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GRAIN YIELD AND CHEMICAL COMPOSITION OF NEW, NAKED LINES OF BARLEY GROWN IN CONDITIONS OF SUBCARPATHIAN REGION

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Abstract. This study presents the results of a three-year field experiment carried out during 2006-2008 at the Didactic and Research Station of the University of Rzeszów in Krasne near Rzeszów. The yield, its components and chemical composition of 4 lines of barley were analysed in comparison with the cultivar Rastik. Statistical analyses indicated that in the area of the Subcarpathian region are favourable conditions for growing naked barley. Of the studied lines, STH 6263, STH 6290, STH 4731 and the cultivar Rastik turned out to be the most useful for growing in this region of Poland in respect of yield. The grain of line STH 6263 contained the most protein, and the grain of the cultivar Rastic had the most fat. Functional characters of the assessed lines of barley indicate a slow breeding progress in the group of naked cultivars.

Key words: grain chemical composition, grain yield, naked barley, Rastik, spring barley, yield components

INTRODUCTION

The main objective of barley growing is introduction into production new cultivars with more favourable economic traits, such as: higher productivity, better technological parameters of grain, lower growing cost absorption [Czembor 1997, 1999, Dziamba *et al*. 1998]. In barley growing naked forms are of growing importance, with grains that are characterized by a low fibre content, and a higher content of starch in comparison with husked cultivars [Yang *et al*. 1997]. Changing the chemical composition involves the improvement of digestibility and energy for monogastric animals [Beames *et al*. 1996]. Currently, there are 55 cultivars of spring barley in the Polish cultivar register [Descriptive list... 2010], including only one naked cultivar – Rastik. The main value of this cultivar, besides the lack of glumelles (the so-called husks), is a high content of protein in grain (exceeding by 14% the mean protein content of husked cultivars), high

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straw yield, moderate lodging resistance, as well as an early time of earing and maturing. However, in comparison with husked forms, the cultivar Rastik is characterized by a lower yield potential, and a negative correlation between the yield and protein content also occurs [Noworolnik and Leszczyńska 2002].

Due to the values of naked barley cultivars, breeding work over new lines of this cereal is still being conducted. Therefore a study was undertaken aiming at the estimation of the yield level and variation of its components, as well as the grain chemical composition of 4 lines of naked barley in comparison with the cultivar Rastik.

On account of breeding progress, the following research hypothesis was put forward: plant development, yield and the chemical composition of grain of new naked lines of barley will be similar or better, as compared with the cultivar Rastik (the first cultivar of this type).

MATERIAL AND METHODS

This study presents the result of a strict field experiment carried out during 2006--2008 at the Didactic and Research Station of the University of Rzeszów in Krasne near Rzeszów (50^{o} 03' N; 22^{o} 06' E). Seed material came from the Hodowla Roślin (Plant Breeding) Strzelce Sp. z o.o. IHAR Group, ZDHR in Strzelce near Kutno. The one--factorial experiment was established in the randomized complete block design in four replications. The experimental factors were 4 lines of naked barley (STH 6263, STH 6290, STH 4476, STH 4731) and the cultivar Rastik. The are of plots for harvest amounted to 10 m^2, and the assumed plant density 350 plants·m^{-2}. The experiment was established in the brown soil, formed from loess with the mechanical composition of the silt loam sandy soil. The organic carbon content in soil was 0.79%, and pH 5.7. The soil was characterized by a low content of available forms of magnesium (3.02 mg in 100 g of soil), as well as a moderate content of phosphorus (5.22 mg P in 100 g of soil) and potassium (14.6 mg K in 100 g of soil). The total nitrogen content was 0.103%.

