DEVELOPMENT OF LOW GLUCOSINOLATE WHITE MUSTARD (*SINAPIS ALBA* SYN. *BRASSICA HIRTA*)

J. Krzymanski, T. Pietka, I. Ratajska, B. Byczynska, K. Krotka

Plant Breeding and Acclimatization Institute (IHAR)
Strzeszynska 36, 60-479 Poznan, Poland

White mustard was examined as a possible spring oil crop for Poland. This species is better adapted to Polish agroclimatic conditions than Brassica campestris, *B. napus* or *B. juncea* in that the seed yield is more stable and less affected by drought. The main disadvantages of this species are:

- low oil content.
- high erucic acid content.
- high glucosinolate content.

A search of white mustard germplasm for variation in these traits followed by selection gave the following results:

- oil content ranged from 27 to 37 per cent.
- erucic acid content ranged from 4 to above 50 per cent.
- glucosinolate content was high and rather stable with the mean value about 176 µmoles/g of defatted meal and a coefficient of variability 6.39 per cent.

A breeding program is now underway to obtain *Sinapis alba* strains with very low glucosinolate content.

MATERIALS AND METHODS

A population of white mustard with genetic variability as large as possible was generated. Hand crosses between two Polish varieties and 15 foreign varieties were made resulting in 30 hybrids.

Progeny of 30 crosses were allowed to interpollinate in the field, and single plant selection for low glucosinolate content was practiced for five generations. Each selected population consisted of 400 to 1250 single plants. Progeny of plants selected for low glucosinolate content did not breed true for this trait due to the self-incompatibility of this crop and the dominance of the high glucosinolate characteristic. However, the frequency of low glucosinolate plants increased slowly in successive generations. To fix the low glucosinolate trait the first seeds set on a plant were harvested as soon as they were mature and the plants cut back to force a second flush of flowers. Those plants producing low glucosinolate seed were then intercrossed. Progeny from intercrosses between these low glucosinolate plants were grown in the greenhouse in the winter of 1989/90. Open pollinated seed was individually harvested from 200 of these plants and analyses of glucosinolate content were performed. Seed from 60 of these 200 plants having the lowest glucosinolate content were sown in four-meter long, single-row plots spaced 45 cm apart in a randomized, complete block experiment with three replications.

Single plant selection for low glucosinolate content was based on a modification of the test tape method described by McGregor and Downey (1975). Then seeds from chosen plants were analyzed using a modification of Josefsson's (1968) method which measures sinalbin plus indolyl glucosinolates. Seed from replicated progeny rows were analyzed for both sinalbin and indolyl glucosinolates using the method of Josefsson and for the presence and amount of progoitrin using the method of Youngs and Wetter (1967). Results obtained by the last method were biased by sinalbin presence (Wetter 1957). The appropriate mathematical correction was applied.

Oil content was measured using a Newport NMR and the fatty acid composition was determined by gas chromatography.

RESULTS

The weather conditions in Poznan were hot and dry during the growing season. Each row of the experiment was harvested separately and analyzed for fat content. Twenty of the 60 strains were discarded on the basis of low fat content. The remaining 40 strains were analyzed for the combined content of sinalbin and indolyl glucosinolates as well as progoitrin (Tables 1 and Figures 1 and 2).

DISCUSSION

The range in fat content was narrow which in part is due to the discarding of the 20 lowest fat content lines from the experiment. However, the selection for low glucosinolate content appears to have been highly effective with one line containing 8 µmoles/g ffm (Table 1) and two additional strains with 11 µmoles/g ffm. Typical values for normal yellow mustard varieties were approximately 180 µmoles/g ffm. The presence of a significant amount progoitrin in some selected lines was an unexpected result of selection.

There was a nonsignificant negative correlation between sinalbin and progoitrin (r=-0.27) with the lowest total glucosinolate content among the strains tested being 20.3 µmoles. The large coefficient of variability values associated with the glucosinolate values indicates that selection for lower content of these components should be possible. The inverse relationship between sinalbin and what, according to gas chromatographic data appears to be progoitrin, is difficult to explain since the precursor of sinalbin is phenylalanine while progoitrin is derived from methionine. Further investigations are underway to determine the relative content of indolyl glucosinolates included in the measurement of the sinalbin component. Analyses of some samples of the low glucosinolate lines by HPLC at Svalof confirmed that progoitrin was indeed present.

It has been speculated that the presence of progoitrin may have originated from spontaneous crosses of white mustard and double low rapeseeds since the white mustard nursery was grown adjacent to such rapeseed plots in each year of selection. However, given the difficulty of producing such a cross under controlled conditions and the high degree of sterility that would be present in the progeny, other explanations are more likely.

One of the parents in the original crosses was a low erucic strain from the Canada Agriculture Research Station Saskatoon. Thus the potential for producing a canola quality or double zero *B. hirta* variety exists in this breeding population.

REFERENCES

JOSEFSSON, E. 1968. Method for quantitative determination of p-hydroxybenzyl isothiocyanate in digests of seed meal of Sinapis alba L. J. Sci. Food Agric. 19: 192-194.

