ADAS

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Project Title: CONTROL OF DOWNY MILDEW IN CRISP HEAD LETTUCE

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CONTENTS

ACTION POINTS FOR GROWERS

This work comprises three experiments:

1. Evaluation of fungicide phytotoxicity of Bavistin WP and Bavistin DF either on their own or in combination with other fungicides during propagation .

2. Evaluation of carry-over effects of fungicides applied during propagation on downy mildew control in the field. Plants in the field received a standard downy mildew control programme.

3. Effect of fungicides applied in the field on the control of downy mildew. Plants received a standard downy mildew control programme during propagation.

1) Propagation experiment - fungicide phytotoxicity

The aim of this work was to see if there were differences between Bavistin WP and Bavistin DF on the growth of lettuce in propagation, either on their own or in combination with other fungicides.

In the 3 years no problems were encountered with Bavistin DF at 0.02 g or 0.04 g per 3.8 cm or 4.3 cm cuboid peat block. However, different results were obtained in July sowings (1991 and 1993) with phytotoxicity occurring in treatment combinations of Aliette in 1991, but not in 1993. The use of Aliette as a block-incorporated treatment in the summer months (May - August) constitutes a risk and is not recommended. It cannot be explained why Bavistin WP, a standard treatment for many years, applied on its own, with Filex, or with Basilex, reduced plant vigour in the smaller block in the summer of 1993.

2) Disease control in propagation

The aim of this work was to investigate the effects of various fungicides in propagation and to establish if there were any carry-over effects on disease control in the field. In the field, plants received a limited dithiocarbamate programme.

Good control in the field was achieved with Aliette applied in propagation as a drench at the 2-3 leaf stage and irrigated with water after application under the terms of the Specific Off-label Approval (SOLA). Slight phytotoxicity was recorded at one site in 1991. It is recommended that renewal of this approval should be sought.

3) Disease control in the field

The aim of this work was to investigate the effects of various fungicides on the control of downy mildew in the field. The plants raised during propagation received a fungicide control programme based on zineb foliar sprays in 1991 and 1992, and an Aliette drench in 1993.

Control in the field was achieved with foliar sprays of Filex, Favour 600 FW and zineb. Zineb may be withdrawn in the near future but its use will be permitted for a further two years after withdrawal date. Based on the 1993 experiment, mancozeb could be a suitable alternative to zineb. The Specific Off-label Approval for the use of Filex foliar sprays on outdoor lettuce should be pursued.

CONTROL OF DOWNY MILDEW IN CRISP HEAD LETTUCE

SUMMARY

The aim of this work was to optimise the range of fungicides, their application and timing, during propagation and in the field, to obtain good downy mildew control. Also, to test various fungicides for phytotoxic effects on plant growth during propagation.

Propagation experiment - fungicide phytotoxicity

The aim of this work was to see if there were differences between Bavistin WP and Bavistin DF on the growth of lettuce in propagation, either on their own or in combination with other fungicides.

In 1991, Bavistin WP at single and double the label recommended rates was compared with similar rates of Bavistin DF on their own and in combination with Filex. No problems were encountered when the above treatments were used during propagation in the summer months (end of July sowing). However, Aliette incorporated in the compost during this period, either on its own or in combination with either Bavistin formulations, was found to be phytotoxic; treated plants were less vigorous and harvest weight was reduced. Aliette is not recommended for use at this time.

In 1992, the propagation experiment started in September, outside the "high-risk period" of the summer months (May to August), and no phytotoxicity was recorded with Aliette in combination with either Bavistin formulation. Bavistin DF only was used at two rates in this experiment. No phytotoxicity was recorded with either of the Bavistin formulations on their own or in combination with Basilex, Filex, Basilex and Filex or Basilex and Aliette. However, the growing conditions were not ideal and there was great variability in the plants as reflected in the harvested weights.

In summer 1993, unlike the summer 1991 experiment, adding Bavistin WP into blocking compost at 0.02 g/3.8 cm block, on its own or with Basilex plus Filex, reduced plant vigour compared with corresponding treatments of Bavistin DF at the same and double the rate. However, in this experiment no adverse effects were recorded with any Bavistin treatment in combination with Aliette or with Aliette plus Basilex.

Reductions in emergence and subsequent plant survival were recorded following drench applications of Filex in all combination with all three Bavistin treatments.

To conclude, in the 3 years no problems were encountered with Bavistin DF at 0.02 g or 0.04 g per 3.8 cm or 4.3 cm cuboid peat block. However, different results were obtained in July sowings (1991 and 1993) with phytotoxicity occurring in treatment combinations of Aliette in 1991 but not in 1993. The use of Aliette as a block incorporating treatment in the summer months (May - August) constitutes a risk and is not recommended. It cannot be explained why Bavistin WP, a standard treatment for many years, applied on its own or with Filex, or with Basilex reduced plant vigour in the smaller block in the summer of 1993.

Disease control in propagation

The aim of this work was to investigate the effects of various fungicides in propagation and to establish if there were any carry-over effects on disease control in the field.

In 1991 and 1992 Aliette incorporated into the compost, and as a drench, and Filex incorporated into the compost and as a drench were compared with foliar sprays of Favour 600 FW, zineb dust and with an untreated control. In 1993, zineb dust was replaced by zineb foliar sprays and in addition mancozeb, thiram and fluazanim foliar sprays were compared.

No downy mildew occurred in propagation in the three years of the experiments.

Control of mildew in the field following treatment in propagation was achieved by Aliette compost-incorporated and as a drench in the two experiments in 1991 at Taplow and Sollom and in 1993 at Terrington. In addition, in 1993 control of mildew was achieved by foliar sprays of Favour 600 FW, zineb and thiram and also by Filex compost-incorporated applied during propagation. The strain of downy mildew at Terrington was tested for resistance to metalaxyl and was found to be sensitive. However, the effect of Aliette treatments on yield was not consistent as at Sollom plants treated with Aliette (compost-incorporated) were a third of the size of untreated plants, and ones treated with the Aliette drench were slightly reduced in size. These findings confirm the propagation-only experiment carried out in 1991 where Aliette was phytotoxic. The poor growth can be explained because the plants were treated outside the normal 'safe period', the plants being treated in July. However, similar plants raised from the same propagation treatments and grown at Taplow showed no reductions in weight; in fact, plants from the Aliette compost treatment gave the highest yields. No reductions in weight were recorded at harvest in plants treated with Aliette in propagation at Terrington. The reason for the variability in phytotoxicity of Aliette plants cannot be explained.

To conclude, the best control was given by Aliette compost-incorporated but there was a great risk of plant phytotoxicity associated with this treatment if plants were propagated during the summer months and this is not recommended by the manufacturer. However, good control was achieved with Aliette as a drench at the 2-3 leaf stage and irrigated with water after application

under the terms of the Specific Off-label Approval (SOLA) at Taplow and Sollom in 1991 and at Terrington in 1993, with slight phytotoxicity recorded only at Sollom in 1991.

Disease control in the field

The aim of this work was to investigate the effects of various fungicides on the control of downy mildew in the field. The plants raised during propagation received a fungicide control programme based on zineb foliar sprays in 1991 and 1992 and an Aliette drench in 1993.

In 1991 and 1992 Aliette drenches, with (as directed under the SOLA) and without being rinsed-off, were compared with foliar sprays of Filex, Favour 600 W, zineb and phosphonic acid and with an untreated control. In 1993, phosphonic acid was not tested but mancozeb and thiram foliar spray treatments were included.

