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Report for the APRC

PRACTICAL USE OF THE HRI DISEASE PREDICTION MODEL FOR APPLE SCAB

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Year one of three

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ADAS

Abstract

A network of ten Metos weather stations monitored by ADAS, FAST and HRI was established, in March 1995 on eight commercial fruit farms and at East Malling Research Station. TinyTalk loggers were also tested at four sites by FAST. Data from the weather stations were used to run the apple scab model within ADEM and produce scab warnings for each site from March to October. A comparison of scab forecast days month by month for each site (based on the same varietal susceptibility and scab inoculum levels for all sites) showed that there were differences between most sites in the frequency of warnings, even where sites were within 3 km of each other. Spraying according to the scab model in the first year of the trial was not possible for the ADAS and FAST sites, but the data were reviewed at the end of the season and a theoretical spray schedule was drawn up for each site, where possible. A saving of 1 -2 spray rounds for scab with consequent reduction in costs would have been possible for these sites. In trial sites at HRI East Malling plots were sprayed according to ADEM warnings for scab and mildew. This resulted in a saving of between 4-7 spray rounds and a reduction in costs of up to £200/ha compared to a routine spray schedule.

Data from the TinyTalk logger sensors were comparable to that from the Metos sensors, with the exception of the rain gauges. These should be relatively straightforward to recalibrate. In addition, several software adjustments were needed to make the data compatible with ADEM. The results of the 1995 test of TinyTalks are contained in a separate report submitted by FAST.

Introduction

Despite the fact that the apple scab prediction model within ADEM (the apple scab model was formerly called Ventem) has been fully tested, using Metos weather stations, and validated by HRI, it has not been taken up by many growers. One reason for this could be the lack of experience with the apple scab model by different growers and consultants. The aim of this trial was to give consultants experience with operating weather stations, downloading data and running the apple scab model, and enable them to recommend the use of the apple scab model to growers. In addition, data from this trial were used to illustrate a possible reduction in spray applications (depending on the season), by comparing theoretical spray schedules based on the apple scab forecasts with the actual schedules used for each site. In 1996 it is intended to use the apple scab model in the orchards to adjust spray schedules. This was not possible in the first year of the trial in 1995 because of the complexity of setting up the system. This involved learning how to set up the weather stations, manage weather data, run ADEM and interpret the outputs. Also, the risks associated with spraying according to the scab model in the first year were too great without experience of using ADEM and detailed knowledge of the scab history of each site for the previous year. Trial sites at HRI East Malling were sprayed according to ADEM warnings for scab and mildew. These trials are part of study financed by MAFF but the results are included in this report for completeness.

A network of weather stations sited on a range of farm locations was established to demonstrate the use of the apple scab model with two types of weather logger, Metos (with which the apple scab model was developed) and TinyTalk. Results from a range of sites were necessary to indicate whether there is a need for individual growers to have on-site weather stations and

computers to run the models, or whether it would be possible for fewer regional 'marker' sites to provide data to run the apple scab model for several farms. TinyTalk loggers are a possible alternative to Metos loggers, mainly due to their lower cost, and it was necessary to test them alongside Metos loggers.

Objectives

[1] to determine the variation in the apple scab model warnings between orchard sites in Kent, Essex and Suffolk and assess the need for individual growers to have their own weather stations. The aim was to indicate the most effective use of weather stations for running the disease models.

[2] to demonstrate the value of the apple scab model in disease control in commercial orchards, by comparing theoretical spray schedules according to the scab model with the actual spray schedules used.

[3] to compare output of weather data from two types of data loggers, Metos and Tiny Talk, at the same location. Tiny Talk loggers were also placed at other sites within the locality of some Metos loggers in order to determine which of the weather data variables gave the critical differences in disease forecasts.

Methods

ADAS and FAST sites were selected such that orchards represented different geographical sites in Kent, Essex and Suffolk (see table 1 and 2 for list of sites). As far as possible, orchards with apples of similar susceptibilities to scab were selected, most with Cox or Bramley apples. For the 1995 season, data were collected to run the apple scab model but the information was not used to adjust spray schedules because of the difficulties associated in this first season with learning how to run and maintain the weather stations and manage the data. Adjusting the spray schedules according to the apple scab model is planned for the 1996 season.

Table 1. Location of weather stations monitored by ADAS and FAST:

Location		Grower	Monitored by:	Logger type
Rochester	Kent	Brice	ADAS	Metos
Sittingbourne	Kent	Doubleday	ADAS	Metos
Marden	Kent	Jenner	ADAS	Metos
Colchester	Suffolk	Woods	FAST	Metos
Linton	Kent	Firmin	FAST	Metos/Tiny Talk 1 & 2
Coxheath	Kent	Martin	FAST	Tiny Talk
Copdock	Suffolk	-	FAST	Tiny Talk

Table 2. Location of additional sites supplying weather data for trial:

Location		Monitored by:	Logger type
Ash	Kent	HRI	Metos
East Malling	Kent	HRI	Metos
Rocks Farm, East Malling	Kent	HRI	Metos
		FAST	Tiny Talk
Matfield	Kent	HRI	Metos
Marden	Kent	Willmot-Pertwee	Metos

