

Project title: Effects of Retain™ on fruit run off and ripening of blackcurrant

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Project Leader: Dr A D Webster, HRI East Malling

Keyworkers: Lorraine Taylor

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Principal Scientists

A.D. Webster PhD (Author of report)
Lorraine Taylor

Authentication

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

Signed-----
A.D. Webster

Dated-----

Contents	Page
Summary	4
Introduction	4
Materials and Methods	5
Results	7
Discussion	10
References	10

Effects of Retain™ on fruit run off and ripening of blackcurrant

Summary:

Sprays of Retain™ (aminoxyvinylglycine - AVG), applied at or just after blossoming to young containerised bushes of Ben Lomond, Ben Tirran and Ben Sarik, increased the harvested yields of fruits. A high volume spray of 250ppm at full bloom was the most effective treatment. Sprays applied 10 days after full bloom also increased yields but inconsistently and these later treatments tended to delay the ripening of a proportion of the fruits. Sprays applied between 5 and 2 weeks before harvest had no effects on time of fruit ripening or fruit yields.

Introduction:

Ethylene production between flowering and fruit set (often in response to damage or stress e.g due to *Botrytis* infection) is a major cause of flower abscission ('run-off') in blackcurrant (McNicol & Williamson, 1989; McNicol et al, 1989). Blackcurrant varieties are known to vary considerably in their susceptibility to run-off. Some varieties, e.g. Baldwin, are highly susceptible others, e.g. Ben Alder, are less susceptible, though the susceptibilities of most varieties have not been characterised. Ethylene production is also believed to be involved in the ripening of blackcurrant fruit.

The plant growth regulator aminoxyvinylglycine (AVG or Retain™), currently being developed and field tested on a range of tree fruits, by Valence Agrochemicals (previously Abbott Laboratories), is known to have significant activity in reducing ethylene production in plants. Research at Long Ashton and East Malling Research Stations in the past has shown that sprays of AVG can reduce fruitlet abscission of apples significantly. The purpose of the proposed work is to investigate whether sprays of Retain™ can be used to prevent flower abscission ('run-off') and/or delay ripening in blackcurrant.

Materials and Methods:

Two replicated experiments were conducted on containerised blackcurrants grown outdoors on drained sand beds. The objective of the first experiment was to ascertain whether sprays of Retain™, applied early in the season at or around the time of flowering, could improve yields by reducing fruitlet abscission. The second experiment was aimed at evaluating whether sprays of Retain™ applied closer to the time of harvest could influence time of ripening or fruit quality.

Experiment 1

Two-year old bushes of three varieties, Ben Lomond, Ben Tirran and Ben Sarik were purchased from two nurseries and potted into 10 litre containers on April 4. The compost used was 'Richmore' with the addition of 'Suscon Green' against vine weevil. At the time of potting many of the bushes were beginning to break into leaf. The bushes were assessed for vigour and branching and grouped, allocating similar sized bushes into the same statistical block. The experiment was designed in 10 randomised blocks with four treatments and a control.

All visible flower buds on each bush were counted on the Ben Lomond (April 25), Ben Sarik (May 2) and Ben Tirran (May 9)

The treatments comprised sprays of Retain™ applied either at the time of full bloom or 10 days later and two spray concentrations, 125ppm and 250 ppm were compared. The sprays were applied to the Ben Lomond and Ben Sarik bushes on May 5 (full bloom) or 10 days later. The Retain™ sprays to Ben Tirran were applied on May 15 (full bloom) or May 25. All sprays were applied with a small knapsack sprayer to incipient run-off.

The Ben Sarik, Ben Lomond and Ben Tirran bushes were harvested on July 10, 19 and 25, respectively. All the fruits from each bush were counted and weighed and the sets per floral bud calculated. The harvested fruits of both Ben Lomond and Ben Sarik were also divided into fully ripe, pink and green fruits and the percentages of each calculated. Calculations were also made of the mean individual fruit sizes.

Experiment 2

Bushes of Ben Lomond and Ben Tirran were obtained from commercial nurseries and containerised as described above. The bushes were set out on an irrigated sand bed in a randomised block experimental design of 10 replicates.