The previous crop in 2007 and 2009 was mustard and in 2008 oat. In the years of the study barley was sown in the first ten days of April. Before sowing grain was dressed with the fungicide Baytan Universal 19,5 WS (in a dose of 200 g per 100 kg of grain). Mineral fertilization was applied in the following amounts per hectare: presowing 30 kg P, 58 kg K and 30 kg N. The other rate of nitrogen in an amount of 30kg was applied as top-dressing at the tillering stage. Chemical plant protection involved the application of spraying with Chwastox Extra (3.5 $dm^3 \cdot ha^{-1}$) and Decis (0.5 $dm^3 \cdot ha^{-1}$) at the full tillering stage. To control wild oat, the preparation Puma Universal was applied in an amount of 1 $dm^3 \cdot ha^{-1}$. During the growing period observation was carried out, noting the dates of successive developmental stages of plants. Before harvesting the number of ears per1m^2 was determined and 10 representative plants was randomly collected from each plot to make measurements of yield components. The following characteristics were analysed: grain yield, stem height, ear length, the number and weight of grain per ear, 1000 grain weight. The harvesting of barley in the years of the study was made from 1st to 10th or to 20th August, using a plot combine harvester Seedmaster Universal. The obtained grain yields and TGW were calculated at 15% humidity. Chemical analysis of grain was made with the reflection spectroscopy method in near infrared using the apparatus by Bruker. Meteorological data was worked out on the basis of records of the

Meteorological Station at Jasionka. The results were analysed statistically using the following methods:

1) the analysis of variance test (univariate ANOVA) – to compare means which determine the yield components and grain quality in the studied barley lines and cultivars. To check whether the assumptions that entitle to apply the analysis of variance are met, the Shapiro-Wilk normality test and Bartlett's test for equality of variances were carried out. In the case of showing statistically significant differences between at least one pair of means, post-hoc tests were applied. To carry out repeated comparisons between the means calculated for the analysed lines and cultivar of barley Tukey's test was used, whereas to compare the means calculated for individual lines with the mean for the cultivar Rastik the Dunnett test was applied;
2) Pearson's linear correlation coefficients – to estimate the direction and strength of relationships between the studied yield components and between characteristics which determine barley grain quality. The statistical significance of the determined correlation coefficients was assessed with Student's significance t-test;
3) multiple regression – to describe the effect of barley yield components on the grain yield height. The quality assessment of the estimated function was made based on the value of residual component standard deviation, and the multiple determination coefficient. Significance of structural parameters was assessed based on the results of Student's t-test. The significance of the whole model was verified with the F Snedecor test. Values of correlation coefficients, regression coefficients and standardized regression coefficients served to build a model of track indexes, which allows the detailed interpretation of cause and effect relationships between characteristics or natural phenomena;
4) descriptive statistics, including measures of location, dispersion and asymmetry, serving for describing the structure of the studied barley characters.

The calculations were made with the use of the program STATISTICA.PL. All the tests were carried out at the significance level P = 0.05. A decision on rejecting or the lack of the grounds for rejecting a given zero hypothesis was taken based on the testing probability p (*p-value*). If its value was less than 0.05, a given zero hypothesis was rejected for the alternative hypothesis.

RESULTS AND DISCUSSION

Changeability of the weather conditions in the years modifies the rhythm of growth and development of barley, including the root system, and consequently it affects different use of water, grain yield height, protein content in grain and the effectiveness of cultivation practices [Bertholdsson 1999, Górski *et al*. 1999, Kukuła *et al*. 1999, Kaniuczak 2001, Noworolnik *et al*. 1995, Pecio 2002]. Spring barley has the shortest time of growth of the cereals, and therefore it is susceptible to even short-term droughts, as well as to the excess of water. Bertholdsson [1999] claims that in spring barley drought before flowering reduces nitrogen uptake from soil and decreases the potential grain yield, whereas drought during the grain filling limits carbohydrate synthesis and the accumulation of dry weight in grain. This author indicated that variability in protein content in barley grain is determined in almost 90% by the year of growing, nitrogen supply and the soil moisture conditions, and only in 7% by the plant genotype. According to Gąsiorowski [1997], for spring barley at the first stage after sowing a temperature ranging from 6 to 8°C and small rainfalls are desirable. Later, at the shooting and earing stages, a high temperature from 17 to 19°C and moderate rainfalls are favourable. In the period after earing, the sunny and warm weather makes suitable conditions for the intensive course of photosynthesis and good grain filling.

In the present study, the arrangement of the weather conditions in 2006-2008 was moderately favourable for barley growth (Table 1). The air temperature during the growth season was in accordance with recommendations given by Gąsiorowski [1997] and Dzieżyc [1998], higher temperatures than recommended were noted only in July 2006 and 2007 (Table 1). Rainfalls highly varied in the years of the study. High rainfalls occurred in May 2006 and 2008, exceeding by about 27 mm the mean long-term total precipitation for this month. July in 2006, in turn, was dry (15.9 mm of rainfall). The lack of rainfall resulted in poor grain filling in the studied barley forms. Similar results, but with malting forms, were obtained by Savin and Nicolas [1996], who observed that drought causes a decrease in weight of the single grain by 20%, whereas high temperature only by 5%.