There was no disease at planting in the three years of the experiments. The resistance status of the pathogen to metalaxyl was not tested in 1991 but good control was achieved with Favour 600 FW foliar sprays at Sollom in an area where strains of the downy mildew fungus resistant to metalaxyl have been recorded and in 1993 at Holbeach where a mixture of metalaxyl-resistant and sensitive strains were detected.

In 1991, foliar sprays of zineb, Favour 600 FW and Filex gave control at Sollom and only the latter gave control at Taplow. In 1993, foliar sprays of mancozeb, zineb, thiram and Favour 600 FW gave control of downy mildew at Holbeach. It is likely that zineb will be withdrawn in the near future. However, good results were obtained with mancozeb in the 1993 experiment at Holbeach and this could be a suitable alternative to zineb.

At Sollom, treatment with an Aliette drench and rinsed-off with water also reduced disease. In 1991, Filex sprays gave control at both sites and at Holbeach in 1993 but the Off-label use for this chemical is for protected lettuce only. The Specific Off-label Approval for the use of Filex foliar sprays on outdoor lettuce should be pursued.

To conclude, control in the field was achieved with foliar sprays of Filex, Favour 600 FW and zineb. Zineb may be withdrawn in the near future, but its use will be permitted for a further two years after withdrawal date. Based on the 1993 experiment mancozeb could be a suitable alternative to zineb.

INTRODUCTION

ADAS disease surveys in 1988 and 1989 showed that downy mildew was the main disease problem causing estimated losses of £3.8 and £1.2 million, respectively. Although there are genes for resistance to downy mildew bred into modern butterhead cultivars there are no effective resistance genes in current outdoor crisp cultivars. Resistance to metalaxyl in the downy mildew pathogen is prevalent in most areas leading to problems in obtaining effective control.

Bavistin WP is currently recommended for the control of lettuce big vein disease and this is the only use of this formulation. At one time it was unavailable but supplies were available for 1994. Another formulation, Bavistin DF, has many approved uses but is not approved for the control of big vein. The efficacy of this product against big vein was outside the remit of this project (Bavistin DF has been investigated in HDC Project FV/62 and found to be as effective as Bavistin WP).

The aim of this work was to test Bavistin DF for phytotoxicity in propagation, when used on its own or in combination with other fungicides, and to optimise fungicide choice, application and timing to obtain good downy mildew control both in propagation and in the field.

Three aspects of downy mildew control were investigated.

EXPERIMENT 1

To examine in the absence of disease the effect of Aliette, Bavistin DF, Bavistin WP and Filex on growth of lettuce seedlings raised in cuboid peat blocks.

EXPERIMENT 2

To compare fungicides as pre-sowing treatments or as drenches or foliar sprays at the seedling stage on the incidence of downy mildew in propagation and on the control of downy mildew and yield of lettuce in the field. (All treatments received a restricted dithiocarbamate foliar spray programme in the field).

EXPERIMENT 3

To compare a range of fungicides as post-planting field treatments on the control of downy mildew and yield of lettuce. (All treatments in propagation to receive a standard commercial programme).

EXPERIMENT 1

Effect of fungicides on the growth of lettuce seedlings in blocks during propagation.

MATERIALS AND METHODS

Treatments applied in 1991

Carbendazim, as Bavistin WP and Bavistin DF, was applied alone and in combination with fosetyl-aluminium as Aliette, or propamocarb hydrochloride as Filex, as listed below.

1. Bavistin WP at 0.02 g per 4.3 cm block
2. Bavistin WP at 0.02 g per 4.3 cm block + Aliette at 900 g per m^3 blocking compost
3. Bavistin WP at 0.02 g per 4.3 cm block + Filex at 300 ml per m^3 blocking compost in 20-100 litre water
4. Bavistin WP at 0.04 g per 4.3 cm block
5. Bavistin WP at 0.04 g per 4.3 cm block + Aliette at 900 g per m^3 blocking compost
6. Bavistin WP at 0.04 g per 4.3 cm block + Filex at 300 ml per m^3 blocking compost in 20-100 litre water
7. Bavistin DF at 0.02 g per 4.3 cm block
8. Bavistin DF at 0.02 g per 4.3 cm block + Aliette at 900 g per m^3 blocking compost
9. Bavistin DF at 0.02 g per 4.3 cm block + Filex at 300 ml per m^3 blocking compost in 20-100 litre water
10. Bavistin DF at 0.04 g per 4.3 cm block
11. Bavistin DF at 0.04 g per 4.3 cm block + Aliette at 900 g cp per m^3 blocking compost
12. Bavistin DF at 0.04 g per 4.3 cm block + Filex at 300 ml per m^3 blocking compost in 20-100 litre water
13. Aliette at 900 g per m^3 blocking compost

14. Filex at 300 ml per m^3 blocking compost in 20-100 litre water

15. Untreated control.

NB. Aliette, Bavistin DF and Bavistin WP were incorporated into compost just prior to blocking. Filex was added to compost just prior to blocking (30 ml per m^3) and as a drench after seeding (rate equivalent to 270 ml per m^3 added pre-blocking).

Treatments applied in 1992

In addition to the treatments applied in 1991 tolclofos-methyl as Basilex was applied with Bavistin WP and Bavistin DF and also in combination with Bavistin WP and Bavistin DF together with Filex as listed below:

1. Bavistin WP at 0.02 g per 4.3 cm block

2. Bavistin WP at 0.02 g per 4.3 cm block + Basilex at 2g in 1 litre water per m^2 of blocks.

3. Bavistin WP at 0.02 g per 4.3 cm block + Filex at 10 ml in 2 litres water per m^2 of blocks + Basilex at 2g in 1 litre water per m^2 of blocks

4. Bavistin WP at 0.02 g per 4.3 cm block + Filex at 10 ml in 2 litres water per m^2 of blocks

5. Bavistin WP at 0.02 g per 4.3 cm block + Aliette 900 g per m^3 blocking compost

6. Bavistin WP at 0.02 g per 4.3 cm block + Basilex at 2 g in 1 litre water per m^2 of blocks + Aliette 900 g per m^3 blocking compost

7. Bavistin DF at 0.02 g per 4.3 cm block

8. Bavistin DF at 0.02 g per 4.3 cm block + Basilex at 2 g in 1 litre water per m^2 of blocks

9. Bavistin DF at 0.02 g per 4.3 cm block + Basilex at 2 g in 1 litre water per m^2 of blocks + Filex at 10 ml in 2 litres water per m^2 of blocks

10. Bavistin DF at 0.02 g per 4.3 cm block + Filex at 10 ml in 2 litres water per m^2 of blocks

11. Bavistin DF at 0.02 g per 4.3 cm block + Aliette at 900 g per m^3 blocking compost

12. Bavistin DF at 0.02 g per 4.3 cm block + Aliette at 900 g per m^3 blocking compost + Basilex at 2 g in 1 litre water per m^2 of blocks

13. Bavistin DF at 0.04 g per 4.3 cm block

14. Bavistin DF at 0.04 g per 4.3 cm block + Basilex at 2 g in 1 litre water per m^2 of blocks

15. Bavistin DF at 0.04 g per 4.3 cm block + Basilex at 2 g in 1 litre water per m^2 of blocks + Filex at 10 ml in 2 litres water per m^2 of blocks

16. Bavistin DF at 0.04 g per 4.3 cm block + Filex at 10 ml in 2 litres water per m^2 of blocks

17. Bavistin DF at 0.04 g per 4.3 cm block + Aliette 900 g per m^3 blocking compost

18. Bavistin DF at 0.04 g per 4.3 cm block + Basilex at 2 g in 1 litre water per m^2 of blocks + Aliette 900 g per m^2 blocking compost

19. Untreated control

NB Aliette, Bavistin DF, Bavistin WP were incorporated into compost just prior to blocking. Basilex and Filex were applied as drenches shortly after seeding.