Electronic location of data:
[1] With each site manager
[2] at ADAS, Wye, on discs in fireproof safe. The discs are labeled by grower and/or site name. The pathnames are: a:\adem\filename, or a:\filename. Each filename incorporates the logger reference code (i.e., name of logger), e.g., atom_001.dat, etc., unless otherwise specified.
[3] at the APRC offices, as for [2]

Objective 1: To determine the variation in apple scab forecasts between different sites, a network of weather stations was established with two types of weather logger, Metos (with which the apple scab model was developed) and Tiny Talk. Metos and/or Tiny Talk loggers were set up at the appropriate ADAS and FAST sites and at HRI East Malling, according to manufacturers guidelines for height and position of sensors, etc. They were downloaded manually, usually weekly, to provide data to run the scab model. The days on which leaf scab forecasts occurred were recorded, for low, moderate and high inoculum levels. The days for scab forecasts from the other sites in the trial were also sent in, and the results for all sites were publicised in ADAS and FAST fruit notes. At the end of the growing season, the data (on discs) from all the sites were collated at ADAS Wye and reviewed for scab forecast days to ensure that comparisons between sites were based on the same inoculum levels (low) and apple susceptibilities.

Objective 2: To demonstrate the value of using the apple scab model, a spray schedule for each of the commercial orchard sites, where possible, was worked out based on the individual leaf and fruit scab forecasts. These schedules were compared with the actual spray schedules used on that site. A key stage strategy was used, with sprays at key stages (bud burst and petal fall), and the chemicals were chosen to be broadly similar to those actually used on each site. For scab sprays up until the end of June, the cost was included of chemicals applied to control mildew but which also had action against scab, e.g. where captan and systhane would have been used together, the cost of both was included. For some sites the comparison with the growers schedule was not possible, e.g. because the data supplied were not associated with an orchard.

In the trial sites at HRI East Malling disease control and pesticide input were compared in plots managed according to scab and mildew warnings from ADEM with that in routine sprayed plots.

Objective 3: To compare weather data output from Metos and Tiny Talk loggers, data from a particular month were selected where uninterrupted data were available for both loggers. Data were compared for each variable, i.e. relative humidity, temperature, leaf wetness and rainfall.

Disease assessments: Assessments for apple scab and powdery mildew were carried out in the ADAS and FAST orchards to establish their disease history and provide a basis for setting the inoculum levels required to run the apple scab model in the following 1996 season. Scab assessments were made post bloom on blossom trusses and extension growth, and regularly on leaves thereafter. Disease levels were based on the scab incidence from the examination of four

shoots on each of 20 trees per assessment date. The levels of fruit scab were based on the examination of 1000 fruit per orchard unless otherwise stated.

At HRI East Malling scab was assessed pre- and post-bloom as above, primary mildew assessed and secondary mildew monitored every two weeks from petal fall. The results were used in ADEM to assist in decision on fungicide inputs in the ADEM managed plots in the two trial sites. In addition pest levels were monitored and decision on insecticides based on these.

Results

[1] The variation in apple scab warnings across different sites

The dates on which scab forecasts occurred for low inoculum levels are presented for ten sites, for leaf scab in Table 3 and for fruit scab in Table 4. Low inoculum levels were chosen as the basis for comparison between sites because in practice most sites had low scab incidence (See Tables 7-13 disease assessments for all sites). The differences in dates between the leaf and fruit scab warnings reflect the different susceptibilites of leaves and fruit to scab infections, with the model taking into account the changes in susceptibility during the course of the season. For the purpose of this comparison, the size of the leaf scab forecasts were not taken into account, although where scab warnings occurred on the same day for different sites, the severity of the forecasts was often quite different.

Table 3. Leaf Scab - Dates on which forecasts occurred*

grower farm location monitors	BRICE MOCKBEGGAR ROCHESTER ADAS	DOUBLEDAY HEMPSTEAD SITTINGBOURNE ADAS	JENNER GT SH'PHURST MARDEN ADAS	WOODS OLD BARN COLCHESTER FAST	FIRMIN WARES LINTON FAST	CHANDLER GOLDSTONE ASH HRI	CHARRINGTON CRYALS MATFIELD HRI	WISEMAN MAIN FARM E. MALLING HRI	LYNN ROCKS E. MALLING HRI	HALL LT. PATTENDEN MARDEN John Knight
MAR	none missing 4-28	none missing 1-6	none missing 1-28	none	missing data	none	none	no data	13	none
APR	none missing 23-30	none	none	none	missing data	none	23, 24, 26	17	17	none missing 14-30th
MAY	16, 30 missing 1-3	16, 24	24	16, 24, 30	missing 1-18 then none	none	16, 28	16	16, 24	30, 31 missing 1-23rd
JUNE	3, 11, 12, 13, 17	3	3, 17	3, 13, 15, 17	3, 11, 17	13, 17	3, 11, 17	17	3, 11, 17	3, 17
JULY	2	2, 10, 12	missing data	2	4, 27, 28	13, 25	3	2	2	2
AUG	31	31	none	30, 31	31	12, 14, 15, 18, 20, 21, 24	31	none	23, 31	31
SEPT	2, 6, 7, 12, 14, 15, 16, 18, 30	6, 7, 10, 14, 15, 16, 17, 18, 26, 30	missing data	2, 6, 10, 12, 14, 15, 16, 17, 26, 30	6, 10, 14, missing 18-30	7, 16, 18, 26	6, 7, 10, 12, 16, 17, 18, 30	2, 14, 16, 17, 26	6, 7, 10, 14, 15, 16, 17, 24, 26, 30	6, 7, 10 missing 12-30th
OCT	3, 5, 6 data ends 10	3 missing 6-20	missing data	3, 6, 11, 12, 14, 15, 26, 31	25, 26 missing 1-17	1, 3, 14	3, 6, 13, 26	none	3, 15	3, 4

