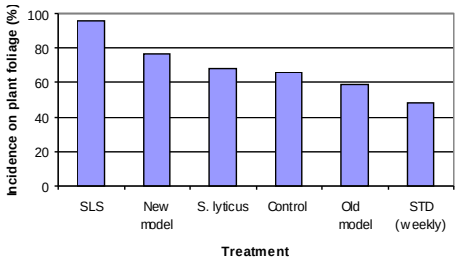
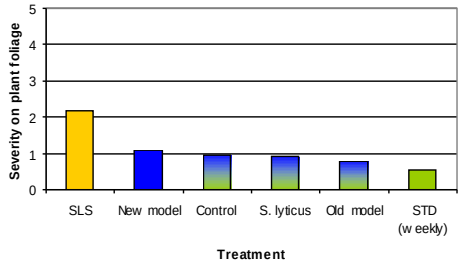


Fig. 16 Severity of white blister on foliage (scale 0-5, lsd=0.48) [A]

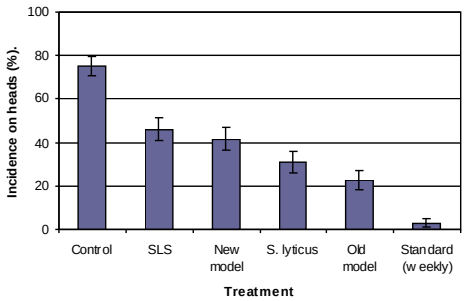


- [A].Graph with bars of different colours differ significantly, ie there is a real statistical difference *in the data*.
- *Data with bars of overlapping colours do not differ.*

Results – Heads

- All treatments controlled white blister on heads (Fig. 17).
- The standard weekly sprays produced the best control of white blister on heads.
- The old model was more successful in predicting times to spray for white blister on heads than the new model.

Fig. 17 Incidence of white blister on heads (bar = standard error)

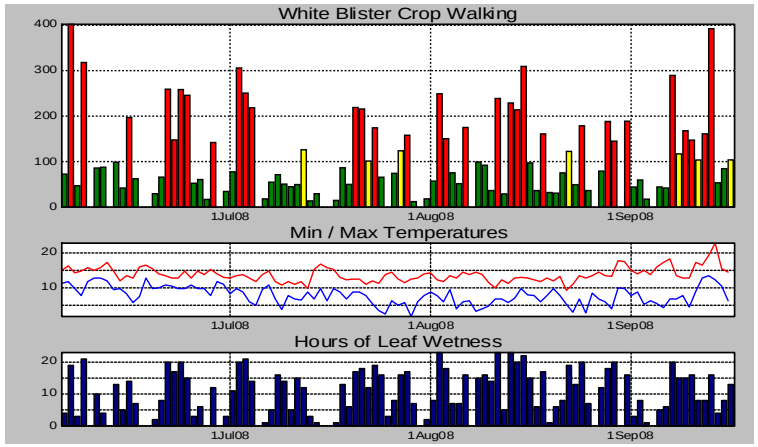


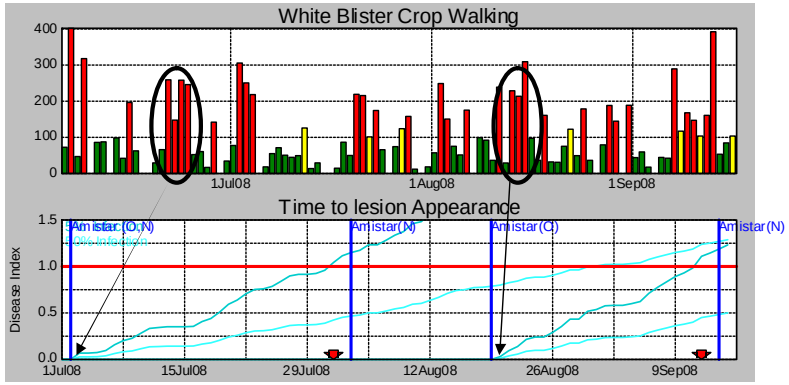
Conclusion

- Using the old model, sprays were reduced by 11 compared to the control
- The old model was better than the new model in predicting when to spray to eliminate white blister from heads
- The analysis of economics will determine which treatment is the most viable.