Treatments applied in 1993

Treatments applied in 1993 were similar to those in 1992, but plants were raised in 3.8 cm blocks, and are listed below:

1. Bavistin WP at 0.02 g per 3.8 cm block

2. Bavistin WP at 0.02 g per 3.8 cm block + Basilex at 2g in 1 litre water per m^2 of blocks.

3. Bavistin WP at 0.02 g per 3.8 cm block + Filex at 10 ml cp in 2 litres water per m^2 of blocks + Basilex at 2g in 1 litre water per m^2 of blocks

4. Bavistin WP at 0.02 g per 3.8 cm block + Filex at 10 ml cp in 2 litres water per m^2 of blocks

5. Bavistin WP at 0.02 g per 3.8 cm block + Aliette 900 g per m^3 blocking compost

6. Bavistin WP at 0.02 g c per 3.8 cm block + Basilex at 2 g in 1 litre water per m^2 of blocks + Aliette 900 g per m^3 blocking compost

7. Bavistin DF at 0.02 g per 3.8 cm block

8. Bavistin DF at 0.02 g per 3.8 cm block + Basilex at 2 g in 1 litre water per m^2 of blocks

9. Bavistin DF at 0.02 g per 3.8 cm block + Basilex at 2 g in 1 litre water per m^2 of blocks + Filex at 10 ml in 2 litres water per m^2 of blocks

10. Bavistin DF at 0.02 g per 4.3 cm block + Filex at 10 ml in 2 litres water per m^2 of blocks

11. Bavistin DF at 0.02 g per 3.8 cm block + Aliette at 900 g per m^3 blocking compost

12. Bavistin DF at 0.02 g per 3.8 cm block + Aliette at 900 g per m^3 blocking compost + Basilex at 2 g in 1 litre water per m^2 of blocks

13. Bavistin DF at 0.04 g per 3.8 cm block

14. Bavistin DF at 0.04 g per 3.8 cm block + Basilex at 2 g in 1 litre water per m^2 of blocks

15. Bavistin DF at 0.04 g per 3.8 cm block + Basilex at 2 g in 1 litre water per m^2 of blocks + Filex at 10 ml in 2 litres water per m^2 of blocks

16. Bavistin DF at 0.04 g per 3.8 cm block + Filex at 10 ml in 2 litres water per m^2 of blocks

17. Bavistin DF at 0.04 g per 3.8 cm block + Aliette 900 g per m^3 blocking compost

18. Bavistin DF at 0.04 g per 3.8 cm block + Basilex at 2 g in 1 litre water per m^2 of blocks + Aliette 900 g per m^2 blocking compost

19. Untreated control

Experiment Design

Randomised block design with three replicates.

Plot size

In 1991 and 1992, 35 plants, each in a 4.3 cm cuboid peat block were grown in a seed tray in a 7 x 5 configuration. In 1993, 40 plants, each in a 3.8 cm cuboid peat block were grown in a lettuce tray filled with unseeded blocks.

Cultivar

cv. Baltic (RSL)

Growth assessments

A count of seedling establishment was made at two or three weeks after seeding and plants were scored for vigour 3 weeks after sowing. Fresh weight of foliage from the central 15 plants in each plot was measured at 5, 7 and 4 weeks post-sowing in 1991, 1992 and 1993, respectively.

Statistical analysis

Data were subjected to analysis of variance. Skewed data values have been transformed into angles (ang trans) and both actual and transformed data are presented. Standard errors of differences between means are quoted when probability P is <0.05. Significance is indicated as * $P<0.05$, ** $P<0.01$, *** $P<0.001$ and NS = not significant $P>0.05$.

Propagation details

In 1991 seed was sown on 28 July into 4.3 cm cuboid peat blocks, (Levington Blocking Compost) made up just prior to use, and placed in an unheated glasshouse.

In 1992 seed was sown on 6 September into 4.3 cuboid peat blocks (Levington Blocking Compost) made up just prior to use and placed in a glasshouse run at 10°C minimum and with supplementary lighting provided between 0700 and 1900 hours each day whenever light level fell below 35 kilojoules per m^2 and switched off if levels exceeded 100 kilojoules per m^2.

In 1993 seed was sown on 26 July into 3.8 cm cuboid peat blocks (Levington Blocking Compost), made up just prior to use, and placed in an unheated glasshouse.

RESULTS

EXPERIMENT 1a - 1991

The results of plant establishment, plant vigour and plant fresh weight 5 weeks after sowing are given in table 1.

Plant establishment was greater than 98% for all treatments two weeks after sowing. Differences were found in vigour scores in that all plants treated with Aliette alone or in combination with the two Bavistin formulations, apart from that with Bavistin WP at 0.04g/block, were less vigorous. There were no vigour differences between the other treatments. Fresh weights of plants treated with Bavistin WP or Bavistin DF, alone or with Filex, and with Filex alone, were similar to the untreated control. Adding Aliette into compost, alone or with Bavistin WP or Bavistin DF, resulted in lower fresh weights.

Table 1 Effect of fungicide treatment during propagation on plant establishment -1991

Treatment	% plant establishment (12 Aug)	Mean vigour (1 = least, 3 = most) (21 Aug)	Total fresh weight of foliage (g) (2 Sep)
Bavistin WP at 0.02 g	99.5	3.0	35.6
" " " 0.02 g + Aliette	99	2.3	23.3
" " " 0.02 g + Filex	100	2.7	35.8
Bavistin WP at 0.04 g	99.5	2.7	35.3
" " " 0.04 g + Aliette	100	3.0	29.0
" " " 0.04 g + Filex	100	2.7	34.3
Bavistin DF at 0.02 g	99.5	3.0	39.0
" " " 0.02 g + Aliette	100	1.7	24.0
" " " 0.02 g + Filex	100	3.0	41.0
Bavistin DF at 0.04 g	100	2.7	38.0
" " " 0.04 g + Aliette	100	2.0	26.9
" " " 0.04 g + Filex	100	2.7	32.5
Aliette at 900 g per m^3	100	2.3	27.7
Filex at 300 ml per m^3	100	3.0	40.4
Untreated control	98.1	3.0	38.5
Significance		*	*
SED ± (28 df)		0.3	4.2
CV (%)		14.5	15.3

EXPERIMENT 1b - 1992

The results of vigour scores and plant fresh weights are given in table 2.

