Project number:	SF 012 (GSK195)
Title:	Blackcurrants: Evaluation of fungicides for the control of *Botrytis*.
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Final report:	*Contract report for GlaxoSmithKline and the Horticultural Development Council* September 2004
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Date project commenced:	1 April 2004
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AUTHENTICATION

I declare that this work was done under my supervision according to the procedures described herein and that the report represents a true and accurate record of the results obtained.

Mr John Atwood
Senior Consultant (Fruit Crops)
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Signature..... Date.....

Dr Tim O'Neill
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Signature..... Date.....

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This work was done in accordance with ADAS Quality Management System (QMS) and the standards office of the Official Recognition of Efficacy Testing Organisations (ORETO registration number 165).

CONTENTS

GROWER SUMMARY

Headline

- Three-spray programmes of the two newer fungicides, Signum and Frupica, gave better control of *Botrytis* than the standard Elvaron Multi.

Commercial benefits of the project

This project provides information on fungicides for the control of Botrytis in blackcurrants to enable growers to reduce flower 'run-off' and improve crop yields.

The recently introduced fungicide Signum (boscalid + pyraclostrobin) has been shown to have excellent potential for use in blackcurrants for the control of *Botrytis cinerea*, giving significantly better control than the industry standard, Elvaron Multi (tolylfluanid). It also has broad-ranging activity against blackcurrant leaf spot and American gooseberry mildew. For use on blackcurrants, a full label recommendation or SOLA will be required.

Results show that the standard Elvaron Multi programme could be improved for both *Botrytis* and leaf spot control by the use of Stroby WG (kresoxim-methyl) at the end of flowering.

The use of Bravo 500 (chlorothalonil) was found to give a very positive yield response, although the results on *Botrytis* control were less clear cut.

Objectives and background

Botrytis is an important disease of blackcurrants causing flower 'run-off' and fruit contamination pre-and post-harvest. Yield losses can range from 15 to 50% and are often underestimated by growers in situations where there is no obvious disease sporulation. The last *Botrytis* control experiment on blackcurrants was carried out four years ago. Since that time, newer fungicides have become available with potential for *Botrytis* control. It is essential to have a range of fungicides available for *Botrytis* control, with different modes of action, as an anti-resistance strategy.

The objectives of this project were to:

1. Provide information on the effectiveness and yield response from two new fungicides applied for *Botrytis* control compared with industry standards.
2. To investigate the optimum timing for a strobilurin fungicide when used in a *Botrytis* control programme.
3. Assess the level of incidental leaf spot and powdery mildew control achieved from the use of these fungicides when applied in a *Botrytis* control programme during flowering.
4. Assess the relative benefit from using a fungicide claimed to have rapid translaminar action (Scala) as the initial spray compared with a standard protectant programme.

Summary of results

Most of the fungicide programmes reduced *Botrytis* levels on flowers and strigs compared with those in the unsprayed plots. Three-spray programmes of the two newer fungicides, Signum and Frupica, gave better control of *Botrytis* than the standard Elvaron Multi.

Signum proved to be the most effective product tested, giving good (93%) control of pre-harvest *Botrytis* within the bush and the best yield response, more than doubling the yield of the untreated. Signum was the only treatment that significantly reduced post-harvest *Botrytis* fruit rots.

Frupica was slightly less effective than Signum in controlling pre-harvest *Botrytis* within the bush but the yield response was small and not significantly better than the control. Further work would be needed to confirm this result and to see if there had been some phytotoxicity resulting in reduced fruit set.

The two-spray programmes (start and end of flowering) were not adequate in controlling pre-harvest *Botrytis*, however the two-spray programme of Bravo 500 still gave a 63% yield increase over the untreated. The substitution of an initial spray of Scala for Elvaron Multi in the two spray programme slightly improved *Botrytis* control and more substantially improved the yield response (from 2% - not significant, to 46% - significant).

The use of Stroby WG instead of Elvaron Multi within the three-spray Elvaron Multi programme was beneficial for *Botrytis* control and slightly improved the yield

response over Elvaron Multi alone. It was more effective when used as the third of three sprays (end of flowering), rather than as a mid-flowering spray.

