

AN EXPERIMENT TO INDUCE EARLY PEAR CROPPING BY THE USE OF GROWTH REGULATORS AND SHOOT TIPPING

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Abstract

Young trees of the cultivars 'Beurré Hardy' and 'Doyenné du Comice' on Quince A were planted in 1969. From 1972 to 1976 GA₄₊₇ at 16 ppm was sprayed yearly and at about 60% of flowering, CCC at 2000 ppm was applied yearly when 8-10 leaves per shoot were present. As a third factor shoot tipping was used. These 3 factors were applied alone or in all possible combinations with a control. The harvests in 1972 and 1973 were small, in 1974 a good crop was obtained and 1975 was a complete off-year. For the harvest in 1974 the combination of GA₄₊₇ + CCC was most effective. Shoot tipping had no advantage. CCC reduced tree size and annual stem increment and enhanced fruit bud formation mainly in 'Beurré Hardy'.

1. Introduction

The planting of pears requires much money and it takes a long time in the Netherlands before it pays. Two important cultivars are 'Beurré Hardy' and 'Doyenné du Comice'. 'Beurré Hardy' needs a relatively long period before it becomes fertile, it has a great vigour of growth and one often obtains big trees (Reedijk, 1974). A rich flowering-period of 'Doyenné du Comice' not always results in a good fruit set and a good set can be reduced sharply by an extensive drop. In connection with experiments of Varga and Borsboom (1970) a trial was started to obtain early fertility by the application of the gibberellin GA₄₊₇ during the flowering-period to obtain a better fruit set, and by the use of CCC (Cycocel, chlormequat) after the flowering-period to retard the growth with an anticipated reduction of fruit drop. The tipping of shoots was included as preliminary results had shown some promise (Varga and Borsboom, 1970).

2. Material and methods

In the spring of 1969 the cultivars 'Beurré Hardy' and 'Doyenné du Comice' were planted on rootstock Quince A. The experiment had a factorial design with the 3 main factors: GA₄₊₇, CCC and tipping, giving a total of 8 treatments (see Table 1). Of 'Beurré Hardy' 8 blocks of 4 trees each per treatment, with 8 treatments giving a total of 8 x 32 = 256 trees were used. Of 'Doyenné du Comice' 6 blocks of 4 trees each giving a total of 192 trees were used. The blocks were randomized. As mathematical analysis of the results the method of the least significant differences was applied and only differences with a 1% chance to be rejected were accepted as significant. The plants were grown on a river clay soil. During 1969, 1970 and 1971 the trees were raised as slender

round spindlebushes. The first treatments were given from spring 1972 and onwards. GA₄₊₇ was sprayed at about 40-60% flowering at a concentration of 16 ppm, till the trees dripped. When the young shoots had 8-10 fully developed leaves, CCC was sprayed at 2000 ppm, till the trees dripped. About the same time the tipping of all one-year-old-shoots was carried out. Yearly all treatments were repeated. Growth, flowering, fruit set and harvest were recorded and analysed.

3. Results

3.1. The vegetative growth

With 'Beurré Hardy' the number of shoots per tree was lowest at all those treatments where CCC was sprayed and 'Doyenné du Comice' showed the same tendency. In both cultivars shoot length was significantly reduced by all CCC-treatments. With 'Beurré Hardy' there was a significantly higher difference in the weight per standard length of shoot between the treatments and the control but with 'Doyenné du Comice' all CCC-treatments were significantly lower than the control with respect to weight per standard length of shoot. In 1975 the sprays of CCC were discontinued in half of the blocks of 'Beurré Hardy'; this induced more shoot-growth in 1976 although this did not reach the level of the control trees.

In 1974/75 the increment of the stem of the trees at 10 cm above the graft union was lowest with both cultivars at all treatments sprayed with CCC. In 1976 the diameter of the stem was lowest with 'Beurré Hardy' at all treatments sprayed with CCC; the same holds true for 'Doyenné du Comice' but on a lower level. In all aspects of vegetative growth 'Beurré Hardy' reacted more strongly to CCC-treatments than 'Doyenné du Comice'. This confirms the results of several authors (Lemmens, 1969; Wertheim, 1970b; Nuttall and Caldicott, 1971; Jaumien, 1973).