Table 1. Weather conditions during growth of barley
Tabela 1. Warunki meteorologiczne w okresie wegetacji jęczmienia

Year – Rok	Month – Miesiąc					Mean Średnia
	April kwiecień	May maj	June czerwiec	July lipiec	August sierpień	
Temperature – Temperatura, °C						
2006	9.6	13.5	16.3	20.9	18.4	15.74
2007	8.7	15.8	19.2	20.2	18.9	16.56
2008	9.1	13.6	18.1	18.9	18.8	15.70
Multiyear – Wielolecie 1986-2008	8.6	13.9	17	19	18.1	15.32
Rainfalls – Opady, mm						Total – Suma
2006	37.7	106.3	91.2	15.9	103.5	354.6
2007	27.2	39.9	70.5	73.6	87.9	299.1
2008	45.5	105.3	86.7	117.6	55.3	410.4
Multiyear – Wielolecie 1986-2008	52.6	79.8	79.2	87.7	70.8	370.1

Analysing the course of barley growth, no differences in the length of individual plant developmental stages were indicated. Development state of the studied lines was similar to that of the cultivar Rastik (Table 2). Duration of the growth period amounted to 111-112 days and was in accordance with data contained in the literature [Gąsiorowski 1997, Pecio 2002]. The calculated variation coefficient showed that line STH 4731 was characterized by the largest differences in the course of next developmental stages in the year of the study in relation to the other lines and the cultivar Rastik (Table 2).

Table 2. Duration of barley developmental stages*
Tabela 2. Czas trwania faz rozwojowych jęczmienia*

Plant development stage – Stan rozwoju roślin		STH 6263	STH 6290	STH 4476	STH 4731	Rastik
Sowing – sprouting Siew – wschody	days – dni CV, %	12 9.3	12 9.8	12 7.2	12 10.2	13 5.3
Sprouting – tillering Wschody – krzewienie	days – dni CV (%)	16 17.6	16 15.8	16 16.1	15 25.3	15 18.8
Tillering – shooting Krzewienie – strzelanie w źdźbło	days – dni CV (%)	14 9.8	14 13.1	13 8.4	14 18.8	14 7.7
Shooting – earing Strzelanie w źdźbło – kłoszenie	days – dni CV (%)	22 9.4	21 6.0	23 4.6	23 10.0	22 8.0
Earing – milk stage Kłoszenie – dojrzałość mleczna	days – dni CV (%)	25 38.6	24 34.8	22 31.6	23 38.9	23 29.3
Milk stage – dough stage Dojrzałość mleczna – dojrzałość woskowa	days – dni CV (%)	11 17.6	11 14.5	12 12.7	13 12.8	11 10.8
Dough stage – full maturity Dojrzałość woskowa – dojrzałość pełna	days – dni CV (%)	16 27.5	16 29.4	16 20.6	15 24.8	15 23.1
Length of growing season Długość wegetacji	days – dni CV (%)	112 4.4	112 4.4	111 4.2	112 4.5	111 4.9

* counted from the beginning of each developmental stage – liczone od początku każdej fazy rozwojowej
CV – coefficient of variation – współczynnik zmienności

The analyses indicate that distributions of all variables connected with yield were leptokurtic, i.e. with a high concentration of empirical values around the mean. Most studied characters (yield, TSW, the stand height, the number of ears before harvesting) can be regarded as quasi-constant, since the value of variation coefficient was less than 10% (Table 3).

It was indicated that barley grain yield was statistically significantly correlated with yield-forming characters, such as: the stem height, the number and weight of grains per ear (Table 4).

In all cases this was moderate and positive interrelationship. Similar results were obtained by Lisowska [2006], where grain yield was determined by the stem height, the number of grains per ear and 1000 grain weight, whereas the proportion of 1000 grain weight in affecting grain yield was the smallest. Also other authors, such as Pecio [2002] and Dziamba et al. [1998] confirm that in barley the components that largely determine grain yield are the number and weight of grains per ear. The study by Szempliński [2003] in turn indicated that the height of spring barley grain yield depend largely on 1000 grain weight, the number of spikelets and the number of grains per ear. These characters together determine grain yield in 54%. Similar results were obtained by Węgrzyn and Bichoński [2000].

