Oil Crop Breeding at Svalöf in 1985

Roland Jönsson
Svalöf AB, S-268 00 Svalöv, Sweden

At Svalöf breeding work is carried out in summer and winter forms of both rape and turnip rape and in smaller scale also in white mustard, brown mustard, poppy and sunflower. In rapeseed the breeding goals are about the same as in most other countries but especially improvements of winter hardiness and oil and meal quality are emphasized.

In winter rape only single low cultivars are grown. Sv Jupiter is the dominating cultivar grown on about 90 % of the acreage. This variety has a rapid growth in autumn, a very good winter hardiness and gives a very high yield. However, its stalk is somewhat weak. The very stiff cultivar Jet Neuf has given a high yield on an average. However, this cultivar has a tendency to develop a high stalk already in autumn and is therefore more easily damaged by frost during cold winters than Jupiter. Jet Neuf is more resistant to *Phoma* than Jupiter but is on the other hand more susceptible to *Sclerotinia* and *Verticillium*. Single low lines with up to 10 % higher yield than Jupiter and with improved winter hardiness, stalk stiffness and protein content are now being tested in official trials. The best double low line tested so far, Sv 0212, has given almost the same yield as Jupiter but is less winter hardy. During the last winter some more winter hardy double low lines were found.

The cultivars Bienvenu, Tandem, Darmor and Mikado are now being tested in official trials in Sweden. None of these cultivars seems to be winter hardy enough for Swedish conditions.

The acreage of winter turnip rape in Sweden is very small at the moment. The cultivar Sv Rapido III, with high erucic acid content, is still grown but will most probably from this autumn be replaced by the new single low cultivar Sv Per. This cultivar has in official trials given the same yield of crude fat and shown almost as good winter hardiness as Rapido III. No double low lines of winter turnip rape have been tested in official trials so far.

In summer rape the double low cultivars Sv Topas and WW Hanna are dominating the market but the single low cultivar Sv Niklas is still grown to some extent. From 1986 only double low cultivars of summer rape will be grown in Sweden. Niklas gives some percentage higher yield than Topas and Hanna. Topas is earlier ripening, has a stiffer stalk and higher oil and protein content than Hanna. Since 1983 Topas has been the dominating cultivar in Denmark. Some promising double low lines with higher yield than Topas are now being tested in official trials. One of them, Sv 02279, has given a very high yield in southern Sweden as well as in Denmark. This cultivar is approved for introduction on the cultivar list in Canada under the name of Global.

In summer turnip rape Sv Tyko and WW Emma are the dominating cultivars. Emma gives 2 % lower yield than Tyko but is somewhat earlier ripening. Both cultivars are of the single low type. In official trials both double low and triple low lines with almost the same yield capacity as Emma are being tested. Therefore, probably a turnover to low glucosinolate cultivars will be possible in summer turnip rape within a few years. The yellow seeded line Sv 03333 holds about 95 % yellow seeds and have high contents of both oil and protein. In 1985 three double low lines with increased content of palmitic acid are being tested in official trials. Later on I will give some more information about the breeding work for improved oil quality going on at Svalöf.

The acreage of white mustard in Sweden is only about 1000 hectares and all the seed produced goes to the spice industry. The cultivars Gisilba and Kirby with low oil content are used. However, a new type of white mustard with an oil suitable for technical purposes is now in progress. By use of half seed technique the erucic acid content in white mustard has been increased from 40 to 55 %. High erucic lines with about the same yield as the cultivar Sv Trico are now being tested in official trials. Eventually a high erucic cultivar of white mustard will be marketed already in 1986.

The breeding work going on at Svalöf has resulted in a very big variation in fatty acid composition. In winter rape breeding lines with more than 40 % linoleic acid and less than 5 % linolenic acid are found. These lines have been rather stable over generations and under various conditions. Breeding work aiming in transfer of the genes for high linoleic acid and low linolenic acid to double low winter rape is going on. The genes have also been transferred to double low summer rape and breeding work aiming in transfer of the genes also to turnip rape is in progress. Probably each step in the fat synthesis is controlled by one or two genes only. In winter rape also lines with increased content of palmitic, oleic or linolenic acid are found.

