



HORTICULTURE RESEARCH INTERNATIONAL  
STOCKBRIDGE HOUSE

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**CRISP LETTUCE: CONTROL OF DISEASES  
UNDER CROP COVERS (FV 38f)**

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## **Summary**

Fungicides were sprayed onto lettuce covered with film covers to assess the effect on disease control on summer planted crops. The lettuce cultivar Saladin were planted on 28 May, 11 June, 5 July and 25 July and covered with Agryl P10, Agryl P17 and Enviromesh compared to a non-covered control. The fungicide programme consisted of Rovral, Favour and Benlate applied using conventional spraying equipment over the film covers.

The levels of disease at harvest were low for the first three sowings due to the dry weather. In general there was a significant improvement in disease control following the use of a full spray programme with lower levels of Botrytis. The levels of disease were highest for the final planting date which was harvested in mid September. There was a significant improvement in Botrytis and Mildew control where fungicides had been used, particularly for those plants covered with Agryl P10 and Enviromesh. The chemicals appeared to be able to pass through these film covers without loosing efficacy or causing plant damage.

The marketable yields were generally similar between the treatments in the first three plantings. For the fourth planting there was a significant benefit from applying the full fungicide programme where film covers had been used.

## **Introduction**

Film covers have traditionally been used to advance crop maturity for early planted crops. The nonwoven cover types such as Agryl can remain on crops for longer periods than the perforated polythene types which generally have to be removed by early May at the latest.

Over the past two seasons trials by HRI and ADAS have shown that the nonwoven cover types can provide protection against pest attacks, particularly lettuce root aphid, carrot fly and cabbage root fly. However, some crops including lettuce, can be more prone to disease problems when grown during the summer under film covers.

This trial, in its first year, aimed to evaluate the potential for applying fungicides through various film covers. Conventional spraying equipment was used with a fungicide programme based on Rovral, Favour and Benlate. The levels of disease were recorded at harvest to indicate whether adequate disease control can be achieved using this non-direct spraying technique.

### **Objective**

To assess the performance of fungicides when sprayed through nonwoven film covers for disease control in lettuce planted on four occasions during the summer.

### **Materials and Methods**

#### Site

HRI Stockbridge House, Cawood, Selby, North Yorkshire YO8 0TZ.

#### Soil Type

Sandy loam of the Quorndon Series.

#### Design

The experimental design was a randomised block with four replicates. Each plot consisted of four rows spaced at 37.5 cm per 1.83 m bed and 24 plants per row spaced at 30 cm.

## Statistical Analysis

All the data was subjected to a full analysis of variance. Where appropriate the data has been angularly transformed to improve the accuracy of the analysis. The least significant differences (LSD) are provided where the differences between treatments were significant at the 5% level. Where the differences were not significant then this is indicated by NS (not significant) and this indicates that results were similar for all treatments.

## Treatments

### 1. Planting Date:

- a. 28 May
- b. 11 June
- c. 5 July
- d. 25 July

### 2. Chemical Treatment:

- a. Untreated (only pre-planting fungicides applied)
- b. Full spray programme (pre and post-planting fungicides applied)

### 3. Film Cover Type:

- a. No cover
- b. Agryl P10 (10 g/m<sup>2</sup>) - a lightweight nonwoven cover
- c. Agryl P17 (17 g/m<sup>2</sup>) - a medium weight nonwoven cover
- d. Enviromesh - a fine mesh net cover

The full fungicide spray programme consisted of post-planting applications of:

<u>Product</u>	<u>Rate</u>	<u>Timing</u>
Rovral	380 g/760 l/ha	7-14 days after planting
Favour	1.5 l/760 l/ha	7 days later
Rovral	380 g/760 l/ha	7 days later
Favour	3.0 l/760 l/ha <sup>#</sup>	7 days later
Benlate	500 g/1000 l/ha	7 days later

<sup>#</sup> A water volume of 1120 l/ha was used at planting date 2, 3 and 4.

All sprays were applied using a Knapsack sprayer. Not all treatment combinations were carried out for each planting date. (See Results section).

#### Assessments

1. Disease severity either one week prior to or at first harvest.
2. Disease incidence at harvest.
3. Yield and quality at harvest (30 plants/plot).

#### Husbandry

Lettuce, cultivar Saladin were sown on four occasions in an unheated glasshouse. Prior to planting the plants were treated with a routine fungicide spray of Thiram and Zineb (See Appendix I).