MCGREGOR, D.I. and DOWNEY, R.K. 1975. A rapid and simple assay for identifying low glucosinolate rapeseed. Can. J. Plant Sci. 55: 191-196.

WETTER, L.R. 1957. The estimation of substituted thiooxazolidones in rapeseed meals. Can. J. Biochem. Physiol. 35: 293-297.

YOUNGS, C.G. and WETTER, L.R. 1967. Microdetermination of the major individual isothiocyanates and oxazolidinethiones in rapeseed. J. Amer. Oil Chem. Soc. 44: 551-554.

Table 1. Chemical characteristics of 40 field-grown lines of low glucosinolate white mustard, Poznan 1990

Component	Mean	Max.	Min.	C of V%
Fat (% d.m.)	32.4	34.0	29.7	3.2
Sinalbin* (µM/g ffm)**	22.3	46.2	8.1	39.5
Progoitrin (µM/g ffm)	13.0	22.9	8.2	16.9
Sinalbin* + progoitrin	36.2	55.5	20.3	23.4
Fatty acids:				
- palmitic	3.3	4.3	2.7	8.2
- stearic	1.1	1.4	0.9	13.6
- oleic	36.7	45.0	31.0	10.2
- linoleic	11.8	14.1	10.4	6.5
- linolenic	13.1	14.8	10.7	5.8
- eicosenoic	10.9	14.8	9.1	9.5
- erucic	22.6	28.6	15.6	16.4

*Includes both sinalbin and indolyl glucosinolates
**ffm = fat free meal

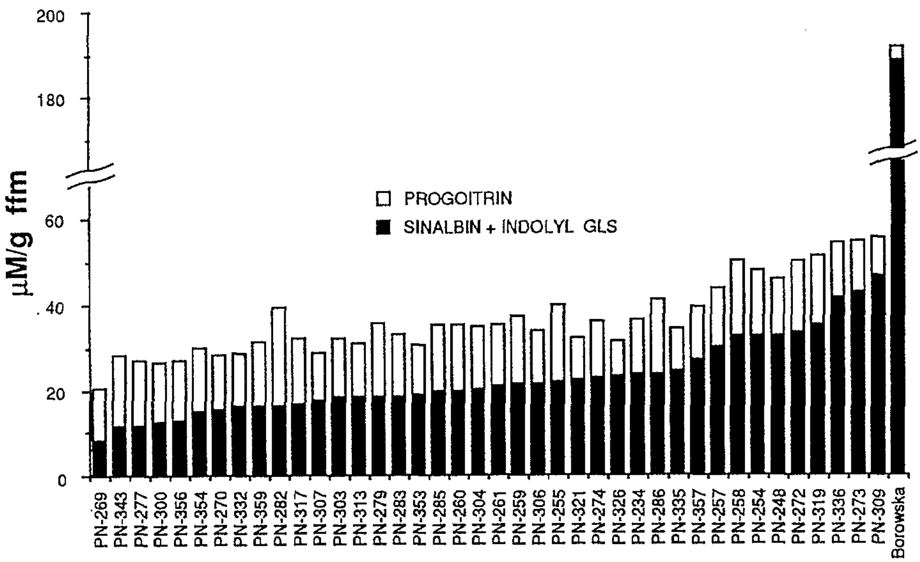

Fig. 1 Effect of selection for low glucosinolate content in white mustard (*Sinapis alba*) as compared with Borowska standard variety.

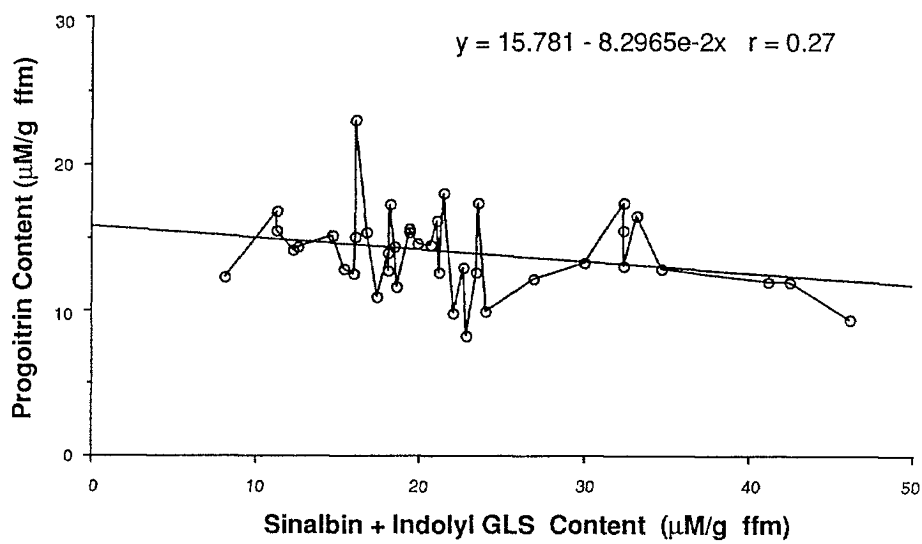

Fig. 2 Correlation between progoitrin and sinalbin + indolyl glucosinolates content in low glucosinolate strains of white mustard (*Sinapis alba*).