

APRC PROJECT REPORT

Project SP105: Evaluation of new thinning chemicals
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A. Experiments on Royal Gala in 1998:

A1. Comparison of three formulations of benzyl adenine (a fruitlet thinning chemical) with ATS (a blossom thinning chemical) on Royal Gala.

Eight-year-old Royal Gala/M.9 trees planted at HRI-East Malling were used to compare three different products containing benzyl adenine. These were Paturyl (manufactured in Hungary), Perlan (Fine Agrochemicals Ltd) and Accel (Abbot Laboratories Ltd). The Accel product also contained GA₄₊₇. The product specifications are shown in Table 1.

All sprays were applied when fruitlets were 12 mm in diameter and compared with hand-thinned (single fruit/cluster) or unsprayed controls. A flower thinning treatment of 1.0% ammonium thiosulphate (ATS) applied at full bloom was also included in the trial. Sprays were applied to run-off using a knapsack sprayer (approximately 0.5 litres/tree or 640 litres/ha) and most of the sprays contained 0.1% Tween 20 surfactant.

Table 1. Products used in thinning trials A1. and B1 on Royal Gala and Jonagold

Trade name	% active ingredient	Concentration(s) (a.i.)	Wetter +/-*
ATS	98-100% ammonium thiosulphate	1.0%	+
Paturyl (D4017)-BA	10% benzyladenine (BA)	100 ppm BA	+
Perlan-BA	2% benzyladenine purine	100 ppm BA	+
Accel-BA	1.8% N-(phenylmethyl)-1H-purine 6 amine 0.18% Gibberellins A ₄ A ₇	100 ppm BA	-
*Tween 20	Polyoxyethylene sorbitan monolaurate at 0.1%.		

Table 2 shows that only the ATS treatment and the hand thinning treatment reduced significantly the final fruit sets per 100 flower cluster or per trunk cross sectional area.

Table 2. The influence of ATS and BA sprays on fruit set and yields of Royal Gala in 1998

Treatment	Final fruit set		Yields/tree		Mean fruit wt (g)
	/100 flower cluster	/trunk CSA	total (kg)	% Class 1 >65 mm Ø	
Control	146	15.0	24.5	11.5	94
Hand-thin	52	6.5	12.8	59.4	125
ATS-1.0%	84	8.7	17.3	43.4	110
Paturyl-BA	140	12.5	25.2	39.7	101
Accel-BA	132	12.8	26.5	30.8	109
Perlan-BA	126	11.6	26.1	29.7	112
LSD (5%)	36.6	2.8	6.9	15.6	12.5

Total yields/tree were also reduced by hand thinning and the ATS treatment but the BA treatments had no effect on total yields/tree.

All the treatments increased significantly the % of Class 1 >65 mm diameter fruits harvested and the Paturyl-BA treatment was particularly effective, increasing almost 3-fold the weight of fruit/tree harvested in this category. These benefits of the treatments are also reflected in the effects on mean fruit sizes.

The beneficial effects of hand thinning and the ATS blossom thinning treatment on fruit size are attributable quite clearly to their thinning effects. However, final fruit set levels were not reduced by the BA treatments and their benefits on fruit size are more difficult to explain. There are two possible alternatives 1) the BA sprays stimulated fruitlet thinning earlier in the season than achieved by hand thinning or 2) BA has a direct effect on cell division and/or expansion in fruits.

A2. Evaluation of combined blossom and fruitlet thinning treatments on Royal Gala

Eight-year-old Royal Gala/M.9 trees planted at HRI-East Malling were also used for this experiment. The treatments are shown in Table 3. The objective was to test the benefits of thinning strategies that combined both blossom thinning (using ATS) applied at different timings, with fruitlet thinning, either by hand (to single fruits/cluster) or using Perlan-BA.

Table 3. Thinning treatments applied to Royal Gala and Jonagold trees on M.9 rootstock in trials A2 and B2.