A very big variation in fatty acid composition has been found in summer turnip rape too. Also in this species materials with very high linoleic and very low linolenic acid content are found. However, of still more interest is the material with increased content of palmitic acid. A margarine produced by standard methods from a hydrogenated low erucic rape oil has a bad texture due to recrystallization. When hydrogenated oil from seed material containing 11 % palmitic acid was tested for margarine production in Lund recently it was found to be as good as soybean oil with regard to crystallization properties. Short information about the breeding material with high palmitic acid content will be given in issue No 10 of Cruciferae Newsletter. Breeders, who are interested in summer turnip rape material with high palmitic acid content, can obtain small seed samples from Svalöf.

The meal quality is improved by lowering the contents of glucosinolates and crude fibre and by increasing the content of protein. By use of a NIR-instrument the contents of protein, crude fibre and oil are determined on whole seeds.

Selection for high protein content in the meal carried out on plant level has given positive results. By repeated selection for 5-7 generations in a double low summer rape population the protein content has been increased from 44.0 to 48.2 %. The increase in protein content had no negative consequences on the amino acid composition and the availability of the protein and no undesirable effects on the content of the hull, fibre, tannin, sinapine and phytic acid. The selected population gave higher yield of both oil and protein than Topas. A very big variation in protein content occurs in the breeding materials of rape and turnip rape. Therefore, by continued breeding work it will be possible to produce cultivars with considerably increased protein content.

Winter rape
Promising lines in official trials in Sweden in 1985-86

Cultivar or line	Type	Number of trials	Relative yield of crude fat	Winter hardiness	Stalk stiffness	Protein in meal % in DM
Sv Jupiter	0		**100**			
Sv 0321	0	38	104	+ 1	+ 6	± 0.0
Sv 0327	0	21	106	+ 2	± 0	+ 0.3
Sv 0329	0	11	110	+ 2	+ 2	– 1.4
Sv 0330	0	11	107	+ 2	± 0	– 0.4
Sv 0357	0	8	105	+ 2	+ 9	+ 1.5
Sv 0363	0	8	106	± 0	+ 14	+ 2.1
Sv 0212	00	18	99	– 3	+ 11	+ 1.4
Sv 0212	00		**100**			
Sv 0223	00	2	106	+ 7	– 5	– 0.3
Sv 0232	00	2	108	+ 8	– 8	– 0.1

Summer rape
Promising lines in official trials in Sweden in 1985

Cultivar	Type	Number of trials	Relative yield of crude fat	Maturity	Stalk stiffness	Crude fat % in DM	Protein in meal % in DM
Sv Topas	00		**100**		74	47.4	42.9
Sv Niklas	0	147	106	± 0.0	– 4	– 1.1	– 1.3
WW Hanna	00	138	100	+ 0.7	– 10	– 0.7	– 1.5
Sv 02279 (Global)	00	55	101	+ 0.6	– 9	– 0.8	– 2.7
Sv 02326	00	26	103	± 0.0	+ 8	+ 0.9	– 0.1
Sv 02262	00	28	102	+ 1.3	+ 4	+ 0.7	+ 1.0
Sv 02267	00	9	107	+ 0.3	+ 4	+ 0.9	+ 0.4
Sv 02266	00	9	106	– 1.3	– 1	+ 0.1	+ 1.9
Sv 02312	00	9	108	– 0.8	– 3	+ 0.5	+ 0.7

