

Fruit thinning

VI. Further experiments on chemical thinning of the apple cultivar 'Summerred'

Frugtudtynding

VI. Fortsatte forsøg med kemisk udtynding af æblesorten 'Summerred'

J. GRAUSLUND

Summary

NAA at three concentrations: 7.5, 15 and 30 ppm with or without the addition of 750 ppm carbaryl were applied at petal fall to the same trees for a period of three years. On average, the effects of the two chemicals seem to be largely additive, and a mixture of 7.5 ppm NAA and 750 ppm carbaryl gave fairly good thinning. Ethepon applied at

balloon stage or early flowering had a strong thinning effect, which decreased by application later in the flowering period. Application at petal fall may reduce fruit growth. Lime sulphur applied at full bloom produced some thinning, which could be increased by a supplementary treatment with NAA at petal fall.

Key words: Chemical fruit thinning, NAA, carbaryl, ethepon, lime sulphur.

Resumé

Sprøjtning med tre koncentrationer af NAA: 7,5, 15 og 30 ppm (svarende til 0,05, 0,10 og 0,20 pct. Pomoxon) med eller uden 750 ppm carbaryl blev udført i tre år på de samme træer. Virkningen af de to udtyndingsmidler synes at være additiv, og en blanding af 7,5 ppm NAA + 750 ppm carbaryl gav en tilfredsstillende virkning. Ethepon havde en stærk virkning ved sprøjtning på ballon-stadiet

og ved begyndende blomstring, men mindre virkning, når sprøjtningen blev udført ved afblomstring. Ved dette udviklingstrin kan ethepon-sprøjtning hæmme frugtens vækst. Svovlkalk har nogen udtyndingsvirkning ved sprøjtning i fuld blomst. Supplerende sprøjtninger på de samme træer med NAA ved afblomstring forøger virkningen.

Nøgleord: Kemisk frugtudtynding, NAA, carbaryl, ethepon, svovlkalk.

Introduction

Satisfactory chemical thinning of some apple cultivars is very difficult to achieve. Since hand thin-

ning is very costly, there is a need for better chemical thinning methods. The cultivar 'Summerred' often needs heavy thinning to ensure regular

bearing and good fruit size. Preliminary results of experiments on the effect of NAA and carbaryl and combinations of these chemicals have been reported (3). This paper reports on further experiments on NAA, carbaryl and ethephon as chemical thinning agents for 'Summerred'.

Materials and methods

Orchards

- A. 8 year old trees on M 26 at the start in 1979 (= A in (3)).
- B. 8 year old trees on MM 106 at the start in 1979.
- C. 7 year old trees on M 26 at the start in 1985.

All trees were spaced at 5×2 m.

Experiment 1. There were 8 treatments consisting of 0, 7.5, 15 and 30 ppm NAA with or without the addition of 750 ppm carbaryl to the NAA-solution. Applied as dilute sprays to runoff 1-3 days after 100 p.c. petal fall to the same trees in 1979, 1980, and 1982. No treatment was given in 1981 due to spring frost. 10 trees per treatment in single tree plots. Orchard A.

Experiment 2. A mixture of 7.5 ppm NAA and 750 ppm carbaryl was applied 1-3 days after 100 p.c. petal fall as a dilute spray. The treatment was applied to the same trees for three years (1979, 1980, 1982). 15 trees per treatment in single tree plots. Orchard B.

Experiment 3. Ethephon at three concentrations (250, 500, 750 ppm) was applied at 10 p.c. open flowers as a dilute spray. 15 trees per treatment in three 5-tree blocks. Orchard B. 1978.

Experiment 4. Ethephon at 300 ppm was applied at 4 stages of flower development as a $10 \times$ concentrate spray. The same trees were treated

for two years (1985, 1986). 14 trees per treatment divided in 2 blocks. Orchard C.

Experiment 5. Five treatments consisting of:

- A. Control.
- B. 5 p.c. lime sulphur at full bloom.
- C. As B + 7.5 ppm NAA at petal fall.
- D. As C + 750 ppm carbaryl at 15 mm fruit diameter.
- E. Mixture of 7.5 ppm NAA + 750 ppm carbaryl at petal fall.

The sprays were applied at $5 \times$ concentration. 24 trees per treatment divided in 4 blocks. Orchard A and B.

Spray volume

Dilute sprays refer to volumes of approximately 2000 l/ha and were applied with a hand gun.

Five and ten times concentrate sprays refer to volume of approximately 400 and 200 l/ha, respectively, and were applied with an air mist blower. All statements of concentrations refer to the dilute solution.

Chemicals

NAA (1-naphthylacetic acid) (Pomoxon).

Carbaryl (1-naphthyl N-methylcarbamate).

Ethephon (2-chloroethylphosphonic acid) (Ethrel 480).

Lime sulphur (a product with a specific gravity of 1.25 (30 Baumé) was used).

Measurements

Blossom density was rated on a 0-10 scale, 10 being equal to 100 p.c. spurs flowering. Fruit yield and fruit size (50 fruit samples) were determined for each tree. In some experiments all fruits from each treatment were size graded.

Data was analysed by analysis of variance.

