THE EFFECT OF RECURRENT SELECTION IN WHITE MUSTARD (Sinapis alba L)

by

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White mustard (Sinapis alba L) is cultivated as an oil crop in Sweden. It is a completely cross-pollinating crop (Olsson 1960). As in all allogamous species it is possible to change the population by recurrent selection. This paper deals with the effects of selections for number of seeds per pod, oil content, fatty acid composition, and nematode resistance.

The investigation was initiated in 1952. At that time the only white mustard variety grown in Sweden was Svalöf's Primex. Consequently Primex was chosen as initial material. During the first 12 years selections were made for number of seeds per pod and oil content in both negative and positive directions. The selections were made in distance-isolated plots while the evaluation of the selection effect was made together with unselected material in comparative trials. Before the selection for oil content was made, a selection was performed in the field for well-developed plants with long pods and a high number of "seed knots" on the pods.

The effects of selection for number of seeds per pod are seen in Table 1. After twelve years the number of seeds was 9.06 in the positive selection, 5.41 in the standard and 3.21 in the negative selection. This indicates that the number of seeds was increased by 3.65 seeds or 67% and decreased by 2.20 seeds or 40%. The differences are highly significant. By counting the number of ovules in the pod before flowering and discarding unwanted plants already at the beginning of the flowering period, it has been possible to make the selection more effective and it is very clear that selection before the flowering period gives a stronger effect than selection on ripe plants. A selection for number of seed per pod might indirectly affect other characters as for instance seed size (Olsson, 1974). The influence on the yield is, however, not very strong.

The effect of selection for oil content is shown in Fig. 1. After twelve years of selection, the oil content in the positive selections was 37.4%, in the standard 30.0% and in the negative selections 22.7%. The total difference between the positive and negative

selections was 14.78± 0.63%, the difference being very significant. There is a tendency for a higher plant yield in the selection for high oil content.

The selection for high oil content has been of great value for the practical plant breeding work. This selection has been tested as Sv 54122 in relation to Primex white mustard in a great number of trials. The results of the trials are given in Table 2. As Sv 54122 has continuously changed during the test period on account of the continuous selection for oil content, the results are devided into three different periods. The simultaneous selection for well-developed plants and pods and a high oil content has increased both the seed yield and the oil content and the oil yield.

In practical plant breeding it is also necessary to take other characters such as stem stiffness and earliness into consideration. Therefore, the best plants have also been sown in a pedigree test. One such plant, selected in 1960, has produced a new variety, Svalöf's Trico white mustard. Trico was marketed in 1967 (Andersson, Jönsson and Lööf 1970).

Between 1968 and 1977 the selections for high oil content have continued, however, less intensively and no test has been carried out in relation to Primex. From 1978 the selection for high oil content, Sv 7839153, has again been tested in comparative trials together with Primex and Trico. Sv 7839153 has now 15% higher seed yield and 39% higher oil yield than Primex (Table 3). The difference in oil content is in absolute figures 6.8%.

The cultivated material of rape and turnip rape has now a low erucic acid content. For some technical purposes a high erucic oil is, however, desired. As it is very difficult to cultivate both high and low erucic varieties of rape, a selection for high erucic acid content in white mustard was started in plants selected in the population with high oil content in 1976. This population had on an average an erucic acid content of about 40%. Individual plants were analysed regarding fatty acid composition. About 10% of the analysed plants with highest erucic acid content were put together into a new population and thereafter sown for further selection. From the second year the effect of the selection has been increased by half seed analyses within the best plants. The results of the selection are given in Table 4. In six selections it has been possible to increase the erucic acid content from about 40% to about 55%. This has been done without loss in yield (Table 5).

Both sugar beets and white mustard are attacked by the same nematode species (Heterodera schachtii). As the two crops are cultivated in the same area in Sweden, it would be valuable to have a nematode resistant variety of white mustard. Therefore, a few years ago, a selection for nematode resistance was initiated in the high oil content population. The effect of two selections is given in Fig. 2 (T Jonasson, unpubl). Also in this case there was a very drastic effect of the selection.