*Inoculum is conidia plus ascospores from Mar to June inclusive, then conidia only from July onwards
*Both conidia and ascospore doses were set at low for all sites for the purposes of this table
(in practice most sites had low inoculum levels throughout the season)

ADAS

Table 4. Fruit scab - Dates on which forecasts occurred*

grower farm location monitors	BRICE MOCKBEGGAR ROCHESTER ADAS	DOUBLEDAY HEMPSTEAD SITTINGBOURNE ADAS	JENNER GT SH'PHURST MARDEN ADAS	WOODS OLD BARN COLCHESTER FAST	FIRMIN WARES LINTON FAST	CHANDLER GOLDSTONE ASH HRI	CHARRINGTON CRYALS MATFIELD HRI	WISEMAN MAIN FARM E. MALLING HRI	LYNN ROCKS E. MALLING HRI	HALL LT. PATTENDEN MARDEN John Knight
MAR	none missing 4-28	none missing 1-6	none missing 1-28	none	missing data	none	none	no data	none	none
APR	none missing 23-30	none	none	none	missing data	29	none	none	none	none missing 14-30
MAY	16, 18, 28, 30 missing 1-3	12, 16, 19, 28, 30	10, 12, 16, 17, 9, 24, 28, 30, 3	16, 18, 19, 24, 28, 30	25, 28, 30, 31 missing 1-18	13, 17, 24, 29, 30	28, 31	12, 16, 18, 19, 24, 28, 30	12, 16, 19, 24, 28, 30	24, 28, 30, 31 missing 1-23rd
JUNE	3, 7, 8, 9, 11, 17	3, 4, 7, 9, 11, 13, 17	3, 4, 7, 9, 11, 17	3, 7, 9, 11, 15, 17	3, 7, 8, 11, 17	3, 4, 7, 9, 12, 13, 17	3, 4, 7, 8, 11, 17	3, 4, 7, 11, 17	3, 7, 9, 11, 17	3, 4, 7, 9, 11, 17
JULY	2, 13, 15, 16, 26, 31	2, 10, 17, 16, 27, 29	none missing 7-31	2, 14, 15, 16, 18, 27, 29	2, 13, 15, 16, 26, 27	2, 3, 13, 16, 27	3, 14, 15, 26, 27, 30	2, 11, 14, 15, 26. 27	, 13, 15, 26, 2	2, 11, 13, 26
AUG	12, 31	23, 31	none	30	4, 31	12, 31	23, 31	27, 31	31	31
SEPT	2, 6, 14, 18, 23, 24, 26, 30	12, 14, 15, 16, 17, 23, 24, 26, 30	missing data	2, 6, 8, 10, 12, 14, 15, 18, 23, 24, 26, 30	2, 5, 6, 7, 10, 12, 14, 15, 16 missing 18-30	2, 6, 7, 11, 12, 15, 16, 17, 18, 23, 24, 26	2, 6, 7, 10, 12, 15, 17, 23, 24, 26, 30	2, 6, 7, 10, 12, 14, 15, 16, 17, 8, 23, 24, 26, 3	, 6, 10, 12, 14 17, 23, 24, 26, 30	2, 5, 6, 10 missing 12-30th
OCT	3, 6 data ends 10th	3 missing 6-20	missing data	3, 24, 26	24, 25 missing 1-17th	1, 3	2, 4, 6, 24, 25	3, 24	3, 4, 6, 24, 25	3, 4, 5

*Inoculum is conidia only (no ascospores required to run fruit model)
*conidial dose was set at low for all sites for the purposes of this table
(in practice most sites had low inoculum levels throughout the season)

ADAS

The sites all differed in the frequency and dates of scab warnings. Even though most sites had periods of missing data (different start dates of loggers; repair or parts replacement needed for loggers) it is clear from the months when there were data from most of the sites that the number of warnings per month differs across sites. On some occasions most of the sites experienced a scab warning on the same day, e.g. 17 June, 16 September, but in most cases there was variation, e.g. in June some sites had only one scab warning (Doubleday, Main Farm East Malling) whereas others had four (Woods) or five (Brice). Some general trends are apparent, such as fewer than might be expected scab warnings in March, April and May (but conclusions based on a reduced number of loggers operating at this time), and an unusually high number of warnings in September (observed at most sites). It is not possible in the scope of this report to analyse the specific weather data variables for correlation with scab warnings. However, the data summaries show that some sites were prone to much longer periods of leaf wetness and/or relative humidity than other sites, and both these factors are critical in influencing the infection efficiency of scab spores. For example, the site at Rochester generally had longer periods of leaf wetness at times when more scab warnings were recorded than at other sites. However, sites such as Ash were known to experience more wind on occasions, which dried leaves faster and this was reflected in a lower number of scab warnings for some months than at other sites. Some sites were irrigated with a rain gun, e.g. Brice and Ash, but although this created environmental conditions favourable for scab infection it did not produce a scab warning for the variety and scab inoculum level (low) in the orchards concerned.

