Variability of some traits of yellow-seeded lines of winter oilseed rape

Aleksandra PIOTROWSKA, Krystyna KROTKA, Jan KRZYMANSKI, Jolanta ZAGIERSKA
Plant Breeding and Acclimatization Institute, Strzeszynska 36, 60-479 Poznan, Poland
e-mail: krzym@nico.ihar.poznan.pl

The yellow-seeded genotypes have seed coat slender than typical black-seeded oilseed rape. This kind of genotypes is characterised by lower fibre content, especially polyphenolic compounds, higher oil and protein contents. Oil-meal obtained from these seeds is valuable fodder with a higher protein content and better digestibility (Ochodzki et al., 1997; Slominski et al., 1997, 1999).

Our work aims at developing winter oilseed lines with true bred yellow colour of seed coat which would be also characterised by good quality and have agronomic value. The study concerns evaluation of developed yellow-seeded lines.

Materials and methods

Yellow-seeded forms of winter oilseed rape (*Brassica napus* L.) were developed in The Department of Oil Crops of IHAR in Poznań by the crossing of natural mutant with the line obtained from interspecific cross *Brassica napus* × *Brassica rapa* (Olsson 1960, Piotrowska et al., 2000; Szestowicka et al., 1995). These yellow seeded breeding materials of winter oilseed rape were improved by further crossing, inbreeding and selection.

Material for the study consisted of 121 yellow-seeded inbred lines. The trials were made in randomized block design in three replications with added standard plots distributed systematically. Interblock variability was reduced with covariance analysis using standard plots. The following traits were investigated:

- seed coat colour
- 1000 seed weight
- oil, protein, glucosinolate and fibre (ADF, NDF) contents
- fatty acid composition.

For the breeding purposes the quantification of yellow seed colour variability was necessary. Five degree scale was elaborated for these purposes:

1 — seeds brown,
2 — seeds brown with yellow overcolouring,
3 — seeds half yellow / half brown,
4 — seeds yellow with brown overcolouring,
5 — pure yellow seed colour.

Seed coat colour was determined for 844 inbred plants taken from lines examined in trials.

Seed samples for chemical analyses were taken from each plot in every replication

of the trials. Oil content was determined with magnetic resonance analyser (NMR) (Krzymanski, 1970); fatty acid composition by gas chromatography (Byczynska et al., 1969); protein and fibre contents using spectrophotometric analysis in near infrared (NIR) by Infratec 1255 analyser (Michalski et al., 2000).

The results of trials were elaborated statistically. The following statistic characteristics were also calculated: mean, standard deviation, variance and coefficient of variability for the measured or analysed traits.

Results

Results in Tab. 1 show differentiation of yellow-seeded lines in reference to investigated traits. Lines are differentiated significantly as concerns all examined traits.

Seed coat colour distribution shown in Graph. 1 demonstrates the possibility to obtain lines with stabilised yellow colour.

Oil content in seed of examined lines is a few per cent higher than in seed of traditional winter oilseed rape varieties (Graph. 2).

Fatty acid composition demonstrates the possibility of selection for the higher oleic acid content in seeds (Graph. 3, 4, 5).

Glucosinolate content variability depends mainly on their very low content in some of the examined lines. The total glucosinolate content is significaly lower than in double low varieties (Graph. 6).

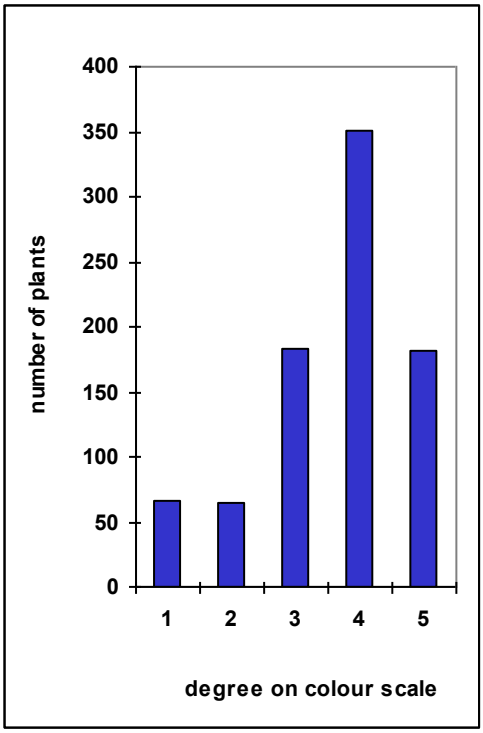
Protein and fibre content differentiations connected with yellow seed colour allows to make selection in desired direction (Graph. 7, 8).

1000 seed weight is characterised by high variability and is similar to the level which is found in black seeded cultivars (Graph. 9).