Table 2 Effect of fungicide treatment during propagation on plant establishment - 1992

Treatment	Mean vigour (1 = least, 6 = most) (28 Sep)	Total fresh weight of foliage (g) (24 Oct)
Bavistin WP at0.02 g	5.0	38.8
" " " 0.02 g + Basilex	4.3	38.5
" " " 0.02 g + Basilex + Filex	5.3	73.7
" " " 0.02 g + Filex	5.7	45.9
" " " 0.02 g + Aliette	5.3	33.8
" " " 0.02 g + Basilex + Aliette	5.3	64.3
Bavistin DF at 0.02 g	5.3	51.5
" " " 0.02 g + Basilex	5.3	34.2
" " " 0.02 g + Basilex + Filex	3.3	63.1
" " " 0.02 g + Filex	4.7	50.2
" " " 0.02 g + Aliette	5.0	53.3
" " " 0.02 g + Basilex and Aliette	3.7	57.6
Bavistin DF at 0.04 g	4.7	60.5
" " " 0.04 g + Basilex	3.3	45.0
" " " 0.04 g + Basilex + Filex	3.3	41.3
" " " 0.04 g + Filex	4.3	43.6
" " " 0.04 g + Aliette	4.3	33.7
" " " 0.04 g + Basilex + Aliette	2.3	33.5
Untreated control	3.0	42.2
Significance	*	*
SED ± (36 df)	1.2	19.3
CV (%)	43.0	49.7

There were no effects of any of the fungicides on vigour assessed 22 days after sowing or on growth measured as fresh weight of foliage 48 days after sowing.

The effects of different fungicides and fungicide combinations on vigour and fresh weight were inconsistent and inconclusive. There did not appear to be a relationship between vigour and harvested fresh weight of foliage.

EXPERIMENT 1c - 1993

The results of establishment, survival, vigour, and fresh weights are given in tables 3 and 4.

Table 3 Effect of fungicide treatment during propagation on plant establishment - 1993

Treatment	Plant establishment %	Plant establishment ang trans	Mean vigour (1 = least, 3 = most)
Bavistin WP at 0.02 g	96.7	79.6	1.3
" " " 0.02 g + Basilex	96.7	81.4	1.2
" " " 0.02 g + Basilex + Filex	5.0	12.2	0.8
" " " 0.02 g + Filex	41.7	37.4	1.0
" " " 0.02 g + Aliette	97.5	82.7	1.8
" " " 0.02 g + Basilex + Aliette	97.5	80.9	1.7
Bavistin DF at 0.02 g	99.2	87.0	2.7
" " " 0.02 g + Basilex	95.8	80.4	2.5
" " " 0.02 g + Basilex + Filex	15.8	23.2	2.3
" " " 0.02 g + Filex	61.7	55.9	2.5
" " " 0.02 g + Aliette	77.5	61.8	2.3
" " " 0.02 g + Basilex and Aliette	82.5	66.3	2.0
Bavistin DF at 0.04 g	96.7	81.7	2.8
" " " 0.04 g + Basilex	97.5	84.7	2.3
" " " 0.04 g + Basilex + Filex	20.8	26.5	2.5
" " " 0.04 g + Filex	62.5	52.7	3.0
" " " 0.04 g + Aliette	97.5	82.7	2.7
" " " 0.04 g + Basilex + Aliette	98.3	85.7	2.3
Untreated control	97.5	82.7	2.8
Significance		***	***
SED ± (36 df)		10.2	0.32
CV (%)		19.1	18.3

Table 4 Effect of fungicide treatment during propagation on plant weights and survival - (26 Aug) 1993

Treatment	Total fresh weight of foliage (g)	Mean weight (g)	No of surviving plants/15
Bavistin WP at 0.02 g	7.9	0.52	15
" " " 0.02 g + Basilex	5.9	0.39	15
" " " 0.02 g + Basilex + Filex	2.4	2.37	1
" " " 0.02 g + Filex	8.1	0.68	9
" " " 0.02 g + Aliette	23.0	1.54	15
" " " 0.02 g + Basilex + Aliette	17.1	1.33	13
Bavistin DF at 0.02 g	20.9	1.39	15
" " " 0.02 g + Basilex	19.7	1.37	14
" " " 0.02 g + Basilex + Filex	5.9	1.99	3
" " " 0.02 g + Filex	19.2	1.71	10
" " " 0.02 g + Aliette	25.1	1.88	13
" " " 0.02 g + Basilex and Aliette	20.9	1.53	13
Bavistin DF at 0.04 g	33.1	2.21	15
" " " 0.04 g + Basilex	24.8	1.70	15
" " " 0.04 g + Basilex + Filex	8.4	1.70	4
" " " 0.04 g + Filex	23.7	2.16	10
" " " 0.04 g + Aliette	35.3	2.44	15
" " " 0.04 g + Basilex + Aliette	44.5	2.97	15
Untreated control	17.2	1.19	15
Significance	***	*	***
SED ± (36 df)	7.35	0.672	2.0
CV (%)	47.1	50.4	20.2

Differences in plant establishment were found with poorer establishment in all the Bavistin treatments in combination either with Basilex plus Filex or with Filex.

All treatments which included Bavistin DF at 0.02 g per block, apart from with Aliette on its own or with Basilex, were more vigorous than the corresponding treatments with Bavistin WP at 0.02 g per block. No differences in vigour were found between the corresponding treatment combinations with Bavistin DF at 0.02 g per block and at 0.04 g per block. Low fresh weights of foliage were found in plots treated with Bavistin plus Basilex and Filex reflecting the low numbers of plants surviving.

Lower mean plant weights were recorded in plots treated with either Bavistin WP 0.02 g/block on its own or with Basilex or with Filex when compared with corresponding treatments with Bavistin DF 0.04 /block.

DISCUSSION

The 1991 experiment sown in late July showed that adding either Bavistin DF or Bavistin WP into blocking compost at the label recommended rate (0.02 g per 4.3 cm cuboid peat block) or double the rate did not affect establishment and growth of crisp lettuce seedlings propagated during the summer in an unheated glasshouse. Similar results were obtained from incorporating combinations of Bavistin WP or Bavistin DF with Filex, and from Filex on its own.

Incorporating Aliette into compost whether alone or in combination with Bavistin WP or Bavistin DF reduced growth but did not impair seedling establishment.

There was clearly a growth-checking effect from Aliette during propagation when incorporated into propagation compost for raising seedlings in a glasshouse during the summer. The label recommendation for this product excludes treatment for seedlings raised between May and August.

The 1992 experiment was sown on 6 September and although no differences were recorded in fresh weights there was great variability in the data reflecting the conditions the crop was grown under. No phytotoxic effects of Aliette were recorded in this experiment in agreement with label recommendations.

No phytotoxic affects were detected following the incorporation of Basilex on its own, with Bavistin WP or Bavistin DF, or in combination with Aliette or Filex.

The 1993 experiment sown in late July showed that adding Bavistin WP into blocking compost at 0.02 g per 3.8 cm cuboid peat block either on its own, or with Basilex, or with Basilex plus Filex

or with Filex reduced plant vigour compared with corresponding treatments with Bavistin DF at 0.02 g per 3.8 cm cuboid peat block or at double rate. Similar reductions in mean plant weight were recorded at the end of the experiment with the exception of treatments which included Basilex plus Filex. These treatments were applied as separate drenches and the blocks became flooded resulting in reductions in plant emergence. Reductions in emergence and subsequent plant survival were recorded following drench applications of Filex in combination with all three Bavistin treatments. No adverse results were recorded with any Bavistin treatment in combination with Aliette or in combination with Aliette plus Basilex. In fact, the largest plant weights were in plots treated with Bavistin DF at 0.04 g per block Aliette plus or with Aliette plus Basilex.

