# THINNING OF 'KATJA' APPLE TREES WITH CHEMICALS AND MANUALLY

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A B S T R A C T

'Katja' apple trees were sprayed with Pomonit R10, at a concentration of 30 mg/l of potassium salt NAA; Ethrel 480 SL, at a concentration of 12 mg/l of etephon, and urea at a concentration of 4%. The trees were sprayed three times: at full bloom, directly after blooming and when the fruitlets were between 8-10 mm in diameter. As well as the treatments mentioned above, manual thinning was applied as BA spraying, at a concentration of 150 mg/l, at the stage when fruitlets were between 10-12 mm in diameter. Good effects of fruitlets thinning were obtained by the application of Ethrel 480 SL directly after blooming. A somewhat worse effect, but also satisfactory, was obtained as a result of the application of BA and urea, directly after blooming and when the fruitlets were between 8-10 mm in diameter. A similar effect resulted from the application of Pomonit R10, when the trees were in full bloom. Pomonit applied directly after blooming and when the fruitlets were between 8-10 mm in diameter caused opposite effects to thinning. Comparing the sum of fruit yield for three years of treatments, it was shown that the highest yield was obtained in combination with manual thinning, and that the mean weight of fruit was also the highest. Spraying with NAA, directly after blooming and when the fruitlets were between 8-10 mm in diameter resulted in increased fruit set, as compared to manual thinning and to the control.

**Key words:** fruitlet thinning, BA, NAA, urea, etephon

## INTRODUCTION

Naphtylacetic acid (NAA) was first applied for apple fruit thinning in 1930s and is still commonly used today. In Poland it is most frequently known under the commercial name Pomonit R10, containing 10% potassium salt NAA and Pomonit Super 050 SL (Basak, 1999). However, fruitlets thinning with NAA can be fallible, so its use requires careful research into the conditions and the dates on which it can be applied.

Preparations containing NAA are administered in orchards with integrated production of fruit in order to regulate the fruiting (Mochecki, 2005).

In Poland, research conducted on fruitlets thinning of 'Šampion' apple trees have given good results with the application of Etephon (commercially known as Ethrel 480 SL), and urea. Regarding this, Ethrel 480 SL not only favorably influenced thinning but also the diameter of the fruit (Poniedziałek et al., 2002). It is a positive effect given that the optimal commercial diameter of apples on the western market includes, within acceptable limits, between 70-75 mm for medium-fruit cultivars, and 75-80 mm for big-fruit cultivars (Weber, 1996). The application of Ethrel 480 SL, during or just after blooming, sped up the ripening of fruit over a 3-5 day period, which can be of great importance in the cultivation of early fruit bearing cultivars. Ethrel 480 SL also stimulates flower buds setting for the following year (Weber, 1996; Baund and Jones, 1997).

Another popular compound for fruitlets thinning is 6-BA (benzyl-aminopurine) (Bubán and Lakatos, 2000; Basak, 1997; 2000). In Poland it is known commercially as Paturyl.

Research has shown that each of the preparations mentioned above produced big differences in effectiveness. This changeability was caused by: climatic conditions; the dates on which the preparations were applied, and the susceptibility of the cultivars. Hence the need for continued research into fruitlets thinning.

The aim of our research was to establish the most effective method of thinning in 'Katja' apple trees; the results of which are presented here.

## MATERIAL AND METHODS

The experiment was carried out in an apple orchard planted in 1997 at the Experimental Station in Garlica Murowana. The cultivars chosen for the experiment were 'Katja' apple trees planted on M.9. rootstock. Although this cultivar produces an abundant amount of fruit yearly, they have a tendency to be rather small. It requires fruitlets thinning in order to improve the size of the fruit.

