

# Control of flower and Pod Development in Oil Seed Rape (Brassica napus)

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## 1. Introduction

The duration of flowering is an important determinant of flower and therefore pod numbers and the present paper describes investigations on the factors which affect this character in spring varieties of oil seed rape.

## 2. Experimental

The first flower to open on all inflorescences is the oldest and most basal one and flowering then proceeds acropetally. However, the terminal inflorescence is normally the first to flower followed thereafter by the axillary inflorescences at the various nodes. In the case of the variety Maris Haplona grown in pots there was a 6 day interval between the opening of the first flower on the terminal inflorescence and that on the axillary at node 4. Notwithstanding this, the production of open flowers ceased 14-16 days after anthesis on all inflorescences.

Recent experiments in which  $^{14}\text{CO}_2$  was fed to the lower part of the plant and the distribution of labelled assimilates followed by means of autoradiography and scintillation counting have shown that flower buds and newly opened flowers were strong sinks for labelled assimilates in the period from anthesis to 10 days after anthesis. After this they became weaker ones so that 14 days after anthesis for axillary 3 and 18 days after anthesis for the other inflorescences they attracted virtually no assimilates (Table 1). There is therefore a marked reduction in sink strength of the developing flower buds and flowers over the plant as a whole and this could be termed a 'switch off'. This is an important change since it determines that further flowers and pods will not normally develop apically on the different inflorescences.

Certain treatments have been found to delay the apical 'switch off' and to prolong the duration of flowering in Maris Haplona. These are:

1. Flower/Pod Removal 20 of the lowermost flowers/pods were removed from the terminal inflorescence at anthesis (A), 6 days (A + 6) and 12 days (A + 12) after anthesis. The removals at A and A + 6 but not A + 12 prolonged flowering and increased the production of open flowers (Table 2).

Table 1

Diagrammatic Summary of the Specific Activity levels of different plant parts of plants of oil seed rape fed with  $^{14}\text{CO}_2$  at different times after anthesis.

Branch	Organ	Time of Harvest				
		1 Day after Anthesis	5 Days after Anthesis	9 Days after Anthesis	13 Days after Anthesis	17 Days after Anthesis
Terminal	Stem*	++++	++++	++++	++	0
	Buds	++++	++++	++++	++	-
	Flowers	++++	++++	++++	++	0
	Pods	-	++++	++++	++++	+++
Axillary 1	Stem*	++++	++++	++++	+	0
	Buds	++++	++++	++++	+	-
	Flowers	-	++++	++++	+++	0
	Pods	-	-	++++	++++	+++
Axillary 2	Stem*	-	++++	++++	++	0
	Buds	-	++++	++++	++	-
	Flowers	-	++++	++++	+++	0
	Pods	-	-	++++	++++	++
Axillary 3	Stem*	-	++++	++++	0	0 or 0
	Buds	-	++++	++++	-	-
	Flowers	-	-	++++	0	0 0
	Pods	-	-	-	0	0 ++++

Key

a. Stem\* refers to the apical 5 cms.

b. Treatment

$^{14}\text{CO}_2$  was fed to lower leaves for 3 h. and the plants harvested after a further 21 h.

c. Activity levels

- ++++ very high
- +++ high
- ++ intermediate
- + low
- 0 virtually none
- organ not present

d. Variety

Maris Haplona

Table 2

Effects of Removing 20 Lowermost Flowers/Pods from the Terminal Inflorescence of Oil Seed Rape Plants (variety Maris Haplona)

Treatment Character	Control	Time of Removal			
		Anthesis	6 Days after Anthesis	12 Days after Anthesis	L.S.D. (5%)
Number of open flowers per plant	154.0	177.1	165.0	144.3	19.60
Number of pods per plant	108.5	132.6	129.5	114.0	12.30
Duration of flowering on Terminal Inflorescence (Days)	23.5	26.5	25.0	22.1	1.43

2. Benzyl Adenine (BA) Application

(BA) (2.0 $\mu$ g) was applied in 0.01 ml of solution to the apices of unbranched plants of Maris Haplona at 2 day intervals from 8 days (A + 8) and 14 days (A + 14) after anthesis. BA applied from A + 8 to A + 24 markedly increased the period of apical development, promoted the production of open flowers and stimulated stem elongation. Nevertheless most of the extra flowers produced did not form pods that were retained to maturity and pod yield was not increased. The BA effects were associated with an increased distribution of <sup>14</sup>C - labelled assimilates to the apical regions and to a decrease to the lower stem and hypocotyl regions. The treatments with BA which started at A + 14 failed to produce any statistically significant effects. (Table 3)