3.2. The number of fruit buds

The average number of fruit buds per tree for 1974, 1975 and 1976 is shown in Table 1. With 'Beurré Hardy' the number of fruit buds in 1974 was significantly highest with CCC (treatment 3), while all other treatments did not differ significantly from the control. During 1975 fruit bud formation was much lower than in 1974. Again the CCC alone (treatment 3) was high, but not significantly different from the control; lowest in fruit bud formation was GA₄₊₇ + tipping (treatment 6). During 1976 fruit bud formation was superfluous and the control and GA₄₊₇-treatments showed significantly more fruit buds than all other treatments. With 'Doyenné du Comice' there were few differences in 1974 although the fruit bud formation with GA₄₊₇ (treatment 2) was lower than with the control. During 1975 GA₄₊₇ + CCC (treatment 5) had significantly more fruit buds than the control. Especially tipping alone (treatment 4) or tipping with other treatments were low, although not always significantly different from the control.

3.3. The number of fruits/100 fruit buds

For the important harvest of 1974 this parameter is given in Table 2. With 'Beurré Hardy' all treatments had raised the number of fruits per 100 fruit buds, especially GA₄₊₇ + CCC (treatment 5) and GA₄₊₇ + CCC + tipping (treatment 8). With 'Doyenné du Comice' the same treatments 5 and 8 differed significantly from the control. However, it

is clear that this is due to the beneficial effect of GA₄₊₇ + CCC, as tipping alone did not raise the number of fruits per 100 fruit buds.

3.4. The harvest in kg per tree from 1972-1974 and the average fruit weight in g in 1974

The figures are given in Table 3. The fruit weight per tree with 'Beurré Hardy' was highest at GA₄₊₇ + CCC (treatment 5), followed by GA₄₊₇ + CCC + tipping (treatment 8) which gave 5 kg per tree less. With 'Doyenné du Comice' also GA₄₊₇ + CCC (treatment 5) is highest but it did not differ significantly from the control.

The average fruit weight in g per fruit with 'Beurré Hardy' was lowest at all treatments with CCC. Also GA₄₊₇ + tipping (treatment 6) was significantly lower than the control. With 'Doyenné du Comice' also all treatments with CCC had a lower average fruit weight than the control. This is mainly an indirect effect of the greater number of fruits harvested.

4. Discussion

In this experiment the concentration of 2000 ppm CCC was chosen on the basis of existing knowledge. In the literature concentrations vary as much as from 400-10.000 ppm (Nicotra and Malagodi, 1970; Donchev, 1973). The concentration of 2000 ppm was very effective for 'Beurré Hardy' and probably rather low for 'Doyenné du Comice'. Bij the CCC-treatment the number of shoots was reduced, their length shortened and their thickness (measured as weight per unit of length) promoted in 'Beurré Hardy' and reduced in 'Doyenné du Comice'. The smaller trees obtained by the CCC-treatments can be planted closer together and this can lead to a higher yield per hectare, as was also mentioned by Reedijk (1972). Less pruning of the central leader is needed (Lemmens, 1969) as the dimensions of the crown are restricted (Nicotra and Malagodi, 1972). It is generally known that GA-sprays can have a negative effect on fruit bud formation (Wertheim, 1971), if sprayed at a concentration which is too high. Only with 'Doyenné du Comice' in 1974 (Table 1) an unfavourable effect of GA₄₊₇ was found. In several cases the results of gibberellin sprays have been disappointing for unknown reasons (Wertheim, 1970a). With 'Beurré Hardy' tipping in 1976 had a negative effect on fruit bud formation and with 'Doyenné du Comice' the same holds true for 1975. On the average tipping has not given the positive effect that was expected. The harvests in 1972 and 1973 were very small. A full crop was obtained in 1974 and the number of fruits per 100 fruit buds, which is a good indication for fertility, was highest at the treatment GA₄₊₇ + CCC with both cultivars (see Table 2 and Lemmens, 1969; Varga and Borsboom, 1970). Unfortunately, the trees had no yield in 1975; it is disappointing that at none of the 8 treatments, including the CCC ones, a crop was obtained. The clear increase of fruit bud formation and the weakening of the vegetative phase by CCC-sprays irrevocably leads to biennial bearing according to several authors (Wertheim, 1970b; Porreye, 1972; Brian et al., 1974; Reedijk, 1974; Grauslund, 1975). In this experiment the biennial effect was not suppressed. In 1976 a heavy crop will be harvested, but again fruit bud formation for 1977 is lacking. From Table 3 it is clear that fruit size was reduced by CCC-treatments. Decrease of fruit size has been reported several times (Nicotra and Malagodi, 1970; Kayali, 1971; Porreye, 1972), but in other cases it was not found (Brian, 1970; Nicotra and Malagodi,