At planting a spacing of 37.5 x 30.0 cm was used with the covers laid as appropriate. Fungicides were applied according to the treatments. All crop husbandry details are given in Appendix I.

## Results and Discussion

### Planting A (28 May)

The results for the first planting date are given in Tables 1 and 2.

**Table 1: Number of heads with Botrytis (% angular transformations) at harvest**

Cover Treatments	Number of Heads with Botrytis (%)	
	Nil Fungicide Post-Planting	Full Fungicide Programme
Nil	0	0
Agryl P10	7.2	2.6
Agryl P17	9.0	-
Enviromesh	10.1	2.6
SED (27 df) for comparing treatments		4.73
LSD (5%)		9.7

At harvest the number of heads with Botrytis was lowest where no film covers had been used. However, where film covers had been used the number of diseased heads had been reduced by the use of the full fungicide spray programme.

Table 2: Botrytis severity score at harvest

Cover Treatments	Botrytis Score (Score 0-9)*	
	Nil Fungicide Post-Planting	Full Fungicide Programme
Nil	7.75	9.0
Agryl P10	7.75	9.0
Agryl P17	8.0	-
Enviromesh	7.25	6.75
SED (27 df) for comparing treatments		0.577
LSD (5%)		1.2

\* 0 = High levels of disease; 9 = No disease

The levels of Botrytis had been significantly reduced following the use of the full fungicide spray programme for the non-covered and Agryl P10 covered plots.

Planting B (11 June)

The results for the second planting date are given in Table 3.

**Table 3: Number of heads with Botrytis (% angular transformations)**

Cover Treatments	Number of Heads with Botrytis (%)	
	Nil Fungicide Post-Planting	Full Fungicide Programme
Nil	17.8	13.1
Agryl P10	0	8.3
Agryl P17	0	-
Enviromesh	34.3	18.6
SED (27 df) for comparing treatments	8.61	
LSD (5%)	NS	

The levels of disease were very low and so only the number of heads with Botrytis were recorded. There was no evidence of differences between covering or fungicide treatments.



**Planting C (5 July)**

The results for the third planting date are given in Tables 4 and 5.

**Table 4: Number of heads with Botrytis (% angular transformation) at harvest**

Cover Treatments	Number of Heads with Botrytis (%)	
	Nil Fungicide Post-Planting	Full Fungicide Programme
Nil	0	2.6
Agryl P10	17.6	3.7
Agryl P17	7.2	10.0
Enviromesh	0	-
SED (27 df) for comparing treatments		5.43
LSD (5%)		11.1

The number of diseased heads was highest under the Agryl P10 treatment but had been significantly reduced by using the comprehensive fungicide programme.

**Table 5: Botrytis severity score at harvest**

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Cover Treatments	Botrytis Score (Score 0-9)*	
	Nil Fungicide Post-Planting	Full Fungicide Programme
Nil	9.0	9.0
Agryl P10	5.75	6.75
Agryl P17	5.75	6.50
Enviromesh	7.25	-
SED (27 df) for comparing treatments		0.68
LSD (5%)		1.4

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\* 0 = High levels of disease; 9 = No disease

The disease severity, mainly Botrytis, was higher where film covers had been used but there was a suggestion of some improvement following the use of the fungicides.

Planting D (25 July)

The results for the fourth planting date are given in Table 6.

**Table 6: Disease severity score at harvest**

Cover Treatments	Downy Mildew Severity (Score 0-9)*	
	Nil Post-Planting	Full Programme
Nil	9.0	8.5
Agryl P10	1.25	8.5
Agryl P17	2.25	-
Enviromesh	1.75	7.25
SED (27 df) for comparing treatments		1.29
LSD (5%)		2.65

\* 0 = High levels of disease; 9 = No disease.

The levels of disease mainly downy mildew, were much greater for this planting date, particularly under the film covers. The fungicide treated plots were clearly visible as the lettuces were very healthy and showed none of the yellowing and apparent premature senescence which had occurred where no post-planting fungicides had been used. The main disease present on this crop was downy mildew but this was at significantly lower levels on the fungicide treated plots.

### General Comment (all four harvests)

The harvest data is presented in Appendix II. In general the number of marketable heads was similar with no significant benefit from applying fungicides. For the fourth planting date there was a yield benefit from using fungicides sprayed through Agryl P10 and Enviromesh with significantly higher numbers of marketable heads produced following the application of a full fungicide spray programme.