Comparing the studied lines and cultivar of barley it was indicated that line STH4476 was characterized by the lowest mean values of most studied characters (except for the ear length and the number of grains per ear), whereas the cultivar Rastik – by the highest. This suggests that in the soil and climatic conditions of the Podkarpackie voivodship this was best adapted for growing (Table 5).

Table 3. Basic descriptive characteristics for yield and characters connected with yield (mean for lines and cultivar)
Tabela 3. Podstawowe charakterystyki opisowe dla plonu i cech związanych z plonem (średnia dla rodów i odmiany)

Variable – Zmienna	Range Zakres	Arithmetic mean Średnia arytmetyczna	Standard deviation Odchylenie standardowe	Variation coefficient Współczynnik zmienności	Skewness Skośność
Grain yield Y, $Mg \cdot ha^{-1}$ Plon ziarna Y, $Mg \cdot ha^{-1}$	2.9-4.3	3.72	0.31	8.3%	-0.39
Thousand grain weight X_1, g Masa tysiąca ziaren X_1, g	37.3-49.4	44.08	2.54	5.8%	0.00
Stem height X_2, cm Wysokość źdźbła X_2, cm	46.9-73.7	60.05	5.52	9.2%	0.31
Ear length X_3, cm Długość kłosa X_3, cm	5.2-8.8	7.11	0.85	11.9%	-0.18
Number of grains per ear X_4, no. Liczba ziarniaków w kłosie X_4, szt.	14.7-23.6	19.53	2.51	12.8%	-0.17
Weight of grains per ear X_5, g Masa ziarniaków w kłosie X_5, g	0.7-1.0	0.89	0.09	10.3%	-0.25
Ear density before harvesting X_6, $no. \cdot m^{-2}$ Obsada kłosów przed zbiorem X_6, $szt \cdot m^{-2}$	413-513	456.54	27.18	6.0%	0.16

Table 4. Simple correlation coefficients between barley yield and characters connected with them
Tabela 4. Współczynniki korelacji prostej pomiędzy plonem jęczmienia a cechami z nim związanymi

Character Cecha	1	2	3	4	5	6	7
1	1.00	0.20	0.58*	0.08	0.52*	0.64*	0.05
2	0.20	1.00	0.42*	0.18	-0.03	0.31*	0.05
3	0.58*	0.42*	1.00	0.33	0.09	0.40*	0.18
4	0.08	0.18	0.33	1.00	0.12	0.18	0.06
5	0.52*	-0.03	0.09	0.12	1.00	0.78*	-0.54*
6	0.64*	0.31*	0.40*	0.18	0.78*	1.00	-0.38*
7	0.05	0.05	0.18	0.06	-0.54*	-0.38*	1.00

* significant at significance level $P \leq 0.05$ – istotne na poziomie istotności $P \leq 0,05$
1 – grain yield – plon ziarna, $Mg \cdot ha^{-1}$
2 – thousand seed weight – masa tysiąca nasion, g
3 – stem height – wysokość źdźbła, cm
4 – ear height – długość kłosa, cm
5 – number of grains per ear, no. – liczba ziarniaków w kłosie, szt.
6 – grain weight per ear – masa ziarniaków w kłosie, g
7 – ear density before harvesting, $no. \cdot m^{-2}$ – obsada kłosów przed zbiorem, $szt. \cdot m^{-2}$

Table 5. Analysis of variance – comparison of yield and yield components in studied lines and cultivar of barley (mean for 2006-2008)
Tabela 5. Analiza wariancji – porównanie plonu i elementów plonowania u badanych rodów i odmiany jęczmienia (średnia za lata 2006-2008)

