The effect of growing and harvesting method on winter seed rape quality

Jerzy Tys* [1], Krzysztof Jankowski [2]
[1] Institute of Agrophysics Polish Academy of Sciences in Lublin
Doswiadczalna 4 Street, P.O. BOX 201
20-290 LUBLIN 27, POLAND
jtys@demeter.ipan.lublin.pl
[2] University of Warmia and Mazury in Olsztyn
Oczapowskiego 8 Street
10-728 OLSZTYN, POLAND
jankow@uwm.edu.pl

ABSTRACT

The paper presents effects of different oilseed rape growing methods on physicochemical seed properties. In the estimation of industrial value the following parameters were taken into account: weight of 1000 seeds, content of crude oil and total protein, acid number, peroxide number and test of oil point.

It was found that the level of inputs did not affect the content of oil in seeds, which ranged from 43.1 to 43.9% of d.m. The level of inputs (low, medium or high) significantly increased the level of total protein and chlorophyll. Increased inputs were accompanied by higher total protein content (by 1.4-2.0 % d.m.) and chlorophyll (by 45%) in rape seeds.

The method of winter rape growing affected physical properties of seed (which indicate ability of long storability) to a smaller extend compared to the effect caused by the method of harvesting. The method of harvesting significantly affected mechanical resistance of seeds. Seeds from one-stage harvesting contained more protein by 0.2-0.6% d.m. and 2-fold more chlorophyll. Seeds harvested in two stages showed reduced resistance (less force caused oil extraction) compared to one stage harvesting.

Key words: winter oilseed rape, growing method, harvesting method, quality seeds

INTRODUCTION

Due to their chemical composition and anatomic structure, rape seeds are particularly vulnerable to any agronomic errors. Technological and nutritional value of rape seeds depends on their chemical composition, which is strongly differentiated when the plants mature. This is the reason why the quality of winter rape seeds is so closely dependent on the proper seed harvest technology, involving the date and method of harvest (Centkowski *et al*., 1989, Kozlowska *et al*., 1988). Seed maturity determines, among other things, the levels of chlorophyll, acid number, peroxide number and storability (Szwed 2000, Tys *et al*., 1998).

High costs of winter oilseed rape cultivation in Poland force farmers to simplify their agronomic practices. Oil producers, on the other hand, are interested in the highest quality raw material. The present study aims to answer the question to what extent simplified agronomic practices and harvest methods may modify the quality parameters of rape seeds, which determine seed storability and food processing utilisation.

MATERIAL AND METHODS

The analysed rape seeds come from a two-year (2000-2002) strict field experiment, carried out at the Experimental Station in Balcyny (north-eastern Poland). The trials were established in a split-plot design in four replications with the following set of variables:
Factor I – growing technologies (Table 1),
Factor II – harvest method: (1) one-stage, (2) two-stage harvest.

Seed samples obtained from the field trials were subject to chemical and physical analysis. Oil stability was assessed according to the Polish National Standards and involved determination of the acid number (PN-60/A-86921), peroxide number (PN-84/A-86918) and chlorophyll content (BN 868050-30). The assessment of the mechanical properties of seeds was accomplished using the methods elaborated by Fornal *et al*. (1994) and by Sukurmaran and Singh (1989). The measurements were done on 5 samples from each combination for every parameter studied.

Table 1. Growing technologies

Agronomical practise		High inputs (A)	Medium inputs (B)	Low inputs (C)
Soil tillage		standard enhanced	standard	simplified
Sowing (seeds per m^2)		100	120	150
Weeding	autumn	metazachlor, propachizafop	chlomazon + alachlor, haloksyfop-R	chlomazon alachlor, haloksyfop-R
	spring	chlopyralid	chlopyralid	chlopyralid
Soil fertilisation ($kg \cdot ha^{-1}$)	autumn	60 N, 35 P, 125 K, 30 S	40 N, 26 P, 91 K	7 N, 17 P, 71 K
	spring	180 N (120+60), 60 S	120 N	100 N
Foliar nutrition ($kg \cdot ha^{-1}$)		14 N, 0.5 B, 2 Mg, 4 S	7 N, 0.5 B	none
Pest control		3 times	2 times	1 time
Disease control		tebukonazol (autumn and spring)	tebukonazol (only spring)	none

RESULTS

The growing and harvesting technologies did not affect significantly the crude oil content in rape seeds (Table 2). The level of this nutrient was 43.1-43.9% d.m. The concentration of protein decreased by 1.4-2.0% as the cultivation technologies were made simpler. Irrespective of the growing technology applied (A, B, C), the two-stage harvesting method had an adverse effect on the content of total protein in rape seeds. Increased inputs on the cultivation technology caused a 45% increase in rape seed chlorophyll content. For all variants of growing technologies, rape seeds harvested in two stages contained on average 2-fold less chlorophyll than those harvested in a single stage. Two-stage harvesting was specially beneficial for the concentration of chlorophyll in the low-input technology variant (Table 2).

