FERTILITY OF ZERO-ERUCIC AND DOUBLE LOW WINTER RAPE CULTIVARS IN RELATION TO LIGHT INTENSITY AND GENOTYPE

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Introduction

In rape the expression of yield components is very variable. The number of seeds per pod is correlated to the plant density and the insertion position of flowers on the plant (GEISLER and HENNING 1981).

At the lower axillary branches exposure to light decreases when plant density increases. Light intensity affects the number of seeds per pod caused by early seed reduction after fertilization (TAYO 1974, PECHAN and MORGAN 1983) and, maybe by inhibited pollen tube growth.

Normally, ovules are distributed homogeneously along the placenta in the unfertilized pod. Later on, previous to harvest one can observe remarkable differences in the distribution and the number of missing seeds along the pod in relation to variety, insertion and environmental conditions.

In this experiment we examined the fertilization and early seed development in four winter rape cultivars under different light exposure.

Material and Methods

The zero erucic cultivars Jet Neuf and Garant and the double low strains 154/81 and 1657/79 were cultivated in 1984 under four different light intensities: normal cultivation (NC), reduced plant density (RD), shadow 1 (S1) and shadow 2 (S2).

Generally, 55 plants per m^2 were grown. In variant RD the plant density was reduced to 25 plants per m^2 and just before flowering all axillary branches except of the first and fifth and of the main branch were cut off. Light intensity was measured during fertilization and early seed development in the crop at a heigth of 140 cm and above the crop.

200 pods of each sample were examined. On the main and the fifth axillary branch the number of well developed seeds and the number of ovules per pod (potential seed number)

were determined. The fertility was calculated by relating the number of seeds to the number of ovules per pod.

In order to investigate pollen tube growth microscopically, five day old pods from the first axillary branch were fixed in ethanol/acetic acid/formaldehyde (8:1:1) for at least 24 hours. After maceration with 8 N NaOH for 1-2 hours and washing in water thoroughly the young pods were placed in a solution of 0.1 % anilinblue dissolved in 0,1 N K_3PO_4 (PREIL 1970). After 24 hours the pollen tubes were analysed microscopically using the fluorescence of callose in UV light.

Results and Discussion

1. Exposure to light in the four experimental variants

Light intensity above the crop varied from 107 klx (RD,NC) to 40 klx in the shadow 2 variant, but was reduced to 37 klx and 14 klx under cloudiness. Light exposure in variant shadow 2 at bright sunshine was similar to the light conditions in variant RD during cloudy days. Already in the upper part of the crop a remarkable light reduction could be observed (Fig.1).

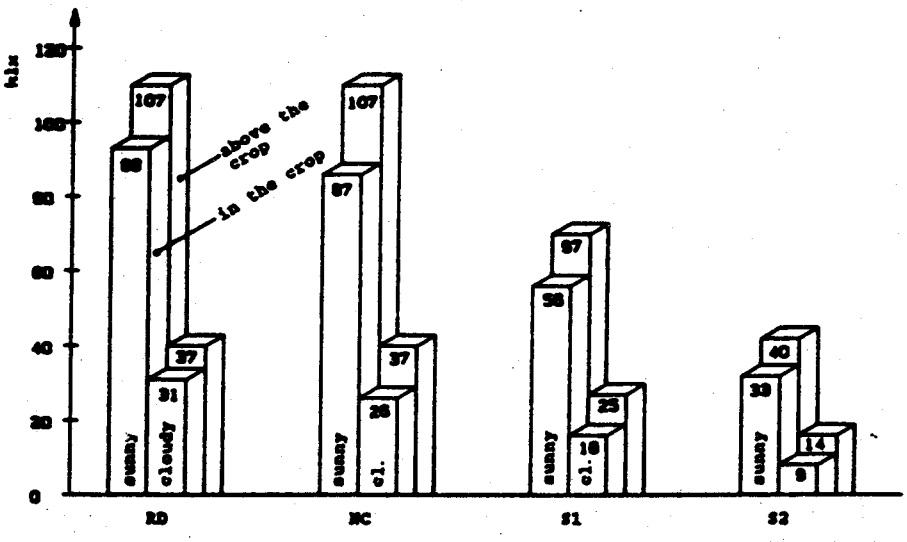

figure 1: The light intensity in the four variants

RD = reduced plant density
NC = normal cultivation
S1 = shadow 1
S2 = shadow 2

2. Fertility of four winter rape cultivars under different exposure to light

The number of ovules per pod did not differ significantly between the main branch and the fifth axillary branch. No relation between the number of ovules per pod and their insertion could be confirmed at branches of the first order in this part of the inflorescence which was analysed during the course of this experiment (BESCHORNER 1986).