The experiment was established using a random block design in six replications of one tree. The following combinations were compared:

1. Control – no thinning.
2. Manual thinning – carried out after June fruitlets drop; one fruitlet was left per an inflorescence and the distance between fruitlets was kept at 10-15 cm.
3. Pomonit R10 applied in full blooming as a solution of 3 ml of the preparation in 10 l of water (30 mg/l of potassium salt of NAA).
4. Pomonit R10 applied right after blooming (90% petals fallen) at the concentration as above.
5. Pomonit R10 applied on fruitlets 8-10 mm in diameter; 7 days after the end of blooming, at the concentration as above.
6. Ethrel 480 SL applied in full blooming at the concentration of 120 mg/l of etephon.
7. Ethrel 480 SL applied right after blooming (90% petals fallen) at the concentration as above.
8. Ethrel 480 SL applied on fruitlets 8-10 mm in diameter 7 days after the end of blooming at the concentration as above.

9. Urea applied as a spray in full blooming at the concentration of 40 g/1 (4%).
10. Urea applied right after blooming at the concentration as above.
11. Urea applied on fruitlets 8-10 mm in diameter 7 days after end of blooming at the concentration as above.
12. BA applied on fruitlets of 10-12 mm in diameter at the concentration of 150 mg/l.

The number of flowers on tagged branches were counted in order to calculate the percentage of fruit setting and the efficiency of fruit thinning. The total number of fruit from each tree and the mean mass of one fruit was determined. Fruit were calibrated according to their diameter, starting at 5.5 cm and increasing in increments of 0.5 cm, in order to determine their class size. To evaluate the significance of the differences between averages the Duncan test, at 5% significance level, was used.

Treatment dates are presented on Table 1 and meteorological conditions during tree spraying with thinning preparations are presented on Figures 1 and 2.

T a b l e 1 . Treatment dates

| Stage of development | 2002 | 2003 | 2004 |
|---|---|---|---|
| I full blooming | 1 May | 9 May | 5 May |
| II end of blooming | 9 May | 16 May | 13 May |
| III fruitlets 8-10 mm in diameter | 15 May | 23 May | 19 May |

