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Apple: Evaluation of surfactants for the eradication of primary mildew

Headline

- Silwett was the most consistently effective surfactant in all three trials in reducing primary mildew.
- Agral, Mixture B, Planet and Activator were also effective.
- In general surfactants at the higher concentration of 3% were more effective in reducing primary mildew.
- At the timing the surfactants were used (when the trees were fully dormant in January) there were no significant effects on tree development or fruit set.

Background and expected deliverables

Powdery mildew is one of the most important diseases of apple in the UK, reducing yield and quality on susceptible varieties. All the main UK culinary and dessert varieties are susceptible. Cox and Jonagold are especially susceptible.

The fungus overwinters as mycelium in fruit buds or vegetative buds that emerge as mildewed blossoms at pink bud or mildewed shoot tips at petal fall. Spores from these infect developing flowers, leaves and shoots and initiate the secondary mildew epidemic. During summer mildew spreads to developing shoots and under favourable conditions can infect leaves and produce sporing mildew colonies in about 4-5 days. Mildew colonises fruit buds in about June and vegetative buds at the end of extension growth in late summer where it remains quiescent until the following spring**.** Control of powdery mildew requires costly season-long fungicide programmes from pink bud in spring to the end of shoot growth in July. The success of these programmes is dependent on maintaining the overwintering primary mildew at a low level. In recent years the incidence of powdery mildew in orchards has increased, especially in the South East, partly through favourable weather in spring and summer and mild winters and partly from a reduction in the number of effective fungicides. Thus in many orchards the incidence of primary mildew has risen, making mildew difficult to control and leading to intensive, costly fungicide programmes. In the 1970s, research at East Malling showed that surfactants applied in the dormant season could eradicate mildew from apple buds and hence eliminate primary mildew from orchards, improving mildew control the following spring and reducing the need for costly fungicide programmes. The research resulted in the development of Dormakill, an ICI product, for use in commercial orchards. Unfortunately this product is no longer available, but this approach to mildew control fits in with the zero pesticide residue strategy, being developed under Defra projects HH2502STF and HH3122STF, by targeting treatment in the dormant season. Recently a number of growers have tried various approved adjuvants as dormant season sprays to eradicate primary mildew, with mixed success. Since the original research at East Malling considerable development has taken place in types of surfactants, particularly in the development of silicone-based surfactants. These may have increased penetration into the plant and may also be active at lower doses and less phytotoxic.

The overall objective of this project was to evaluate various approved surfactants for their effectiveness in eradicating primary mildew to provide growers with an alternative approach to mildew control.

Summary of project and main conclusions

In two replicated orchard experiments and one replicated pot experiment all on cv. Cox, various surfactants (Table 1), applied at 1.5% or 3%, were compared for their effectiveness in reducing or eliminating powdery mildew overwintering in buds on apple trees when applied as high volume sprays in January when the trees were fully dormant. Incidence of primary mildew was assessed on blossoms and vegetative shoots in May. Phytotoxicity of the treatments was also assessed as effects on tree development and on fruit set. Silwett (organo silicon wetter) was the most consistently effective surfactant in reducing primary mildew over the three trials. Agral, Mixture B, Activator (all non-ionic phenyl wetters) and Planet (non-ionic non phenyl wetter) were also effective. In general the surfactants were more effective at 3% concentration. A greater reduction in primary mildew was achieved in the orchard trial where treatments were applied at the higher volume of 1000L/ha. None of the treatments appeared to have any significant effect on stage of tree development or fruit set.

In year two of the project the following will be investigated:

- Silwett and a non-ionic wetter (Agral, Activator or Planet) will be further evaluated.
- The surfactants will evaluated in use with fungicides from different activity groups such as Nimrod (hydroxyl-pyrimidine), Systhane (DMI) and Corbel (morpholine).
- The effect of spray volume on efficacy will also be evaluated.