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1. Control - untreated.
 2. Hand thin to single fruitlets. Remove all fruitlets from axillaries.
 3. 0.5% ATS at full bloom on old wood.
 4. 0.5% ATS at full bloom on old wood + Hand thin at 10-12 mm fruitlet stage.
 5. 1.0% ATS at full bloom on old wood.
 6. 1.0% ATS at full bloom on old wood + Hand thin at 10-12 mm fruitlet stage.
 7. 100 ppm Perlan-BA at 10-12 mm fruitlet stage.
 8. 0.5% ATS at full bloom + Perlan-BA at 10-12 mm fruitlet stage.
 9. 1.0% ATS at full bloom + Perlan-BA at 10-12 mm fruitlet stage.
 10. 0.5% ATS (x2) at full bloom on old wood and again at full bloom on axillary wood.
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Table 4 shows that all the treatments, except ATS 0.5% (3) and Perlan-BA (7) applied singly, reduced final fruit set. Treatments that included hand thinning had the most severe effect on final set values. None of the treatments that combined ATS with Perlan BA reduced final set values as much as the treatments including hand thinning.

Total yields/tree were also reduced by all treatments that included hand-thinning and also by the ATS 1.0% (5) ATS 0.5% x 2 (10) and ATS 1.0% + Perlan BA (9) treatments. Yields/tree of Class 1 >65 mm diameter fruits were increased significantly by hand thinning. ATS applied at 0.5% or 1.0% appeared to increase yields of Class 1 >65 mm Ø fruits slightly, but the effect was not statistically significant and combinations of ATS with hand thinning produced similar responses. The most promising treatments on the evidence of this trial were those which combined ATS with Perlan BA (treatments 8 and 9). Yields of Class 1 >65 mm fruits from trees receiving these treatments were almost twice those on the unsprayed controls. Also beneficial and worthy of further testing was the treatment using two sprays of ATS at 0.5% (10).

Table 4. The effects of thinning treatments applied in trial B2. on the fruit set and yield of Royal Gala trees in 1998.

Treatment	Final fruit set		Yields		Mean fruit wt (g)
	/100 floral buds	trunk CSA	total wt/tree (kg)	wt of Class 1 >65 mm Ø	
1. Control unsprayed	183	14.9	27.7	6.8	101
2. Hand-thinned (HT)	66	6.0	14.2	10.9	138
3. ATS 0.5%	150	12.0	23.8	8.8	107
4. ATS 0.5% + HT	54	4.3	12.3	9.0	147
5. ATS 1.0%	106	10.6	19.2	9.1	119
6. ATS 1.0% + HT	44	3.1	10.1	8.1	154
7. Perlan-BA	178	13.7	26.7	10.8	112
8. ATS 0.5% + Perlan-BA	131	10.9	23.7	12.5	122
9. ATS 1.0% + Perlan-Ba	105	8.6	21.2	13.0	130
10. ATS 0.5% x 2	109	9.3	22.2	11.0	120
LSD 5%	38.7	3.63	5.77	3.63	14.9

A3. Evaluation of 'Armothin' as a blossom thinner on Royal Gala

Armothin is a 98% fatty amine polymer manufactured and sold by the Akzo Nobel Company. It has been used successfully to thin stone fruits in Italy and is now being tested as a flower thinner for apples in several different countries. Reports from abroad suggest that in some trials the product causes russeting and supplementary sprays of GA₄₊₇ (Regulex or Novagib at 10 ppm) are recommended to reduce this deleterious side effect.

In 1998, the product was applied at 0.5% at several timings during the blossoming period to 8-year-old Royal Gala trees planted at HRI-East Malling. Supplementary sprays of Novagib were applied four times to some of the treatments to prevent russeting. The effects on final fruit set and total yields were small and not significantly significant. Although several of the treatments appeared to increase yields/tree of Class 1 >65 mm Ø fruits, the trees were very variable in response and these effects were not statistically significant (Table 5).