The scab warning days were sufficiently different between the sites in this study to indicate that in general, a weather station may need to be sited on or close to the farm which will use the data. The two closest sites in this project, East Malling Main Farm and Rocks Farm, East Malling,

which are only 3 km apart, often experienced scab warnings on the same days but Rocks Farm had warnings on 13 additional days during the season. This suggests that local topography will determine the area which can be covered by a specific weather station. The possibility of siting a central logger with key sensors placed separately at other sites is being investigated in this project by the use of TinyTalk loggers. Some farms are large in area or have orchards at separate locations, and in these cases one logger could be used to run the scab model successfully for the whole farm if it is placed at the site of greatest risk.

The scab warning days indicate that the use of ADEM in practice would result in spraying at different times for each site in this study. Spray schedules adjusted according to the apple scab model would also differ from the routine schedules, in terms of reducing the number of applications (see next section of results). Information from ADEM also provides a rationale for reducing the rates of some sprays.

[2] The value of the apple scab model in disease control

Results from the three ADAS sites are available and illustrate three possible scenarios:
The details of the chemicals and rates chosen are shown in the appendix.

Table 5. Theoretical comparison of number of spray rounds cost and of scab sprays applied according to ADEM warnings and in routine treated orchards in 1995.

Site	Number of scab spray rounds	Total cost of scab sprays (£/hectare)
Brice, Rochester		
grower schedule	10	176.67
ADEM schedule	7	193.46
Doubleday, Sittingbourne		
grower schedule	7	147.21
ADEM schedule	7	131.95
Jenner, Marden		
grower schedule	8	209.51
ADEM schedule	7	153.91

Table 6. Number of sprays and cost of crop protection programme (Fungicides, insecticides and acaricides) used in plots sprayed routinely according to the farm schedule compared to plots managed according to ADEM and IPM methods at East Malling 1995.

Site	Number of pesticide spray rounds	Total cost of pesticide inputs (£/ hectare)
Main Farm, East Malling		
Routine Schedule	14	325.45
*ADEM (A)	10	195.28
*ADEM (B)	7	138.28
Rocks Farm, East Malling		
Routine schedule	18	389.96
ADEM schedule	11	198.35

* ADEM (A) managed plots contain varieties with moderate and high susceptibility to scab. ADEM (B) plots contain varieties of low susceptibility to scab.

The number of spray rounds for apple scab with the grower's schedule was equal to or more than the number of sprays predicted by the ADEM schedule. The costs were reduced by using ADEM in two of the three sites. At the third site, the high incidence of powdery mildew prevented planned costs in the fungicide dose of the scab/mildew fungicide. In the trial sites at East-Malling the number of spray rounds in plots treated according to ADEM warnings for scab and mildew was reduced by 4-7 sprays compared to routine treated plots Table 6), with up to £ 200/ha reduction in costs. Further reduction in sprays and costs were made possible by the use of apple varieties with a low susceptibility to scab and mildew (ADEM (B) schedule, Table 6).

[3] Results of disease assessments

The disease assessments (Tables 7 - 13) provide information for setting the inoculum levels in the ADEM programme for 1996. Only one of the orchards, the Colchester Bramley, had visible scab on leaves and fruit by the end of the season (3.75% and 0.5%, respectively) such that in practice inoculum levels in ADEM would need to be set at moderate for this particular site. Scab and mildew control in ADEM managed plots in the trials at East-Malling were as good or better than that in routine sprayed plots (Tables 12 &13).

Table 7. Disease assessments (1995) for cv Bramley at Doubleday, Sittingbourne (ADAS)

Date	Stage	% Leaf Scab	% Primary Mildew	% Secondary Mildew
3/5	pink bud	-	0 (blossom)	-
22/5	full blossom	0.13	0 (vegetative)	-
1/6	post bloom	1.25	-	0
15/6		1.25	-	0
29/6		0	-	1.25
13/7		0	-	1.25
26/7		0	-	2.50
24/8		0	-	1.25
7/9		0	-	1.25

/3 Fruit scab assessment (1000 fruits examined):

Table 8. Disease assessments (1995) for cv Cox at Brice, Rochester (ADAS)

Date	Stage	% Leaf Scab	% Primary Mildew	% Secondary Mildew
1-5	full bloom	-	3.9 (blossom)	-
19-5	blossom	no assessment, too much mildew	38 (vegetative)	-
15-6	post bloom	0	-	100
29-6		0	-	70
14-7		0	-	30

12-9 Fruit scab assessment (1000 fruits examined): 0.1%

Table 9. Disease assessments (1995) for cv Bramley at Jenner, Marden (ADAS)

Date	Stage	% Leaf Scab	% Primary Mildew	% Secondary Mildew
1-5	pink bud	-	0 (blossom)	-
15-5	blossom	0.13	0 (vegetative)	-
1-6	post bloom	0	-	2.5
14-6		1.25	-	6.25
28-6		0	-	1.25
19-7		0	-	1.25

11-9 Fruit scab assessment (1000 fruits examined): 0.1%

Table 10 . Disease assessments for cv a)Bramley and b) Cox at Woods, Colchester (FAST)

a) Bramley

Date	Stage	% Leaf Scab	% Primary Mildew	% Secondary Mildew
22-5	blossom	1.25	2.13 (blossom) 0.52 (vegetative))	0.02
27-6		5.0	-	13
16-8		3.75	-	8.75

