Project title	Improving basal breaking of field-grown roses using ethylene releasing agents
Project number:	HNS 164
Project leader:	Dr Mark A Else, East Malling Research
Report:	Final Report August 2010
Previous report	Annual Report March 2009
Key staff:	Mrs June M Taylor Miss Clare Hopson Mrs Abi Dalton
Location of project:	Paul Chessum Roses Ltd, Briar Patch Nursery, Ickwell Road, Upper Caldecote, Biggleswade, Bedfordshire, SG18 9BS UK
Project coordinator:	Dr Neal Wright, Micropropagation Services
Date project commenced:	1 April 2008
Date project completed (or expected completion date):	30 June 2010
Key words:	Basal breaking, Class 1 grade-out, Ethrel C, Cerone, Ethylene releasing agent, Field trial, Quality, Rose

The results and conclusions in this report are based on an investigation conducted over a two-year period. The conditions under which the experiments were carried out and the results have been reported in detail and with accuracy. However, because of the biological nature of the work it must be borne in mind that different circumstances and conditions could produce different results. Therefore, care must be taken with interpretation of the results, especially if they are used as the basis for commercial product recommendations.

AUTHENTICATION

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

Dr Mark A. Else
Research Group Leader
East Malling Research

Signature ..... Date .....

Mrs June M. Taylor
Research Assistant
East Malling Research

Signature ..... Date .....

Report authorised by:

Dr Christopher J. Atkinson
Head of Science
East Malling Research

Signature ..... Date .....

CONTENTS

GROWER SUMMARY

Headline

- Cerone improved basal breaking and grade-out of some ‘shy’ breaking Hybrid Tea cultivars tested in field trials at Paul Chessum Roses. However, there was no improvement in the Floribunda cultivars tested.
- The overall quality of Cerone-treated Class 1 plants was similar to, or better than, that of the untreated controls.

Background and expected deliverables

The accepted standard for Class 1 rose bushes requires a minimum of three strong shoots (basal breaks) originating from just above the graft union. However, at present only 60% of the 12 million bushes propagated annually make this grade. Some so-called ‘shy’ breaking cultivars produce only one or two breaks despite repeat pruning during production to try to stimulate branching. These roses often have other very desirable attributes such as large blooms or fragrance. Improving the Class 1 grade-out of ‘shy’ cultivars would help to increase the profitability of the industry and reduce wastage during production.

Although Ethrel C (2-chloroethylphosphonic acid), an ethylene releasing agent, is a very powerful defoliant, work over three seasons in a previous Defra-funded project has shown that low concentration, low volume sprays have the potential to increase basal breaking in ‘shy’ cultivars by up to 66%, if applied at the optimum time during the production cycle. Furthermore, one spray at the critical time during development was more effective than three separate pruning treatments in triggering basal breaking in some ‘shy’ breaking cultivars.

To determine whether this approach would be successful in commercial rose production, field trials were carried out at Paul Chessum Roses during 2008, 2009 and 2010. An alternative ethylene releasing agent was needed for the project since at the beginning of the trial Ethrel C was due to be withdrawn from use and therefore Cerone (2-chloroethylphosphonic acid or Ethephon) was selected as a direct replacement.

The overall aim of this project was to improve product quality and Class 1 grade-out in commercial containerised rose production by increasing the number of basal breaks using an ethylene releasing agent applied once during the production cycle. In addition to improvements in product quality, it was envisaged that the project would also help to deliver the potential to reduce waste at grade-out and reduce labour costs associated with pruning and grading.

Summary of the project and main conclusions

Application of the ethylene releasing agent

'Shy' breaking rose cultivars were selected for the trial by Mr Clive Faulder (David Austin Roses, formerly of Paul Chessum Roses) and Mr Paul Chessum (Paul Chessum Roses).

Hybrid Tea cultivars

'Alec's Red', 'Just Joey', 'Renaissance' and 'Wendy Cussons'.

Floribunda cultivars

'Margaret Merril', 'Mountbatten', 'Burgundy Ice', 'Champagne Moment' and 'Pure Abundance'.

Scions were budded on to *Rosa laxa* rootstocks in single rows at two field sites at Paul Chessum Roses, Great West at Upper Caldecote and Montilliers, Everton (Figure GS1). Experimental blocks, each consisting of seven budded rootstocks, were staked out in April 2008 and in June 2009.