Financial benefits of the project

Effective control of powdery mildew in apple requires season-long fungicide programmes that are costly (approximately £300/ha). Failure to control mildew during the growing season results in a high incidence of primary mildew the following season, further reducing the chances of successful mildew control and leading to reductions in yield and fruit quality. The availability of a method of reducing primary mildew inoculum would enable mildew control to be restored and reduce the need for expensive intensive fungicide use in the growing season. In addition to the cost of controlling mildew, orchards with a high incidence of mildew usually require fungicide use to continue near harvest with the risk of residues in the fruit. Such residues are usually below the maximum residue level permitted, but to many consumers the presence of any residue is unacceptable. Under Defra-funded projects HH2502STF and HH3122STF, a zero pesticide residue strategy is being developed for apples. This strategy involves the use of conventional pesticides up to petalfall and after harvest, but only biocontrol agents during the fruit development period. Currently in this programme mildew control during the post blossom period, which is the main mildew epidemic period, is achieved by the use of sulphur while alternative approaches are being developed. The key to successful disease control in this strategy depends on maintaining overwintering inoculum at a very low level. The availability of an effective means of eliminating mildew overwintering in the buds would contribute considerably to the success of the zero pesticide residue strategy. One drawback of this approach to mildew control could be cost. Surfactants, particularly organo silicon based products, are expensive. Silwett, the most effective surfactant evaluated, costs around £38/L and if used at 3% concentration and 1000L/ha would cost around £1,140/ha. Activator (non-ionic wetter) costs about £6.40/L and if used at the same concentration and spray volume would cost £192/ha. These costs have to be considered against the cost of intensive fungicide programmes to eliminate mildew: an early season intensive mildew programme based on mixtures of Stroby with Systhane alternating with Nimrod would cost around £292/ha. In year two of the project investigations will focus on using Silwett and a non-ionic surfactant in combination with fungicides which, if effective, would allow the surfactants to be used at lower concentrations and hence lower cost.

Table 1. Treatments applied to Cox trees in two different orchards and in potted trees for evaluation as eradicants of overwintering mildew in apple 2003/2004

Treatment	Concentration %	Wetter type	TL 109 MM106 Cox	CW120/121 M9 Cox	Potted trees Cox
1 untreated	-	-	X	X	X
2 Activator 90	1.5	Non-ionic phenyl	X	X	
3 Activator 90	3.0		X	X	
4 Agral	1.5	Non-ionic phenyl	X	X	X
5 Agral	3.0		X	X	X
6 Mixture B	1.5	Non-ionic phenyl		X	X
7 Mixture B	3.0			X	X
8 Designer	1.5	Organo silicon		X	X
9 Designer	3.0			X	X
10 Silwett L-77	1.5	Organo silicon	X	X	X
11 Silwett L-77	3.0		X	X	X
12 Planet	1.5	Non-ionic nonphenyl		X	
13 Planet	3.0			X	X
14 Solar	1.5	Non-ionic non phenyl	X	X	X
15 Solar	3.0		X	X	X
16 Codacide + Systhane	2.5L/ha +0.45L/ha	Vegetable oil + fungicide		X	

Action points for growers

No action points at present as the project is at an early stage.

Science Section

Introduction

Powdery mildew is one of the most important diseases of apple in the UK, reducing yield and quality on susceptible varieties. All the main UK culinary and dessert varieties are susceptible. Cox and Jonagold are especially susceptible.

The fungus overwinters as mycelium in fruit buds or vegetative buds that emerge as mildewed blossoms at pink bud or mildewed shoot tips at petal fall. Spores from these infect developing flowers, leaves and shoots and initiate the secondary mildew epidemic. During summer mildew spreads to developing shoots and under favourable conditions can infect leaves and produce sporing mildew colonies in about 4-5 days. Mildew colonises fruit buds in about June and vegetative buds at the end of extension growth in late summer where it remains quiescent until the following spring. Control of powdery mildew requires costly season-long fungicide programmes from pink bud in spring to the end of shoot growth in July. The success of these programmes is dependent on maintaining the overwintering primary mildew at a low level. In recent years the incidence of powdery mildew in orchards has increased, especially in the South East, partly through favourable weather in spring and summer and mild winters and partly from a reduction in the number of effective fungicides. Thus in many orchards the incidence of primary mildew has risen, making mildew difficult to control and leading to intensive, costly fungicide programmes. In the 1970s, research at East Malling showed that surfactants applied in the dormant season could eradicate mildew from apple buds and hence eliminate primary mildew from orchards, improving mildew control the following spring and reducing the need for costly fungicide programmes. The research resulted in the development of Dormakill, an ICI product, for use in commercial orchards. Unfortunately this product is no longer available, but this approach to mildew control fits in with the zero pesticide residue strategy, being developed under Defra project HH2502STF, by targeting treatment in the dormant season. Recently a number of growers have tried various approved adjuvants as dormant season sprays to eradicate primary mildew, with mixed success. Since the original research at East Malling considerable development has taken place in types of surfactants, particularly in the development of silicone-based surfactants. These may have increased penetration into the plant and may also be active at lower doses and less phytotoxic.