27-6 Fruit scab assessment (200 fruits examined): 1%
16-8 Fruit scab assessment (200 fruits examined): 0.5%

b) Cox

Date	Stage	% Leaf Scab	% Primary Mildew	% Secondary Mildew
22-5	blossom	0	1.12 (blossom) 0.44 (vegetative)	0
27-6		0	-	7.5
16-8		0	-	6.25

27-6 Fruit Scab assessment (200 fruits examined): 0%
16-8 Fruit Scab assessment (200 fruits examined): 0%

Table 11. Disease assessments for cv Cox at Firmin, Linton (FAST)

Date	Orchard	% Leaf Scab	% Fruit Scab	% Secondary Mildew
24/6	Cherry	0	0	28
	Top	0	0	30
	Plum	0	0	25
6/9	Whole orchard	1	0	10

Table 12. Disease assessments (1995) a) scab and b) powdery mildew for cv Cox in untreated, routine sprayed and ADEM managed plots at Rocks Farm, East Malling (HRI).

a) scab

Date /Stage	Assessment	Routine sprayed	ADEM managed	Untreated
27/4 Pink bud	% scabbed trees	0	0	0
15/5 Petal fall	,,	0	0	13.4
30/5	,,	0	0	20.0
26/6	,,	0	0	0
17/7	% infected fallen fruitlets	0	0	1.8
11/9	% fruits infected	0	0	1.2
31/10	% infected leaves	0.3	0	10.8

b) powdery mildew

27/4 Pink bud	% mildewed blossom (primary mildew)	0.2	0	2.1
15/5 Petal fall	% mildewed shoots (primary mildew)	0.3	0.2	8.7
30/5	% mildewed shoots (secondary mildew)	0	0	75.8
26/6	,,	10.8	6.7	100
10/7	,,	44.2	4.2	100

Table 13 a. **Assessments of apple scab in untreated, routine sprayed and ADEM-managed plots of apple cv. various at East Malling in 1995**

Date/ Growth Stage	Assessment	Routine Sprayed				ADEM Managed				ADEM managed		Untreated				
		C	G	D	F	C	G	D	F	S	D	C	G	S	F	S
11/4	% trees	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15/5 Petal fall	% trees	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
31/5	% trees	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19/6	% shoots	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/7	% shoots	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4/11	% scabbed leaves	0	0	0	0.7	0.7	0	0	0	0	0	1.3	0	0	0	0

Key: C = Cox; G = Royal Gala; D = Discovery; F = Fiesta; S = SA15/4

ADAS

Table 13 b. **Assessment of powdery mildew in untreated, routine sprayed and ADEM-managed plots of apple cv. various at East Malling in 1995**

Date/ Growth Stage	Assessment	Routine Sprayed				ADEM Managed (A)				ADEM managed (B)		Untreated				
		C	G	D	F	C	G	D	F	S	D	C	G	S	F	S
15/5 Petal fall	% infected trees (primary)	0	0	0	3.3	0	0	0	3.3	3.3	0	6.7	0	0	0	0
31/5	% infected shoots (secondary)	0.8	0	0	1.7	0.8	2.5	0	2.5	3.3	0	61.7	76.7	36.7	68.3	73.3
9/6	% infected shoots (secondary)	-	-	-	-	7.5	5.8	-	-	10.0	-	-	-	-	-	-
19/6	% infected shoots (secondary)	3.3	1.7	0.8	4.2	16.7	28.3	1.7	6.7	25.8	10.0	77.5	91.7	23.3	91.7	55.0
7/7	% infected shoots (secondary)	-	-	-	-	30.0	46.7	-	-	35.0	-	-	-	-	-	-
8/8	% infected shoots (secondary)	13.3	15.0	2.5	6.7	15.8	35.0	0	15.8	14.2	2.5	77.5	89.3	17.5	71.7	55.8

Key: C = Cox; G = Royal Gala; D = Discovery; F = Fiesta; S = SA15/4

[4] A comparison of Metos loggers with Tiny Talk loggers

A separate report will be provided by FAST on the results of the use of TinyTalk loggers.

[5] Comments on practical experience with Metos loggers and the ADEM programme

Use of Metos loggers

The Metos loggers needed more repairs and adjustments than anticipated, particularly in the first half of the season. Most of the problems were resolved within a week, but there were several data gaps. Initially the frustration level with the Metos was extremely high, and most of the consultants' time was spent troubleshooting rather than examining weather data and learning to use the ADEM programme.

However, towards the end of the season, the Metos loggers were more reliable. Downloading data became a relatively quick process and more time was available to use the scab programme. All the ADAS Metos loggers are now being serviced by Graham Amos, the Metos agent, and he has provided a guarantee in writing that the loggers will be repaired or replaced as necessary to ensure continuity of data in the 1996 season.

Metos loggers operated by HRI East Malling functioned well throughout the season (March - December) with no need to repairs. Loss in data at two sites was entirely due to operator error.

Use of the ADEM programme

There were several areas of the programme that caused difficulty, and a meeting was held with HRI on 23 January 1995 to discuss these problems. As far as possible some of these problems will be resolved. However, major changes to the software are not possible, especially within the funding allocated, and some problems are intrinsic to the Metos downloading software, which cannot be changed by HRI. Some of the difficulties with the data management and the use of ADEM were partly due to lack of training or practice with ADEM and the lack of a formal 'help desk' to assist with questions as they arose. We often depended on Angela Berrie and XiangMing Xu for informal help, and without this help the project would not have proceeded.