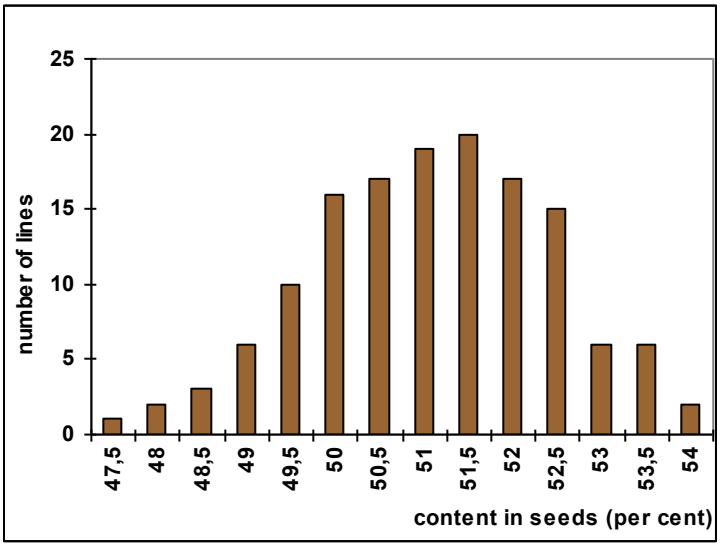
Table 1

Statistical characteristics of yellow winter oilseed rape

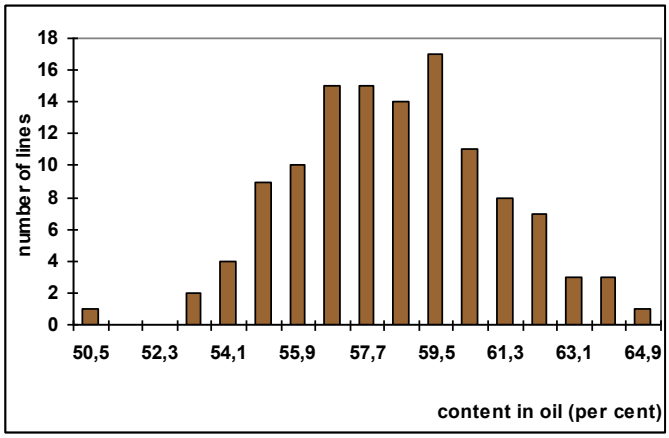
	Content										1000 seeds weight (g)
	in seeds (per cent)				fatty acid in oil (per cent)			glucosinolates (μM/g of seeds)			
	fat	protein	fibre ADF	fibre NDF	oleic	linolic	linolenic	alkenyl	indol	total	
Mean	50,8	22,8	16,5	21,1	58,1	23,6	11,2	3,2	4,7	7,8	4,0
Error of mean	0,1	0,1	0,2	0,1	0,2	0,2	0,1	0,2	0,1	0,2	0,0
Variance	1,8	2,0	5,6	0,8	7,0	3,1	1,0	2,9	0,9	5,5	0,2
Standard deviation	1,3	1,4	2,4	0,9	2,6	1,8	1,0	1,7	1,0	2,4	0,4
Minimum	47,2	19,6	11,0	17,8	50,5	18,7	6,3	0,7	1,8	2,9	3,2
Maximum	53,6	26,3	22,3	23,0	64,8	27,8	13,9	10,2	8,1	15,8	5,2
Variability coeffic.	2,6	6,2	14,3	4,3	4,5	7,5	9,1	53,8	20,2	30,0	10,1



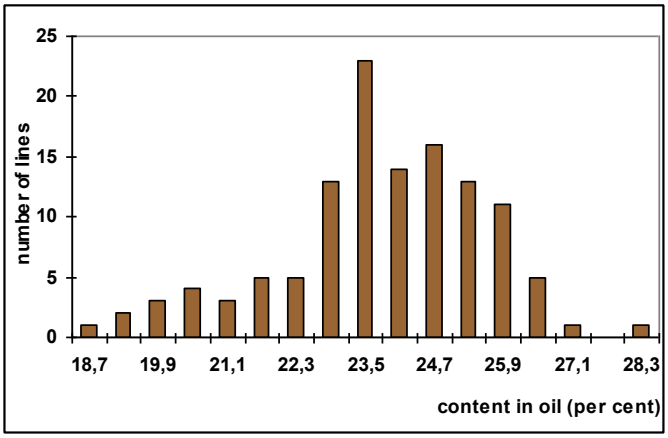
Graph 1. Distribution of seed coat colour