Summary

By recurrent selection in white mustard it has been possible

to increase the number of seeds per pod

to increase the oil content

to increase the erucic acid content and

to improve the nematode resistance

Literature cited

Andersson, G., Jönsson, R.,and Lööf, B. 1970. Svalöf's Trico white mustard. - Sveriges Utsädesförenings Tidskrift 80:36-40

Olsson, G. 1960. Self-incompatibility and outcrossing in rape and white mustard. - Hereditas 46:241-252.

Olsson, G. 1974. Continuous selection for seed number per pod and oil content in white mustard. - Hereditas 77:197-204

Table 1. The effect of continuous selection for number of seeds per pod in ripe plants
(In 1953–1961 n = 100, in 1962 –1965 n = 48)

Year	Generation	Selection for high seed number		Unselected Number of seeds per pod	Selection for low seed number	
		Diff.	t		Diff.	t
1953	1	+ 0.16 ± 0.113	1.42	5.76	− 0.55 ± 0.128	4.30***
1954	2	+ 0.52 ± 0.101	5.15***	5.74	− 0.66 ± 0.096	6.88***
1955	3	+ 0.84 ± 0.095	8.84***	5.17	− 0.70 ± 0.088	7.95***
1956	4	+ 1.15 ± 0.100	11.50***	5.74	− 1.00 ± 0.109	9.17***
1957	5	+ 1.33 ± 0.096	13.85***	5.87	− 1.51 ± 0.121	12.48***
1959	6	+ 1.80 ± 0.103	17.48***	5.24	− 2.00 ± 0.110	18.18***
1960	7	+ 1.61 ± 0.115	14.00***	5.89	− 2.65 ± 0.123	21.54***
1961	8	+ 2.66 ± 0.101	26.34***	5.20	− 2.14 ± 0.115	18.61***
1962	9	+ 2.95 ± 0.133	22.18***	5.43	− 2.98 ± 0.163	18.28***
1963	10	+ 2.09 ± 0.213	9.8***	4.89	− 1.79 ± 0.164	10.91***
1964	11	+ 3.47 ± 0.145	23.93***	5.41	− 1.95 ± 0.124	15.73***
1965	12	+ 3.65 ± 0.172	21.22***	5.41	− 2.20 ± 0.130	16.92***

Table 2. Seed yield, oil content and oil yield of Sv 54/122 in comparison with Primex in 1954–1967

	Year	Number of trials	Primex	Sv 54/122	Diff.	Rel. value
Seed yield, kg/ha	1954—61	66	1693	1703	+ 10	101
	1962—64	54	1640	1670	+ 30	102
	1965—67	23	1900	1989	+ 89	105
Oil in % of dry matter	1954—61	61	30.8	32.8	+ 2.0	
	1962 – 64	54	32.0	35.9	+ 3.9	
	1965—67	23	32.5	36.6	+ 4.1	
Oil yield, kg/ha	1954 – 61	61	449	480	+ 31	107
	1962 – 64	54	446	511	+ 65	114
	1965—67	23	525	624	+ 99	119

Table 3. The effect on seed yield, oil content, and oil yield of continuous selection. Mean value of 5 trials in 1978-1982

	Sv Primex	Sv Trico	Sv 7839153
Seed yield, kg/ha	2.625	2.990	3.020
Seed yield, rel value	100	113	115
Oil content in % of dry matter	32.6	37.5	39.4
Oil content diff		+ 4.9	+ 6.8
Oil yield, kg/ha	726	953	1.011
Oil yield, rel value	100	131	139

Table 4. The effect of recurrent selection for high erucic acid content in white mustard

Year	Erucic acid content, %		
	Mean value for the population	Mean value in selected plants	Lowest value used in the seed selections
1	39,7 *	44,2	
2	44,5	49,7	53,0
3	50,1	52,0	58,0
4	52,5	55,0	59,5
5	52,9	54,5	59,5
6	53,3	56,8	60,5
7	55,0		