One area where all consultants had difficulty was the interpretation of the output for scab warnings. Parts of the manual will be amended and further discussion will take place to address these changes and also changes to the software if desirable. In 1996 formal training days are planned for ADEM.

The ADAS consultants experienced difficulty with downloading a Metos by two different people, an arrangement which has been necessary for the purposes of this trial. It will likely be necessary in the future for growers who use a consultant for help with ADEM but who would like to download data themselves and run ADEM as needed. ADEM is licensed for one user and consequently is set up for ease of use with one computer only. Another computer can be used to download but great care is needed to ensure data are not lost, or become attached to a file that does not have the most recent data in it. This problem should provoke some discussion as to how ADEM will be promoted, e.g., grower use only, consultant use only, or a combination of both. The use of remote downloading, e.g., modem or radio link, will help resolve the data management problem, but in the near future it may be unrealistic to assume many growers will want to pay the extra cost.

APPENDIX - Spray Schedules

TABLE A. BRICE - Grower's schedule (Scab only)

Date/Growth stage	Spray target	Fungicide	rate/ha (% label dose)	Cost/ha (£)
13/3 budburst	scab	Dithianon	0.5 (45)	12.25
28/3	scab	Dithianon	0.5 (45)	12.25
10/4	scab	Dithianon	0.4 (36)	10.50
	scab/mildew	Dorado	0.14 (50)	11.20
25/4	scab/mildew	Dorado	0.14 (50)	11.20
	scab	Captan	0.85 (25)	4.54
2/5	scab/mildew	Systhane	0.5 (45)	10.54
	scab	Captan	0.5 (15)	2.65
10/5	scab/mildew	Systhane	0.5 (45)	10.54
	scab	Captan	0.5 (15)	2.65
20/5	scab/mildew	Systhane	0.5 (45)	10.54
	scab	Captan	0.5 (15)	2.65
31/5	scab/mildew	Systhane	1 (90)	21.07
	scab	Captan	0.5 (15)	2.65
8/6	scab/mildew	Systhane	1 (90)	21.07
	scab	Captan	0.5 (15)	2.65
14/6	scab/mildew	Systhane	1 (90)	21.07
	scab	Captan	0.5 (15)	2.65
			Total cost/ha:	172.67

Table B. BRICE - ADEM Adjusted schedule (Scab only).

Date/Growth stage	Spray target	Fungicide	rate/ha (% label dose)	Cost/ha (£)
13/3 budburst	scab	Dithianon	1.3 (120)	32.50
10/4	scab	Dithianon	0.83 (75)	21.25
2/5	scab/mildew	Systhane	1.1 (100)	23.65
	scab	Captan	0.85 (25)	4.59
10/5 petal fall	scab/mildew	Systhane	1.1 (100)	23.65
	scab	Captan	0.85 (25)	4.59
17/5	scab/mildew	Systhane	1.1 (100)	23.65
	scab	Captan	0.85 (25)	4.59
31/5	scab/mildew	Systhane	1.1 (100)	23.65
	scab	Captan	0.85 (25)	4.59
14/6	scab/mildew	Systhane	1.1 (100)	23.65
	scab	Captan	0.57 (16.5)	3.1
			Total cost/ha:	193.46

Table C. DOUBLEDAY - Grower's schedule (Scab only).

Date/Growth Stage	Spray/target	Fungicide	Rate/ha (% label dose)	cost/ha (£)
13/4	scab	Radspor	2.75 (180)	23.93
21/4	scab/mildew	Dorado	0.22 (75)	17.60
	scab	Manex	2.2 (45)	9.28
3/5	scab/mildew	Dorado	0.22 (75)	17.60
15/5 late petal fall	scab/mildew	Dorado	0.22 (45)	17.60
	scab	Manex	2.2 (75)	9.28
24/5	scab/mildew	Dorado	0.22 (45)	17.60
	scab	Manex	2.2 (75)	9.28
3/6	scab	Manex	2.2 (75)	9.28
15/6	scab	Captan	0.6 (16.5)	3.24
29/6	scab	Captan	0.6 (16.5)	3.24
13/7	scab	Manex	2.2 (75)	9.28
			Total cost/ha:	147.21

Table D. DOUBLEDAY - ADEM Adjusted schedule (Scab only).

Date/Growth Stage	Spray/target	Fungicide	Rate/ha (% label dose)	cost/ha (£)
15/3 budburst	scab	Radspor	1.5 (100)	13.05
15/4	scab	Captan	1.1 (30)	5.94
25/4	scab/mildew	Systhane	1.1 (100)	23.65
	scab	Captan	0.85 (25)	4.59
5/5 petal fall	scab/mildew	Systhane	1.1 (100)	23.65
	scab	Captan	0.85 (25)	4.59
17/5	scab/mildew	Systhane	1.1 (100)	23.65
	scab	Captan	0.85 (25)	4.59
26/5	scab/mildew	Systhane	1.1 (100)	23.65
	scab	Captan	0.85 (75)	4.59
			Total cost/ha:	131.95

Table E. JENNER - Grower's schedule (Scab only).