EXPERIMENT 2

To compare a range of fungicides in propagation, on the control of downy mildew and yield of lettuce. In the field all plants received a restricted dithiocarbamate programme.

MATERIALS AND METHODS

Propagation treatments were carried out at ADAS Reading in July 1991 and in August 1992, and at Quadring in July 1993. The plants were subsequently grown in 1991 at Taplow (Bucks) and Sollom (Lancs), in 1992 at Marlow (Bucks) and Scarisbrick (Lancs) and in 1993 at Terrington St Clement (Norfolk).

Propagation treatments 1991 and 1992

1. Aliette incorporated into compost prior to blocking.
2. Aliette as a drench after seeding. (SOLA)
3. Filex incorporated into compost prior to blocking (and also as a drench after seeding 1991 only).
4. Filex as a drench after seeding.
5. Favour 600 FW as foliar sprays.
6. Zineb 15% Dust as dust applications to foliage.
7. Control - no fungicide prior to planting

Propagation treatments 1993

1. Aliette incorporated into compost prior to blocking.
2. Aliette as a drench after seeding (SOLA).
3. Favour 600 FW as foliar sprays.
4. Filex incorporated into compost.
5. Filex as a drench prior to planting out.

6. Unicrop Zineb as foliar sprays.

7. Unicrop Mancozeb as foliar sprays.

8. Unicrop Thianosan DG as foliar sprays.

9. Fluazinam as foliar sprays.

10. Control - no fungicide prior to planting.

Rate, method and timing of fungicide application

Product	Rate	Method of application	Time of application
Aliette	900 g per m^3	compost incorporation	prior to blocking
Aliette	10 g in 2 litres per m^2	drench and irrigated with water immediately after application	2-3 true leaves
Favour 600 FW	5 ml in 2.5 litres water per 70 m^2	foliar spray	first true leaf
followed by	5 ml in 2.5 litres water per 50 m^2	foliar spray	2-3 true leaves
Filex (1991)	30 ml per m^3 + equivalent of 270 ml per m^3 uncompressed compost	compost incorporation + drench	prior to blocking + cotyledon leaves unfolded
Filex (1992 and 1993)	300 ml per m^2	compost incorporation	prior to blocking
Filex (1991 and 1992)	10 ml in 2 litres water per m^2	drench then washed off the foliage with water	first true leaf
Filex per m^2	5 ml in 2 litres water	drench then washed off the foliage with water	prior to planting out
FS Zineb 15% Dust	3.2 g per m^2	dust	2-3 true leaves and 4-5 true leaves
Zineb	2 kg/1000 litres water	foliar spray	first true leaf* and 2-3 true leaves**
Mancozeb	1.8 kg/1000 litres water	foliar spray	first true leaf* and 2-3 true leaves**
Thianosan DG	4 kg/1000 litres water	foliar spray	first true leaf* and 2-3 true leaves**
Fluazinam	100 ml/100 litres water	foliar spray	first true leaf* and 2-3 true leaves**

* 2.5 litres per 70 m^2 ** 2.5 litres per 50 m^2

Experiment Design

Randomised block design with 4 replicates.

Plot size

2.4 m long x 0.6 m wide. (Bucks 1991), 2.5 m x 1.5 m (Bucks 1992), 5.0 m x 1.5 m (Lancs 1991), 3.0 m x 1.5 m (Lancs 1992), 4.2 m x 1.5 (Norfolk 1993).

Cultivar

cv. Baltic (RSL)

Cultural

Plots were located within a commercial crop of transplanted crisp lettuce except for 1993 lettuce which were planted in isolation from commercial crops. Apart from fungicides the plants were treated as in normal commercial practice.

Downy mildew assessments and yield records:

Downy mildew - on 20 plants per plot at random, excluding outside rows and plants at either end.
7 weeks after planting - assessed on individual leaves using ADAS Disease Assessment Key 10.1.2.
9 weeks after planting (harvest) - assessed on whole plants using ADAS Disease Assessment Key 10.1.3.

Yield - 20 plants per plot were selected at random, excluding plants from outside rows and those at either end, and weights untrimmed and trimmed were recorded.

Statistical analysis

Data were subjected to analysis of variance. Standard errors of differences between means are quoted when probability P is <0.05. Significance is indicated as * P<0.05, ** P<0.01, *** P<0.001 and NS = not significant P>0.05.

Field treatments 1991

At Taplow Bucks, the blocks were planted on 19 August and harvested on 15 October. Zineb as Hortag Zineb Wettable was applied at 2 kg in 1000 l water per ha, 25 and 44 days after planting. At Sollom Lancs, the blocks were planted on 21 August. Zineb as Hortag Zineb Wettable was applied at 2 kg in 1000 l water per ha 14, 41 and 51 days after planting but the experiment was not harvested.

Field treatments 1992

At Marlow, Bucks, the blocks were planted on 3 September, no fungicides were applied post-planting and the experiment was not harvested. At Scarisbrick Lancs the blocks were planted on 4 September and harvested on 4 November; two applications of Zineb 70% in 1000 l water were applied at 21 day intervals commencing a fortnight from planting out ie 19 September and 12 October.

Field treatments 1993

At Terrington St Clement, Norfolk, the blocks were planted on 18 August and harvested on 22 October. Four "infector" plants which had previously been inoculated with downy mildew and showing symptoms were planted at the end of each plot. Three applications of Mancozeb were applied at fortnightly intervals at 1.3 kg/750 l/ha on 25 August and 9 September at the rosette stage and 2.7 kg/1500 l/ha on 22 September at the mature plant stage alternating with fortnightly applications of Rovral WP applied at 0.35 kg/750 l/ha on 2 September and 15 September at the rosette stage and at 0.5 kg/1000 l/ha on 30 September at the mature plant stage. Ambush was applied with the Mancozeb and DSM with Rovral WP.

RESULTS

Propagation

Downy mildew was not seen during propagation on any of the treatments in the three years.

Field Experiment 1991

a) Taplow, Bucks

Downy mildew developed after planting out. The results of disease assessments and yield are given in table 5.

Table 5 Lettuce downy mildew percentage and yield, October 1991, Taplow, Bucks

Treatment in propagation	Mean % Downy Mildew on basal leaves		Mean yield (kg)	
	7 weeks after planting	At harvest	Untrimmed	Trimmed
1. Aliette incorporated	3.6	16.1	0.86	0.48
2. Aliette drench	7.3	20.0	0.81	0.44
3. Filex incorporated + drench	10.2	26.3	0.72	0.41
4. Filex drench	10.0	28.4	0.80	0.46
5. Favour 600 FW spray	9.9	28.9	0.78	0.45
6. FS Zineb 15% Dust	9.5	26.7	0.79	0.46
7. Control - no treatment during propagation	9.4	24.7	0.76	0.41
Significance	*	*	NS	NS
SED ± (18 df)	1.6	2.0	0.053	0.065

At 7 weeks after planting control was given only by Aliette incorporated into the compost. At harvest, Aliette incorporated into the compost, or applied as a drench during propagation, were the only treatments which gave a reduction in downy mildew. There were no differences in yields of trimmed and untrimmed lettuce.

b) Sollom, Lancs

Downy mildew was first recorded 2 weeks after planting on the untreated control plots and on all other treatments apart from the two with Aliette (treatments 1 and 2). Infection was principally confined to the oldest leaves. Disease levels increased during the autumn on affected plants but no downy mildew was noticed on plants of the two Aliette treatments a month after planting out, and these plants remained disease-free until just prior to the intended harvest date. Both Aliette treatments caused some stunting of growth right through the growing period with treatment 1 (Aliette incorporated in the compost) being the worst. A month after planting out, plants in treatment 1 were approximately a third the size of untreated plants, while only a slight reduction

in size was exhibited in plants treated with the Aliette drench. Unfortunately, owing to a misunderstanding, the trial was destroyed (rotovated) before a detailed assessment and yields could be taken.