Table 2. Effect of the growing and harvesting methods on chemical properties of rape seeds and oil (means from 2 years)

Harvesting method	Growing technologies		
	high inputs (A)	medium inputs (B)	low inputs (C)
Content of crude oil in seeds (per cent of dry matter)			
One-stage	43.6	43.3	43.9
Two-stage	43.4	43.1	43.4
Content of protein total in seeds (per cent of dry matter)			
One-stage	24.7	23.4	22.9
Two-stage	24.5	23.1	22.3
Content of chlorophyll in seeds (mg per kg)			
One-stage	9.1	8.1	6.4
Two-stage	3.7	5.7	0.6
Value of acid number (mg KOH per g oil)			
One-stage	1.3	1.4	0.6
Two-stage	1.2	0.6	1.3
Value of peroxide number (mmol O per kg oil)			
One-stage	1.3	1.1	0.3
Two-stage	1.1	0.6	1.1

When analysing stability of oil, it was found that both acid number and peroxide number had the highest values under the high-input technology (A), at either harvesting method (Table 2). The value of oil obtained from the rape plants grown by the medium-input (B) or extensive (C) technologies was closely dependent on the harvesting method. In the medium-input technology (B), one-stage harvesting increased nearly 2-fold the values of the peroxide and acid numbers, whereas in the low-input (C) technology it had a positive effect on the quality of oil produced (Table 2).

Table 3. Effect of the growing and harvesting methods on 1000 seeds weight and seed physical properties

Harvesting method	Growing technologies		
	high inputs (A)	medium inputs (B)	low inputs (C)
Weight of 1000 seeds (g)*			
One-stage	4.75	4.65	4.80
Two-stage	4.80	4.85	4.85
Oil point - value of maximum pressure necessary to extract oil from oilseed rape (MPa)**			
One-stage	15.6	15.4	15.3
Two-stage	13.7	13.5	13.4

* - means from 2 years; ** - means from 1 year

The rape production technologies examined, which differed in the soil cultivation methods, fertilisation levels and plant protection (A, B, C) as well as in the harvesting method (one- and two-stage harvest) did not have any significant impact on 1000 seeds weight, which ranged from 4.7 to 4.9 g (Table 3).

The growing technologies (A, B, C) of winter rape did not differentiate the value of oil point, which describes the force necessary to cause release of oil from rape seeds. Oil point was much more strongly influenced by the harvest methods. Pressing oil from seeds harvested in two stages required significantly less force (13.4-13.7 MPa) compared to those harvested in one stage (15.3-15.6 MPa) (Table 3). Rape seeds harvested in two stages were characterised by much poorer storability in silos (under large pressure) than those obtained by one-stage harvest.

CONCLUSIONS

1. More intensive agronomic practices resulted in considerably increased protein content in rape seeds, causing at the same time an increase in chlorophyll by as much as 45%. One-stage harvesting also increased the content of total protein and chlorophyll in seeds.
2. Oil from the rape seeds produced by the intensive technology was characterised by poorer stability (higher acid and peroxide numbers). One-stage harvesting had a positive effect on the acid and peroxide numbers only under the condition of the extensive rape cultivation. With the medium-intensive growing technologies, better quality of oil was obtained using the two-stage harvesting method.
3. Rape seeds harvested in two stages had considerably inferior capability of being stored over long time in silos than those harvested in a single stage.

REFERENCES

Centkowski S., S. Sokhansoni, F.W. Sosulski, 1989: The effect of drying temperature on green colour and chlorophyll content of canola seed. Can. Inst. Food Sci. Technol., 22 (4): 383-386.

Fornal J., K. Sadowska, R. Jaroch, B. Kaczynska, T. Winnicki, 1994: Effect of drying of rapeseeds on their mechanical properties and technological usability. International Agrophysics, 8 (2): 215-224.

Kozlowska H., H. Nowak, R. Zadernowski, 1988: Rapeseed hulls fat characteristics. Fat Sci. Technol. 6: 216 –219.

Sukumaran R. C., B.P.N Singh, 1989: Compression of bed of rapeseeds: The oil – point. J. Agric. Engng Res., 42: 77 – 84.

Szwed G., 2000: Kształtowanie fizycznych i technologicznych cech nasion rzepaku w modelowanych warunkach przechowywania. Acta Agrophisica, 27.

Tys J., G. Szwed, W. Strobel, 1998: Influence of storage conditions on behaviour of rapeseeds in bulk. Operations on granular materials. Proceedings of the Seminar IA PAN Lublin: 55-58.