Date/Growth Stage	Spray/target	Fungicide	Rate/ha (% label dose)	cost/ha (£)
23/3 budburst	scab	Dithianon	1.1 (100)	27.50
5/4	scab	Dithianon	1.1 (100)	27.50
18/4	scab	Dithianon	0.5 (50)	12.50
	scab/mildew	Systhane	1.1 (100)	23.65
15.5 late petal fall	scab/mildew	Systhane	1.1 (100)	23.65
	scab	Captan	1.1 (30)	5.94
25/5	scab/mildew	Systhane	1.1 (100)	23.65
	scab	Captan	1.1 (30)	5.94
6/6	scab/mildew	Systhane	1.1 (100)	23.65
	scab	Captan	1.1 (30)	5.94
15/6	scab/mildew	Systhane	1.1 (100)	23.65
	scab	Captan	1.1 (30)	5.94
			Cost:	209.51

Table F. JENNER - ADEM Adjusted schedule (Scab only).

Date/Growth stage	ADEM Risk/ justification	Spray target	Fungicide	Rate/ha (% label dose)	Cost/ha (£)
25/3 bud burst	None-keystage	scab	Dithianon	1.7 L (100)	42.50
18/4 Green cluster	None - rain forecast	scab	Dithianon	0.4 L (25)	10.00
15/5 petal fall	None - keystage	scab/mildew	Systhane	1.1 (100)	23.65
		scab	Captan	0.85 (25)	4.59
25/5	scab risk	scab/mildew	Systhane	1.1 (100)	23.65
		scab	Captan	0.85 (25)	4.59
4/6	scab risk	scab/mildew	Systhane	1.1 (100)	23.65
		scab	Captan	0.85 (25)	4.59
15/6	None - rain forecast	scab/mildew	Systhane	0.5 L (50)	10.75
		scab	Captan	1.1 kg (30)	5.94
				Total cost/ha:	153.91

Table G. Pesticide sprays applied to routine treatment plot at Rocks Farm, East Malling in 1995

Date/Growth Stage	Target Pest/Disease	Chemical	Rate*/hectare	Cost £/ha
21/3 Bud burst	scab/canker	Radspor	1.5 L	13.05
3/4	scab/canker	Radspor	1.5 L	13.05
12/4 Green cluster	scab	Systhane	1.1 L	23.65
	scab	Dithianon	0.4 L	10.00
	caterpillars	Dursban	1.0 L	4.69
18/4 Pink bud	scab/mildew	Systhane	1.1 L	23.65
	scab	Dithianon	0.4 L	10.00
1/5 Blossom	scab/mildew	Systhane	1.1 L	23.65
	scab	Captan 80	0.85 kg	4.59
10/5	scab/mildew	Systhane	1.1 L	23.65
	scab	Captan 80	0.85 kg	4.59
	sawfly	Gamma Col	0.35 L	3.00
18/5	caterpillars/capsid	Spannit	2.0 L	9.38
22/5	scab/mildew	Systhane	1.1 L	23.65
	scab	Captan 80	0.85 kg	4.59
	aphids	Aphox	420 g	14.08
31/5	scab/mildew	Topas C50	2.0 kg	25.00
12/6	scab/mildew	Topas C50	2.0 kg	25.00
	summer fruit tortrix	Spannit	2.0 L	9.38
21/6	scab	Captan 80	0.85 kg	4.59
	mildew	Nimrod	1.1 L	6.60
	canker	Defensor	1.1 kg	3.00
3/7	mildew	Nimrod	1.1 L	6.60
	scab/canker	Derosal	700 g	3.00
12/7	mildew	Nimrod	1.1 L	6.60
24/7	mildew	Topas 100	0.5 L	8.82
	codling moth	Thinsec	3.8 L	8.00
4/8	mildew	Nimrod	1.4 L	8.40
	summer fruit tortrix	Dursban	2.0 L	9.38
16/8	storage rots	Captan 80	3.4 kg	18.36
21/8	storage rots	Captan 80	3.4 kg	18.36
	summer fruit tortrix	Novosol	2.0 L	9.80
24/8	summer fruit tortrix	Novosol	2.0 L	9.80
			Total cost/ha	**389.96**

*all applied at recommended rate

Table H. Pesticide sprays applied to ADEM-managed plots at Rocks Farm, East Malling in 1995

Date/Growth Stage	ADEM risk	Pest/Disease Justification	Chemical	Rate/hectare (% dose)	Cost £/ha
20/3 budburst	None	scab keystage	Radspor	1.5 L (100)	13.05
13/4 green cluster	None	scab **Easter near**	Captan 80	1.1 kg (30)	5.94
		aphid, caterpillar above threshold	Spannit	0.75 L (75)	3.52
24/4 pink bud	None	Rain forecast scab	Systhane	1.1 L (100)	23.65
		Mildew	Captan 80	0.85 kg (25)	4.59
5/5 petal fall	None	scab keystage	Systhane	1.1 L (100)	23.65
			Captan 80	0.85 kg (25)	4.59
18/5	scab period	scab	Systhane	1.1 L (100)	23.65
			Captan 80	0.85 kg (25)	4.59
		sawfly/aphids/ caterpillars above threshold	Dursban	2.0 L (100)	9.38
6/6	scab period	scab/mildew	Systhane	1.1 L (100)	23.65
			Captan 80	0.85 kg (25)	4.59
16/6		summer fruit tortrix above threshold	Spannit	2.0 L (100)	9.38
26/6	mildew	mildew	Topas 100	250 ml (50)	4.16
		summer fruit tortrix above threshold	Spannit	2.0 L (100)	9.38
11/7	mildew	mildew	Nimrod	500 ml (50)	3.00
4/8	mildew	mildew	Nimrod	1.4 L (100)	8.4
		summer fruit tortrix above threshold	Dursban	2.0 L (100)	9.38
21/8		summer fruit tortrix above threshold	Novosol	2.0 L (100)	9.80
				Total cost/ha	198.35