Overall objective: To evaluate the efficacy of surfactants in eradicating powdery mildew overwintering in apple buds

Specific objectives

1. To evaluate surfactants for their effectiveness in eradicating powdery mildew overwintering in apple buds.
2. To identify the optimum dose of the surfactant that eradicates overwintering mildew without damage to apple buds.
3. To identify the optimum timing for application of the surfactant.

Materials and Methods

In year one, a range of surfactants were evaluated in three experiments, two in small plots in orchards and one on potted trees. Due to the number of trees available for treatment in each site it was not possible to include all treatments in all sites. The details of treatments evaluated at each site are shown in Table 1. Experiments were conducted in January and February 2004 when trees were fully dormant.

Potted trees

Mature potted trees of cv. Cox on MM106 rootstock, unsprayed in 2003 and therefore expected to have a high incidence of primary mildew, were moved into a polythene-clad tunnel on 16 January 2004, to ensure that the trees were dry and that treatments could be applied under dry conditions. On 19 January, the surfactants listed in Table 1 at concentrations of 1.5 or 3% were applied to single pot plots to run-off using a hand-held sprayers. An untreated control was included. Each treatment was replicated four times in a randomised block design. Four days after treatment the potted trees were removed from the polytunnel and laid out in the replicated blocks on a sand bed.

Orchard experiments

Two Cox orchards (TL109, Rocks Farm, East Malling and CW120/121, East Malling main) both located at East Malling and known to have a high incidence of powdery mildew in 2002 and 2003, and therefore expected to have a high incidence of overwintering mildew, were chosen for the experiments.

On 23 January 2004, single tree plots of Cox on MM106 rootstock (orchard TL109) were treated with surfactants at concentrations of 1.5 or 3% as shown in Table 1. An untreated control was included. Treatments were applied at 1000 L/ha using a Hardi MRY (pink Micron restrictor nozzle) motorised knapsack sprayer.

On 9 February 2004, single tree plots of Cox on M9 rootstock (CW120/121) were treated with surfactants listed in Table 1, at concentrations of 1.5 or 3%, at 500L/ha, using a Hardi MRY motorised knapsack sprayer. An untreated control was included.

In both experiments, treatments were replicated four times in a randomised block design.

Assessments

In all trials, primary blossom mildew was assessed at pink bud as percentage mildewed blossoms, on the whole tree by recording the total number of blossoms present and the number with powdery mildew. Similarly at petal fall, the percentage vegetative primary mildew was recorded from the total number of vegetative shoots on each tree and the number infected with mildew. In addition the effect of treatments on tree development was recorded by noting the stage of development of 50 fruit buds on each tree plot prior to flowering. The effect of treatments on fruit set was assessed by recording the total number of flowers on either the whole tree (pot experiment) or two marked branches (orchard experiments) and then later in June the resulting number of fruits. Any obvious phytotoxicity resulting from treatments, such as leaf distortion, flower distortion or leaf discoloration, were also noted.

Table 1. Treatments applied to Cox trees in two different orchards and in potted trees for evaluation as eradicants of overwintering mildew in apple 2003/2004

Treatment	Concentration %	Wetter type	TL 109 MM106 Cox	CW120/121 M9 Cox	Potted trees Cox
1 untreated	-	-	X	X	X
2 Activator 90	1.5	Non-ionic phenyl	X	X	
3 Activator 90	3.0		X	X	
4 Agral	1.5	Non-ionic phenyl	X	X	X
5 Agral	3.0		X	X	X
6 Mixture B	1.5	Non-ionic phenyl		X	X
7 Mixture B	3.0			X	X
8 Designer	1.5	Organo silicon		X	X
9 Designer	3.0			X	X
10 Silwett L-77	1.5	Organo silicon	X	X	X
11 Silwett L-77	3.0		X	X	X
12 Planet	1.5	Non-ionic nonphenyl		X	
13 Planet	3.0			X	X
14 Solar	1.5	Non-ionic non phenyl	X	X	X
15 Solar	3.0		X	X	X
16 Codacide + Systhane	2.5L/ha +0.45L/ha	Vegetable oil + fungicide		X	

Statistical analysis

The data were analysed using ANOVA, following angular transformation.