Figure GS1. One of the field sites at Paul Chessum Roses used to test the effectiveness of Cerone sprays on basal breaking in 2008. Photo taken on 15 April 2008.

As it was known that Ethrel C was to be withdrawn from use, Cerone, was used as an alternative product as it has the same active ingredient. Following action by the HDC, an updated SOLA (Table GS1) was secured for the use of Cerone in ornamental plant production. (The maximum rate according to the current SOLA is 1 litre of product per hectare applied in a minimum of 125 litres of water per hectare, i.e. up to 0.8%v/v).

Two concentrations of Cerone (0.25 or 0.5% v/v, 2.5 ml or 5ml in 1000ml) solutions were prepared with a wetting agent (0.1% v/v Activator 90, 1ml in 1000ml). A water solution containing a wetting agent (0.1% v/v Activator 90, 1ml in 1000ml) served as a control treatment (0%).

Table GS1. Current approval status for Cerone (as at 25 October 2010)

Product	MAPP number	Active ingredient	Use	Crop	Approval status
Cerone	15087	480g/l 2-chloroethylphosphonic acid (Ethephon)	Plant growth control	Ornamental plant production	SOLA, extension of use number 2743 of 2010

Spray applications (0%, 0.25% and 0.5% Cerone) were applied to 'maiden' bushes at the beginning of the first growth flush ('shot' bud stage) in 2008 and to the following year's crop at the end of the first growth flush in 2009 to determine whether effects on the propensity for basal breaking depended upon the timing of the treatments (see Table GS2).

Low volume sprays of Cerone were applied to the new shoots (approximately 5 cm long) and around the bud shield on April 16 2008 and to the lower 15 cm of stem on the following year's crop on 24 June 2009 using handheld sprayers. An additional treatment was also included in 2009 where stems were cut back to 45 cm at the end of the first growth flush to mimic commercial practice carried out at Paul Chessum Roses. The number and diameter of basal breaks, stem height and the number of flower buds in response to each treatment were recorded at intervals over each growing season.

Figure GS2. Experimental plants on the container nursery at Paul Chessum Roses. Overall plant quality for each cultivar and each treatment was scored by grower experts. Photo taken on 16 June 2010.

All the experimental roses were lifted in autumn 2008 and 2009 and graded by nursery staff. The number of Class 1 roses for each cultivar was counted; these plants were then pruned and placed into cold store. All bare-rooted bushes were potted into 4 L pots and moved onto holding beds the following spring. Overall plant quality for each cultivar was scored by 'grower experts' from Paul Chessum Roses at the half-growth and full-growth stages (Figure GS2) to determine whether the Cerone sprays applied in the previous year affected plant architecture, flower number or form.

Table GS2. Rose production timescale

	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct
Year 1		Root-stocks planted				Root-stocks budded			
Year 2	Root-stocks headed back		First flush of growth*		Second flush of growth^			Rose bushes lifted and placed into cold store	
Year 3	Grade-out and containerisation		Holding beds	Retail half growth stage	Retail full growth stage				

*Cerone treatment in 2008; ^Cerone and 'tipping back' treatments in 2009.

Effects of Cerone on shoot morphology during the maiden year

2008: Stem height was reduced significantly by the Cerone sprays to the Hybrid Tea cultivars 'Alec's Red' and 'Just Joey' at the beginning of the first growth stage but was not consistently affected in the Floribunda cultivars. Compared to the control treatment, the number of basal breaks was increased by both Cerone concentrations in 'Alec's Red' and 'Just Joey'. Cerone sprays did not improve basal breaking in the Floribunda cultivars 'Margaret Merril' or 'Mountbatten'. (The 'tipping back' treatment practised at the nursery on commercial crops increased basal breaks in 'Just Joey' and 'Margaret Merril'). The diameter of the basal breaks was not greatly affected by the Cerone sprays. The numbers of flower buds were reduced in most cultivars, but only by one or two buds per plant.

2009: When measured eight weeks after the application of the treatments, the number of basal breaks in Cerone-treated plants was increased by up to 50% in all cultivars except 'Renaissance' and 'Champagne Moment'. The diameter of the breaks was reduced by 1-2 mm in some Cerone-treated plants compared to the control treatment and tipping back treatments but overall, diameters averaged between 8 to 10 mm. In these trials, the Cerone sprays did not trigger the production of weak shoots as has been found previously with other ethylene releasing agents.