Field Experiment 1992

a) Marlow, Bucks

Establishment and growth of the transplants was severely checked by predominantly cool, very unsettled weather. Downy mildew was already noted as being severe 18 days (21 September) after planting. Weeds became a problem and it was decided to terminate the trial after downy mildew levels were assessed 36 days after planting. There was no prospect of the plants developing to maturity before the end of the season. The results of the disease assessment are given in table 6.

Table 6 Lettuce disease assessment* (36 days after planting) October 1992 Marlow, Bucks

Treatment in propagation	**% Downy Mildew**
Aliette incorporated	10.7
Aliette drench	14.2
Filex incorporated	13.3
Filex drench	11.9
Favour 600 FW sprays	13.7
Zineb 15% dust	14.8
Control - no treatment during propagation	11.6
Significance	NS
SED ± (18 df)	5.4
CV (%)	59.4

* rosette stage of growth

No differences in the levels of downy mildew were detected between treatments.

b) Scarisbrick, Lancs

Due to delay in sowing, the date of planting out was later than planned and the plants failed to reach maturity by late autumn when the first frosts occurred. As a result only total plant weights could be measured and a disease assessment performed. The results of the disease assessment are given in table 6 and the yields in table 7.

Table 7 Lettuce disease assessment at harvest November 1992 Scarisbrick, Lancs

Treatment in propagation	Mean % infection	
	Downy mildew	Botrytis
Aliette incorporated	0	0.3
Aliette drench	0	0.2
Filex incorporated	0	0.4
Filex drench	<0.1	0.3
Favour 600 FW sprays	0	0.3
Zineb Dust	0	0.3
Control - no treatment during propagation	0	0.1
Significance	NS	NS
SED ± (18 df)	0.0057	0.15
CV(%)	529.2	80.9

NS = No significant differences between treatment means

No downy mildew was observed throughout the growing period apart from only one lesion scored at the time of harvest. Some *Sclerotinia* infection occurred with an average loss of 12% of plants, distributed evenly across the experimental area. Low levels of *Botrytis* were also noted at harvest; there were no effects of any treatments.

Table 8 Lettuce yield November 1992 Scarisbrick, Lancs

Treatment in propagation	Mean weight of whole lettuce (g)
Aliette incorporated	75.5
Aliette drench	66.9
Filex incorporated	75.6
Filex drench	81.1
Favour 600 FW sprays	78.2
Zineb drench	74.9
Control - no treatment during propagation	69.3
Significance	NS
SED ± (18 df)	5.13
CV (%)	9.7

Yields were variable but no differences between treatments were detected.

Field Experiment 1993

Terrington St Clement, Norfolk

Low levels of downy mildew were recorded in untreated plots in late September and the disease developed dramatically after mid-October. The plants were not mature at harvest, just starting to heart-up, and had suffered slightly from frost. Control in the incidence of mildew was achieved only by the Aliette treatments, either incorporated or applied as a drench, during propagation. Control in severity of mildew was achieved by the two Aliette treatments which also had the lowest disease scores, by foliar sprays of Favour 600 FW, zineb and thiram and by Filex compost-incorporated.

The results of the disease and yield assessments are given in Table 9.

Table 9 Lettuce downy mildew and yield Terrington , Norfolk 1993

Treatment in propagation	Downy mildew +		Mean yield (kg)	
	Incidence	Severity	Untrimmed	Trimmed
Aliette incorporated	15	0.22	0.22	0.17
Aliette drench	21	0.71	0.25	0.20
Favour 600 FW foliar sprays	49	1.45	0.27	0.21
Filex incorporated	48	2.11	0.23	0.17
Filex drench (prior to planting out)	94	2.78	0.27	0.21
Zineb foliar sprays	60	1.59	0.27	0.21
Mancozeb foliar sprays	86	3.79	0.25	0.18
Thiram foliar sprays	60	2.22	0.26	0.19
Fluazanim foliar sprays	63	2.85	0.23	0.20
Control - no fungicide during propagation	84	4.82	0.26	0.19
Significance	**	*	NS	NS
SED ± (27 df)	20.6	1.293	0.023	0.024
CV (%)	50.4	81.1	12.8	17.6

+ Assessed 22 October

No differences were found between treatments in the weight of trimmed or untrimmed lettuce.

DISCUSSION

The main aim of the experiment was to evaluate the carry-over effect of treatments applied during propagation on downy mildew in the field.

Control of downy mildew in the field following treatment in propagation was achieved by Aliette compost-incorporated as a drench in three experiments (1991 at Taplow and Sollom, and in 1993 at Terrington). In addition in 1993, control of mildew was achieved by foliar sprays of Favour 600 FW, zineb and thiram and also by Filex compost-incorporated applied during propagation. The strain of downy mildew at Terrington was tested for resistance to metalaxyl and was found to be sensitive.

However, the effect of Aliette treatments on yield was not consistent as at Sollom plants treated with Aliette compost incorporated were a third of the size of the untreated, and ones treated with the Aliette drench were slightly reduced in size. These findings confirm the propagation only experiment (Experiment 1) carried out in 1991 where Aliette was phytotoxic. The poor growth can be explained because the plants were treated outside the normal 'safe period'. However, similar plants raised from the same propagation treatments and grown at Taplow showed no reductions in weight; indeed, plants from the Aliette compost treatment gave the highest yields. No reductions in weight were recorded at harvest in plants treated with Aliette in propagation at Terrington. The reason for the variability in phytotoxicity of Aliette plants cannot be explained.

In 1992 the experiments were planted in September and no differences in mildew development were detected at Marlow and no reductions in plant growth were recorded. At Scarisbrick, no mildew developed and no differences in plant weights were recorded between treatments.

To conclude, the best control in the field was given by Aliette compost - incorporated in propagation but there was a great risk of this treatment being phytotoxic if used in the "high risk" summer months and is not recommended for use at that time. However good control was achieved in three experiments with Aliette as a drench applied at the 2-3 leaf stage and washed off immediately with water as directed under the Specific Off-label Approval (SOLA 91/0556) with only slight phytotoxicity recorded at Sollom in 1991. It is recommended renewal of this approval should be sought.

EXPERIMENT 3

To compare a range of fungicides as post planting field treatments on the control of downy mildew and yield of lettuce.

MATERIALS AND METHODS

The plants received zineb treatments during propagation in 1991 and 1992. In 1993 the plants received an Aliette drench during propagation.

The following treatments were applied after planting:-

Treatments 1991 and 1992

1. Untreated control - no sprays after planting.

2. Aliette as a drench followed by irrigation to rinse-off the fungicide from the foliage one hour after each post-planting application (SOLA).