Results and Discussion

Potted trees

The percentage of blossoms with mildew was recorded in May and is shown in Table 2. The incidence of primary blossom mildew on the untreated potted trees was relatively low. No individual treatment showed any significant difference from the untreated control. In general the higher concentration of the wetters resulted in a lower incidence of mildewed blossoms apart from Solar which appeared to be ineffective. Primary vegetative mildew was recorded as numbers rather than percentages. The numbers of mildewed shoots was low, but there was some evidence of a significant reduction in numbers of mildewed shoots compared to the untreated control for the higher concentrations of Mixture B and Silwett. In general the higher concentrations of the wetters gave better mildew control.

A number of the trees in the trial failed to break bud or died soon after bud burst. This was not related to treatment and appeared to be due to attack by wood boring beetles. The percentage of buds at green cluster growth stage was recorded in mid April. Bud development stage was very variable even on trees within treatments (Table 2). There was no great evidence for the effects of individual treatments on tree development. However, there was an indication that Agral and Silwett delayed tree development compared to Mixture B, Designer and Solar overall. Fruit set recorded in early July was low (<1%-15%). There appeared to be no significant effect of individual treatment on fruit set compared to the untreated. Overall there appeared to be some effect of concentration on fruit set with higher concentrations resulting in lower fruit set, but the mean % fruit set for the higher concentration was similar to that for the untreated control so this apparent effect should be treated with caution.

Table 2. Percent buds at green cluster, percent fruit set and primary mildew (blossom and vegetative) following treatment of potted Cox trees with various surfactants in January 2004. Figures shown are back-transformed (%) scale and figures in brackets are angular transformations except for* where figures are back transformed from square root transformation and figures in brackets are square root transformation

Treatment	Concentration %	% fruit buds at green cluster in mid April	% fruit set in mid July	% primary blossom mildew	*No. veg shoots with primary mildew
untreated	-	76.2 (60.8)	4.3 (11.9)	0.71 (4.83)	2.43 (1.56)
Activator 90	1.5	-	-	-	-
Activator 90	3.0	-	-	-	-
Agral	1.5	34.8 (36.2)	7.9 (16.3)	0.03 (1.01)	0.36 (0.60)
Agral	3.0	26.5 ***(31.0)***	2.1 (8.4)	0.02 (0.90)	0.40 (0.63)
Mixture B	1.5	84.2 (66.6)	6.5 (14.8)	0.06 (1.39)	1.06 (1.03)
Mixture B	3.0	36.5 (37.2)	2.4 (9.0)	0.06 (1.39)	0.04 (***0.20)***
Designer	1.5	66.5 (54.6)	15.1 (22.9)	1.41 (6.82)	3.6 (1.90)
Designer	3.0	58.4 (49.8)	8.3 (16.8)	0.09 (1.74)	0.04 (0.20)
Silwett L-77	1.5	18.4 ***(25.4)***	11.2 (19.5)	0.6 (4.42)	0.74 (0.86)
Silwett L-77	3.0	47.3 (43.5)	0.8 (5.0)	0.02 (0.90)	0.04 ***(0.20)***
Planet	1.5	-	-	-	-
Planet	3.0	41.2 (39.9)	5.1 (13.0)	0.14 (2.11)	0.92 (0.96)
Solar	1.5	68.1 (55.6)	3.0 (9.9)	0.29 (3.10)	0.73 (0.85)
Solar	3.0	80.7 (63.9)	9.2 (17.7)	0.42 (3.73)	0.36 (0.60)
Codacide + Systhane	2.5L/ha +0.45L/ha	-	-	-	-
F prob		0.119	0.107	0.143	0.064
SED		14.64	5.45	2.082	0.519
LSD (p=0.05)		29.8	11.2	4.30	1.07

Treatments in **bold** indicate treatments which show a significant difference (for p<0.05) compared to the untreated control; in cases where the overall F-prob is not significant (i.e. p>0.05), the value is ***italicised*** as well as bold and interpretation treated with caution.