The aim to spray the bushes three and six weeks before harvest was made difficult by poor weather conditions and earlier than anticipated harvesting. Nevertheless, the Ben Lomond bushes were treated on June 13 and July 5 (approximately 5 and 2 weeks prior to the actual harvest date. (July 18/19) The bushes were sprayed at high volume to incipient run off using a knapsack sprayer. Mistakes in estimating the date of harvest of Ben Tirran (the fruits ripened on July 26 compared with an August 14

estimate) meant that only one spray timing was possible with this variety, on July 5, approximately 3 weeks prior to harvest.

The Ben Lomond and Ben Tirran bushes were harvested on July 18 and 26, respectively. All the fruits from each bush were harvested, counted and weighed. The fruits were then separated into fully ripe, pink and green fruits and the proportions of each calculated. Samples of Ben Lomond were collected and fruit soluble solids measured using an electronic refractometer.

Results:

Experiment 1

A slight and transient yellowing of the leaves of a few plants of all three varieties was noted a few days after spraying.

Most of the spray treatments applied to Ben Lomond increased the final fruit set (Table 1) although the 125ppm treatment at full bloom was just short of statistical significance. The total weights of fruits harvested per bush were also increased by 250ppm treatment at full bloom and the 125ppm treatment applied 10 days later. The total weight of ripe fruit harvest per bush was also increased by the 250ppm treatment at full bloom. The sprays applied 10 days after full bloom reduced the percentages of ripe fruits at harvest time and also reduced mean fruit size.

The Retain™ sprays applied to Ben Sarik increased levels of fruit set slightly but the effects were not statistically significant (Table 2). However, sprays of 250ppm at full bloom did significantly increase the total fruit number and weight of fruit harvested as well as the weight of fully ripe fruits harvested. Sprays of similar concentration applied 10 days later had no effect on yield and reduced the percentage of fully ripe fruits at the time of harvest. The treatments had no effect on the individual size of fruits of this variety.

Sprays of 125ppm or 250ppm at full bloom or 250ppm 10 days later increased fruit set on the variety Ben Tirran (Table 3). The two treatments using the higher concentration of Retain™ both increased the harvested fruit numbers/bush. Although all the treatments increased the weight of fruit harvested/bush, none of these differences were statistically significant.

Table 1 Yield of Ben Lomond treated with Retain™ at or around flowering time

Treatment	% Fruit set (June)	Total Fruit No /bush	Tot. Wt. fruit harv/ Bush (g)	Tot. Wt. Full Ripe Fruit harv Bush (g)	% at harvest of fully ripe fruits	Mean individ wt. of ripe fruit (g)
Control	54.8	212	219	173	70.4	1.18
125ppm Full bloom (FB)	63.5	208	202	174	76.3	1.10
250ppm F.B.	71.7	278	270	228	75.1	1.09
125ppm FB + 10 days	73.8	360	288	199	54.6	1.07
250ppm FB + 10 days	69.6	316	241	204	62.9	1.02
LSD (P=5%)	9.56	53.2	42.3	34.7	7.83	0.094
DF	45	45	45	45	45	45

Table 2 Yield of Ben Sarek treated with Retain™ at or around flowering time

Treatment	% Fruit set (June)	Total Fruit No harv/ Bush	Tot. Wt. fruit harv/ bush (g)	Tot. Wt. Full Ripe Fruit harv/ Bush (g)	% at harvest of fully ripe fruits	Mean individ wt. of ripe fruit (g)
Control	68.4	245	287	233	68.2	1.4
125ppm Full bloom (FB)	77.3	284	344	288	73.2	1.4
250ppm F.B.	79.8	311	371	302	70.2	1.5
125ppm FB + 10 days	72.4	290	295	244	67.9	1.3
250ppm FB = 10 days	69.5	270	265	184	50.7	1.4
LSD (P=5%)	NS (9.76)	51.0	73.1	69.9	10.36	NS (0.16)
DF	35	35	35	35	35	35

Table 3 Yield of Ben Tirran treated with Retain™ at or around flowering time

Treatment	% Fruit set (June)	Total Fruit No harv/bush	Total Wt. Fruit Harv/bush (g)
Control	66.7	257	189
125ppm Full bloom (FB)	80.8	284	208
250ppm F.B.	80.6	369	230
125ppm FB + 10 days	74.0	326	221
250ppm FB + 10 days	78.9	366	233
LSD (P=5%)	8.8	90.4	NS (53.6)
DF	45	45	45

Experiment 2:

No phytotoxicity, or leaf discolouration were noted following any of the treatments. None of the treatments to Ben Lomond or Ben Tirran had any significant effects on any of the parameters measured (Tables 4 and 5). No statistically significant differences in total numbers or weight of fruit harvested were recorded. Unfortunately the treatments also had no significant effect on the proportions of fully ripe fruits harvested or the soluble solids content of Ben Lomond fruits.

