INTERNAL FACTORS AFFECTING SEED SET OF RAPESEED

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INTRODUCTION

The number of seeds per pod is one of the important yield components of rapeseed. In the individual pod under natural light, the number of seeds per pod determines seed yield fundamentally (Inanaga et al., 1986a). The process of the determination of the number of seeds per pod (the process of seed set in a pod) consists in the processes of pollination, fertilization, and seed growth. Williams (1978) showed that the process of pollination affected the number of seeds per pod. Mendham and Scott (1975) reported that the number of seeds per pod at maturity was lower than that during early pod growth due to seed abortion. This shows that the number of seeds per pod is regulated in the process even after pollination. In this point, Clarke and Simpson (1978) suggested that the number of seeds per pod was determined by the ability of the individual pod to supply assimilates.

Our interest in the physiological process of seed set in a pod stems from the following finding. That is, the number of seeds per pod was significantly reduced by shading for leaves and cutting of leaves carried out at and earlier than the end of the flowering period and was not affected so by later ones, and cutting of leaves was more effective than shading for leaves (Table 1). This suggested that the physiological process of seed set in a pod was regulated by photoassimilate or other substances supplied from leaves during early

Table 1. Effects of shading (S) and cutting (C) treatments for leaves* started at various stages of reproductive period** on the number of seeds per pod (From Inanaga et al., 1986b).

	Starting date of treatments (The days after beginning of flowering)						Control
	3	10	17	24	31	45	
S	10.5bcd***	11.1cdef	11.8cdef	14.5g	13.4efg	14.4g	13.7f
C	5.7a	8.3b	10.1bc	12.4cdef	13.1efg	12.6def	

* Shading : 80% of natural light condition, shading periods are from the starting dates of treatments to maturity, respectively;
** Cutting : Cutting of all leaves.
*** Flowering period : 0-20 days after beginning of flowering.
Figures followed by the same alphabetical letter within rows are not significantly different (Duncan's multiple range test, P=0.05).

pod growth.

The experiments reported herein were designed to investigate the effects of photoassimilate and plant hormones supplied from leaves on the number of seeds per pod.

EXPERIMENTAL

Using rapeseed (*Brassica napus* L., cv. Norin No.16), two experiments were conducted. In the first experiment, just after the end of the flowering period, pod thinning (25 and 50 % of non-treated plant), leaf cutting (cutting of all leaves), and shading (whole plant, 50% of natural light condition) were carried out (Inanaga et al., 1986b). The result is shown in Fig.1. The effects of whole plant shading and leaf cutting were quite different. The shading affected little or only slightly the number of seeds per pod though the treatment resulted in considerable reduction in net production of plant per pod. Pod thinning (without leaf cutting) resulted in a large increase in net production of plant per pod, nevertheless it did not bring about an increase in the number of seeds per pod. In contrast, leaf cutting caused a large reduction in the number of seeds per pod even when net production of plant per pod was similar

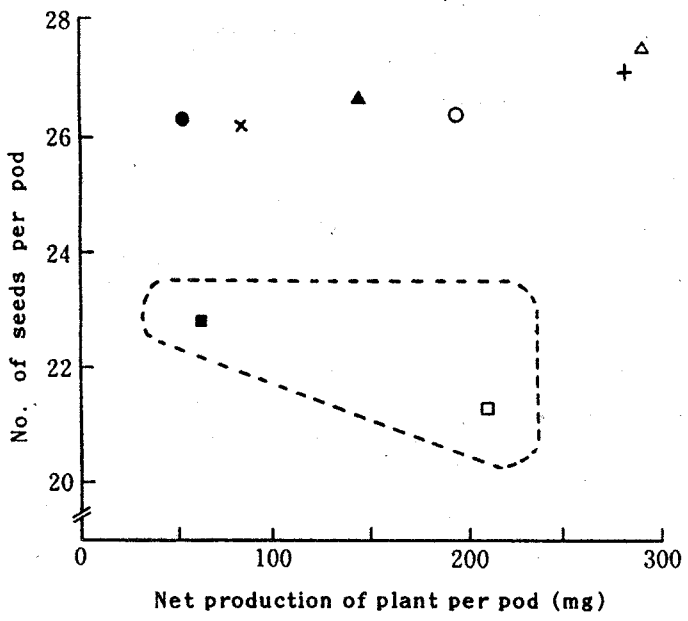

Fig. 1. Dependence of the number of seeds per pod on net production of plant per pod (From Inanaga et al., 1986b).
+ ✕: Pod thinning (Relative pods number per plant: 25%).
△ ▲: Pod thinning (do.: 50%).
○ ●: intact.
□ ■: Leaf cutting.
100 50
Light condition(%).

to that for control. From these facts, we consider that the physiological process of seed set in a pod is regulated by some unknown substances from leaves rather than photoassimilate.