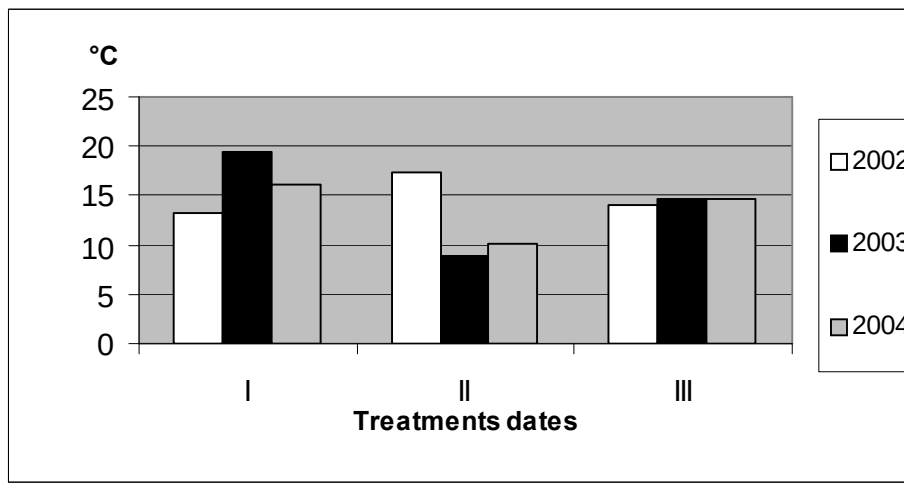


**Figure 1.** Mean temperatures on the day of treatment

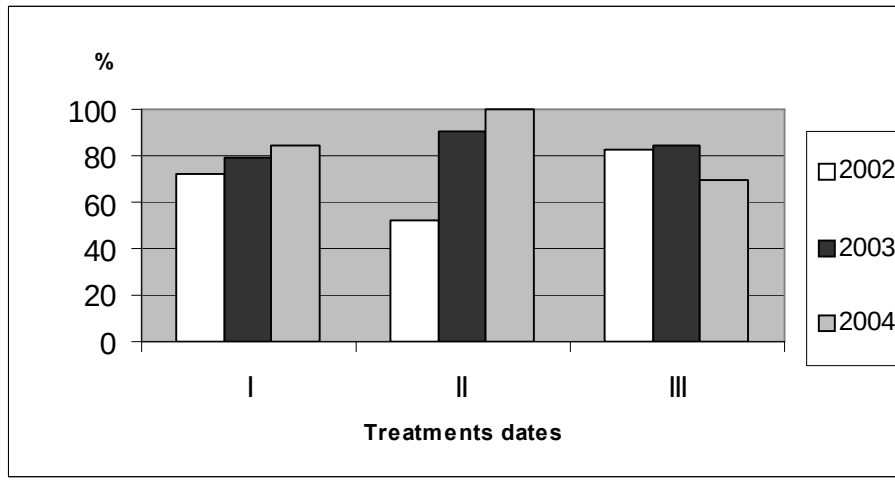


**Figure 2.** Relative humidity of the air on the day of treatment

## RESULTS AND DISCUSSION

The thinning treatments influenced the total yield of fruit (Tab. 2). In the control there were significant fluctuations between yields over the years of the experiment. However, the combined yield from all years was higher or the same as in the others combinations. It shows that biennial cropping occurred in the control. This confirms the findings from earlier research (Poniedziałek et al., 2002).

The most regular fruiting was as a result of manual thinning, which also produced fruit with the largest mean mass. The sum of yield, in combination with manual thinning over the duration of the experiment, was comparable to that of the control. The yield from trees sprayed with Ethrel 480 SL was also comparable to that of the control, but only when the treatment was applied at full bloom. When Ethrel 480 SL was applied at other dates, it tended to reduce both fruit yield and mean fruit mass, despite relatively uniform yielding over the years. Similar results were obtained in our previous experiment (Poniedziałek et al., 2002). Urea had the biggest influence on fruit yield when the spraying was executed on the second date. However, mean mass of fruit decreased after such a treatment.

The application of BA produced weaker fruit setting, reduced fruit yield, but increased their mean mass. Previous research has shown that BA stimulates cellular division in young fruit, which causes increased growth, regardless of the reduction level of fruit setting (Pietranek et al., 2000).

To determine the efficiency of applied treatments in fruitlets thinning, the following were calculated: the percentage of fruit setting in relation to the number of flowers (Tab. 3) and the percentage of fruit setting in relation to the control, which was assumed as 100% (Tab. 4). It was also found that trees sprayed with Pomonit didn't give

Table 2. The influence of thinning methods on fruit yield and size

| Combination | Mean yield of fruits per one tree [kg] | | | Total yield per tree [kg] | Mean mass of fruit [g] |
|---|---|---|---|---|---|
| | 2002 | 2003 | 2004 | 2002-2004 | 2002-2004 |
| 1 Control | 13.0 de | 8.2 abc | 23.5 d | 44.7 c | 109 bcd |
| 2. Manual thinning | 13.5 e | 13.0 de | 19.8 bcd | 46.3 c | 121 e |
| 3. Pomonit I | 10.0 a-e | 9.0 a-d | 20.9 cd | 39.9 bc | 118 de |
| 4. Pomonit II | 9.1 a-d | 12.0 c-e | 18.3 b-d | 39.4 bc | 114 de |
| 5. Pomonit III | 12.2 c-e | 11.3 b-e | 13.7 ab | 37.2 bc | 109 b-d |
| 6. Ethrel I | 11.3 b-e | 14.2 e | 19.0 b-d | 44.5 c | 104 a-c |
| 7. Ethrel II | 6.8 a | 6.0 a | 10.6 a | 23.4 a | 115 de |
| 8. Ethrel III | 8.4 a-c | 8.5 a-c | 14.3 ab | 31.2 ab | 101 ab |
| 9. Urea I | 7.8 ab | 9.1 a-d | 15.9 a-c | 32.8 ab | 113 de |
| 10. Urea II | 9.0 a-d | 11.6 c-e | 22.8 d | 43.4 c | 98 a |
| 11. Urea III | 10.4 a-e | 6.7 a | 14.1 ab | 31.2 ab | 109 b-d |
| 12. BA | 7.7 ab | 7.4 ab | 10.0 a | 25.1 a | 111 cd |