Although the treatment programmes were not timed to give a full season's control of powdery mildew or leaf spot, Signum and Frupica, with a final spray of three applied on the 10th May both gave good control of leaf spot until July. The standard Bravo 500 treatment also gave good control over the same period, despite only two sprays being applied. The Elvaron Multi programmes gave a reduced but still significant level of leaf spot control; inclusion of Stroby WG at the fruit set stage further improved control.

Powdery mildew infection started rather too late for the treatments applied over flowering to be fully effective. Results indicate that Signum was the most effective treatment, followed by Frupica.

The full results are listed in Table 1.

Table 1: Summary of results

	Yield (t/ha)	**Botrytis** (infections/shoot m)	**Leaf Spot** (%)
		10/06/04	**09/07/04**
1,2: Untreated Controls	1.60	54.7	37.0
3: Elvaron Multi x 3	2.54	38.5	26.5
4: Frupica x 3	1.81	17.6	3.5
5: Signum x 3	3.51	5.1	1.8
6: Elvaron Multi, Elvaron Multi, Stroby WG	2.61	29.2	16.5
7: Elvaron Multi, Stroby WG, Elvaron Multi	2.35	40.2	24.0
8: Bravo 500, nil, Bravo 500	2.60	48.9	1.2
9: Elvaron Multi, nil, Elvaron Multi	1.63	33.4	22.5
10: Scala, nil, Elvaron Multi	2.33	32.0	25.1
F pr	<0.001	<0.001	0.003
%CV	21.1	36.6	28.5
s.e.d. (df=28)(comparing 3-10)	0.338	9.16	3.94
s.e.d. (df=28)(comparing 1,2 with 3-10)	0.292	7.93	3.41
LSD at 5% (comparing 3-10)	0.837	18.76	8.06
LSD at 5% (comparing 1,2 with 3-10)	0.599	16.24	6.99

Results that differ by less than the LSD (least significant difference) are not significantly different at the 5% probability level.

Action points for growers

- Fungicide products currently permitted for *Botrytis* control on blackcurrant are Bravo 500 (and other formulations of chlorothalonil), Teldor, Talat, Scala and Elvaron Multi.
- Signum shows great potential as a multi purpose fungicide for use in blackcurrants, and should be used as part of a programme when available through SOLA or label recommendation.
- When using Stroby WG for powdery mildew control, some incidental *Botrytis* control can be achieved. The best timing for the first spray is end of flowering rather than mid-flowering.
- Bravo 500 remains an extremely cost-effective treatment when used during flowering for yield response and leaf spot control. However, it did not give a significant reduction in *Botrytis* levels within the bush.
- There are some indications that Scala gives an enhanced yield response compared with Elvaron Multi, when used as the first flower spray.
- Although Frupica gives excellent control of the leaf spot and good control of botrytis, the failure to increase yield suggests it may be phytotoxic.

Practical and anticipated financial benefits

The use of Signum fungicide as part of spray programme has the potential benefit of improving disease control and increasing yield providing a SOLA or label recommendation can be obtained for its use. The use of Stroby WG at the end of flowering is shown to be the best timing for disease control and yield response. The benefit of using Bravo 500 as a fungicide over flowering is confirmed.

SCIENCE SECTION

Introduction

The three main diseases of blackcurrants are American gooseberry mildew (*Sphaerotheca mors-uvae*), leaf spot (*Drapenopeziza ribis*) and grey mould (*Botrytis cinerea*). *Botrytis* is an important disease of blackcurrants causing flower run-off (Williamson et, al 1989), and contamination pre-and post-harvest. Yield losses can range from 15 to 50% and are often underestimated by growers in situations where there is no obvious disease sporulation. The last *Botrytis* control experiment on blackcurrants was carried out four years ago (Old, 2000). Since that time, newer fungicides have become available with potential for *Botrytis* control. It is essential to have a range of fungicides available for *Botrytis* control with different modes of action as an anti-resistance strategy.

The objectives of the project were to:

1. Provide information on the effectiveness and yield response from two new fungicides applied for *Botrytis* control compared with industry standards.
2. To investigate the optimum timing for a strobilurin fungicide Stroby WG when used in a *Botrytis* control programme.
3. Assess the level of incidental leaf spot and powdery mildew control achieved from the use of these fungicides when applied in a *Botrytis* control programme during flowering.
4. Assess the relative benefit from using a fungicide claimed to have rapid translaminar action (Scala) as the initial spray compared with a standard protectant programme.