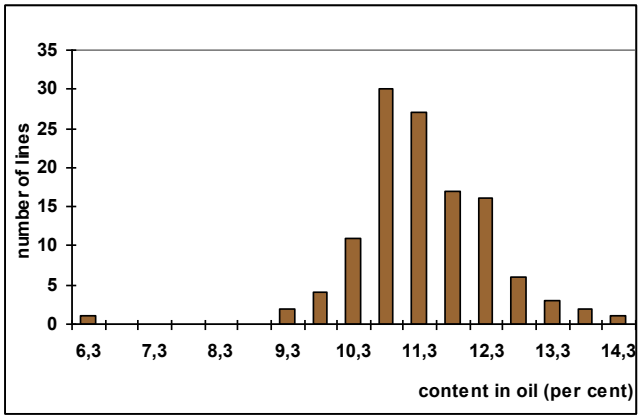
Graph 2. Histogram of oil content in seeds of yellow lines



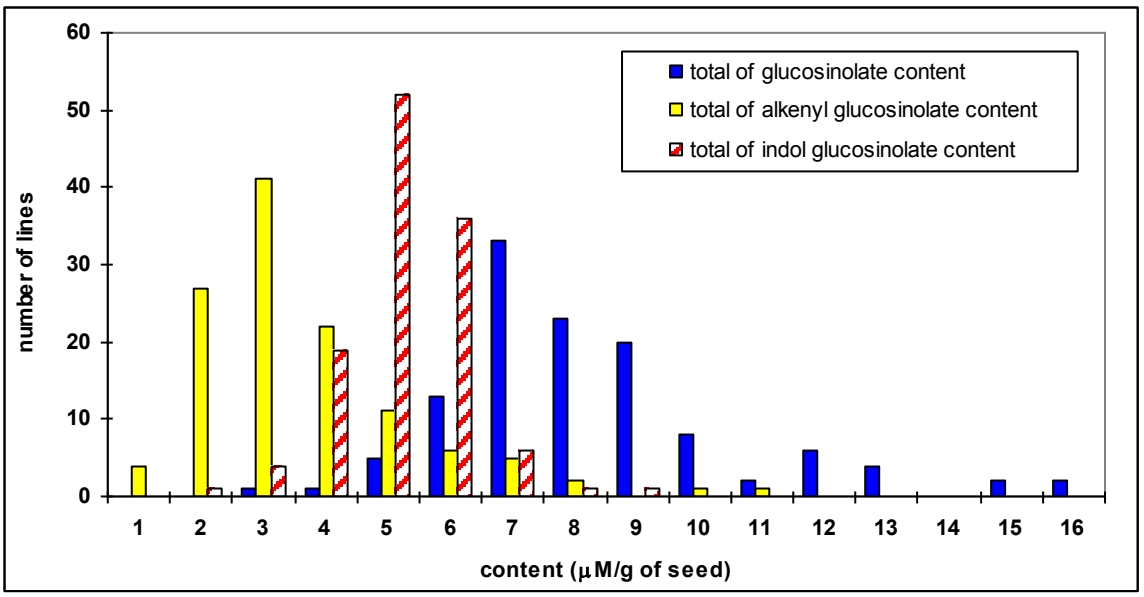
Graph 3. Histogram of oleic acid in seeds of yellow lines



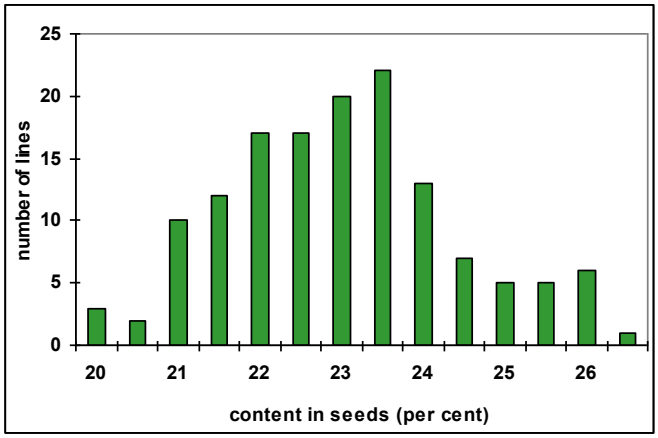
Graph 4. Histogram of linolic acid in seeds of yellow lines



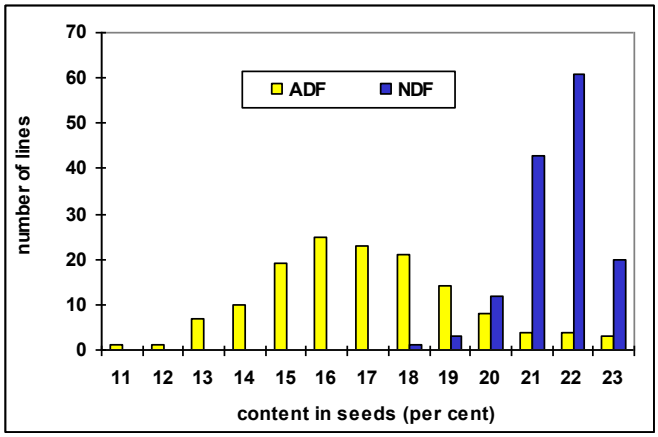
Graph 5. Histogram of linolenic acid in seeds of yellow lines