Table 4 The influence of pre-harvest sprays of Retain™ on the yields and ripening of Ben Lomond

Treatment	Tot. No. Fruits harv.	Total Wt. of Fruits at Harv (g)	Tot. Wt. Full Ripe Fruit harv/ Bush (g)	% at harvest of fully ripe fruits	% soluble solids in ripe fruits	Mean individ wt. of ripe fruit (g)
Control	202	221	205	86.9	10.6	1.17
125ppm 5wks BH	223	250	230	85.3	10.4	1.21
125ppm 2wks BH	196	204	186	84.8	10.2	1.14
250ppm 5wks BH	193	211	196	85.4	9.8	1.19
250ppm 2wks BH	176	183	165	83.3	10.4	1.15
LSD (5%)	NS(41.4)	NS(50.3)	NS(46.3)	NS(5.19)	NS(0.88)	NS(0.112)
DF	45	45	45	45	15	45

BH = before date of harvest

Table 5 The influence of pre-harvest sprays of Retain™ on the yields and ripening of Ben Tirran

Treatment	Total fruit Wt. / bush (g)	Total fruit No. / bush	No. of black ripe fruit / bush
Control	232	298	277
Retain-125ppm*	198	259	242
Retain-250ppm*	189	-	-
LSD	NS (129)	NS(181)	NS (164)
DF	9	9	9

* sprays applied 3 weeks before harvest

Discussion:

Sprays of Retain™ applied at full bloom to three varieties of blackcurrant increased final fruit set per 100 floral buds, and yields. The active ingredient in Retain™, aminoxyvinylglycine (AVG), is a powerful inhibitor of ethylene biosynthesis within plants and ethylene is heavily implicated in the processes of natural fruit and leaf abscission. It is not surprising, therefore, that the sprays helped reduce flower/fruitlet abscission.

What we cannot deduce from these experiments is whether the ethylene levels produced by the bushes and which were possibly reduced by the sprays were in response to infection of the flowers by *Botrytis* (McNicol and Williamson, 1989). Most fruiting tree species produce ethylene in response to a range of various stress factors, other than *Botrytis* infection, (e.g. cold, drought) and the effect of these and the associated severity of flower/fruitlet abscission varies from season to season. Studies on several temperate tree fruit species have demonstrated that applications of AVG can reduce fruitlet abscission and increase yields often in years when flowers are damaged by frost. (Atkinson – unpublished; Webster – unpublished; Crisosto et al 1986). Further studies involving infection with *Botrytis* will be needed if this question is to be answered.

Sprays of Retain™ applied 10 days after full bloom were less effective in increasing yields than the full bloom sprays and there was a tendency for the fruit ripening to be slightly delayed. This latter effect was surprising, in that ripening delay has usually been stimulated in other species, such as apple, by treatments applied much closer to the date of harvesting. Treatments applied here (Experiment 2) showed that sprays applied to blackcurrants between 5 and 2 weeks before harvest had no influence on time of ripening. The conclusion must be that ripening time in blackcurrants is determined quite early in the sequence of fruitlet development and that if this is to be influenced Retain™ treatments will need to be applied shortly after flowering. Further trials will be needed if this hypothesis is to be explored further.

Sprays of Retain™ applied to apples at or around the time of flowering have, in some instances, reduced the size of fruits at harvest time. Although much of this response can be attributed to indirect effects of the heavier crop loading induced by the treatments, there is also evidence of a direct effect of the Retain™ on fruit size (Webster – unpublished). In one trial reported, where Ben Lomond was sprayed with Retain™ at or near to flowering time fruit size at harvest was reduced slightly. This effect may warrant further investigation.

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