Materials and methods

Site and crop details

The experiment was carried out at C Wharton & Ptnrs. Ltd., Winsford Hall, Stokesby, Norfolk on a blackcurrant plantation of cv. Baldwin. The plantation was planted in autumn 1996, with bushes spaced at 3 m x 0.3 m.

Prior to the start of the experiment, the following treatments were applied: 23/1/04 Dichlobenil granules 125 kg/ha row only (herbicide), 12/3/04 Solfa 10 kg/ha (acaricide / fungicide), 23/3/04 Solfa 10 kg/ha + Karamate 1.5 kg/ha (acaracide / fungicide), 2/4/04 Solfa 10 kg/ha + Karamate 1.5 kg/ha (acaracide / fungicide).

During the course of the experiment the following insecticides were applied: 8/4/04 Meothrin 1 litre/ha, 3/5/04 Meothrin 1 litre/ha, 15/5/04 Masai 0.5 kg/ha. No fungicides were applied apart from the experimental treatments.

The soil type was a fine sandy loam, P index 4, K index 2, Mg index 2. The following fertilisers were applied: 29/3/04 9.5:0:16.3:6.8mg:9s 520 kg/ha, 19/5/04 Ammonium nitrate 34.5% N 210 kg/ha.

Treatments

Experimental treatments consisted of either a two or three-spray programme, applied at the start of flowering, mid-flower and end of flowering. Where two sprays were used, these were applied at the start and end of flowering, omitting the mid-flower spray.

Treatment programmes

Treatment no.	**1st flower**	**Mid flower**	**End flower**
1.	Nil	Nil	Nil
2.	Nil	Nil	Nil
3.	Elvaron Multi	Elvaron Multi	Elvaron Multi
4.	Frupica	Frupica	Frupica
5.	Signum	Signum	Signum
6.	Elvaron Multi	Elvaron Multi	Stroby WG
7.	Elvaron Multi	Stroby WG	Elvaron Multi
8.	Bravo 500	Nil	Bravo 500
9.	Elvaron Multi	Nil	Elvaron Multi
10.	Scala	Nil	Elvaron Multi

Product details

Product	Active ingredient(s)	Rate of use
Bravo 500	Chlorothalonil (500 g/l)	4.2 litres/ha
Elvaron Multi	Tolylfluanid (50.5% w/w)	1.7 kg/ha
Frupica	Mepanipyrim (50% w/w)	0.8 kg/ha
Scala	Pyrimethanil (400 g/l)	2.0 litres/ha
Signum	Boscalid (26.7% w/w) + pyraclostrobin (6.7% w/w)	1.8 kg/ha

All sprays were applied in water volumes equivalent to 1000 l/ha. Applications were made by ADAS staff using a pressurised knapsack sprayer.

Assessments

Pre-harvest *Botrytis* was assessed by taking 10 shoots at random from the middle 6 m of plot row and recording the total number of sporulating infection points along 0.5 m of shoot, measured back from the start of the current season's growth. Results were expressed as infections per m of shoot.

Post-harvest *Botrytis* was assessed by taking 100 fruits and incubating at ambient temperature (20 deg C) for 72hr, then recording the percentage of fruit with sporulating *Botrytis* infection.

American gooseberry mildew was assessed according to a standard key, shown below

Category	Disease Incidence Description
0	No mildew visible.
1	Trace. Mildew seen on only one leaf per bush.
2	Mildew seen on up to six leaves per bush. No leaf curling or distortion.
3	Mildew frequent on leaves. Slight curling but no browning or necrosis of leaves.
4	Mildew frequent on leaves with moderate curling and leaf distortion and/or mildew on stems. Slight leaf browning and necrosis present, but no shoot tip death.
5	As for No 4, but with a little shoot tip death. No obvious retardation of shoot growth.
6	As for No 5, but with moderate killing of shoot tips. Some obvious retardation of shoot growth, and leaf browning common.
7	As for No 6, but with much shoot tip death and some severe retardation of shoot growth.

Five bushes per plot were assessed individually and a mean score calculated for the plot.