Character – Cecha	STH6263	STH6290	STH4476	STH4731	RASTIK
	mean – średnia				
Grain yield, $Mg \cdot ha^{-1}$ Plon ziarna, $Mg \cdot ha^{-1}$	3.80^{B}	$3.75^{A B}$	3.39^{A}	$3.73^{A B}$	3.93^{B}
	$F = 5.008; p = 0.002$				
Thousand grain weight, g Masa tysiąca ziaren, g	$43.9^{B C}$	$42.3^{A B}$	41.6^{A}	$46.1^{C D}$	46.5^{D}
	$F = 15.78; p = 0.000$				
Stem height, cm Wysokość źdźbła, cm	$58.6^{A B}$	61.2^{B}	54.2^{A}	$58.6^{A B}$	67.7^{C}
	$F = 18.87; p = 0.000$				
Ear length, cm Długość kłosa, cm	6.68^{A}	7.09^{A}	7.06^{A}	6.77^{A}	8.24^{B}
	$F = 11.91; p = 0.000$				
Number of grains per ear, no. Liczba ziarniaków w kłosie, szt.	19.5	18.4	20.0	19.4	20.4
	$F = 0.738; p = 0.572$				
Weight of grains per ear, g Masa ziarniaków w kłosie, g	0.87	0.86	0.86	0.91	0.95
	$F = 1.963; p = 0.110$				
Ear density before harvest, $no. \cdot m^{-2}$ Obsada kłosów przed zbiorem, $szt. \cdot m^{-2}$	448.7	466.5	448.2	456.6	462.7
	$F = 1.801; p = 0.148$				

A, B – grupy jednorodne – homogeneous groups

The Dunnett test indicated the significantly lower thousand grain weight than in the standard cultivar, in lines STH 6263, STH6290 and STH4476. All the lines were also characterized by a significantly lower stem height and the ear length, as compared with the cultivar Rastik. Mean values of the other yield components in the studied lines were similar to the cultivar Rastik (Table 6).

Table 6. Results of Dunnett's test
Tabela 6. Wyniki testu Dunnetta

Character - Cecha	STH6263	STH6290	STH4476	STH4731	RASTIK
	mean – średnia				
Grain yield, $Mg \cdot ha^{-1}$ Plon ziarna, $Mg \cdot ha^{-1}$	3.80 p = 0.703	3.75 p = 0.432	3.39* p = 0.000	3.73 p = 0.329	3.93
Thousand grain weight, g Masa tysiąca ziaren, g	43.92* p = 0.007	42.32* p = 0.000	41.57* p = 0.000	46.10 p = 0.961	46.50
Stem height, cm Wysokość źdźbła, cm	58.57* p = 0.000	61.15* p = 0.001	54.22* p = 0.000	58.64* p = 0.000	67.68
Ear length, cm Długość kłosa, cm	6.68* p = 0.000	7.09* p = 0.001	7.06* p = 0.001	6.77* p = 0.000	8.24
Number of grains per ear, no. Liczba ziarniaków w kłosie, szt.	19.52 p = 0.894	18.43 p = 0.322	19.98 p = 0.993	19.37 p = 0.824	20.35
Weight of grains per ear, g Masa ziarniaków w kłosie, g	0.87 p = 0.717	0.86 p = 0.111	0.86 p = 0.084	0.91 p = 0.770	0.95
Ear density before harvesting, $no. \cdot m^{-2}$ Obsada kłosów przed zbiorem, $szt. \cdot m^{-2}$	448.70 p = 0.654	466.48 p = 0.995	448.22 p = 0.628	456.57 p = 0.969	462.73

* means of individual lines differing from means of the cultivar Rastic at significance level $P \leq 0.05$ – średnie poszczególnych rodów różniące się od średnich odmiany Rastik na poziomie istotności $P \leq 0,05$

The multiple regression equation from the sample for barley yield height took the following form:

$$Y = 0,025\ X_2 + 0,004\ X_6 + 0,065\ X_4 + e_i$$

(0.007) (0.001) (0.021) (0.188)

p = 0,000 p = 0,004 p = 0,004

The determined function was fitted to empirical data in 67.3%. Multiple correlation coefficient R_2 = 0.82 – showed a high relationship between the yield height (Y) and yield-forming characters together (X_2, X_4, X_6). The value of statistics F = 16.047 (p = 0.000) indicates that the whole model was statistically significant.

Multiple regression coefficients (track coefficients) and standardized regression coefficients for barley yield were listed in Table 7. According to Januszewicz and Puzio-Idźkowska [2002], analysis of track coefficients allows a detailed interpretation of cause and effect relationships linking characters of natural phenomena. In the present experiment the highest degree of covariation with the yield height occurred in the following characters: the number of grains per ear, the stem height and the number of ears before harvest (Table 7, Fig. 1).