*Values designated with the same letters within columns do not significantly differ at P=0.05

Table 3. The influence of thinning methods on the percentage of fruit setting in relation to flowers

| Combination | 2002 | 2003 | 2004 | Mean for 2002-2004 |
|---|---|---|---|---|
| 1 Control | 19.7 cd* | 14.8 cd | 19.6 cd | 18.0 d |
| 2. Manual thinning | 12.8 a-c | 11.5 bc | 13.2 a-c | 12.5 b |
| 3. Pomonit I | 9.3 ab | 5.9 a | 20.0 cd | 11.7 ab |
| 4. Pomonit II | 37.7 e | 13.9 b-d | 27.7 e | 26.4 e |
| 5. Pomonit III | 26.5 d | 17.8 d | 26.7 de | 23.7 e |
| 6. Ethrel I | 16.7 a-c | 17.4 d | 18.0 c | 17.4 cd |
| 7. Ethrel II | 9.7 a-c | 5.0 a | 8.6 ab | 7.8 a |
| 8. Ethrel III | 18.7 b-d | 11.1 bc | 6.3 a | 12.0 ab |
| 9. Urea I | 8.5 a | 12.0 bc | 19.1 cd | 13.2 bc |
| 10. Urea II | 6.5 a | 12.3 bc | 13.5 a-c | 10.8 ab |
| 11. Urea III | 9.7 a-c | 9.0 ab | 16.0 bc | 11.6 ab |
| 12. BA | 7.1 a | 11.2 bc | 9.2 ab | 9.2 ab |

*Note: see Table 2

Table 4. The percentage of fruit remaining after thinning in relation to control established as 100%

| Combination | 2002 | 2003 | 2004 | Mean for 2002-2004 |
|---|---|---|---|---|
| 1 Control | 100 | 100 | 100 | 100 |
| 2. Manual thinning | 65.0 | 77.7 | 67.3 | 70.0 |
| 3. Pomonit I | 47.2 | 39.9 | 102.0 | 63.0 |
| 4. Pomonit II | 191.4 | 93.9 | 141.3 | 142.7 |
| 5. Pomonit III | 134.5 | 120.3 | 136.2 | 130.0 |
| 6. Ethrel I | 84.8 | 117.6 | 91.8 | 98.1 |
| 7. Ethrel II | 49.2 | 33.8 | 43.9 | 42.3 |
| 8. Ethrel III | 94.9 | 75.0 | 32.1 | 67.3 |
| 9. Urea I | 43.1 | 81.1 | 97.4 | 73.9 |
| 10. Urea II | 33.0 | 83.1 | 68.9 | 61.7 |
| 11. Urea III | 49.2 | 60.8 | 81.6 | 63.9 |
| 12. BA | 36.0 | 75.7 | 46.9 | 52.9 |

*Note: see Table 2

the expected results, even though in a number of previous experiments Pomonit, as well as other NAA-based preparations, has shown to give an effect similar to that of manual thinning (Michalski et al., 2000; Basak, 1999). Pomonit R10, applied directly after blooming and on small fruitlets, gave the opposite effect to fruitlet thinning in that it stepped up excessive number of fruitlets. Indeed, other researchers has reported the similar effects of NNA, but only when it was used in order to prevent fruit dropping before the harvest (Basak and Krokocka, 2000). In our experiment, unfavourable weather conditions or too low a concentration of Pomonit R10 could have influenced the weak effects with this particular cultivar (Basak, 1999) (Fig. 1, 2).