Leaf spot was assessed using the standard key of Clarke and Corke (1955) which takes into account both the level of leaf infection and defoliation. The key is presented in the Appendix. Five bushes were assessed in each plot and a mean percentage infection calculated for the plot.

Plot yields were recorded following machine harvest of individual plots on 28/7/04.

Experimental design and analysis

The experiment was arranged in randomised blocks with four replicates of each treatment and eight replicates of the untreated plots. Plot size was 10 m length of row. Results were analysed by analysis of variance.

Crop diary

Spray treatment dates were:

14/04/04	1st flower	Growth stage F1
26/04/04	Mid flower	Growth stage F2
10/05/04	Fruit set	Growth stage l1

Disease assessments were made on 10/06/04, 9/07/04, 27/07/04 and 13/08/04

An assessment for phytotoxicity symptoms was made on 22/04/04, 28/04/04 and 13/05/04

The trial was harvested and yields recorded on 27 July. Post-harvest fruit rot assessments were made on 31 July.

Results

Bushes were examined 7 – 14 days after each spray application but there was no sign of phytotoxicity symptoms from any of the treatments.

The first disease assessments were made in early June, by which time *Botrytis* sporulation was very apparent on dead flowers and the dead ends of strigs throughout the trial. It was also noticeable at this stage that fruit set was very poor on the untreated control plots.

Table 2: Effect of fungicide programmes on botrytis (infections/shoot m)

	10/06/04	**09/07/04**	**27/07/04**
1,2: Untreated Controls	54.7	10.0	4.6
3: Elvaron Multi x 3	38.5	7.4	4.8
4: Frupica x 3	17.6	2.7	3.3
5: Signum x 3	5.1	0.6	6.0
6: Elvaron Multi, Elvaron Multi, Stroby WG	29.2	4.2	5.3
7: Elvaron Multi, Stroby WG, Elvaron Multi	40.2	5.6	6.9
8: Bravo 500, nil, Bravo 500	48.9	5.1	5.5
9: Elvaron Multi, nil, Elvaron Multi	33.4	6.9	2.8
10: Scala, nil, Elvaron Multi	32.0	6.0	4.1
F pr	<0.001	<0.001	0.24
CV%	36.6	27.7	45.9
s.e.d. (df=28)(comparing 3-10)	9.16	1.14	1.55
s.e.d. (df=28)(comparing 1,2 with 3-10)	7.93	0.99	1.34
LSD at 5% (comparing 3-10)	18.76	2.34	3.22
LSD at 5% (comparing 1,2 with 3-10)	16.24	2.02	2.07

The highest levels of *Botrytis* were recorded at the first assessment (one month after the final spray timing), when there was the most dead flower and strig present; this was probably the best time to assess the effects of the treatments on *Botrytis* infection of the flowers. At this stage, the best level of control was achieved by the three-spray programme of Signum (91% control), with the Frupica programme (68% control) also giving very good control. All other treatments apart from the Elvaron Multi, Stroby WG, Elvaron Multi programme, and the two-spray Bravo 500 programme gave a lesser but significant reduction compared with the controls. Apart from Signum, differences between these treatments were not significant, but there

was an indication that using Stroby WG at the end of the Elvaron Multi programme gave better results than its use in the middle of the programme.

By the second assessment, *Botrytis* levels recorded were lower as the amount of fruit, flower and strig had declined. Signum and Frupica continued to give the two highest levels of control. All other treatments give a significant degree of control, but differences between these treatments were not significant.
At the third assessment *Botrytis* levels recorded had evened out, as it was over 10 weeks since the last treatment.

By this stage, those treatments with poor fruit set tended to have less *Botrytis* recorded, possibly because there was less infectable material present. None of the differences recorded at this assessment were statistically significant.

The crop was harvested normally, by machine on 27 July, and the resulting yields are shown below.