Table 1. The effect of a mixture of 7.5 ppm NAA and 750 ppm carbaryl applied shortly after petal fall on total yield, and yield of large fruits. The treatment applied to the same trees every year. No treatment in 1981. Exp. 2.

Treatments	1979	1980 ¹⁾	1981	1982	Average
	Total kg/tree				
Control	53	34	43	49	45
Treated	46	39	46	48	45
LSD	n.s.	n.s.	n.s.	n.s.	-
	Fruits over 60 mm, kg/tree				
Control	12	27	31	36	27
Treated	18	36	32	41	32

1) Additional fruit thinning by hand: Control 127, treated 35 fruits per tree.

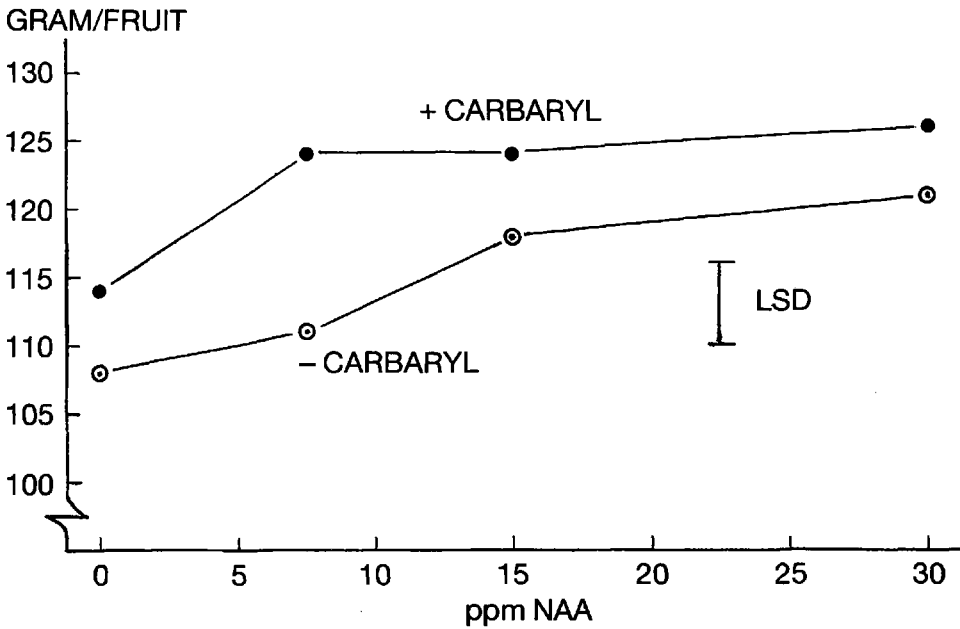
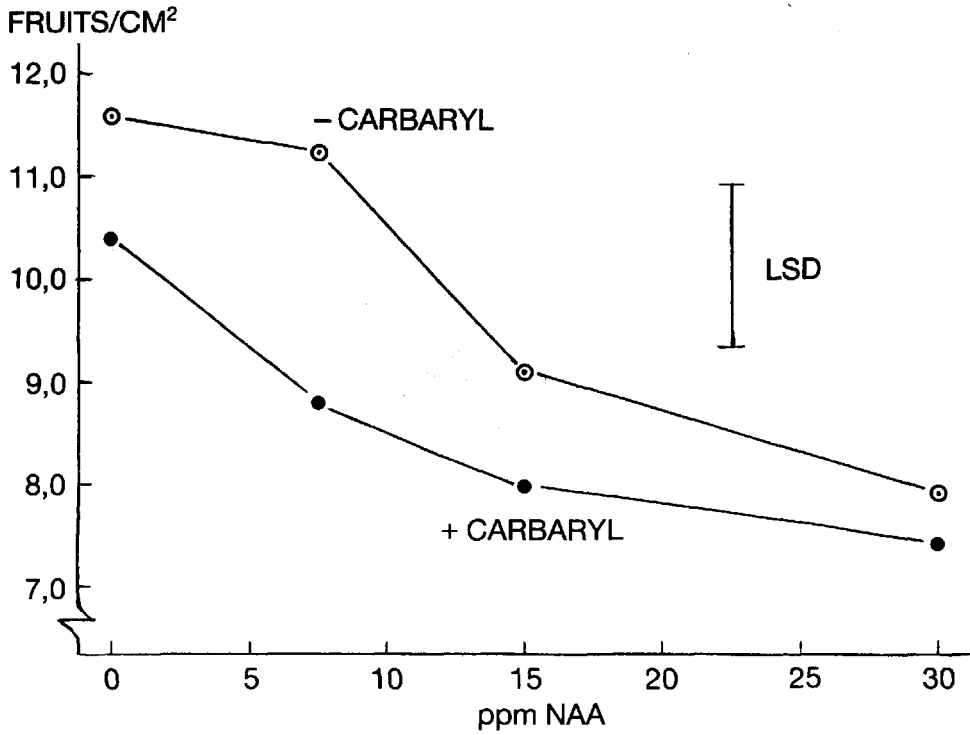


Figure 1. The effect of three rates of NAA with or without the addition of 750 ppm carbaryl on number of fruits per cm² of trunk cross sectional area and fruit weight. Average of three years results. Treatments were applied to the same trees every year 1-2 days after petal fall. Exp. 1.