Effects of Cerone on percentage grade-out

2009: The final grade-out of plants lifted in 2008 was carried out on 16 March 2009. The percentage grade-out was improved from 60% in the untreated control to over 90% in 'Alec's Red' sprayed with 0.5% Cerone spray. Grade-out was not affected by Cerone sprays in 'Margaret Merril' and 'Mountbatten'. The grade-out of 'Just Joey' could not be determined since some experimental bushes were lifted with the commercial crop and the labels removed. However, earlier measurements of basal breaks and shoot diameters indicated that the Cerone treatment would also have increased grade-out of this 'shy' cultivar.

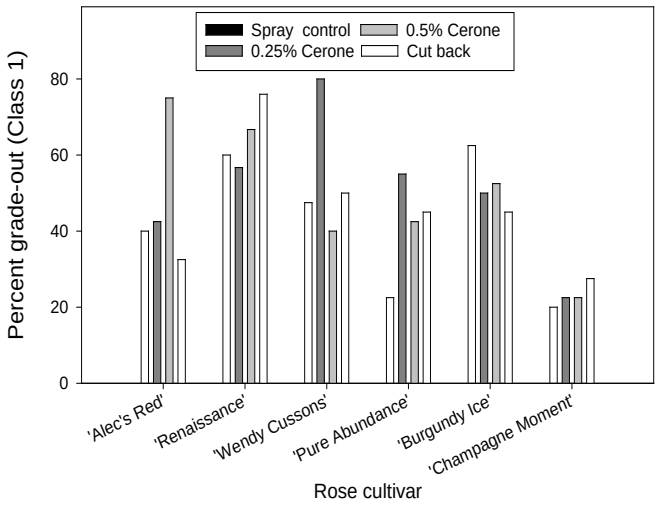

Figure GS3. Effect of Cerone sprays on grade-out of Hybrid Tea and Floribunda roses measured in February 2010 by nursery staff.

2010: Percentage grade-out from plants lifted in 2009 was increased from 40% to 75% in 'Alec's Red' and from 48% to 80% in 'Wendy Cussons' by the 0.5% and the 0.25% Cerone sprays, respectively (Figure GS3); percentage grade-out of 'Renaissance' and the three

Floribunda cultivars was not improved by the Cerone sprays. In the Class 1 plants, the mean number of basal breaks was significantly improved by both Cerone sprays in 'Wendy Cussons', compared to the untreated control and plants that were 'cut back'. Effects of Cerone on basal breaking in the Floribunda cultivars were not statistically significant.

Effects of Cerone on plant quality at the half- and full-growth stages

In 2009, the 'expert grower' scores awarded at the half and full-growth stages were generally similar, irrespective of treatment. The exception was 'Margaret Merril' at the half-growth stage when the experts awarded higher scores to plants from the untreated control; at the full-growth stage, plants from all treatments were given similar scores. In 2010, no treatment differences in overall quality were detected at the half-growth stage. At the full–growth stage, the experts preferred the Cerone-treated (Figure GS4) and the cut back 'Burgundy Ice' (these plants were shorter and more compact). Quality scores given to the other cultivars were similar, irrespective of treatment.

These data suggest that the overall quality of the Class 1 bushes was not adversely affected by Cerone sprays applied during the maiden year. In other words, there were no residual treatment effects on bud number or quality of the flowers.

Figure GS4. Cerone-treated (0.5%) 'Burgundy Ice' at full-growth stage. Photo taken on 16 June 2010.

Financial benefits

Improving basal breaking in 'shy' cultivars using Cerone has the potential to improve plant quality and grade-out in many Hybrid Tea roses, and reduce waste during production. Using a low volume, low concentration Cerone spray is likely to be very cost effective. Over 1,000,000 plants could be treated with just one 5 L container of Cerone costing £108.30, this equates to a chemical cost of 0.01 p per plant. Costs of application would vary depending on the grower's usual practice but increasing the grade-out of some cultivars by 30-35% would result in similar increases in wholesale value.

Action points for growers

- A low volume, targeted spray of Cerone at the SOLA rate of 1 litre per hectare in a minimum water volume of 125 litres plus wetting agent, applied at the 'shot' bud stage or at the end of the first growth flush could improve basal breaking and percentage grade-out in certain 'shy' Hybrid Tea cultivars (Table GS3).