1972; Reedijk, 1974); in our experiment it is mainly due to an increased set of all CCC-treatments. The early cropping of two pear cultivars was partly enhanced, mainly by sprays of GA₄₊₇ and CCC successively. The experiment will be continued and study the effect of the treatments on the biennial bearing habit of the 2 cultivars.

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Table 2. Number of fruits per 100 fruit buds in 1974. A different letter, within a column, means a significant difference at the 1% level.

Treatment	Cultivars	
	'Beurré Hardy'	'Doyenné du Comice'
1. Control	70.8 a	43.8 ab
2. GA ₄₊₇	75.2 abc	50.2 bc
3. CCC	75.7 abc	48.1 ab
4. Tipping	71.9 ab	43.1 a
5. GA ₄₊₇ + CCC	100.7 e	56.8 c
6. GA ₄₊₇ + Tipping	85.2 bc	47.9 ab
7. CCC + Tipping	88.2 cd	50.6 bc
8. GA ₄₊₇ + CCC + Tipping	100.3 de	56.0 c

Table 1. Number of fruit buds per tree before pruning. A different letter, within a column, means a significant difference at the 1% level.

Treatment	'Beurré Hardy'		'Doyenné du Comice'	
	1974	1975	1974	1975
1. Control	372 a c	94 bcd	603 b	293 bc
2. GA ₄ +7	421 a c	94 bcd	469 a	309 bc
3. CCC	491 b	159 c	594 ab	414 b d
4. Tipping	371 a c	85 a c	534 ab	128 a
5. GA ₄ +7 + CCC	427 bc	126 cd	520 ab	551 d
6. GA ₄ +7 + Tipping	345 a	62 a	486 ab	122 a
7. CCC + Tipping	410 a c	91 a cd	601 ab	199 a
8. GA ₄ +7 + CCC + Tipping	348 a	92 a cd	542 ab	209 a c
				1976
				1339 c
				1173 abc
				1341 c
				1087 abc
				1288 bc
				1068 ab
				1198 bc
				943 a

Table 3. Fruit weight in kg/tree from 1972-1974 and average weight in g per fruit in 1974. A different letter, within a column, means a significant difference at the 1% level.

Treatment	Fruit weight in kg/tree		Average fruit weight per fruit in g	
	'Beurré Hardy'	'Doyenné du Comice'	'Beurré Hardy'	'Doyenné du Comice'
1. Control	34.3 ab	36.0 ab	174 c	215 de
2. GA ₄ +7	38.1 abcd	34.0 a	168 bc	221 e
3. CCC	41.3 cd	40.1 b	153 a	201 bc
4. Tipping	31.8 a	34.2 a	171 bc	216 de
5. GA ₄ +7 + CCC	47.0 e	40.8 b	146 a	199 abc
6. GA ₄ +7 + Tipping	36.3 abc	34.4 a	164 b	207 cd
7. CCC + Tipping	39.8 bcd	39.6 ab	146 a	184 a
8. GA ₄ +7 + CCC + Tipping	42.0 d	39.5 ab	147 a	190 ab