Table 2. The effect of three concentrations of ethephon applied at 10 p.c. open flowers on yield and fruit size. Exp. 3.

Treatment ppm ethephon	kg/tree		g/fruit	Additional thinning by hand fruits/tree
	total	over 60 mm		
0	38	19	92	370
250	34	22	96	291
500	33	27	106	235
750	18	17	144	74
LSD	5	—	6	49

Results and discussion

NAA and carbaryl-combinations

Results of treatments with three concentrations of NAA, with or without the addition of 750 ppm carbaryl, are shown in Fig. 1. Fruit number was significantly reduced by both chemicals leading to significant increases in fruit size. 30 ppm NAA, with or without carbaryl, overthinned some trees, especially in the first year. The apparent interaction between NAA and carbaryl in the first year (3) was not found in the two last years. Therefore it is likely that the effects of the two chemicals are largely additive as suggested by *Looney* and *McKellar* (7). The combination of 7.5 ppm NAA and 750 ppm carbaryl was tested in another block for 4 years, Table 1. Fairly good thinning was obtained, although additional hand thinning was sometimes necessary. Without loss of total yield thinning increases the yield of large fruits by 19 p.c.

Ethephon

Ethephon at 250–500 ppm thinned only moderately in the first experiment, Table 2. 750 ppm

ethephon overthinned some trees, especially on old branches, while too many fruits remained on young branches, so some hand thinning was necessary. Trees receiving the high concentration became strongly biennial (data not shown).

The second application shows that timing of ethephon application is very crucial, Table 3. Most thinning was obtained after the early spray at the balloon stage. Spraying at petal fall probably did not thin at all and seemed to inhibit fruit growth. Reduced thinning activity of ethephon during the flowering period has been found in early experiments on 'Summerred' (6). Inhibition of fruit growth after ethephon treatment has also been a concern in other experiments (2, 5).

Ethephon-treated trees had more bloom in the following year, and the treatment at the balloon stage again had a strong thinning effect, while spraying at full bloom or petal fall was ineffective in reducing fruit set.

The effect of 300 ppm ethephon in this experiment was apparently greater than similar concentrations in the previous one (Table 2), possibly due to the use of concentrate sprays (1).

Table 3. Yield and fruit size following treatment with 300 ppm ethephon at four stages of flower development. The same trees received the same treatment both years. Exp. 4.

Development stage	kg/tree		g/fruit		kg/tree over 60 (70) mm		Blossom density (0–10). 1986
	1985	1986	1985	1986	1985	1986	
Control	48	24	101	112	37(2)	21(2)	2.7
Balloon	38	21	120	146	35(11)	20(11)	6.2
10 p.c. open flowers ¹⁾	40	43	118	90	37(9)	27(0)	6.9
Full bloom	41	34	105	95	35(3)	19(1)	5.5
Petal fall	44	30	90	93	26(1)	12(1)	4.4
LSD	8	7	7	9	—	—	1.1

1) Treatment applied at full bloom in 1986.

Table 4. Yield and fruit size after treatment with lime sulphur, NAA and carbaryl. Trees with high blossom density. Exp. 5.

Treatment	kg/tree		g/fruit
	Total	over 60 mm	
A. Control	69	27	89
B. 5 p.c. lime sulphur at full bloom	63	36	96
C. As B + 7.5 ppm NAA at petal fall	61	41	104
D. As C + 750 ppm carbaryl at 15 mm fruit diameter	54	39	108
E. Mixture of 7.5 ppm NAA + 750 ppm carbaryl at petal fall	61	40	101
LSD	8	-	5

However, it is very difficult with certainty to relate differences in thinning effect to water volume or to different stages of flower development alone, since thinning response to ethephon is very temperature-dependent. In 'Golden Delicious' thinning increased strongly with increasing temperature from 12 to 24°C (4). In the present experiments average temperature during the flowering period was 16.5°C (Table 2), 15.6 and 12.1°C in 1985 and 1986 respectively (Table 3).

Multiple sprays

One treatment is often insufficient to produce the desired level of thinning, perhaps due to unfavourable weather conditions at the time of spraying. Repeated applications of carbaryl did not give greater thinning than one spray (3). Another approach was investigated by using multiple sprays on the same trees consisting of a bloom spray of lime sulphur, followed by a low concentration of NAA at petal fall and finally carbaryl at 15 mm fruit diameter.

Lime sulphur is a caustic material used to thin plums, and was chosen in order to find an alternative to ethephon. The results show that lime sulphur has some thinning effect, Table 4. Treating the same trees again at petal fall with NAA removed more fruits, and inclusion of a third spray (carbaryl) one week later tended to produce the strongest thinning. The results indicate the possibility of regulating thinning level by using multi-

ple sprays, which also gives greater opportunities than relying on only one treatment. However, in this experiment treatment with a mixture of 7.5 ppm NAA and 750 ppm carbaryl produced equally good thinning.

Literature

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