Reaction Of Pods Of Oilseed Rape (Brassica napus L.) In Relation To Raceme Position And Nitrogen Supply

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Introduction

Oilseed rape is one of the most important crop of the temperated climate. The high nitrogen requirement is well known. There are some reactions in the plant development in relation to a different nitrogen supply. One of the most important yield components are the number and the dry weight of the pods per aerea. Other important yield components are the number of seeds per pod and the dry weight of the seeds. We have some informations about the influence of nitrogen onto the development of rape plants (Allen and Morgan 1972, Scott et al. 1973, Holmes 1980, Scarisbrick et al. 1981). There are also informations about the nitrogen influence on the oil content, oil concentration and the fatty acid composition (Hermann et al. 1976, Holmes and Ainsly 1977, 1979, Holmes and Bennett 1979, Diepenbrock and Geisler 1979, Ogunlela et al. 1990).
This experiment was conducted to study the role of the hulls for the yield development and to describe the nitrogen efficiency within the pods in relation to N supply and raceme position. Other yield components like number of seeds per pod and the dry weight of the seeds were analysed.

Materials and Methods

The experiment was conducted using a hydroponic system in a greenhouse under controlled conditions. Seeds of summer rape (cv. Callypso) were germinated and grown on nutrient solution in plastic pots. The solution was aerated continuously and replaced weekly. The nutrient solution was a modified Hoagland solution. The pH was maintained by additions of $CaCO_3$. The main treatments were three N-levels (2,7 and 12 mM N) given as NH_4NO_3 and the raceme position.
Plants were harvested 132 days after transplanting. The terminal and the five axillary branches for each plant were separated and then the pods sub-divided (Table 1). Then the dry weights , the nitrogen concentrations, the number of seeds per pod and the seed weight were analysed.

Table 1. A specification of the different analysed plant parts

code	plant part
PDT / HT / ST	pods / hulls / seeds of the main stem
PD1 / H1 / S1	" " " of the 1. axillary branch
PD2 / H2 / S2	" " " of the 2. axillary branch
PD3 / H3 / S3	" " " of the 3. axillary branch
PD4 / H4 / S4	" " " of the 4. axillary branch
PD5 / H5 / S5	pods / hulls / seeds of the 5. axillary branch

Results

The pod dry matter increased with an increas of 2 up to 7 mM N. When the plants grow up in a higher concentration the addition of dry matter was very small (Table 2).

Table 2. Absolute (g) and relative (%) dry weights of vegetative and generative plant parts of total rape plants

N-supply (mM N)	absolute dry weights		relative dry weights	
	vegetative	generative	vegetative	generative
2	32.28	24.86	56.50	43.50
7	62.14	44.12	58.48	41.52
12	90.19	46.26	66.10	33.90

generative parts = root + stem + leaves
vegetative parts = pods

The dry matter development of the pods, the hulls and seed in relation of nitrogen supply and raceme position is described in table 3. The dry matter of the hulls increased under higher N-levels much more than the dry matter of the seed.

Table 3. Dry matter of pods, hulls and seed (g) per branch in relation of nitrogen level and raceme position

N-supply (mM N)	pods					
	PDT	PD1	PD2	PD3	PD4	PD5
2	8.95	4.66	4.32	3.57	2.14	1.20
7	12.39	7.29	5.73	6.99	5.92	5.80
12	11.88	7.00	6.82	7.98	7.14	5.43
	hulls					
	HT	H1	H2	H3	H4	H5
2	4.83	2.47	2.40	2.01	1.27	0.75
7	7.24	4.30	3.40	4.24	3.70	3.64
12	8.33	4.99	4.75	5.65	5.17	4.20
	seed					
	ST	S1	S2	S3	S4	S5
2	4.11	2.20	1.92	1.56	0.87	0.45
7	5.15	2.99	2.33	2.75	2.23	2.16
12	3.55	2.00	2.07	2.33	1.97	1.23

In table 4 we calculated a special harvest index for the pods. The results show that the harvest index decreased in all raceme positions when there is an increase of the N-level. The highest harvest index we have under the lowest N-level and the lowest harvest index under the highest N-level. The mean difference between the harvest index under the lowest and highest N-level over all raceme

positions is 15.5%.