In the second experiment (in green house), supplying CO_2 free air to leaves of intact plant, applying water and five plant growth regulators {3-indoleacetic acid, gibberelic acid (A_3), abscisic acid, 6-benzyladenine and brassinolide} to the petioles attached to main stem of plant cut all leaves were carried out during the flowering period. The result is shown in Table 2. Supplying CO_2 free air to leaves of intact plant affected little the number of seeds per pod. However, leaf cutting (in the treatment of applying water to the plant cut all leaves) decreased significantly the number of seeds per

Table 2. Effects of applying plant growth regulators to plant cut all leaves and supplying CO_2 free air to leaves of intact plant during flowering period on the number of seeds per pod (From Inanaga et al., 1986c).

Plant material	Treatment (ppm)	No. of seeds per pod**
Intact	Control	15.5f***
	CO_2 free air	13.7ef
Leaf cutting	Water	8.9ab
	IAA*(10^{-1})	12.7de
	(1)	11.3cd
	(10)	9.3abc
	GA_3 (1)	10.8bcd
	(10)	9.9abc
	(10^2)	9.3abc
	ABA (10^{-2})	9.5abc
	(10^{-1})	9.6abc
	(1)	10.1abc
	BA (10^{-2})	9.4abc
	(10^{-1})	10.0abc
	(1)	9.7abc
	BR (10^{-3})	9.8abc
	(10^{-2})	8.7a
	(10^{-1})	10.1abc

* IAA, 3-indoleacetic acide; GA_3, gibberelic acid (A_3); ABA, abscisic acid; BA, 6-benzyladenine; BR, brassinolide.
** Pods on inflorescences attached to main stem and upper three primary branches.
*** Figures followed by the same alphabetical letter in columns are not significantly different (Duncans multiple range test, P=0.05).

pod. These facts also suggest that the physiological process of seed set in a pod is affected by some unknown substances from leaves except photoassimilate. Of five plant growth regulators applied to the plant cut all leaves, only 3-indoleacetic acid (IAA: 10^{-1}, 1 ppm) increased the number of seeds per pod. IAA is known to affect the intensity of physiological processes in cell and organ (cf. Jacobs, M.R. and P.M. Pay, 1976). However, even the highest number of seeds per pod in the treatment of application of IAA (10^{-1}ppm) did not reach the same level as that for control. This suggests that other substances from leaves besides IAA also regulate the physiological process of seed set in a pod. By the way, leaf cutting decreased seed set percentages in not the

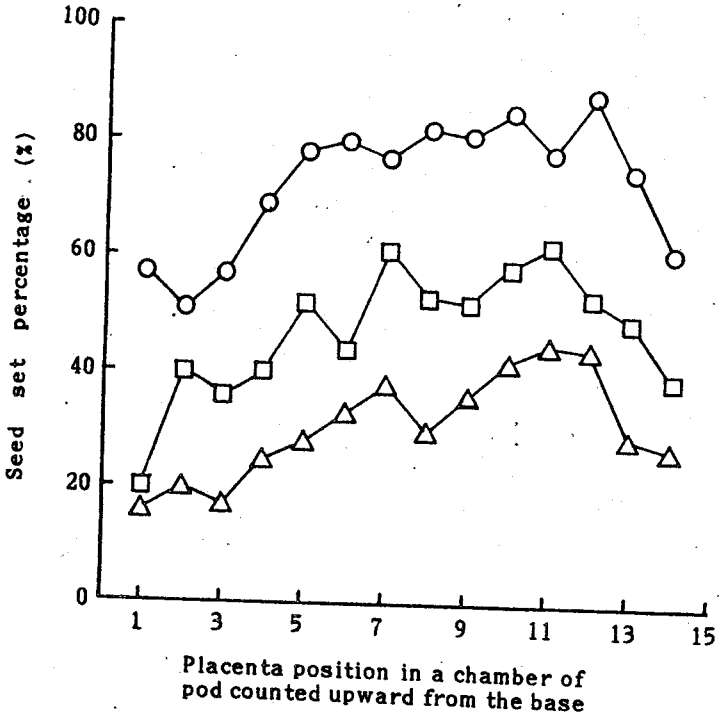

Fig. 2. Effect of leaf cutting and applying 3-indoleacetic acid (IAA) to plant cut all leaves on seed set percentages at placentas in a chamber of pod.
○ :Control.
△ :Leaf cutting (water).
□ :Leaf cutting (IAA, 10^{-1}ppm).

specific placentas, but all placentas in a chamber of pod (Fig. 2). And IAA (10^{-1}ppm) also increased seed set percentages in all placentas.

In these two experiments, there is no evidence that the treatments of pod thinning, shading, leaf cutting and supplying CO_2 free air to leaves changed certainly the amount of photoassimilate supplied to a pod. Therefore, we can not completely deny the possibility of photoassimilate from leaves affecting the physiological process of seed set in a pod. Further research on direct effect of photoassimilate from leaves on the physiological process of seed set is required.

CONCLUSION

The results reported herein suggest that IAA itself from leaves or some unknown substance induced by IAA is one of internal factors affecting the physiological process of seed set in a pod of rapeseed.

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