* Mean value in the unselected population

Table 5. Yield of strains of white mustard with increased erucic acid content

Variety	Number of trials	Seed yield rel value	Oil content % of dry matter	Oil yield rel value	Erucic acid content, %
Sv Trico	13	100	36.8	100	42,0
Sv 04103	13	95	+0.5	97	54.0
Sv 04108	5	96	+0.8	98	54.5
Sv 04109	4	104	+1.7	109	54.1

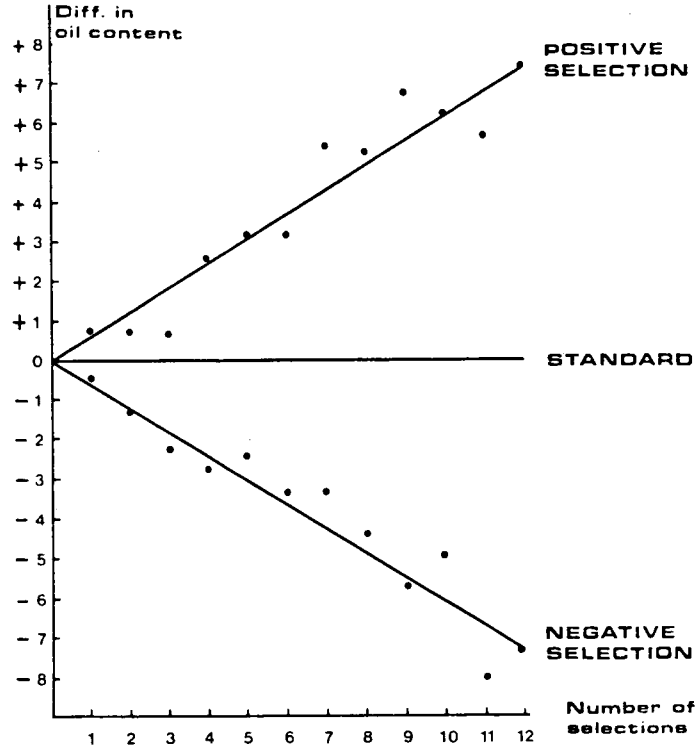

Fig 1. The effect of continuous positive and negative selections for oil content in white mustard

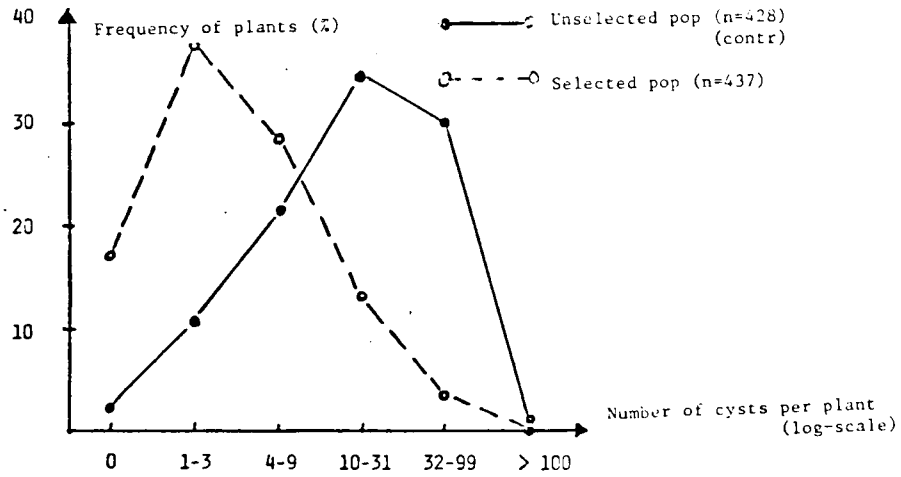

Fig 2. The effect of two selections for nematode resistance in white mustard (T Jonasson unpubl)