A similar relationship was shown in the study by Lisowska [2006]. According to this author, the grain yield is determined mainly by the stem height, the number of grains per ear and 1000 grain weight.

Table 7. Assessments of multiple regression coefficients (track coefficients) and regression coefficients for standardized variables
Tabela 7. Oceny współczynników regresji wielokrotnej (współczynników ścieżek) oraz współczynników regresji dla standaryzowanych zmiennych

Variable Zmienna	Współczynnik regresji wielokrotnej Multiple regression coefficient	Standaryzowany współczynnik regresji Standardized regression coefficient
Stem height Wysokość źdźbła	0.025	0.450
Ear density before harvesting Obsada kłosów przed zbiorem	0.004	0.345
Number of grains per ear Liczba ziaren w kłosie	0.065	0.525

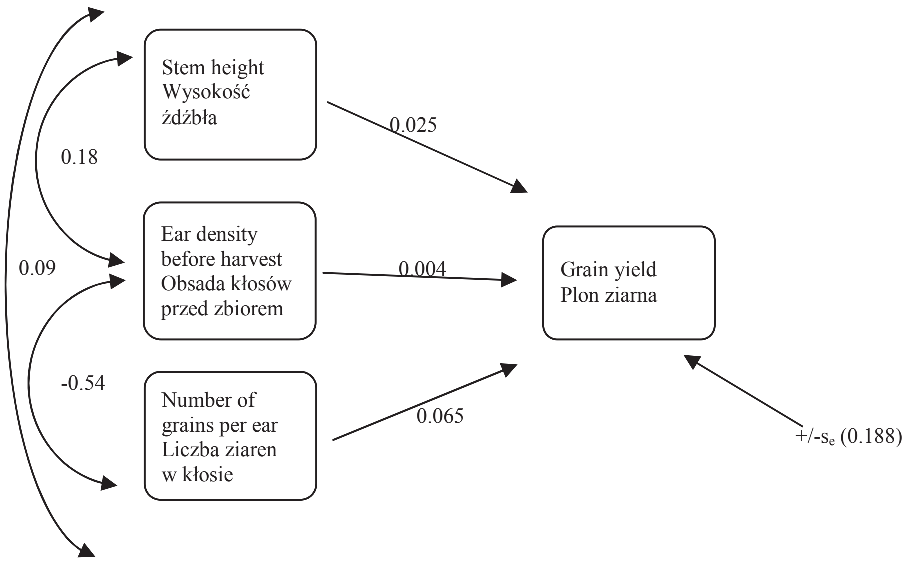

Fig. 1. Diagram of relations between barley yield and yield components
Rys. 1. Diagram zależności pomiędzy plonem a elementami plonowania jęczmienia

Values of the basis descriptive statistics for traits characterizing grain quality were presented in Table 8.

Table 8. Basic descriptive characteristics for the chemical composition of barley grain (mean for lines and cultivar)
Tabela 8. Podstawowe charakterystyki opisowe dla składu chemicznego ziarna jęczmienia (średnia dla rodów i odmiany)

Variable, % DM Zmienna, % s.m.	Range Zakres	Arithmetic mean Średnia arytmetyczna	Standard deviation Odchylenie standardowe	Variation coefficient Współczynnik zmienności	Skewness Skośność
Crude protein Białko ogólne	12.6-16.1	14.2	0.96	6.8%	0.32
Crude fat Tłuszcz surowy	1.93-2.89	2.48	0.24	9.8%	-0.33
Crude ash Popiół surowy	1.30-2.10	1.74	0.20	11.8%	-0.05
Crude fibre Włókno surowe	1.57-2.99	2.10	0.42	19.9%	0.63
N-free extract Bezazotowe wyciągowe	79.1-83.2	81.0	1.14	1.4%	0.11