3. Nitrogen Application

In the case of Zollerngold, another spring variety of oil seed rape, and in another experiment it has been shown that flower production over the plant as a whole continued until 24-26 days after anthesis and then ceased on all inflorescences.<sup>4</sup> For this variety and in a greenhouse experiment flower production has been prolonged by increasing the concentration of nitrogen in a nutrient solution from 23 to 232 ppm

Table 3

The effects of applications of Benzyl Adenine to the apices of plants of oil seed rape (variety Maris Haplona)

Plant Treatment Character	Period of treatment				L.S.D. (5%)
	From 8d after Anthesis		From 14d after Anthesis		
	Control	BA	Control	BA	
Plant Height (cm)	84.9	97.5	82.2	88.9	7.03
Open flowers produced per plant	44.6	52.7	43.1	43.6	3.7
Pods formed per plant	31.3	30.3	30	30.9	2.8
Duration of flowering (d)	18.1	26*	18	18.9	-

\* Plants had not stopped flowering at the time of Harvest at A + 26

for 14 day periods starting from 10 days (A + 10) and 16 days (A + 16) after anthesis. Both treatments increased Leaf Area and the effects of the extra nitrogen on flower and pod development were therefore confounded with those of the extra supply of carbon assimilates likely to accrue from the greater Leaf Area (Table 4).

Supplementing the nitrogen supply from A + 10 and A + 16 increased the numbers of flowers and pods and the A + 16 treatment brought about a late burst of flower production with some of the flowers giving rise to productive pods. The growth of individual pods was also promoted. In pods formed before receiving the extra nitrogen only the weight of the husk and the individual seeds was increased but in pods being formed at the time of treatment or thereafter, the numbers of seeds per pod and pod length were promoted as well. Greatest increases were observed in the youngest pods (Table 4).

Table 4

Effects of supplementing supply of Nitrogen for 14 day periods from 10(A + 10) and 16 days (A + 16) days after anthesis

		PLANT CHARACTERS						Leaf Area (cm <sup>2</sup> ) on different days from anthesis					
Treatment Days after Anthesis	Number of flowers opening at daily intervals from anthesis which formed pods retained to final harvest	Seed weight per pod (g) at final harvest in pods formed on different days from anthesis		Length per pod (cms) at final harvest in pods formed on different days from anthesis		Seed number per pod at final harvest in pods formed on different days from anthesis		Leaf Area (cm <sup>2</sup> ) on different days from anthesis					
		Control	A + 10 to A + 24	A + 16 to A + 30	Control	A + 10 to A + 24	A + 16 to A + 30	Control	A + 10 to A + 24	A + 16 to A + 30			
1	1.8	60	72	65	6.5	7.2	6.8	22	22	21	120	120	120
2	3.5												
3	4.8	45	70	62	6.0	6.8	6.2	17	19	17	110	110	110
4	4.2												
5	4.0												
6	4.1	35	50	50	5.4	5.4	5.4	14	14	14	100	100	100
7	3.8												
8	2.5												
9	2.0	18	60	24	3.8	6.0	4.0	6	19	6	95	95	95
10	0.8												
11	0.4												
12	0.2												
13	0												
14	0												
15	0												
16	0												
17	0												
18	0												
19	0												
20	0												
21	0												
22	0												
25													
31													
37													

## Discussion

The ineffectiveness of the last removal and BA treatments in the above experiments suggests that once the 'switch off' has taken place, it is probably impossible to restore sink strength and growth in the apical regions of the inflorescences. The duration of flowering in plants of oil seed rape is therefore limited to the period when the apical flower buds and young flowers are able to attract assimilates. The promotory effects of applying BA from 8 days after anthesis indicate that this capacity may be linked with the maintenance of a critical concentration of cytokinins in the tissues to participate directly in cell division and to act with other growth substances to attract assimilates through a hormone-directed transport mechanism.

It has proved possible to prolong the duration of flowering and increase the numbers of flowers and pods by flower/pod removals and by chemical treatments so long as these were performed soon enough. In this connection, increasing the supply of nitrogen as well as causing marked and desirable effects on flowering also gave an added bonus of increasing Leaf Area and the growth of the individual pods.

It is emphasised that the above results and conclusions apply to plants of spring rape grown in pots and in greenhouses. Further work is needed to determine the situation in the field and for winter rape as well.

## References

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