Table 4: Harvest index of the pods calculated as percentage of the seed dry matter in relation to the total pod dry matter

N-supply (mM N)	harvest index (pods) in %					
	PDT	PD1	PD2	PD3	PD4	PD5
2	45.92	47.21	44.44	43.70	40.65	37.50
7	41.57	41.02	40.66	39.34	37.67	37.24
12	29.88	28.57	30.35	29.20	27.59	22.65

The nitrogen contents of the pods increased very much in relation to the increase of the N supply though the dry weight decreased in some cases. The hulls growing up on plants with a very low N nutrition (2mM N) contain very low nitrogen. Most of the nitrogen we found under these conditions in the seeds. The hulls of plants growing up under a high nitrogen level (12 mM N) contain extremely high nitrogen. The increase of the nitrogen content between seeds of plants growing up under low and high nitrogen nutrition are not so great.

Table 5. Nitrogen contents of the pods, hulls and seed (mg) in relation of nitrogen supply and raceme position

N-supply (mM N)	pods					
	PDT	PD1	PD2	PD3	PD4	PD5
2	185	93	83	70	42	23
7	368	220	166	210	173	182
12	515	282	267	327	297	222
	hulls					
	HT	H1	H2	H3	H4	H5
2	32	14	13	11	09	06
7	102	67	49	68	57	65
12	320	172	157	204	185	154
	seed					
	ST	S1	S2	S3	S4	S5
2	153	79	70	59	33	17
7	266	153	118	142	116	117
12	195	110	111	124	112	68

The nitrogen harvest index of the pods calculated as percentage of the seed nitrogen weight in relation to the total nitrogen content of the pods show that we have the highest nitrogen index under low N-level. Between the pods of the main stem and the first three axillary branches there are no differences. Then there is a decrease in the nitrogen index. Under high nitrogen level the nitrogen index is very low. There are no significant differences between the hulls of the different raceme positions except the pods of the fith axillary branch.

Table 6. Nitrogen harvest index of the pods in relation of nitrogen supply and raceme position

N-supply (mM N)	harvest index (pods) in %					
	PDT	PD1	PD2	PD3	PD4	PD5
2	82.70	84.95	84.34	84.29	78.57	73.91
7	72.28	69.55	71.08	67.62	67.05	64.29
12	37.86	39.01	41.57	37.92	37.71	30.63

Most of the total nitrogen was retranslocated out of hulls under low N-level. Under these conditions there is an increase of translocated nitrogen from the hulls of the main stem up to the hulls of the fith axillary branch. Under high nitrogen conditions there is only a very small or no nitrogen translocation (Table 7).

Table 7: Retranslocated nitrogen (%) out of senescent hulls in relation of nitrogen supply and raceme position

N-supply (mM N)	HT	H1	H2	H3	H4	H5
2	50.0	60.7	59.4	50.0	68.0	78.3
7	60.2	10.7	47.9	48.7	30.0	52.4
12	1.8	n.t.	9.3	n.t.	n.t.	n.t.

n.t. = no translocation

Seed number in respect of pods on the main stem and on axillary branches 1, 2 and 3 failed to respond to N supply but in the case of pods on branches 4 and 5seed number per pod increased significantlya as N nutrition of the rape plant increased. Pods on the lowest two axillary branches contained seeds which were generally fewer in number than those on the upper branches.

Nitrogen supply influenced seed weight significantly when N supply was increased from 2 to 7 mM N but as N nutrition was increased to 12 mM N seed weight tended to decrease.

Table 8. Number of seeds per pod and weight of thousands seeds at different racemes in relation to N-supply

N-supply (mM N)	number of seeds per pod					
	PDT	PD1	PD2	PD3	PD4	PD5
2	22.4	21.6	19.1	17.4	10.5	5.9
7	22.6	21.5	20.5	20.1	17.7	16.8
12	23.2	23.2	21.3	20.7	19.4	19.6
N-supply (mM N)	**weight of thousand seeds (g)**					
	PDT	PD1	PD2	PD3	PD4	PD5
2	3.44	3.19	2.83	2.65	2.45	2.87
7	3,99	4.49	4.15	4.22	4.05	4.38
12	3.03	3.13	3.03	3.15	3.17	3.15

Discussion

The results of the experiment show that there is a great influence of different nitrogen nutritions on the development of pods , hulls and seeds. It seems that the harvest index and the nitrogen harvest index are not the best parameter to describe the optimal internal situation to develope a physiological best yield. With increasing nitrogen levels the number of seeds per pod changed differently in relation to raceme position. The dry weight of seeds increased when the nitrogen level increased from 2 up to 7 mM N. With more nitrogen the dry weights tended to decrease.

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