Orchard Trial TL109

The percentage of mildewed blossoms was recorded in May and is shown in Table 3. The incidence of primary blossom mildew in TL109 was higher than in the potted trees with up to a third of blossoms mildewed in some plots. A mean of around 8% mildewed blossoms was recorded in untreated plots which was reduced significantly by Activator, Agral and Silwett at the higher concentration. Of the surfactants evaluated, Solar was the least effective in reducing primary blossom mildew. The percentage of vegetative buds with mildew is shown in Table 3. The highest incidence was recorded in untreated plots and in plots treated with Solar. The incidence of primary vegetative mildew was reduced significantly by all treatments except Solar. The lowest incidence of mildewed shoots was on trees treated with Silwett.

Fruit bud development was recorded in April and was very variable. There were no significant differences in bud development between treatments. Fruit set was assessed in early July. There were no significant effects of any of the treatments compared to the untreated control.

Table 3. Percent buds at green cluster, % fruit set and primary mildew (blossom and vegetative) following treatment of Cox trees on MM106 rootstock (TL109) with various surfactants in January 2004. Figures shown are back-transformed (%) scale and figures in brackets are angular transformations

Treatment	Concentration %	% fruit buds at green cluster in mid April	% fruit set in mid July	% primary blossom mildew	% veg shoots with primary mildew
untreated	-	68.0 (55.50	12.8 (20.9)	7.6 (16.0)	12.0 **(20.23)**
Activator 90	1.5	80.6 (63.9)	7.4 (15.8)	1.6 (7.2)	5.2 **(13.15)**
Activator 90	3.0	85.2 (67.4)	4.1 (11.7)	0.7 **(4.7)**	4.8 **(12.71)**
Agral	1.5	70.8 (57.3)	6.9 (15.3)	4.3 (12.0)	3.6 **(10.87)**
Agral	3.0	48.5 (44.1)	3.5 (10.8)	0.3 (**3.3)**	2.5 **(9.03)**
Mixture B	1.5	-	-	-	-
Mixture B	3.0	-	-	-	-
Designer	1.5	-	-	-	-
Designer	3.0	-	-	-	-
Silwett L-77	1.5	54.0 (47.3)	2.3 ***(8.8)***	1.8 (7.7)	1.8 (**7.81)**
Silwett L-77	3.0	67.4 (55.2)	4.7 (12.5)	0.3 **(3.3)**	0.8 (**5.08)**
Planet	1.5	-	-	-	-
Planet	3.0	-	-	-	-
Solar	1.5	70.9 (57.4)	9.0 (17.4)	5.6 (13.7)	13.0 (21.14)
Solar	3.0	70.8 (57.3)	12.0 (20.2)	9.0 (17.4)	12.6 (20.78)
Codacide + Systhane	2.5L/ha +0.45L/ha	-	-	-	-
F prob		0.398	0.259	0.050	<0.001
SED		9.72	5.10	5.03	2.543
LSD (p=0.05)		20.1	10.5	10.4	5.25

Treatments in **bold** indicate treatments which show a significant difference (for p<0.05) compared to the untreated control; in cases where the overall F-prob is not significant (i.e. p>0.05), the value is ***italicised*** as well as bold and interpretation treated with caution.

Orchard Trial CW120/121

The percentage of mildewed blossoms and shoots was recorded in May and was the highest incidence of the three trial sites (Table 4). The incidence of primary blossom mildew was significantly reduced compared to the untreated by Activator, Agral, Mixture B, Designer and Silwett at the higher concentration and also by Agral and

Silwett at the lower concentration. However, despite the significant effect of these treatments, the incidence of primary blossom mildew was still unacceptably high. In general use of the surfactants at the higher concentration was more effective in reducing primary blossom mildew. Silwett appeared to be the best surfactant overall, but it was not significantly better than Agral or Mixture B. Similarly the incidence of primary vegetative mildew was significantly reduced compared to the untreated by all

Table 4. Percent buds at green cluster, percent fruit set and primary mildew (blossom and vegetative) following treatment of Cox trees on M9 rootstock (CW120/121) with various surfactants in February 2004. Figures shown are back-transformed (%) scale and figures in brackets are angular transformations