Table I. Pesticide sprays applied to routine treatment plots at East Malling in 1995

Date/Growth Stage	Target Pest/Disease	Chemical	Rate*/hectare	Cost £/ha
21/3 Bud burst	scab/canker	Radspor	1.5 L	13.05
3/4	scab canker	Radspor	1.5 L	13.05
12/4 Green cluster	scab	Systhane	1.1 L	23.65
	scab	Dithianon	0.4 L	10.00
	aphids/caterpillars	Spannit	1.0 L	4.69
18/4 Pink bud	scab/mildew	Systhane	1.1 L	23.65
	scab	Dithianon	0.4 L	10.00
1/5 Blossom	scab/mildew	Systhane	1.1 L	23.65
	scab	Captan 80	0.85 kg	4.59
10/5 Petal fall	scab/mildew	Systhane	1.1 L	23.65
	scab	Captan 80	0.85 kg	4.59
16/5	red spider mite	Masai	500 g	67.50
22/5	scab/mildew	Systhane	1.1 L	23.65
	scab	Captan 80	0.85 kg	4.59
31/5	scab/mildew	Systhane	1.1 L	23.65
	scab	Captan 80	0.85 kg	4.59
12/6	mildew	Nimrod	1.1 L	6.60
	scab	Captan 80	0.85 kg	4.59
21/6	mildew	Nimrod	1.1 L	6.60
	scab	Captan 80	0.85 kg	4.59
	canker	Defensor	1.1 kg	3.00
3/7	mildew	Nimrod	1.1 L	6.60
12/7	mildew	Nimrod	1.1 L	6.60
24/7	mildew	Topas 100	500 ml	8.82
			Total cost/ha:	325.45

*all applied at recommended rate

Table J. Pesticide sprays applied to ADEM-managed plots (A) of apple at East Malling in 1995
Apples cvs - Cox, Gala, Fiesta, Discovery

Date/ Growth Stage	ADEM risk	Pest/Disease Justification	Chemical	Rate/hectare (% dose)	Cost £/ha
21/3 budburst	None	scab keystage	Radspor	1.5 L (100)	13.05
13/4 green cluster	None	scab **Easter near**	Captan 80	1.1 kg (30)	5.94
		aphid, caterpillar	Spannit	0.75 L (75)	3.52
25/4	None	scab/mildew	Systhane	1.1 L (100)	23.65
		scab rain forecast	Captan	0.85 kg (25)	4.59
9/5 petal fall	None	keystage scab/mildew	Systhane	1.1 L (100)	23.65
		scab	Captan	0.85 kg (25)	4.59
16/5		red spider mite above threshold	Masai	500 g (100)	67.50
18/5	scab period (16/5)	scab/mildew	Systhane	1.1 L (100)	23.65
		scab	Captan	0.85 kg (25)	4.59
16/6	mildew	mildew	Nimrod	0.5 L (50)	3.00
27/6	mildew	mildew	Topas 100	250 ml (50)	4.16
12/7	mildew	mildew	Topas 100	300 ml (60)	4.99
8/8	mildew	mildew	Nimrod	1.4 (100)	8.40
				Total cost/ha:	195.28

Table K. Pesticide sprays applied to ADEM-managed plots (B) of apple at East Malling in 1995
Apples cvs - SA15/4 and Discovery - low susceptibility to scab and mildew

Date/ Growth Stage	ADEM risk	Pest/Disease Justification	Chemical	Rate/hectare (% dose)	Cost £/ha
5/4 late budburst	None	keystage scab	Radspor	1.5 L (100)	13.05
13/4 green cluster	None	aphid, caterpillars over threshold	Novosol Aphox	1.0 L (50) 210 g (50)	4.90 7.04
9/5 Petal fall	None	keystage scab/mildew	Systhane	1.1 L (100)	23.65
		scab	Captan	0.85 kg (25)	4.59
18/5		red spider mite above threshold	Masai	500 g (100)	67.50
27/6	mildew	mildew	Topas 100	250 ml (50)	4.16
12/7	mildew	mildew	Topas 100	300 ml (60)	4.99
10/8	mildew	mildew	Nimrod	1.4 L (100)	8.40
				Total cost/ha:	138.28

Table L. Summary of fungicide sprays applied to routine sprayed and ADEM-managed plots at East Malling in 1995

	Routine sprayed no. of sprays (% dose)	ADEM (A) managed no. of sprays (% dose)	ADEM (B) managed no. of sprays (% dose)
Radspor	1 (100)	1 (100)	1 (100)
Systhane + Dithianon	2 (100)	0	0
Systhane + Captan	4 (100)	3 (100)	1 (100)
Captan	1 (25)	1 (30)	0
Nimrod	3 (100)	2 (50-100)	1 (100)
Topas 100	1 (100)	2 (60-50)	2 (50-60)
Total rounds	11	9	5
Target scab	8	5	2
Target mildew	10	6	4