3. Aliette as a drench without rinsing-off the fungicide from foliage.

4. Filex as foliar sprays.

5. Favour 600 FW as foliar sprays.

6. Hortag Zineb Wettable as foliar sprays.

7. Phosphonic acid as foliar sprays.

Treatments 1993

1. Untreated control - no sprays after planting.

2. Aliette as a drench followed by irrigation to rinse-off the fungicide from the foliage one hour after each post-planting application. (SOLA)

3. Aliette as a drench without rinsing-off the fungicide from foliage.

4. Filex as foliar sprays.

5. Favour 600 FW as foliar sprays.

6. Unicrop Zineb Wettable as foliar sprays.

7. Unicrop Mancozeb as foliar sprays.

8. Unicrop Thianosan DG as foliar sprays.

Rates and timings of fungicide treatments

Product/ Chemical	**Rate**	**Target Timing**
Aliette	30 g per 100 m² in 5-20 l + rinsing off an hour later with 2 mm water	7 and 21 days after planting
Aliette	30 g per 100 m² in 5-20 litres (no rinsing-off)	7 and 21 days after planting
Filex	1.5 l/ha in 750 litres water	7 and 21 (and 49 1993) days after planting
Favour 600 FW	1.5 l/ha in 750 litres water	7 days after planting
	3 l/ha in 1500 litres water	21, 35 and 49 days after planting
Hortag Zineb Wettable	2 kg/ha in 1000 litres water	7, 21 and 35 days after planting
Unicrop Zineb Wettable	2 kg/ha in 1000 litres water	7 days after planting
followed by	2 kg/ha in 1500 litres water	21, 35 and 49 days after planting
Unicrop Mancozeb	1.8 kg/ha in 1000 litres water	7 days after planting
followed by	1.8 kg/ha in 1500 litres water	21, 35 and 49 days after planting
Unicrop Thianosan DG	4 kg/ha in 1000 litres water	7 days after planting
followed by	4 kg/ha in 1500 litres water	21, 35 and 49 days after planting
Phosphonic acid	1.2 l/ha in 500 litres water	7 and 21 days after planting

Actual treatment application dates

Year **1991**

Sollom (Lancs)

Application dates	Treatments
12.8.91	4, 5, 6
14.8.91	2, 3, 7
27.8.91	2, 3, 4, 5, 6, 7
9.9.91	4, 5, 6
30.9.91	5, 6

Taplow (Bucks)

Application dates	Treatments
28.8.91	2, 3, 4, 5, 6, 7
13.9.91	2, 3, 4, 5, 6, 7
3.10.91	4, 6

Year **1992**

Scarisbrick (Lancs)

Application dates	Treatments
14.8.92	2, 3, 4, 5, 6, 7
5.9.92	2, 3, 4, 5, 6, 7
19.9.92	4, 5, 6,
6.10.92	5, 6
20.10.92	5, 6

Marlow (Bucks)

Application dates	Treatments
20.8.92	2, 3, 4, 5, 6, 7

Year **1993**

Holbeach St Marks (Lincs)

Application dates	Treatments
25.8.93	2, 3, 4, 5, 6, 7, 8
22.9.93	2, 3, 4, 5, 6, 7, 8
8.10.93	4, 5, 6, 7, 8

Site details are listed below:-

Year:	**1991**		**1992**		**1993**
Site	Sollom (Lancs)	Taplow (Bucks)	Marlow (Bucks)	Scarisbrick (Lancs)	Holbeach (Lincs)
Cultivar	Telda	Baltic	Baltic	Saladin	Saladin
Planting Date	9 August	20 August	6 August	7 August	18 August
Harvest Date	14 October	16 October	10 October	4 November	1 November

Experiment Design

Randomised block design with 4 replicates per treatment.

Plot size 2.4m x 0.6m (Taplow 1991), 2.5m x 1.5m (Marlow 1992) 5.0m x 1.4m (Lancs both years), 4.5m x 1.5m (Holbeach 1993).

Cultivar

cv. Baltic (RSL)

Cultural

Plots were located within a commercial crop of transplanted crisp lettuce with fertilisers and herbicides applied as normal commercial practice.

Downy mildew assessment and yield records:

Downy mildew - on 20 plants per plot at random, but excluding outside rows and plants at either end pre-harvest or at harvest assessing whole plants using ADAS Disease Assessment Key 10.1.3.

Yield - 20 plants per plot were selected at random (excluding plants from outside rows and those at either end) and weights untrimmed and trimmed were recorded.

Statistical analysis

Data were subjected to analysis of variance. Standard errors of differences between means are quoted when probability P is <0.05. Significance is indicated as * P<0.05 ** P<0.01 *** P<0.001 and NS = not significant P>0.05.

RESULTS

1991 Field Experiments

a) Sollom, Lancs

The results of the disease and yield assessments are given in tables 10 and 11.

Table 10 Lettuce disease assessment at harvest - Sollom, Lancs 1991

Treatment	Mean % infection		
	Downy Mildew	**Powdery Mildew**	**Botrytis**
Unsprayed control	18.92	6.00	2.25
Aliette drench + water rinse off	13.02	5.52	2.53
Aliette drench	14.15	6.57	3.53
Filex sprays	10.57	6.57	3.35
Favour 600 FW sprays	5.50	3.83	3.38
Hortag Zineb Wettable spray	2.95	4.08	2.88
Phosphonic acid sprays	13.70	7.40	2.43
Significance	***	*	NS
SED ± (18 df)	2.445	0.879	0.320
CV(%)	30.7	21.8	33.5

Downy mildew was first noticed on 3 September 1991, 25 days after planting, and was recorded on all plots. The disease was principally confined to the oldest leaves. Untreated plots were slightly more affected than all the treated plots with plants in the Aliette treated plots having the least disease. By harvest in mid-October, the plants treated with Aliette had become re-infected, although plants treated with Aliette drench and rinsed off had less downy mildew than the untreated control. The best control of downy mildew was given by Favour 600 FW and Zineb sprays. Filex sprays also reduced the disease. Phosphonic acid had no effect. Powdery mildew also occurred in the trial and was reduced by Favour 600 FW sprays only. No treatments reduced *Botrytis* levels.

Table 11 Lettuce yields - Sollom, Lancs

Treatment	Mean weight of untrimmed lettuce (kg)	Mean weight of trimmed lettuce (kg)
Unsprayed control	0.58	0.35
Aliette drench + water rinse off	0.63	0.36
Aliette drench	0.60	0.34
Filex sprays	0.59	0.32
Favour 600 FW sprays	0.57	0.32
Hortag Zineb Wettable sprays	0.57	0.32
Phosphonic acid sprays	0.58	0.36
Significance	NS	NS
SED ± (18 df)	0.04	0.05
CV(%)	10.3	10.2

No differences were recorded between treatments for untrimmed or trimmed lettuce weights.

b) Taplow, Bucks

The results of disease assessments at harvest and yields of lettuce are given in table 12.

Table 12 Lettuce downy mildew at harvest and yield of lettuce Taplow, Bucks 1991

Treatment	Mean % downy mildew on basal leaves	Mean Yield (kg)	
		Untrimmed	Trimmed
Unsprayed control	24.4	0.82	0.48
Aliette drench + water rinse off	22.7	0.85	0.53
Aliette drench	22.3	0.90	0.53
Filex sprays	13.7	0.99	0.55
Favour 600 FW sprays	26.2	0.86	0.48
Hortag Zineb Wettable sprays	18.8	0.91	0.53
Phosphonic acid sprays	29.5	0.83	0.49
Significance	*	NS	NS
SED ± (18 df)	3.3	0.072	0.03

Filex sprays was the only treatment to give a reduction in downy mildew at harvest. There were no differences between treatments in the yield of untrimmed or trimmed lettuce weights.