Under normal conditions the strain 1657/79 showed the highest seed set of the four cultivars at both, the main and the fifth axillary branch (Table 1). There were significant differences between the four cultivars as well as between the four light variants. Significant interactions of variety to light were found (Table 2).

In general, seed set varied significantly between both branches except in variant RD. In all other variants significant variety to insertion interactions were detected (Table 3).

Table 1 : The number of well developed seeds per pod (x)

		RD	NC	S1	S2
main branch	St.1657/79	31.0	28.7	28.9	23.1
	St.154/81	28.7	19.4	26.5	19.1
	Jet Neuf	33.4	22.5	18.2	17.9
	Garant	27.6	24.3	24.7	20.0
5. axillary branch	St.1657/79	30.5	25.5	20.5	20.4
	St.154/81	27.6	15.8	24.9	9.1
	Jet Neuf	32.7	19.3	18.5	13.2
	Garant	26.6	13.2	15.7	7.5

Table 2 : F-values of the 2-factorial analysis of variance for well developed seeds

Source variant	cultivar	light exposure	interactions cultiv./light
main branch	15.32 ***	56.86 ***	8.30 ***
5. axillary branch	36.78 ***	142.66 ***	7.97 ***

*** α = 0.1%

Table 3 : F-values of the 2-factorial analysis of variance for well developed seeds

Source variant	cultivar	insertion	interactions cultivar/ insertion
RD	25.47 ***	2.46	0.08
NC	22.14 ***	33.77 ***	4.72 **
S1	15.84 ***	31.49 ***	5.58 ***
S2	21.0 ***	84.69 ***	7.86 ***

** α = 1% *** α = 0.1%

Computing the fertility for all cultivars in all experimental variants the same picture could be found (Table 4). This is due to the constant expression of the potential seed number (number of ovules per pod) in all variants of the experiment for each cultivar.

Table 4 : Percentage of fertility at the main branch and the 5. axillary branch

		RD	NC	S1	S2
main branch	St.1657/79	87.3	82.8	83.2	68.8
	St.154/81	89.4	61.0	85.5	59.7
	Jet Neuf	91.9	64.7	53.2	50.3
	Garant	81.7	71.7	74.2	62.5
5. axillary branch	St.1657/79	89.4	76.1	64.0	61.8
	St.154/81	84.8	76.1	65.0	29.0
	Jet Neuf	90.6	56.4	54.6	38.3
	Garant	79.5	41.1	49.8	25.0

Considering the results in tables 1 and 4 it is obvious that light reduction did affect seed set as well as fertility much less in strain 1657/79 than in the other cultivars. Particularly the data obtained from the pods at the 5. axillary branch demonstrate this special reaction.

Whereas at reduced plant density strain 1657/79 was not superior to the other cultivars in general, it exceeded their seed set at the 5. axillary branch with more than 20% under normal cultivation. In variant shadow 2 only the strain 1657/79 reached more than 60% fertility.

There were differences in pollen tube growth among the two varieties and the variants of light exposure as we know from preliminary observations of the strains 1657/79 and

154/81. Light reduction retarded lenghtening of the pollen tubes or even inhibited their growth.

In strain 154/81 this reaction was more distinct than in strain 1657/79. Under the light conditions of variant shadow 1 fertilization was nearly normal in strain 1657/79 while the number of pollen tubes was reduced in pods of the strain 154/81.

In variant shadow 2 only a limited number of pollen tubes could be found in the pods of both cultivars. But, the reaction to light reduction was less manifested in strain 1657/79. Normally, pollen tubes could be seen in the basal part of the pods of strain 1657/79 near the ovules or just invading them. Often this region was not invaded by pollen tubes in pods of strain 154/81.

The strain 1657/79 reacted more stable to varying light exposure. Compared to the other cultivars, especially to Jet Neuf, it seems that this strain is characterized by more photosynthetic activity or translocation of assimilates during fertilization and early seed development.

Literature

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We gratefully acknowledge the co-operation with DSV Lippstadt and NPZ Hohenlieth.