- 'Tipping back' will help to improve the number of basal breaks produced, and therefore, the grade-out of some 'shy' breaking rose cultivars.

Table GS3. Summary of the effects of Cerone on grade-out in the rose cultivars examined

Cultivar	Class 1 grade-out improved	
	0.25% Cerone	0.5% Cerone
'Alec's Red'*	No	Yes
'Just Joey'*	NA	NA
'Wendy Cussons'*	Yes	No
'Renaissance'*	No	No
'Margaret Merril'**	No	No
'Mountbatten'**	No	No
'Champagne Moment'**	No	No
'Burgundy Ice'**	No	No
'Pure Abundance'**	No	No

*Hybrid Tea cultivars

**Floribunda cultivars

NA = not assessed, although earlier measurements of basal breaks and shoot diameters indicated that Cerone treatment would also have improved grade-out.

SCIENCE SECTION

Introduction

The accepted standard for Class 1 rose bushes requires a minimum of three strong shoots (basal or bottom breaks) originating from just above the graft union. However, at present only 60% of the ca. 12 million bushes propagated annually make this grade. Some so-called 'shy' breaking cultivars (cvs) produce only one or two breaks despite repeat pruning during production to try to stimulate branching. These roses often have other very desirable attributes such as large, fragrant blooms and improving the Class 1 grade-out of 'shy' cvs would help to increase the profitability of the industry and reduce wastage during production.

Ethylene releasing agents (ERAs) were used in glasshouse rose production in the 1970's at the former Glasshouse Crops Research Institute. A 1% solution of Ethrel C (2-chloroethylphosphonic acid) was used to stimulate basal bud outgrowth in cut flower production. Work carried out by Chris Burgess in HNS 101[1] showed that solutions of 1.5% Ethrel C applied to field-grown 'Margaret Merril' (a 'shy'-breaking cv.) increased basal breaking by up to 60%[3]. These trials were conducted in the final year of the project and so were not progressed further. Burgess concluded that that more knowledge was needed about the hormonal signals that interact to regulate the development of adventitious buds before techniques to manipulate bud outgrowth and increase the numbers of basal branches could be developed.

The use of Ethrel C was developed further at East Malling Research (EMR) in Defra project HH3715SHN[2] and in collaboration with Paul Chessum Roses (PCR). Ethrel C is a very effective defoliant and 'scorches' young, soft tissues so the timing of sprays during the first and second growth flushes was found to be critical. Dose response experiments conducted over three years showed that a single low volume spray of 0.25% Ethrel C solution consistently improved basal breaking in 'shy' cvs by 50% compared to plants that were pruned three times during the maiden year[3]. Following these very successful pot experiments, the Ethrel C approach needed to be developed further for use in commercial-scale field trials.

A recent attempt to use Ethrel C to improve branching in several HNS species was unsuccessful (HNS 154)[4]. However, severe symptoms of phytotoxicity developed in many of the species tested. Due to these disappointing results, the contract for HNS 154 was terminated. Our unpublished results[2] have confirmed that low volume, low concentrations of Ethrel C can promote bud outgrowth in *Cotinus coggygria* and *Photinia fraserii*. The potential of Cerone sprays to improve branching in high-value HNS species should perhaps be re-assessed following judicious dose response tests.

Knowledge of the hormonal changes underpinning the effects of ERAs is also important to maximise success. The changes in tissue hormone concentrations induced by the large burst of ethylene production that prompt the outgrowth of basal buds following treatment with Ethrel C have been determined in HH3715SHN[5]. Polar auxin transport is quickly eliminated following treatment with Ethrel C and this increases the export of cytokinins from *Rosa laxa* rootstocks. The increased delivery of cytokinins coupled with the reduced polar auxin supply presumably triggers the release from dormancy and subsequent outgrowth of adventitious buds.

