THE INFLUENCE OF GENOTYPE AND DONOR PLANT ON THE NITROGEN EFFICIENCY OF DH-LINES OF WINTER RAPE

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ABSTRACT

DH-lines are a useful basic material for the development of rape forms with improved N-efficiency. The genotype the donor plants for DH-line production are derived from as well as the donor plants themselves influence the N-efficiency of DH-lines significantly. Beside of that, DH-lines of one donor plant differ in their N-efficiency considerably. Therefore, an additional test assessing the N-efficiency of every single DH-line is essential.

INTRODUCTION

Winter rape has been selected under conditions of almost optimal nutrient supply up to now and belongs to the nutrition intensive crops. In recent times, the requirement for a lower intensity in fertilisation, especially in N-fertilisation, has become of increasing relevance and therefore cultivars with improved N-efficiency are needed urgently. The most important reasons are increasing energy expenses and environmental pollution caused by high N-applications. A first proof of usable variability in the N-requirement per unit biomass produced was furnished in 1991 under conditions of a controlled pot trial (Gerath and Schweiger, 1991). This result could be confirmed in a field trial with 12 industrial rape cultivars and 12 high-quality rape cultivars/strains in 1993 and three reaction types could be generalized from the relative yields (tab. 1).

TABLE 1. Reaction types regarding N-efficiency in winter rape

Reaction type	Relative yield (max. yield = 100)		
	low N-supply	medium N-supply	high N-supply
I	60	80	100
II	60	100	100
III	60	100	80

Reaction type I has an insufficient N-efficiency, i.e. it requires a high N-supply to use its yield potential. 13 cultivars belonged to this type.

Reaction type II is the efficient type which is asked for by commercial growing. In contrast to type I this type makes use of its yield potential even under a reduced N-supply and tolerates a high or temporarily high N-supply (caused by weather conditions). 10 cultivars belonged to this type.

Reaction type III is a very efficient one. The unlimited high yield potential is already used in case of a reduced N-supply. A high N-supply inhibits yield formation by excessive N-concentrations in single plant organs. One cultivar could be assigned to this type. This type is too sensitive for commercial growing and has to be rejected therefore, but it is very interesting as basic material in the breeding process.

Basing on the available results of pot and field trials the improvement of N-efficiency by plant breeding seems to be promisingly (Gerath, 1993).

MATERIALS AND METHODS

In a pot trial 15 cultivars were screened under 3 different N-supply levels for their N-efficiency. From the 4 most efficient cultivars one genotype had been selected each which was especially high yielding in case of a reduced N-supply. From selfing progenies of these genotypes 5 donor plants were grown each and used for the production of DH-lines by microspore culture. DH-lines were investigated for their N-efficiency under controlled growth conditions as the source material before. Unfortunately, because of the different suitability for tissue culture the number of plants tested per genotype and donor plant was not uniform.

RESULTS AND DISCUSSION

The following results, summarised in table 2, were obtained:

- N-efficiency of DH-lines is influenced significantly by the genotype the donor plant is derived from.
- N-efficiency of DH-lines is, independently of the genotype, significantly influenced by the donor plant the DH-line is derived from.
- Single DH-lines from one donor plant differ significantly in their N-efficiency.

This result is especially remarkable because all genotypes from which the donor plants were obtained resulted from a positive selection. Therefore, an additional test for N-efficiency is inevitable after the production of DH-lines. This additional test has not necessarily to be a relative costly pot or field trial. It can also be carried out in hydroculture, if more attention is paid to the ability of nutrient utilization than to the ability of nutrient acquisition. A pre-selection is already possible regarding the vegetative growth up to DC 30. However, the assessment of N-efficiency is more certain after formation of grain yield. In any case the test for N-efficiency should be carried out under a low, medium and high N-supply to assign DH-lines to N-reaction types and to make it possible to calculate indices of N-efficiency.

There are further characteristics which should be taken into consideration during selection for N-efficiency in DH-lines:

- regarding the efficiency of nutrient acquisition - the dynamics of root growth and the tension of roots,
- regarding the efficiency of nutrient utilisation - the duration of leaf senescence and the ratio of N-content in the leaf at flowering to the N-content in the leaf after senescence.

Only in case the expression of N-efficiency and its components is known in every single DH-line, these DH-lines can be used purposive for the improvement of genetic determined N-efficiency in the breeding process.

TABLE 2. Rank order of 20 donor plants of 4 genotypes regarding N-efficiency (5 donor plants per genotype)

Rank	Donor plants (No.)				Rank of donor plants (Tuckey-test)	
	Madora	St. 019	St. 1. 98	St.I_4E 90		
1	496				496	a
2			508		508	ab
3	499				499	abc
4	501				501	abcd
5			512		512	abcd
6			509		509	abcde
7		502			502	abcdef
8				514	514	abcdef
9				515	515	bcdefg
10		504			504	bcdefg
11			532		532	cdefg
12	497				497	cdefg
13				517	517	defg
14		507			507	defg
15		505			505	efgh
16			511		511	fghi
17				518	518	ghi
18		534			534	hi
19				519	519	ij
20	537				537	j

	Rank of genotypes (Tuckey-test)	
1	Madora	a
2	St. 1. 98	a
3	St. 019	b
4	St. I_4E 90	b

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