Table 3: Effect of fungicide programmes on fruit yield (t/ha)

	27/07/04
1,2: Untreated Controls	1.60
3: Elvaron Multi x 3	2.54
4: Frupica x 3	1.81
5: Signum x 3	3.51
6: Elvaron Multi, Elvaron Multi, Stroby WG	2.61
7: Elvaron Multi, Stroby WG, Elvaron Multi	2.35
8: Bravo 500, nil, Bravo 500	2.60
9: Elvaron Multi, nil, Elvaron Multi	1.63
10: Scala, nil, Elvaron Multi	2.33
F pr	<0.001
CV%	21.1
s.e.d. (df=28)(comparing 3-10)	0.338
s.e.d. (df=28)(comparing 1,2 with 3-10)	0.292
LSD at 5% (comparing 3-10)	0.837
LSD at 5% (comparing 1,2 with 3-10)	0.599

Overall, yields were low, ranging from 1.6 to 3.5 t/ha. The bushes were large and dense, with a high proportion of old wood, and some branches on the ground.

The best yield (3.51 t/ha) was achieved by the Signum programme, which gave a yield more than double that of the control. The next best treatments were the three-spray Elvaron Multi, the Elvaron Multi followed by Stroby WG, and the two-spray Bravo 500 programmes. With the exception of the Bravo 500 programme, the two-spray programmes were generally less effective. The two-spray Elvaron Multi and the Frupica programme failed to give a significant yield response. The result from Frupica is surprising considering the *Botrytis* control appeared to be good. Further work may be required to see if there was a phytotoxic effect on fruit set.

Fruit from the harvested plots was assessed for post-harvest *Botrytis*. The results are shown below.

Table 4: Effect of fungicide programmes on post-harvest *Botrytis* fruit rot (%)

	31/07/04
1,2: Untreated Controls	56.1
3: Elvaron Multi x 3	44.2
4: Frupica x 3	53.2
5: Signum x 3	29.5
6: Elvaron Multi, Elvaron Multi, Stroby WG	60.5
7: Elvaron Multi, Stroby WG, Elvaron Multi	43.5
8: Bravo 500, nil, Bravo 500	46.2
9: Elvaron Multi, nil, Elvaron Multi	50.0
10: Scala, nil, Elvaron Multi	60.0
F pr	0.333
CV%	36.6
s.e.d. (df=28)(comparing 3-10)	12.9
s.e.d (df=28)(comparing 1,2 with 3-10)	11.2
LSD at 5% (comparing 3-10)	26.5
LSD at 5% (comparing 1,2 with 3-10)	22.9

Following incubation, *Botrytis* infection levels in the fruit were very high and only Signum gave a significant (48%) reduction compared with the control.

Although the trial was primarily designed to investigate *Botrytis* control from the various fungicide programmes, the incidental control of powdery mildew and leaf spot was also recorded. The results of powdery mildew assessments are shown below.

Table 5: Effect of fungicide programmes on powdery mildew (0-7 index)

	10/06/04	**09/07/04**
1,2: Untreated Controls	0.38	3.45
3: Elvaron Multi x 3	0.50	3.15
4: Frupica x 3	0.75	2.65
5: Signum x 3	0.25	2.10
6: Elvaron Multi, Elvaron Multi, Stroby WG	0.25	2.80
7: Elvaron Multi, Stroby WG, Elvaron Multi	0.25	2.70
8: Bravo 500, nil, Bravo 500	0	3.00
9: Elvaron Multi, nil, Elvaron Multi	0.25	2.85
10: Scala, nil, Elvaron Multi	0.50	2.90
F pr	0.669	<0.001
%CV	144.1	11.1
s.e.d. (df=28)(comparing 3-10)	0.357	0.242
s.e.d. (df=28)(comparing 1,2 with 3-10)	0.309	0.210
LSD at 5% (comparing 3-10)	0.731	0.496
LSD at 5% (comparing 1,2 with 3-10)	0.633	0.430

At the time of the first assessment powdery mildew levels were very low and none of the differences were statistically significant. By the time of the second assessment powdery mildew had built up considerably and none of the treatments were giving good control (score 1 or less).

This was expected as it was eight weeks since the last treatment. Normally a powdery mildew spray programme would be applied every 10-14 days. Signum appeared the most active against powdery mildew giving a 40% reduction. The other treatments (apart from Elvaron Multi x 3) also gave a significant degree of control. It was not possible to make a post-harvest assessment of powdery mildew because of general leaf deterioration due to leaf spot.

Leaf spot was apparent at trace levels in early June. The results of pre-and post-harvest assessments are shown below.