At the beginning of this project, Ethrel C was expected to be withdrawn from use and so the effectiveness of other ERAs at promoting basal breaking needed to be tested. Cerone (Ethephon, 2-chloroethylphosphonic acid) was suggested by Mr John Adlam (personal communication) as an alternative ERA with the same active ingredient but in a slightly different formulation. Preliminary work conducted at EMR in 2008 confirmed that the burst of ethylene production following treatment of Hybrid T roses with Cerone was similar to that caused by the same concentration of Ethrel C. Thus, Cerone may be equally as effective as Ethrel C at promoting basal breaking in 'shy' rose cvs. If successful, the approach is likely to be very cost-effective. Currently, 5 L of Cerone costs £108.30 including VAT. This will make 2000 L of a 0.25% v/v solution which can treat 1,000,000 plants if 2 mL of solution is applied. This equates to a chemical cost of 0.01 p per plant. Our preliminary work using Ethrel C also suggests that low concentrations of an ERA can be used to induce leaf drop in rose before maiden bushes are lifted in autumn[2]. Chemical defoliation at this time could potentially be of great benefit to the UK rose industry but further work is needed to ensure that flower number and quality are not affected in the following season..

The potential of low volume, low concentrations of Cerone to improve basal breaking and product quality in 'shy' rose cultivars was determined in field trials at PCR. The use of ERAs to improve basal breaking will only be taken up by the industry if the approach is proved to be cost-effective, risk-free and can readily be integrated into commercial rose production. This project will provide that critical information. Paul Chessum Roses' 'in kind' contribution to this project underlines the level of grower interest and commitment to this work.

Format of the Final Report

The format will follow HDC guidelines on reporting procedures for Final reports, namely that previously reported work should be included in outline with the final year's work reported in detail. Full details of the experiments carried out in 2008-2009 can be found in the Annual Report for HNS 164.

Materials and methods

Application of Cerone sprays

Suitable shy breaking rose cvs were selected for the trial by Mr Paul Chessum (PCR). The Hybrid T roses 'Alec's Red', 'Renaissance'' and 'Wendy Cussons' and the Floribunda roses 'Pure Abundance', 'Burgundy Ice' and 'Champagne Moment' were budded on to *Rosa laxa* rootstocks in single rows at a field site at PCR (Montilliers Everton) (Figure 1). Experimental plots, each consisting of seven budded rootstocks, were staked out on 20 May 2009. There were eight experimental plots per treatment for each cv. with the exception of 'Renaissance' where there were five or six plots per treatment.

Figure 1. The field site at Paul Chessum Roses used to test the effectiveness of Cerone sprays on basal breaking in 2009. Photo taken on 24 June 2009.

Solutions of 0.25% or 0.5% v/v Cerone (containing a wetting agent [0.1% v/v Activator 90]) were applied on 24 June 2009 to the five plants immediately behind treatment labels, the two remaining plants in each plot served as guard plants. Control plants were sprayed with water containing the same concentration of wetting agent (0.1%) as the Cerone-treated plants. Sprays were applied directly to the lower 15 cm of stem using handheld 5 L Hozelock sprayers; approximately 2 mL of solution was applied to each plant. In the 'cutting back' treatment, all shoots were cut back to a height of 45 cm.

Routine measurements

The number of basal breaks was recorded on 15 July and 26 August 2009. Basal shoot diameters were measured with digital callipers at a point 10 cm above the graft union and heights of each stem were measured with a ruler. All plants at the site were cut back by PCR staff to 50 cm towards the end of the second growth flush (August 2009).

All experimental roses were lifted with the commercial crop and graded by PCR staff in October 2009. The number of Class 1 roses for each cv. was counted; these plants were then pruned and put into cold store. All bare-rooted bushes were potted into 4 L pots at PCR and moved to the holding beds in February 2010. Final counts of Class 1 bushes were carried out on 18 March 2010 and the number of basal breaks recorded for each cv. and treatment.

The roses were maintained on the container nursery and overall plant quality for each cv. and for each treatment was determined by PCR staff at the half- and full- growth stages using criteria developed in HNS 141.

Results

Effects of ERA on shoot morphology during the maiden year

Compared to spray controls and plants that had been cut back, the number of basal breaks was significantly increased by both Cerone concentrations in 'Alec's Red' and 'Wendy Cussons' and in 'Pure Abundance' and 'Burgundy Ice' (Figure 2). Cerone sprays did not improve basal breaking significantly in 'Renaissance' or 'Champagne Moment'. The diameter of the basal breaks was reduced significantly by both Cerone sprays in 'Renaissance' but not enough to affect quality at final grade-out (see below). Stem diameters were not affected by Cerone sprays in the other cvs, compared to spray controls and plants that had been cut back.