Treatment	Concentration %	% fruit buds at green cluster in mid April	% fruit set in mid July	% primary blossom mildew	% veg shoots with primary mildew
untreated	-	53.1 (46.8)	28.5 (32.29)	12.7(20.92)	18.5 (25.45)
Activator 90	1.5	32.4 (34.7)	24.7 (29.81)	11.1(19.42)	15.4 (23.11)
Activator 90	3.0	33.8 (35.6)	27.6 (31.70)	4.9 **(12.82)**	5.8 **(13.95)**
Agral	1.5	25.2 ***(30.1)***	22.4 (28.28)	5.6 **(13.67)**	8.4 (16.87)
Agral	3.0	31.9 (34.4)	17.6 (24.81)	5.8 **(13.91)**	3.4 **(10.65)**
Mixture B	1.5	35.9 (36.8)	29.3 (32.79)	6.9 (15.20)	12.7 (20.85)
Mixture B	3.0	32.1 (34.5)	28.2 (32.08)	4.4 (**12.09)**	4.3 **(12.00)**
Designer	1.5	36.7 (37.3)	24.5 (29.67)	10.9(19.31)	17.4 (24.64)
Designer	3.0	44.1 (41.6)	28.0 (31.93)	5.7 **(13.84)**	5.0 (**12.90**)
Silwett L-77	1.5	54.1 (47.4)	36.4 (37.12)	5.1 (**13.10)**	3.7 (**11.02)**
Silwett L-77	3.0	37.5 (37.8)	27.2 (31.43)	3.0 **(10.00)**	1.1 (**6.02)**
Planet	1.5	29.8 (33.1)	24.7 (29.81)	8.5 (16.98)	6.0 (**14.17)**
Planet	3.0	44.5 (41.8)	21.6 (27.68)	8.2 (16.61)	4.6 **(12.42**)
Solar	1.5	44.7 (42.0)	33.2 (35.20)	8.8 (17.22)	8.9 (17.33)
Solar	3.0	37.4 (37.7)	30.1 (33.26)	9.0 (17.41)	7.4 (**15.77)**
Codacide + Systhane	2.5L/ha +0.45L/ha	36.2 (37.0)	39.3 (38.84)	10.3 (18.69)	8.3 (16.75)
F prob		(0.718)	(0.382)	(0.018)	(0.002)
SED		(7.75)	(4.713)	(2.893)	(4.341)
LSD (p=0.05)		(15.6)	(9.49)	(5.83)	(8.74)

Treatments in **bold** indicate treatments which show a significant difference (for p<0.05) compared to the untreated control; in cases where the overall F-prob is not significant (i.e. p>0.05), the value is ***italicised*** as well as bold and interpretation treated with caution.

individual treatments at the higher concentration and by Silwett and Planet at the lower concentration. Despite the significant effect the incidence of primary vegetative mildew was still unacceptably high. The higher concentration of surfactants was more effective in reducing primary mildew and again Silwett was the best surfactant overall, although not significantly better than Agral and Planet. The reduction in overall incidence of primary mildew appeared to be better in the trials in TL109 and on the potted trees. The former was sprayed at 1000L/ha and the potted trees were sprayed to run-off, compared to this trial where treatments were applied at 500L/ha in perfect conditions. The previous studies carried out by Bent *et al.* (1977) indicated that treatments were more effective at higher volumes which could explain the greater reduction in primary mildew in the trials in TL109 and on the potted trees. The volume effect was thought to be related to a slower drying time allowing better penetration of buds rather than improved spray cover.

Data for percentage of buds at green cluster when assessed in April and for fruit set are also shown in Table 4. There was no significant effect of treatment on stage of development or fruit set.

Conclusions

- The surfactant Solar appeared to be ineffective in all three trials in reducing primary blossom or shoot mildew.
- Surfactants at the higher concentration of 3% were more effective in reducing primary mildew.
- Silwett was the most consistently effective surfactant in reducing primary mildew.
- Agral, Mixture B, Planet and Activator were also effective.
- Differences in efficacy in reducing primary mildew between the three trials suggested that treatments may be more effective at higher volumes.
- No significant effect was found on tree development or fruit set.

Future work

- In year two of the project Silwett and a non-ionic wetter (Agral, Activator or Planet) will be further evaluated.
- The surfactants will evaluated in use with fungicides from different activity groups such as Nimrod (hydroxyl-pyrimidine), Systhane (DMI) and Corbel (morpholine).
- The effect of spray volume on efficacy will also be evaluated.

Technology transfer

Growers have been informed of the project, but no data has yet been presented as the project is at an early stage.

References

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