The best quality of fruit, specified as percentage shares in classes of fruit size, was in combination with manual thinning. Resulting from this, 79% of fruit were in the range of between 7-8 cm in diameter (Fig. 3). Very good sized fruit were obtained with the inclusion of urea, applied at full bloom. This yielded 100% of fruit which were in the range of between 6.5-7.5 cm in diameter. BA also strongly influenced fruit size with 71% being in the range of between 7-7.5 cm in diameter, which reflects the results of previous studies (Basak, 1997; Basak and Jadczuk, 1999; Wieniarska et al., 2000).

The worst results were obtained from the use of Ethrel 480 SL applied at full bloom. Here 40% of fruit were classified in the range of between 6-6.5 m in diameter. Administered in combination with NAA, when the fruitlets were between 8-10 mm in diameter, the results were also poor at 33%, as opposed to similar experiments having shown that spraying with NAA usually contributed to an increase in fruit mass (Michalski et al., 2000; Guzewski, 1998).

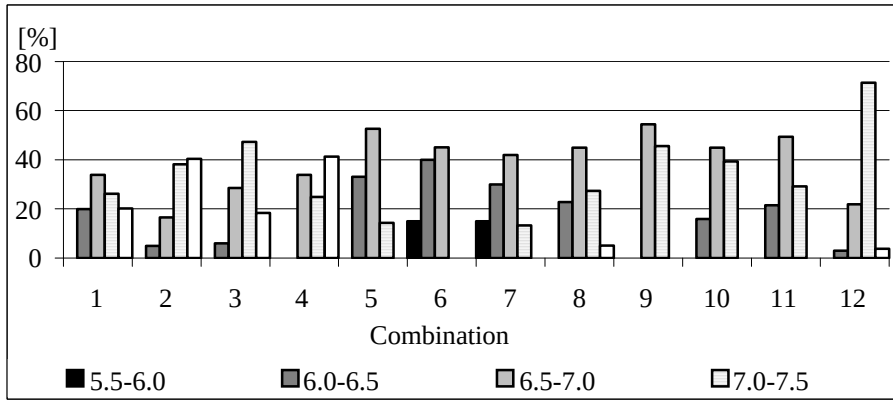


**Figure 3.** Percentage shares in classes of fruit size depending on thinning method

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# CHEMICZNE I RĘCZNE PRZERZEDZANIE JABŁONI ODMIANY 'KATJA'

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## S T R E S Z C Z E N I E

Jabłonie odmiany 'Katja' opryskiwano preparatami: Pomonit R10 w stężeniu 30 mg soli potasowej NAA/l $H_2O$, Etherel 480 SL – 12 mg etefonu/l $H_2O$ oraz 4% roztworem mocznika. Preparaty te stosowano w trzech terminach: w pełni kwitnienia, bezpośrednio po kwitnieniu i w fazie zawiązków o średnicy 8-10 mm. Oprócz wyżej wymienionych zabiegów stosowano przerzedzanie ręczne oraz opryskiwanie BA w stężeniu 150 mg/l w fazie zawiązków o średnicy 10-12 mm. Dobre efekty przerzedzania uzyskano stosując Ethrel 480 SL w drugim terminie, nieco gorsze, ale również zadowalające stosując BA, ponadto mocznik w drugim i trzecim terminie, Ethrel 480 SL w trzecim terminie oraz Pomonit R10 w pierwszym terminie. Pomonit R10 stosowany w drugim i trzecim terminie wywoływał efekt odwrotny do przerzedzania. Porównując sumę plonu owoców za trzy lata stosowania zabiegów, stwierdzono najwyższy plon w kombinacji z przerzedzaniem ręcznym, gdzie odnotowano również najwyższą średnią masę owoców. Opryskując NAA w drugim i trzecim terminie obserwowano większą liczbę zawiązków owocowych niż w kontroli.

**Słowa kluczowe:** przerzedzanie owoców, BA, NAA, mocznik, etefon