Table 5. Influence of sprays of Armothin \pm Novagib on yields and fruit grades of Royal Gala in 1998

Treatment/Treatment	Final set/ 100 floral buds	Yields/tree (kg)	
		Total	Class 1 >65 mm \emptyset
1. Control	86	26	2.7
2. Hand thin	44	18	7.4
3. Armo. at balloon stage	81	23	5.6
4. Armo. at full bloom + 5 days	69	23	5.7
5. Armo. at full bloom + 10 days	61	20	5.4
6. Armo. at balloon + Novagib	76	20	2.3
7. Armo. at full bloom + 5 days + Novagib	65	22	5.6
8. Armo. at full bloom + 10 days + Novagib	81	20	5.1
9. Novagib	103	24	1.8
LSD	NS	NS	NS

NS = treatment effects not statistically significant

Armothin was more effective as a thinner in another trial conducted in 1998 and warrants further evaluation in the future.

B. Experiments on Jonagold 1998

B1. Comparison of three formulations of benzyl adenine with ATS as thinning chemicals for Jonagold.

Eight-year-old Jonagold trees on M.9 rootstock planted at HRI-East Malling were used for this trial in 1998. The materials and methods used were similar to the first trial described above on Royal Gala (Table 1).

Hand thinning had the most severe effect on final fruit set (Table 6) although all the BA treatments also reduced slightly final set/100 floral buds.

Table 6. The influence of ATS and BA sprays on the fruit set and yields of Jonagold in 1998

Treatment	Final set/100 floral buds	Yields/tree (kg)		Mean fruit wt (g)
		Total	Class 1 >90 mm	
Control	62	39	0.2	186
Hand-thin	34	29	7.8	262
ATS 1.0%	62	39	2.1	201
Paturyl-BA	51	37	5.5	223
Accel-BA	43	32	7.5	238
Perlan-BA	52	37	4.4	219
LSD	8.0	6.8	2.85	18.2

Total yields/tree were reduced by hand-thinning and also slightly by the Accel treatment. Yields of Class 1 >90 mm fruits were highest on the hand-thinned and Accel-sprayed trees although all the treatments, except ATS, had a beneficial effect on the size grade out and also on mean fruit size.

B2. Evaluation of combined blossom and fruitlet thinning treatments on Jonagold.

The treatments were identical to those described previously for Royal Gala under Section A2 (Table 3). Final fruit set/100 floral buds was reduced most by the treatments that included hand thinning (Table 7).

Table 7. The effects of thinning treatments applied in 1998 on the fruit set and yields of Jonagold

Treatment	Fruit set/100 floral buds	Yields/tree (kg)		
		Total	Class 1 >90 mm	Mean fruit wt (g)
1. Control unsprayed	57	44	0.2	179
2. Hand-thinned (HT)	26	29	9.1	260
3. ATS 0.5%	53	40	0.8	176
4. ATS 0.5% + HT	13	15	5.8	264
5. ATS 1.0%	48	39	1.1	190
6. ATS 1.0% + HT	10	11	4.6	265
7. Perlan	50	42	2.0	190
8. ATS 0.5% + Perlan	47	42	5.1	208
9. ATS 1.0% + Perlan	36	34	5.0	219
10. ATS 0.5% x 2	48	39	2.2	194
LSD 5%	8.0	7.8	2.2	18.8

ATS at 1.0% (treatment 5) but not 0.5% (treatment 3) also reduced final set slightly. Both concentrations of ATS reduced final set when combined with Perlan as did ATS 0.5% applied twice. Total yields/tree were reduced by all the treatments except ATS 0.5% (3), ATS 1.0% (5), Perlan (7), ATS 0.5% + Perlan (8) and ATS 0.5% x 2 (10). Yields of Class 1 fruit >90 mm were increased most by hand thinning (2) but smaller increases were also induced by all of the treatments combining ATS with either Perlan or hand thinning.