Summer turnip rape
Promising lines in official trials in Sweden in 1985

Cultivar or line	Type	Number of trials	Relative yield of crude fat	Maturity	Stalk stiffness	Crude fat % in DM	Protein in meal in % DM
Sv Tyko	0		**100**		56	44.2	39.4
WW Emma	0	175	98	– 1.1	± 0	– 1.1	
Sv 03223	00	26	97	– 0.2	+ 8	– 1.3	– 0.4
Sv 03209	00	32	95	– 1.5	– 6	– 0 7	± 0.0
Sv 03242	00	35	96	– 0.5	– 6	– 1.0	– 0.1
Sv 03232	00	28	97	– 0.7	+ 4	– 0.9	– 0.4
Sv 03333	000	8	97	– 1.8	+ 4	+ 2.4	+ 1.7

White mustard
Promising lines in official trials in Sweden in 1985

Cultivar or line	Erucic acid %	Number of trials	Seed yield	Crude fat		Maturity	Stalk stiffness
				Rel. yield	% in DM		
Sv Trico	40		**100**	**100**	36.9		75
Gisilba	39	12	94		– 3.9	– 3.3	+ 4
Kirby	39	27	101		– 3.7	– 3.2	+ 15
Sv 04108	55	12		94	+ 0.8	– 0.2	+ 10
Sv 04109	55	8		100	+ 1.0	– 0.2	+ 11

Variation in fatty acid pattern found in breeding material of winter rape at Svalöf

Fatty acid	Fatty acid composition in percent							
	Norde Jupiter		Breeding material					
Palmitic	4	5	7	5	6	9	5	8
Oleic	10	56	45	65	35	40	70	27
Linoleic	13	22	42	26	49	40	19	45
Linolenic	10	12	3	2	8	8	4	18
Eicosenoic	9	2	/	/	/	/	/	/
Erucic	52	1	0	0	0	0	0	0

Winter rape grown in greenhouse at Svalöf

Material	Year	Fatty acid composition %					
		C_{16}	$C_{18:0+1}$	$C_{18:2}$	$C_{18:3}$	C_{20}	C_{22}
Breeding line, generation 1	1982	7.4	41.0	44.2	5.5	0.9	0.0
" " 2	1983	8.7	46.7	40.2	3.4	1.0	0.0
" " 3	1984	7.2	39.1	45.8	5.7	1.7	0.0
" " 3	"	6.8	41.4	43.2	4.1	1.9	0.0
Jupiter	"	5.7	59.2	21.7	11.4	1.7	0.0

Variation in fatty acid pattern in breeding materials of summer turnip rape

Fatty acid	Fatty acid %						
	Bele	**Tyko**	**Breeding material**				
C 16:0 Palmitic	2.7	4.2	4.5	8.3	3.0	**12.6**	2.7
C 16:1 Palmitoleic	0.3	0.3				**5.2**	0.0
C 18:0 Stearic	1.3	1.1	31.1	61.8	**80.2**	1.0	**5.8**
C 18.1 Oleic	26.9	57.9				41.7	66.9
C 18:2 Linoleic	16.7	22.9	**51.1**	26.9	9.4	20.4	14.0
C 18:3 Linolenic	9.0	12.0	12.3	**3.0**	4.5	17.6	5.5
C 20.0 Arachidic	0.8	0.3	0.6	0.0	2.4	0.4	2.1
C 20:1 Eicosenoic	11.7	0.7				0.5	1.6
C 20:2 Eicosadienoic	0.6						0.1
C 22:0 Behenic	0.4	0.7		0.0		0.2	1.2
C 22:1 Erucic	27.5						
C 22:2 Docosadienoic	0.4						
C 24:0 Lignoceric	0.2						
C 24:1 Nervonic	1.5						

Protein content in summer rape grown at Svalöf in 1981-83

Cultivar or line	Protein in meal % in DM
Sv Gulliver	41.3
Sv Niklas	42.0
DP Line	41.7
CDA Andor	43.1
Sv Karat	44.0
Sv Topas	45.0
Sel : for high protein content in the metal	48.2