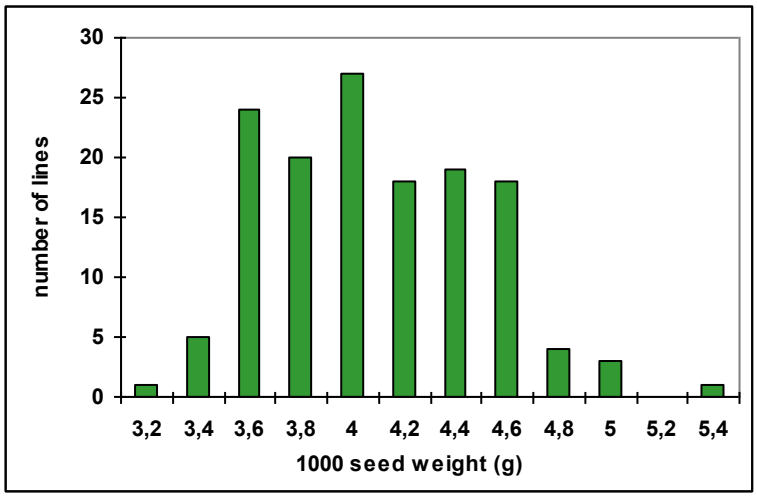
Graph 6. Histogram for glucosinolate content in seeds of yellow lines



Graph 7. Histogram of protein content in seeds of yellow lines



Graph 8. Histogram of fibre (ADF, NDF) content in seeds of yellow lines



Graph 9. Histogram of 1000 seed weight of yellow lines

Conclusions

- Breeding works conducted on winter oilseed rape for yellow seeds colour are progressing well. Harvested plants show that seed colour is true bred — 29,4 per cent of plants possess pure yellow colour (degree 5) and 41,5 per cent almost yellow colour (degree 4).
- All obtained lines meet the requirements of glucosinolate and erucic acid content for double low oilseed rape standard. The mean glucosinolate content is very low - below half of standard level.
- The fatty acid composition shows substantial variation and is a little bit different from this of black seeded double low varieties. This demonstrates the possibility of selection in the direction for higher oleic acid or higher polyunsaturated fatty acid.
- Differentiations for such traits as: oil, protein, fibre (ADF, NDF), hemicellulose contents are significant, so further improvement of fodder value of oil meal is evidently possible.
- 1000 seed weight for the most of lines does not differ from black seeded cultivars. Differentiation of this trait is statistically significant.

References

1. Byczynska B., Krzymanski J. (1969) – Quick method fatty acid methyl esters preparation for gas chromatography – Tluszcze Jadalne: XIII, 108-114
2. Krzymanski J. (1970) – Estimation of fat and moisture content in oilseeds NMR – Tluszcze, Srodki Piorace i Kosmetyki: 14/4, 202-208
3. Michalski K., Czernik-Kolodziej K. (2000) – Application of NIR spectrometry for analysis of basic chemical constituents of rapeseed – Rosliny Oleiste - Oilseed Crops: XXI (3), 801-806
4. Ochodzki P., Piotrowska A. (1997) – Variation of chemical composition of defated rape seeds selected for low fibre content – Rosliny Oleiste - Oilseed Crops: XVIII (2), 511-524
5. Olsson G., (1960) – Species crosses within the genus *Brassica*. II. Artifical *Brassica napus* L. – Hereditas: 46, 351-386
6. Piotrowska A., Krotka K., Krzymanski J. (2000) – Economic value of yellow-seeded lines of winter oilseed rape (Brassica napus L.) – Rosliny Oleiste - Oilseed Crops: XXI (2), 359-368
7. Slominski B.A. (1997) – Developments in the breeding of low fibre rapeseed canola – Mat. Konf.: Wlokno pokarmowe – sklad chemiczny i biologiczne dzialanie – Radzikow, 24-25.IV.1997, 89-100
8. Slominski B.A., Kienzle H.D., Ping Jiang, Campbell L.D., Pickard M., Rakow G. (1999) – Chemical composition and nutritive value of Canola-quality *Sinapsis alba mustard.* – Proc. 10th International Rapseed Congress, 26-29.09.1999, Canberra, Australia, CD ROM
9. Szestowicka B., Spasibionek S., Krzymanski J. (1995) – Use of interspecific hybrids between Brassica napus and Brassica carinata in the breeding for quality of winter oilseed rape. – Rosliny Oleiste - Oilseed Crops: XVI (1), 63-68