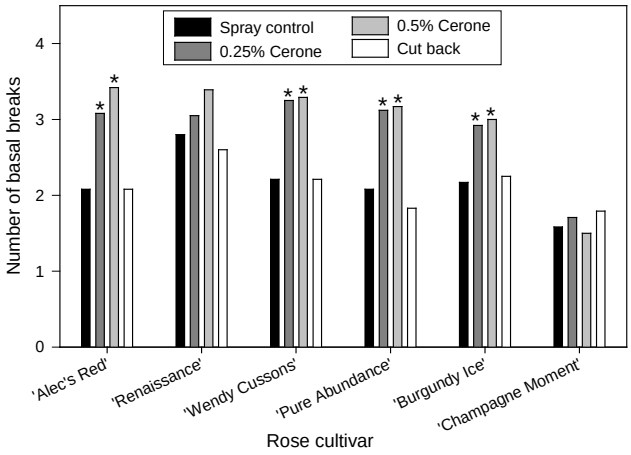

Figure 2. Effect of Cerone sprays on numbers of basal breaks in Hybrid T and Floribunda roses measured in the maiden year (26 August 2009). Results are means of eight replicate plants, except for 'Renaissance' where five or six replicate plants were measured. Asterisks indicate statistically significant differences ($p < 0.05$).

Effects of ERA on percentage grade-out

Percentage grade-out was increased from 40% to 75% in 'Alec's Red' and from 48% to 80% in 'Wendy Cussons' by the 0.5% and the 0.25% Cerone spray, respectively (Figure 3) but was not improved in 'Renaissance'. Grade-out was improved in Cerone-treated 'Pure Abundance' but not in the other two Floribundas. In these trials, cutting back improved percentage grade-out of 'Renaissance', 'Champagne Moment' and 'Pure Abundance', although the effect was often small.

In the Class 1 plants, the mean number of basal breaks was significantly improved by both Cerone sprays in 'Wendy Cussons' (Figure 4), compared to spray controls and plants that were cut back. Effects of Cerone on the number of basal breaks in Class 1 Floribunda cvs were not statistically significant.

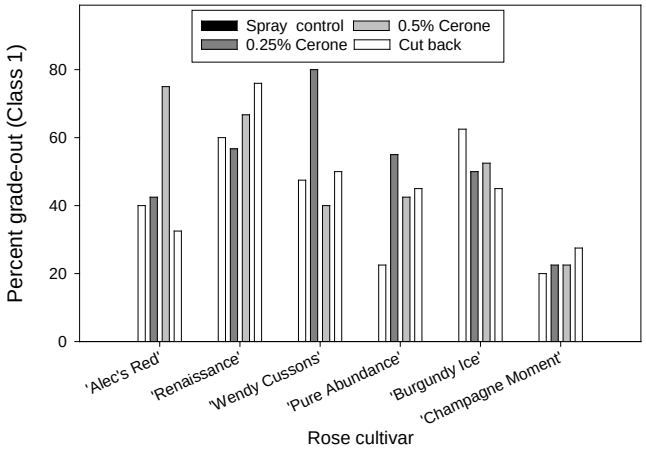

Figure 3. Effect of Cerone sprays on grade-out of Hybrid T and Floribunda roses graded in February 2010 by PCR staff.

Effects of ERA on plant quality at the half- and full-growth stages

2009: Plant heights, spread, flower bud number, any disorders and disease symptoms were recorded by EMR staff at the half-growth (13 May 2009) and full-growth (3 June 2009) stages. At the half-growth stage, plant height of 'Alec's Red' was significantly increased in Cerone-treated plants and significantly decreased by Cerone applications in 'Margaret Merril' (data not shown). Plant heights of 'Just Joey' and 'Mountbatten' were not affected by Cerone applications and plant spread was similar in all cvs, irrespective of treatment (data not shown). Significant effects on plant height in 'Alec's Red', 'Just Joey' and 'Mountbatten' were noted at the full-growth stage but plant spread was again similar in all treatments (data not shown). The 'expert grower' scores awarded at the half- and full-growth stages were generally similar, irrespective of treatment (data not shown). The exception was 'Margaret Merril' at the half-growth stage when the experts awarded higher scores to plants from the control treatment; at the full-growth stage, plants from all treatments were given similar scores.