1992 Field Experiments

a) Scarisbrick, Lancs

The results of disease assessments at harvest and yield of lettuce are given in the tables 13 and 14 respectively.

Table 13 Lettuce disease assessment at harvest Scarisbrick, Lancs 1992

Treatment	**Mean % infection Botrytis**
Unsprayed control	4.5
Aliette drench + water rinse off	1.9
Aliette drench	3.5
Filex sprays	2.4
Favour 600 FW sprays	3.7
Hortag Zineb Wettable sprays	2.3
Phosphonic acid sprays	3.1
Significance	NS
SED ± (18 df)	1.102
CV(%)	50.9

Bad weather after planting resulted in a loss of some plants across the trial site. Conditions not conducive to spraying (wet and windy) also caused some delay in applying treatments at the correct timings. Unusually, no downy mildew was noted throughout the growing period; however, some *Sclerotinia* infection occurred and several plants were lost. Low levels of *Botrytis* were also noted. Treatments did not affect *Botrytis* levels.

Table 14 Lettuce yields Scarisbrick, Lancs

Treatment	Mean weight of untrimmed lettuce (g)	Mean weight of trimmed lettuce (g)
Unsprayed control	235	120
Aliette drench + water rinse off	241	106
Aliette drench	271	128
Filex sprays	261	120
Favour 600 FW sprays	263	138
Hortag Zineb Wettable sprays	248	111
Phosphonic acid sprays	246	105
Significance	NS	NS
SED ± (18 df)	34.2	24.6
CV(%)	19.2	29.4

Poor growing conditions during the autumn reduced the size of the crop and average weights were lower than normal. No yield differences between treatments were recorded (mean untrimmed and trimmed weights).

No phytotoxic effects of any fungicide were noted. Lack of irrigation following Aliette treatment did not adversely affect the plants.

b) Marlow, Bucks

The results of disease assessments (pre-harvest) and yield of lettuce are given in table 15.

Table 15 Lettuce downy mildew (whole plant) 11 days pre-harvest and plant weight at harvest Marlow, Bucks 1992.

Treatment	Mean % downy mildew	Mean Weight per plant (g)	
		Untrimmed	Trimmed
Unsprayed control	7.5	328	168
Aliette drench + water rinse off	7.0	319	173
Aliette drench	5.4	344	172
Filex sprays	6.0	317	173
Favour 600 FW sprays	6.9	315	170
Hortag Zineb Wettable sprays	6.9	332	163
Phosphonic acid sprays	6.8	306	160
Significance	NS	NS	NS
SED ± (18 df)	1.88	39	18
CV (%)	40.0	17.3	14.8

Treatments had no effect on downy mildew or on mean plant weights either before or after trimming.

1993 Field Experiments

Holbeach St Marks, Lincs

The results of the disease assessment at harvest and yield of lettuce are given in tables 16 and 17 respectively.

Table 16 Lettuce downy mildew at harvest Holbeach St Marks, Lincs 1993

Treatment	**Incidence %**	**Downy Mildew (angular transformation)**	**Severity**
Unsprayed control	100	90.0	7.92
Aliette drench + water rinse-off	100	90.0	5.60
Aliette drench	100	90.0	6.23
Filex foliar sprays	96	81.9	2.95
Favour 600 FW foliar sprays	87	69.2	1.78
Unicrop Zineb foliar sprays	49	40.6	0.84
Mancozeb foliar sprays	33	34.0	0.45
Thiram foliar sprays	68	59.7	2.29
Significance		***	***
SED ± (21 df)		9.43	1.159
CV (%)		19.2	46.8

Table 17 Lettuce yields - Holbeach St Marks, Lincs 1993

Treatment	Mean Weight per plant (kg)	
	Untrimmed	Trimmed
Untreated control	0.37	0.28
Aliette drench + water rinse-off	0.42	0.31
Aliette drench	0.36	0.28
Filex as foliar sprays	0.39	0.31
Favour 600 FW as foliar sprays	0.41	0.31
Zineb foliar sprays	0.40	0.34
Mancozeb foliar sprays	0.44	0.37
Thiram foliar sprays	0.38	0.32
Significance	NS	NS
SED ± (21 df)	0.031	0.03
CV (%)	11.1	13.4

Downy mildew developed dramatically in late October and was mainly confined to the oldest leaves. At harvest disease incidence was reduced by foliar sprays of Favour 600 FW, mancozeb, thiram and zineb. Disease severity was reduced by all the fungicide treatments apart from the ones which included Aliette. These latter treatments were applied in August and September while the last application of all the other fungicide treatments was on 8 October. Because of adverse weather conditions the spray treatments scheduled for 21 days after planting were applied 2 weeks late and the sprays scheduled for 35 days after planting were also applied 2 weeks late.

No differences were recorded between treatments for untrimmed or trimmed lettuce weights.

DISCUSSION

Experiments carried out in 1991 and in 1993 showed that Filex sprays reduced disease at both sites. Although approval for the Off-label use of Filex was given on 25 August 1992 (SOLA No 939/92) it was for use on protected lettuce only. Possibly this use should be pursued for outdoor lettuce.

At Sollom, in 1991, Favour 600 FW and zineb sprays gave the lowest disease scores with three sprays of Favour and four of zineb applied. However, at Taplow, two and three sprays respectively of each chemical were applied which could account for their ineffective control.. Aliette as a drench followed by irrigation to rinse it off gave control only at the Sollom site in 1991. Approval for the Off-label use of Aliette was given on 26 September 1991 (SOLA No 91/0556) for its use post-planting. There were no problems experienced in **not** rinsing with water after application. This result is in contrast to that obtained in protected lettuce experiments (HDC Project PC/20).

A feature of Sollom site in 1991 was the development of powdery mildew which was controlled by Favour 600 FW sprays.

In 1992 no control of downy mildew was obtained at Marlow reflecting the single spray applied two weeks post-planting. No downy mildew developed at the Lancashire site in 1992 which was unusual. However, low levels of *Botrytis* were recorded but none of the treatments reduced this disease.

In 1993 at Holbeach, disease incidence and severity were reduced by foliar spray treatments of Favour 600 FW, zineb, mancozeb and thiram. It is likely that zineb will be withdrawn in the near future. However, good results were obtained with mancozeb and this could be a suitable alternative to zineb. The downy mildew was a mixture of metalaxyl resistant and sensitive strains and good control was achieved by Favour 600 FW foliar sprays. No control was obtained from the Aliette treatments, possibly because the mildew developed very late and the effect of the Aliette treatments applied 7 and 21 days after planting may not have been persistent..

In none of the trials, where fungicides were applied post-planting, did they have an effect on yield of either untrimmed or trimmed plants.

No phytotoxicity as recorded by plant weights at harvest was recorded following any of the treatments applied.

To conclude, control in the field was achieved with foliar sprays of Filex, Favour 600 FW and zineb. Zineb, may be withdrawn in the near future but its use will be permitted for a further two

years after the withdrawal date. Based on the 1993 experiment, mancozeb could be a suitable alternative to zineb.

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