The number of heads with dry edge tipburn is given in Appendix III. There was a significant decrease in the number of plants with this disorder following the use of fungicides, particularly for the fourth planting date. The number of heads with this disorder under the film crop covers was generally significantly lower. The reasons for this are unclear but might be due to the more uniform microclimate found beneath the film cover which would reduce the fluctuation in transpiration. Those grown without a film cover would be more prone to changes in the plant's water requirement due to the fluctuating weather conditions, particularly on windy days.

## Conclusions

1. Overall the levels of disease were low in the two early plantings. However, levels of downy mildew increased from late July onwards.
2. The application of fungicides through film covers appeared promising with no adverse affect on head quality. However, due to low levels of disease no consistent effect on yield was observed for the first three lettuce crops.
3. The fungicide programme used provided good control of Mildew in the fourth planting. However, there was a poor correlation between the number of marketable heads and the disease severity score taken prior to harvest.
4. The fungicide programme appeared to reduce the number of heads with tipburn symptoms but the reasons for this are unclear.

## Recommendations

The trial should be repeated as encouraging results were obtained in 1991. The treatment list should remain the same but should exclude the Enviromesh as it is a very expensive type of film (£5,000 /ha) and appeared to offer only limited protection against aphids due to the mesh size (observed on an adjacent trial). The first planting date should be delayed to allow for a mid August planting to coincide with an increased risk of mildew developing within the crop. The treatments included in this trial were applied using an experimental permit. The legal position of applying any pesticides through film covers is generally unclear.

**APPENDIX I:**

Crop Diary for Planting Date 1

Field: B4

16 April	Saladin sown in 37 mm peat blocks (B2).
2 May	133 kg/ha N; 33 kg/ha P <sub>2</sub> O <sub>5</sub> ; 100 kg/ha K <sub>2</sub> O. Soil cultivated.
9 May	Mulches laid as appropriate.
24 May	Thiram at 4 g/l + Zineb at 2 g/l (pre-planting drench)  Pirimor at 5 g/10 l water (pre-planting drench)
28 May	Trial planted and covered as appropriate.
29 May	Irrigated 15 mm. Kerb at 2.2 kg/760 l/ha water.
30 May	Treatments covered as appropriate.
13 June	Rovral WP at 380 g/760 l/ha water (Treatment 2b only).
19 June	Favour at 1.5 l/760 l/ha water (Treatment 2b only).
26 June	Rovral WP at 380 g/760 l/ha water (Treatment 2b only).
5 July	Favour at 1.5 l/760 l/ha water (Treatment 2b only).
12 July	Harvest and disease assessment.
18 July	Harvest and disease assessment.

Crop Diary for Planting Date 2      Field: B4

8 May            Saladin sown in 37 mm peat blocks (B2).

4 June            133 kg/ha N; 33 kg/ha P<sub>2</sub>O<sub>5</sub>; 100 kg/ha K<sub>2</sub>O.  
Land prepared.

5 June            Irrigated (15 mm).

10 June           Thiram at 4 g/l + Zineb at 2 g/l (pre-planting  
drench)  
  
Pirimor at 5 g/10 l water (pre-planting drench)  
  
Mulches laid as appropriate.

11 June           Trial planted.    Kerb at 2.2 kg/760 l/ha water.

12 June           Trial covered as appropriate.

19 June           Rovral WP at 380 g/760 l/ha water (Treatment 2b  
only).

26 June           Favour at 1.5 l/760 l/ha water (Treatment 2b only).

5 July            Rovral WP at 380 g/760 l/ha water (Treatment 2b  
only).

12 July           Favour at 3 l/1120 l/ha water (Treatment 2b only).

18 July           Pirimor at 500 g/1000 l/ha water (Treatment 2b  
only).

19 July           Benlate at 0.5 kg/1120 l/ha water (Treatment 2b  
only).

24 July           Harvest and disease assessments.

30 July           Harvest and disease assessments.

2 August          Harvest and disease assessments.

Crop Diary for Planting Date 3

Field: B4

12 June           Saladin sown in 37 mm peat blocks (B2).

25 June           133 kg/ha N; 33 kg/ha P<sub>2</sub>O<sub>5</sub>; 100 kg/ha K<sub>2</sub>O.  
Land prepared.

26 June           Mulches laid as appropriate.

5 July            Thiram at 4 g/l + Zineb at 2 g/l (pre-planting  
drench)

                  Pirimor at 5 g/10 l water (pre-planting drench)  
Trial planted.