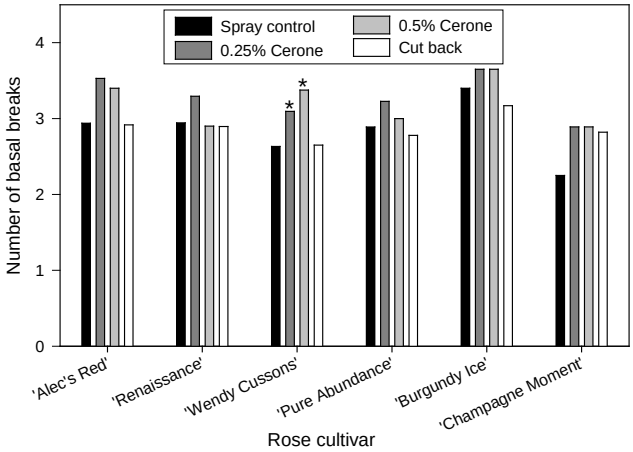

Figure 4. Effect of Cerone sprays on numbers of basal breaks in Hybrid T and Floribunda roses in grade 1 plants measured on 18 March 2010. Results are means of six replicate plants; asterisks indicate statistically significant differences ($p < 0.05$).

2010: No significant treatment effects on plant height were noted at the half-growth stage but the spread of 'Burgundy Ice' was significantly reduced by both Cerone treatments and the cutting back treatment (data not shown). These treatment differences on plant spread were not, however, apparent at the full-growth stage. Plant height was significantly increased in 'Wendy Cussons' by the 0.25% Cerone spray and the cutting back treatment, and significantly decreased in 'Burgundy Ice' by both Cerone sprays and the cutting back treatment (data not shown). The 'expert grower' scores awarded at the half- and full-growth stages were generally similar, irrespective of treatment (Figure 5). The exception was

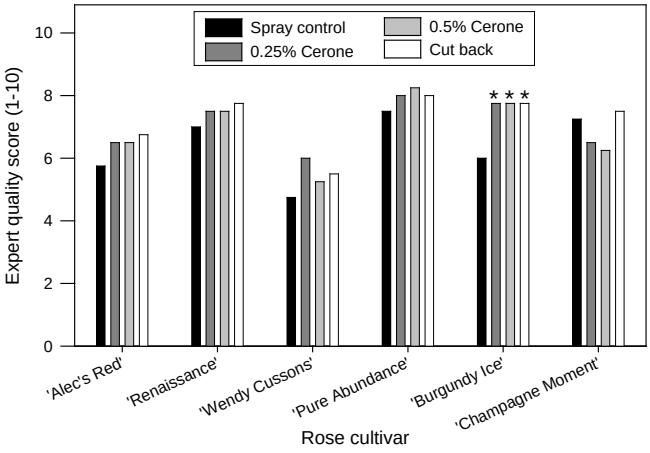

Figure 5. Effect of Cerone sprays and cutting back treatment on overall plant quality at the full-growth stage. Plant quality was scored from 1 to 10 (10 = excellent quality) by grower experts from PCR on 16 June 2010. Results are means of six replicate plants; asterisks indicate statistically significant differences ($p < 0.05$).

'Burgundy Ice' at the full-growth stage when the experts awarded higher scores to plants from the Cerone and 'cutting back' treatments.

Discussion

Over the two years of field trials, Cerone sprays increased basal breaking without reducing stem diameters in four out of five Hybrid T roses tested. This led to an improved percentage grade-out of up to 35% in some cvs. However, the optimum Cerone concentration differed between cvs; a concentration of 0.5% (with wetting agent) proved most effective at stimulating basal breaking in both years of the trial for 'Alec's Red' but a spray of 0.25 % was most effective in 2009-2010 for 'Wendy Cussons'.

Both Cerone spray concentrations improved the number of basal breaks in all Class 1 Hybrid T plants (see Figure 4), although the results were not necessarily statistically significant. Therefore, treatment with Cerone in the maiden year not only improved grade-out in some cvs but also the quality (*i.e.* number of basal breaks) of Class 1 plants. No residual effects of Cerone treatment in the maiden year were detected in the quality assessments made by the grower experts at the half- and full-growth stages. If Cerone can improve the grade-out and quality of other Hybrid Ts by the same extent as that demonstrated for 'Alec's Red' and 'Wendy Cussons' (and Just Joey' – see Annual Report 2009), this approach would deliver considerable financial benefits to the UK rose industry. However, the optimum Cerone concentration would need to be identified for each Hybrid T cv. to ensure consistent improvements in percentage grade-out. The consistent and positive response of 'Alec's Red' over two growing seasons to the 0.5% Cerone spray suggests that an optimum concentration for each cv. could be determined over just two growing seasons.