Table 6: Effect of fungicide programmes on leaf spot (% leaf area affected)

	10/06/04	09/07/04	13/08/04
1,2: Untreated Controls	1.8	37.0	97.5
3: Elvaron Multi x 3	1.5	26.5	96.2
4: Frupica x 3	0.6	3.5	92.5
5: Signum x 3	0.2	1.8	67.5
6: Elvaron Multi, Elvaron Multi, Stroby WG	2.0	16.5	96.2
7: Elvaron Multi, Stroby WG, Elvaron Multi	0	24.0	97.5
8: Bravo 500, nil, Bravo 500	1.0	1.2	80.0
9: Elvaron Multi, nil, Elvaron Multi	1.2	22.5	90.0
10: Scala, nil, Elvaron Multi	2.2	25.1	92.5
F pr	0.282	0.003	0.003
%CV	94.9	28.5	11.5
s.e.d. (df =28)(comparing 3-10)	0.87	3.94	7.37
s.e.d (df=28)(comparing 1,2 with 3-10)	0.76	3.41	6.39
LSD at 5% (comparing 3-10)	1.79	8.06	15.09
LSD at 5% (comparing 1,2 with 3-10)	1.56	6.99	13.09

Leaf spot was present at very low levels at the time of the first assessment on 10 June and differences between treatments were not significant. By 9 July, leaf spot was building up reaching 37% leaf area infected in the untreated control. Signum, Frupica and Bravo 500 all gave exceptional levels of control at that stage. All other treatments gave a significant level of control compared with the untreated. For leaf spot, the use of Stroby WG at the fruit set stage significantly improved control compared with the three-spray programme of Elvaron Multi.

Following prolonged spells of wet weather, leaf spot levels continued to build up, so that by mid-August, a high level of infection was present. By this stage, the effects of the earlier treatments had been largely lost, although the Signum and Bravo 500 treatments were still statistically significant compared with the untreated.

Conclusions

The 2004 season saw weather conditions that were extremely favourable to the development of *Botrytis* in East Norfolk. Under these conditions, none of the

fungicide programmes tested provided complete control and *Botrytis* was present to some extent in all of the plots throughout the experiment. To ensure a full level of control through to harvest it would have been necessary to follow up the fungicide sprays used during flowering with a full protective programme up to harvest. The conditions however provided an excellent test of the flowering treatments programmes' ability to protect fruit set.

Signum proved to be the most effective product tested, giving good (93%) control of pre-harvest *Botrytis* within the bush and the best yield response, more than doubling the yield of the untreated. Signum was the only treatment that significantly reduced post-harvest *Botrytis* rots.

Frupica was slightly less effective than Signum in controlling pre-harvest *Botrytis* within the bush but the yield response was disappointing, being not significantly better than the control. Further work would be needed to see if there had been some phytotoxicity resulting in reduced fruit set.

The two-spray programmes were not adequate in controlling pre-harvest *Botrytis*, however the two spray programme of Bravo 500 still gave a 63% yield increase, confirming results from an earlier (Old, 2000) experiment comparing fungicides for *Botrytis* on blackcurrants. The substitution of an initial spray of Scala for Elvaron Multi in the two spray programme did slightly improve *Botrytis* control and more substantially improved the yield response (from 2% - not significant, to 46% - significant)

The use of Stroby WG instead of Elvaron Multi within the three-spray Elvaron Multi programme was beneficial for *Botrytis* control and improved the yield response over Elvaron Multi alone. It was more effective when used as the third of three sprays (end of flowering), rather than as a mid flowering spray. A yield penalty has previously been reported from the use of strobilurin fungicides during flowering (Locke, 2000)

The programmes of two or three sprays over flowering were not sufficient to give full season control of powdery mildew or leaf spot. However, the results indicate that Signum and Frupica both gave good control of leaf spot until July. The standard Bravo 500 treatment also gave good control over the same period, despite only two sprays being applied. The Elvaron Multi programmes gave a reduced but still

significant level of leaf spot control; inclusion of Stroby WG at the fruit set stage further improved control.

Powdery mildew infection started rather too late for the treatments applied over flowering to be fully effective. Results indicate that Signum was the most effective treatment, followed by Frupica.

Technology Transfer

No technology transfer activities relating to this project have been carried out as yet.

