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Breeding spring turnip rape for marginal conditions

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Finland is the northernmost region for the cultivation of both spring turnip rape and spring rape. Spring rape is grown only in the southern coastal area, although cultivation of spring turnip rape has expanded northward in recent years. In 1986, cultivation contracts were made, for instance, near the town of Oulu (65°N). When breeding oil crop varieties for Finnish conditions both early maturity and yield are essential.

Variation in yield in variety trials

The variety trials for spring turnip rape (Brassica campestris L.) at the Hankkija Plant Breeding Institute in 1983-1985 included 336 breeding lines and market varieties annually (table 1). The effect of the trial year upon the distribution of yield is large. The yield observations for single varieties surpass 3000 kg only in exceptionally favourable climatic conditions (in trials in 1983). Over a number of years the yields for the best actual varieties average out in the 2000-2200 kg/ha class. In large-scale cultivation the yield level is actually about 500 kg lower. The main objective of breeding is a variety whose yield will remain high year after year.

Table 1.
Distribution of seed yield of varieties in three-replicated trials

Yield class kg/ha	Number of varieties in class		
	1983	1984	1985
800-1000	0	3	0
1000-1200	0	11	0
1200-1400	0	54	2
1400-1600	0	57	16
1600-1800	0	80	85
1800-2000	10	87	141
2000-2200	30	36	63
2200-2400	61	6	25
2400-2600	96	1	4
2600-2800	78	1	0
2800-3000	52	0	0
3000-3200	6	0	0
3200-3400	2	0	0
3400-3600	1	0	0
Average kg/ha	2541	1685	1904

Breeding for higher yield

The trial results show that late maturing varieties only occasionally produce the best yields. A significant (*) positive correlation between growing time and seed yield was found in five out of twenty-four trials (table 2). Late spring turnip rape varieties are not able to take advantage of yield capacity under marginal conditions of cultivation. This is surprising, as in Finland, spring rape varieties with a growing time of 2-3 weeks longer are cultivated.

In the abovementioned trials the range of single observations of growing time is 90-118 days. Obviously a variety has to have a growing time of 102-105 days on average to obtain optional yield. Most of the present spring turnip rape breeding material is within this optimal range.

Seed size is also a yield component for spring turnip rape. In five trials out of twenty-five the correlation between yield and thousand seed weight was significantly positive (table 3). One can say that in special growing conditions large seed size is of value to the high yield of a variety. Under no conditions does it constitute a disadvantage. These findings indicate that seed size will be a constant selection criterion in yield breeding.

The harvest index for spring turnip rape remains low, especially in northern growing conditions. As an illustration, the harvest indexes from the 1985 trial (table 4) are presented for some varieties. Varietal differences are statistically insignificant. The harvest indexes were measured for plants taken randomly from plots. The best way to improve seed yield is to raise the harvest index without lowering the total biomass volume. In Hankkija's own material the mutants that were

induced by neutron irradiation and affect morphology may render it possible to raise the harvest index.

too tall and lodge early in rainy summers. This is a particular problem under Finnish growing conditions.

Table 2.
Linear correlations of seed yield with growing time, days

Trial	1983		1984		1985	
	n	r	n	r	n	r
1	36	−0.00	49	0.17	49	−0.0
2	30	0.48**	49	0.30*	49	0.0
3	25	0.12	42	0.33*	42	0.0
4	30	0.12	42	0.09	42	0.3*
5	36	−0.26	42	0.07	42	0.2
6	56	−0.08	56	0.29*	56	−0.0
7	30	0.06	56	0.11	56	−0.0
8	36	−0.01				
9	25	−0.14				
10	20	−0.18				

Table 3.
Linear correlations of seed yield with thousand seed weight

Trial	1983		1984		1985	
	n	r	n	r	n	r
1	36	0.40*	49	−0.08	49	0.3*
2	12	0.61*	49	−0.04	49	−0.0
3	30	−0.21	42	0.12	42	0.1
4	25	0.15	42	0.30	42	0.1
5	30	0.08	42	−0.18	42	0.0
6	36	0.17	56	0.19	56	0.2*
7	56	0.12	56	−0.06	56	0.1
8	30	0.04				
9	36	0.43**				
10	25	0.27				
11	20	0.18				

Dwarf material

Morphology mutants, which were induced by neutron irradiation, most visibly affect the height of plants, but also the branching and the size of leaves. Mutant height ranges steplessly between 30-100 cm. For the sake of comparison one can state that the varieties with "normal" height had a height range of 73-139 cm in the above mentioned trials in 1983-1985. The current varieties tend to grow

With dwarf mutants the problem of lodging could be solved, provided they are otherwise suitable for cultivation.

Relationship between yield and quality

New breeding lines to be included in variety trials are zero-erucic and low in glucosinolate content, and therefore the basis for comparison

with high glucosinolate varieties is narrow. In comparison with the most productive single low varieties at present, Emma and Tyko, only the very best brown-yellow seeded double-low lines produce equal yields. An example is Valtti, which came on the market in 1985; its yields do not differ significantly from those of Emma and Tyko. Thus breeding has progressed to the point, where the best double-low varieties produce yields comparable to the best single-low varieties. High quality seed yield does not seem to obstruct progress in breeding for yield.

Table 4.
Harvest indexes of ten varieties
in a three-replicated trial 1985

Variety	Harvest index, %
Tobin	23.1
Emma	23.5
Hja 96350	24.3
Span	24.5
Ante	24.8
Valtti	25.3
Hja 96401	25.5
Hja 96337	26.4
Tyko	26.7
Vankka	27.1
Average	25.1
F Var. 1.17 NS	

Résumé

La Finlande se trouve sur la périphérie septentrionale de la zone de culture de printemps de la navette. Les variétés à sélectionner pour ces conditions doivent nécessairement être précoces. La fragilité de la tige pose problème du fait de la pluviosité de l'automne. Un raccourcissement et une amélioration de la solidité de la tige sont recherchés à travers l'emploi de types nains. Il est en outre visé l'obtention d'un grain de plus grandes dimensions, celui-ci étant considéré comme un élément de récolte important. Les meilleures lignées du type 00 sont aussi productives que les meilleures variétés simple zéro actuellement cultivées dans la pratique.

Zusammenfassung

Finnland stellt ein nördliches Randgebiet für den Anbau von Sommerrübsen dar, und deswegen sollen die Sorten, die für diese Verhältnisse gezüchtet werden, früh sein. Eine schwache Standfestigkeit bildet ein Problem, weil die Herbste regnerisch sind. Durch die Benutzung von Zwergtypen strebt man danach, die Pflanzenhöhe zu verkürzen und die Standfestigkeit zu verbessern. Das Samengewicht versucht man zu vergrössern, weil es festgestellt worden ist, dass es einen wichtigen Ertragsfaktor bildet. Die besten Züchtungslinien des 00-Typs sind ebenso ertragsreich wie die besten, zur Zeit im praktischen Anbau vorkommenden Einnul-Sorten.