The effects of the Cerone sprays on the propensity for basal breaking in two of the three Floribunda roses was encouraging when measurements were made eight weeks after spray applications (see Figure 2) but percentage grade-out was improved only in 'Pure Abundance'. The average number of basal breaks was improved in the Class 1 bushes but the effects were small and not statistically significant. Both Cerone sprays and the cutting back treatment significantly improved the perception of quality of 'Burgundy Ice' by the grower experts at the full-growth stage; this may have been due to the reduction in plant height (by 10 -12 cm) caused by all three treatments. A shorter, more compact bush may have been visually more appealing.

The two Cerone concentrations used in this trial (0.25% and 0.5%) also failed to improve basal breaking in two other Floribundas, 'Margaret Merril' and 'Mountbatten' (see Annual Report 2009). This was surprising since our Defra work showed repeatedly that similar concentrations of Ethrel C promoted basal breaking by up to 40% in 'Margaret Merril'. The promotive effect of the sprays noted after eight weeks and the slight reduction in bud number in Cerone-treated

'Margaret Merril' measured in 2009 implies that the sprays did have a physiological effect but grade-out was not improved in four out of five Floribunda roses ('Pure Abundance' being the exception). The reasons for this lack of response are not known but may have arisen from the switch from Ethrel C to Cerone. We had intended to conduct pot experiments comparing Ethrel C with Cerone in the first year of this project to identify optimum concentrations of Cerone for Hybrid Ts and Floribundas. However, we were advised by the HDC Panel to proceed directly with Cerone in the field trials at PCR. Our comparative tests carried out in the Defra project on containerised 'Just Joey' and 'Margaret Merril' showed that the promotive effects of Ethrel C or Cerone on the numbers of basal breaks were similar in both cvs. However, higher concentrations of Cerone may be needed to affect shoot morphology in field-grown plants, as suggested by Burgess *et al*. (2001). Alternatively, two applications, one at the beginning and one at the end of the first growth flush, may be needed to improve basal breaking in Floribunda roses. Further trials are needed to test this approach. For Hybrid T roses in our trials, the timing of sprays relative to developmental stage did not affect greatly the propensity for basal breaking; 'Alec's Red' responded equally well to 0.5% Cerone applied either at the beginning or the end of the first growth flush.

The 'tipping back' or 'cutting back' treatment practised at PCR improved numbers of basal breaks produced in each of the cvs that were measured in 2008-2009 but improved percentage grade-out in only some of the cvs tested in 2009-2010. Burgess (2001) reported no effects of 'tipping back' on the propensity to form basal breaks in 'shy' cvs during a one year field trial at Efford. Again, the response to this treatment seems to be cultivar-dependent.

Conclusions

Cerone sprays increased basal breaking and grade-out in four out of five Hybrid-T cvs but not in Floribunda roses. The cutting back treatment practised at PCR also improved percentage grade-out in some cvs. The extent to which Cerone increases the propensity for basal breaking and the subsequent percentage grade-out appears to be dependent on cultivar and it has not been possible in this project to identify a Cerone concentration that would effectively improve basal breaking and grade-out in all Hybrid T cvs. Further field trials would be necessary to identify the Cerone concentration(s) that improve the propensity for basal breaking in Floribunda roses.

Technology transfer

The project aims, objectives and results to date were delivered in a spoken presentation at the HTA/HDC Roses Research and Development Forum held at NIAB on 4 December 2008. An article for HDC News is currently being prepared.

Glossary

Blow out – breaking of the scion shoot from the bud union, caused by high winds in the maiden year.

Cutting back – removing mature stems in the first and second growth stages to stimulate basal breaking and reduce 'blow out'

Ethylene releasing agent (ERA) – a chemical that when sprayed on to plants, readily enters plant tissues and breaks down to form the natural gaseous plant hormone ethylene. Endogenous ethylene production is stimulated further by ERAs.

Tipping back – pruning the first flush of shoot growth from the scion bud to stimulate basal breaking and reduce 'blow out'

References

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