Values of all the variables were very strongly concentrated around the mean value, and nitrogen-free extract can be regarded as the quasi-constant variable due to a very small value of variation coefficient (Table 7). The content of total protein and lipids ranged from 12.6 to 16.07% and from 1.93 to 2.89%, respectively, and depended on the course of weather during growth. The analysis of variance indicated statistically significant differences between the protein content and the content of nitrogen-free extract in individual forms of barley (Table 9). Line STH 6290 was characterized by the lowest protein content (13.45% DM), whereas STH6263 – by the highest (14.96% DM). Also the cultivar Rastik, which with line STH6263 constituted a homogeneous group in respect of the value of arithmetic means was characterized by a high content of protein (14.76% in DM).The grain of line STH 6263 and of the cultivar Rastik was characterized by the lowest content of nitrogen-free extract. Those forms constitute a homogeneous group in respect of the mean value of this trait. The highest content of nitrogen-free extract occurred in line STH6290 – 81.88% in DM. Similar results were obtained in the studies by Kawka *et al*. [1998] and Noworolnik *et al*. [2004], who while studying various forms of barley indicated a definitely higher content of protein and a lower content of ash and crude fibre in naked forms than in the husked ones.

Table 9. Analysis of variance – comparison of characters determining barley grain quality, % DM
Tabela 9. Analiza wariancji – porównanie cech określających jakość ziarna jęczmienia, % s.m.

Character Cecha	STH6263	STH6290	STH4476	STH4731	RASTIK
	mean – średnia				
Crude protein Białko ogólne	15.0^{C}	13.5^{A}	$13.7^{A B}$	$14.1^{A B C}$	$14.8^{B C}$
F = 6.020; p = 0.001					
Crude fat Tłuszcz surowy	2.48	2.37	2.57	2.38	2.59
F = 1.661; p = 0.178					
Popiół surowy Crude ash	1.69	1.71	1.74	1.73	1.82
F = 1.486; p = 0.225					
Crude fibre Włókno surowe	2.00	2.17	2.15	2.07	2.10
F = 1.218; p = 0.318					
N-free extract Bezazotowe wyciągowe	80.3^{A}	81.9^{B}	$81.4^{A B}$	$81.2^{A B}$	80.3^{A}
F = 4.700; p = 0.003					

A, B, C – grupy jednorodne – homogeneous groups

The content of fat, ash and fiber in the studied forms was similar (Table 9). Thus the opinion of many authors that the chemical composition of barley grain is modified not only by weather conditions but it also depends on the plant genotype was only partly confirmed [Beames *et al*. 1996, Gąsiorowski 1997, Noworolnik *et al*. 2004, Pecio 2002, Yang 1998].

CONCLUSIONS

1. In the area of Subcarpathian region there are favorable soil and climate conditions for growing naked forms of spring barley.

2. Duration of the growth period of the four new lines of naked barley was similar to that of the cultivar Rastik.

3. The grain yield level of the new barley lines was determined mainly by the stem length, the number of ears before harvesting and the number of grains per ear.

4. The cultivar Rastic was characterized by the highest grain yield. Lines STH6263, STH6290 and STH4731 yielded on the similar level.

5. The grain of line STH6263 and the cultivar Rastik contained the most of protein. The grain of this cultivar also contained the most of fat.

6. Functional characters of the assessed lines of barley indicate a slow breeding progress in the group of naked cultivars.

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PLON I SKŁAD CHEMICZNY ZIARNA NOWYCH, NIEOPLEWIONYCH RODÓW JĘCZMIENIA UPRAWIANYCH W WARUNKACH PODKARPACIA

Streszczenie. W pracy przedstawiono wyniki trzyletniego doświadczenia polowego przeprowadzonego w latach 2006-2008 w Stacji Dydaktyczno-Badawczej Uniwersytetu Rzeszowskiego w Krasnem koło Rzeszowa. Analizowano plon, jego komponenty i skład chemiczny 4 rodów jęczmienia w porównaniu do odmiany Rastik. Przeprowadzone analizy statystyczne wykazały, iż w rejonie Podkarpacia istnieją korzystne warunki do uprawy jęczmienia nieoplewionego. Spośród badanych rodów pod względem plonowania najbardziej przydatne do uprawy w tym rejonie Polski okazały się STH 6263, STH 6290, STH 4731 i odmiana Rastik. Najwięcej białka zawierało ziarno rodu STH 6263, a tłuszczu ziarno odmiany Rastik. Cechy użytkowe ocenianych rodów jęczmienia świadczą o powolnym postępie hodowlanym w grupie odmian nieoplewionych.

Słowa kluczowe: jęczmień nieoplewiony, jęczmień jary, komponenty plonu, plon ziarna, Rastik, skład chemiczny ziarna

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