C. Comparison of three formulations of ATS as blossom thinner for Queen Cox, Bramley's Seedling and Jonagold.

Two formulations of ATS are sold as fertilisers on the UK market; these are Thiosul (Hydratek) and F.3000 (Phosyn). A third formulation is marketed on the European mainland by the Common Market Fertiliser Company (CMF). Small trials were conducted in 1998 to compare the efficacy of these three formulations applied at 1.5% a.i. as blossom thinners for Queen Cox, Bramley's Seedling and Jonagold apple varieties.

The results are shown in Table 8.

Table 8. The comparative effects of three formulations of ATS in thinning three apple varieties in 1998

Variety	ATS formulation	Fruit set/100 floral buds	Yields/tree (kg)	
			Total	Class 1*
Queen Cox	CMF	36	9	6.2
	Thiosul	52	12	8.7
	F3000	51	12	9.8
	Control - none	97	16	6.5
Bramley	CMF	77	25	12.0
	Thiosul	84	28	12.2
	F3000	85	26	11.0
	Control - none	104	29	10.2
Jonagold	CMF	40	23	2.8
	Thiosul	49	26	10.0
	F3000	49	27	1.6
	Control - none	52	28	1.6

* Class 1 sizes were >65 mm on Queen Cox, >80 mm on Bramley and >85 mm on Jonagold.

All three formulations of ATS thinned Queen Cox and the CMF formulation induced the most severe effect. Yields of Class 1 >65 mm fruits were highest from the trees sprayed with either Thiosul or F3000. The CMF formulation also caused slightly more thinning of Bramley than the other two formulations. All three formulations improved the grade-out of Bramley slightly. The CMF formulation was the only one to reduce significantly the set of Jonagold and this also was the only treatment to increase fruit size on this variety.

D. Thinning trial on Conference Pear in 1998

A variety of thinning chemicals was tested on mature (19-year-old) trees of Conference/QC planted at HRI-East Malling. ATS was applied (2.0%) at full bloom, benzyl adenine (Perlan or Paturyl at 200 ppm) at 11 mm fruitlet diameter, Armothin (0.5%) 5 days after full bloom, or Cultar (300 ppm) at full bloom.

The results are shown in Table 9.

Table 9. The influence of thinning treatments on fruit set and yields of Conference Pear in 1998.

Treatment	Fruit Set/100 floral buds	Fruit yields/tree (kg)		
		Total	Class 1 >65 mm Ø	Mean fruit wt (g)
Control unthinned	60	15	0.2	111
Hand-thinned to 3 fruits/cluster	52	14	0.4	111
ATS	28	9	0.9	136
Paturyl-BA	48	12	0.7	112
Perlan-BA	49	14	0.5	119
Armothin	21	8	2.0	155
Cultar	39	9	1.1	121
LSD	14.6	3.4	0.63	20.6

The most severe reductions in final fruit set were achieved using ATS (2.0%) or Armothin (0.5%) as blossom thinners. Sprays of Cultar at full bloom also reduced final set significantly. Total yields were reduced by the same three treatments. Yields of Class 1 >65mm Ø fruits were disappointing in this orchard but were increased significantly by the Armothin treatment and to a more limited degree by the ATS sprays. These two treatments also increased the mean weight of harvested fruits. The Perlan-BA and Paturyl-BA treatments had no effect on size of Conference fruits in 1998.

Conclusions

The project has demonstrated clearly the efficacy of ammonium thiosulphate as a blossom thinner for apple varieties. Further work should focus on timing and targeting of the sprays over the blossom period. Other products tested as blossom thinners, such as Armothin and Wilthin require further development work. Benzyl adenine shows promise as a fruitlet thinner, for application at the 12 mm stage. If carbaryl (Thinsec) is withdrawn for use as an apple thinner, as seems likely in the future, the industry will need to lobby to get a formulation of benzyl adenine cleared for UK use as an apple thinner.

Combined treatments, using a blossom thinner followed by a fruitlet thinner show preliminary promise but require further development.

Project SP 105 has now terminated and a final report summarising the results of all the work will be prepared.