                  Kerb at 2.2 kg/760 l/ha water.

                  Trial covered as appropriate

8 July            Irrigated 15 mm.

12 July           Rovral WP at 380 g/760 l/ha water (Treatment 2b  
only).

18 July           Pirimor at 500 g/1000 l/ha water (Treatment 2b  
only).

19 July           Favour at 1.5 l/760 l/ha water (Treatment 2b only).

25 July           Rovral WP at 380 g/760 l/ha water (Treatment 2b  
only).

30 July           Favour at 3 l/1120 l/ha water (Treatment 2b only).

2 August          Pirimor at 500 g + Ambush C at 250 ml/1000 l/ha  
water (Treatment 2b only).

7 August          Benlate at 0.5 kg/1120 l/ha water (Treatment 2b  
only).

23 August         Harvest.



Crop Diary for Planting Date 4      Field: L

1 July            Saladin sown in 37 mm peat blocks (B2).

22 July           Lime applied at 1.5 t/ha.

23 July           102 kg/ha N; 102 kg/ha P<sub>2</sub>O<sub>5</sub>; 102 kg/ha K<sub>2</sub>O.  
Land prepared.

24 July           Mulches laid as appropriate.  
  
Thiram at 4 g/l + Zineb at 2 g/l (pre-planting  
drench)

25 July           Trial planted.  
  
Kerb at 2.2 kg/760 l/ha water.  
  
Metasystox at 420/1000 l/ha water  
  
Trial covered as appropriate.

2 August          Rovral WP at 380 g/760 l/ha water (Treatment 2b  
only).  
  
Pirimor at 500 g + Ambush C at 250 ml/1120 l/ha  
water (Treatment 2b only).

7 August          Favour at 1.5 l/760 l/ha water (Treatment 2b only).

14 August        Rovral WP at 380 g/760 l/ha water (Treatment 2b  
only).

21 August        Favour at 3 l/1120 l/ha water (Treatment 2b only).  
  
Pirimor at 500 g + Ambush C at 250 ml/1120 l/ha  
water (Treatment 2b only).

28 August        Benlate at 0.5 kg/1000 l/ha water (Treatment 2b  
only).

17 September    Harvest and disease assessment.

**APPENDIX II: Table A: Number of marketable heads (Class I + Class II) (% angular transformations). Actual numbers recorded in brackets (%).**

Treatment	Planting 1	Planting 2	Planting 3	Planting 4
<u>No Fungicide</u>				
Nil	25.3 (18.3)	12.7 (9.3)	51.8 (61.7)	40.2 (41.7)
Agryl P10	74.2 (92.7)	61.9 (74.3)	58.4 (71.0)	16.9 (15.8)
Agryl P17	64.4 (79.3)	38.1 (44.3)	63.9 (79.3)	0 (0)
Enviromesh	46.6 (58.3)	36.5 (36.0)	47.3 (54.3)	34.7 (39.2)
<u>Full Fungicide</u>				
Nil	54.8 (57.7)	45.3 (50.0)	58.5 (72.7)	54.1 (64.2)
Agryl P10	77.9 (94.3)	50.6 (58.3)	59.0 (72.7)	47.9 (60.0)
Agryl P17	- (-)	- (-)	51.9 (61.7)	- (-)
Enviromesh	44.0 (48.3)	34.5 (32.5)	- (-)	63.9 (78.3)
SED (27 df) for comparing treatments	12.39	12.19	11.17	12.36
LSD (5%)	25.4	25.0	NS	25.4

**APPENDIX III: Table B: Number of heads with tipburn (% angular transformations). Actual numbers recorded in brackets (%).**

Treatment	Planting 3	Planting 4
<u>No Fungicide</u>		
Nil	24.3 (15.8)	2.6 (1.7)
Agryl P10	13.6 (9.2)	44.0 (45.0)
Agryl P17	21.9 (13.3)	77.3 (85.0)
Enviromesh	7.5 (3.3)	39.8 (38.3)
<u>Full Fungicide</u>		
Nil	10.0 (7.5)	5.3 (1.7)
Agryl P10	2.6 (0.8)	13.6 (5.8)
Agryl P17	12.4 (7.5)	-
Enviromesh	- (-)	9.9 (4.2)
SED (27 df) for comparing treatments	7.4	18.45
LSD (5%)	15.2	37.9