Fig. 18 Brassica$_{spot}$ model for the Rosebud trials (old model top, new model bottom)

No bars = no risk of disease, green bars = low risk, yellow bars = moderate risk and red bars = high risk of white blister infection. N = new model spray; O = old model spray





Old model
A group of 3 or more red bars (black circles) in the above graph indicates weather conditions are conducive to infection and the crop should be inspected at 7, 14 and 21 days to see if infection has taken place and white blister is present. If it is present, then make a decision to spray. The old model predicted at least 2 spray events.

New model
The presence of white blister was noted and tracked and when the dark blue line on the model (top tracking line) intersects the red horizontal bar then the crop was sprayed with Amistar. The new model predicted 4 spray events but only 3 sprays were applied as the latter was near harvest. This new model requires more input and more interpretation by the user, since the disease must be tracked in the program in order to determine the best time to spray.
Note dates do not line up in the above graphs.

Evaluation of susceptibility/resistance to white blister rust in *Brassica rapa* vegetables

Aim: To identify resistance in commercial cultivars of *B. rapa* vegetables.

The list of *Brassica rapa* vegetable cultivars and differentials, which were tested against the white blister isolate from Chinese cabbage.

1. Turnip rape cv Torch – differential host of *Albugo candida* race 7 (Ac 7)
2. Turnip rape cv Reward – diferential host of Ac 7V
3. Oilseed rape cv Regent – differential host – resistant to Ac 7
4. Chinese cabbage cv Waltz
5. Chinese cabbage (mini wong bok) cv 001-6
6. Chinese cabbage cv Manoko
7. Chinese cabbage cv Matilda
8. Pak choi cv Mei Quing Choi
9. Green pak choi cv Miyako F1
10. Green pak choi cv Seven Gates F1
11. White stem pak choi cv Joi Choi F1
12. Chinese kale (*B. oleracea*) cv Kailaan

The trial: set up in the glasshouse on a double glasshouse bench on 16/10/2008. Seedlings were raised in 12x12 multicell trays filled with seed raising mix (Debco) and amended with fertiliser Nitrophoska acc. the manufacturer instructions. The experiment was set as a randomised complete block of 12 treatments (cultivars) with 8 reps (trays).

Inoculation: Performed twice on 1 and 2 weeks old seedlings.

Disease assessment: Performed on 7/11/2008

Results: All varieties of *B. rapa* vegetables tested were more or less susceptible to white blister. Miyako was the most susceptible (91% of seedlings with blisters) and Joi Choi was the least susceptible (56% seedlings with blisters). Seedling of Chinese cabbage cultivars Wlatz, 001, Matilda and Manoko were susceptible with 80, 70, 64, and 61percent of seedlings with symptoms.
Pak choi cv Seven Gates had smaller blisters surrounded by discoloured rings of leaf tissues. This indicates the presence of some resistance to the white blister isolate tested.

Statistical analyses of the trial are pending.

Fig. 19 The glasshouse experiment at DPI Knoxfield. Each tray contains seedlings of 12 hosts (cultivars) as listed above. All seedlings were inoculated with the *Albugo candida* isolate from Chinese cabbage.

Preliminary report on the 'downy mildew of lettuce' module of VG07070

Aim

- Obtain a better understanding of the life cycle of the disease downy mildew;
- Apply knowledge to formulate a working model to use weatherstation data;
- Gather real-time data from weatherstations and assess the risk of downy mildew on lettuce crops through a working model.

Methods

- Model formalised in Excel as a calculation program (see below);
- Commissioning of a sporetrap in the field to obtain data as to the release of spores over a 24-hr, 7-day period (Fig. 32);
- 12-hr and 24-hr experiment in DM-infected crops to try and ascertain when DM spores are released (Fig. 33);
- Real-time data obtained from three weatherstations in three locations and advising growers as to the risk of DM infection in crops (Fig. 34);
- Walk through crops to obtain DM incidence data to connect it to weatherstation data and the model (Fig. 35).

Model Parameters
(Obtained from the literature)

- Night temperature > 5°C
- Day temperature < 22°C
- Leaf wetness period > 3 hours
- Midday temp. < 22°C

Fig. 32 Spore trap in position in field of infected lettuce. Note the weatherstation behind the sporetrap. The vane on top of the trap ensures the trap self-orients under windy conditions

Fig. 33 Lettuce seedlings positioned in infected crop.
Briefly, seedlings were placed in the crop every hour for an hour over a 12-hr or 24-hr period. These were then assessed for downy mildew development in the glasshouse.
Note the infected lettuces (arrows)

- Growth chamber studies are planned to refine downy mildew model
- In process of establishing collaborative links with research group in Norway