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Acknowledgements

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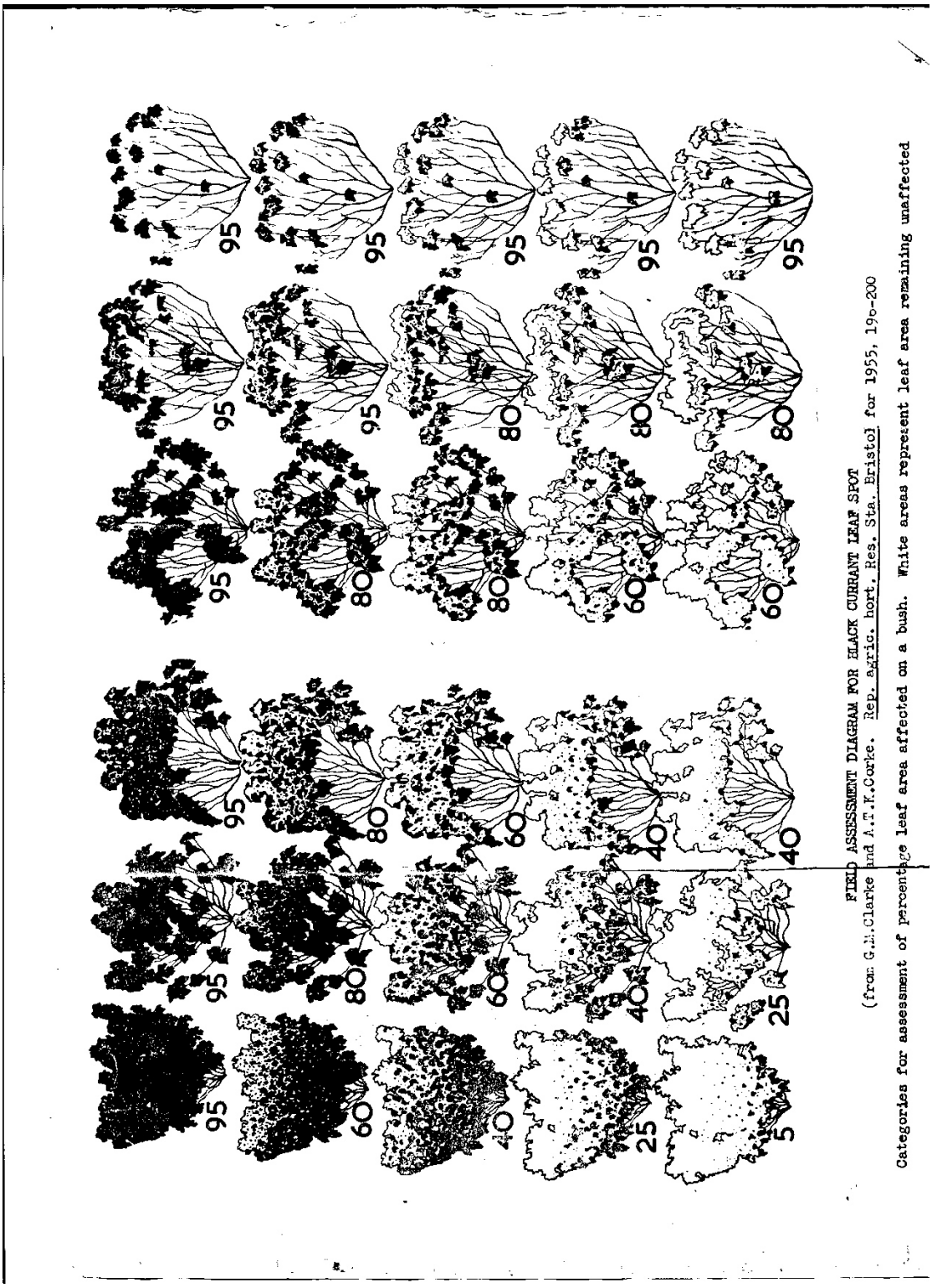
APPENDIX

Leaf Spot % assessment key



FIELD ASSESSMENT DIAGRAM FOR BLACK CURRANT LEAF SPOT
(from G.M.Clarke and A.T.K.Corke. Rep. agric. hort. Res. Sta. Bristol for 1955, 190-200

Categories for assessment of percentage leaf area affected on a bush. White areas represent leaf area remaining unaffected

