TRITICUM SPELTA – A SPECIALTY GRAIN FOR ECOLOGICAL FARMING SYSTEMS

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Abstract: *Spelt wheat appears to be a future source for the agriculture, food sector and also for the consumer. Now, it is mostly used for production of bioproducts. High interest from consumer side is affected by its nutritional value. Consumption of spelt wheat-based products could assure increased intake of minerals, vitamins and fibre what could play an important role by decreasing of glycemic index of final products containing spelt. The aim of this study was to determine the production parameters (yields, TGW, weight of grains per spike, share of glumes, stem length) and indirect baking quality parameters of spelt varieties, which are essential for agriculture, food industry and consumer. The assessment of the technological quality included : wet gluten content, swelling of gluten, exstensibility of gluten, falling number, gluten index. Eight spelt wheat varieties (Bauländer Spelz, Holstenkorn, Franckenkorn, Schwabenkorn, Rouquin, Ostro, Altgold and Rubiota) were cultivated during 2005-2008 growing seasons within ecological arable farming systems in south Slovakia. Experimental plots belongs to warm agroclimatic region, arid subregion with predominantly mild winter. Indirect baking quality properties and production parameters depends on the variety and weather conditions. Spelt was rich in the content of wet gluten. More than 45% was found in Altgold, Ostro and Rubiota. Very tensile gluten of spelt wheat was of standard quality. The best adaptable spelt wheat variety to growing condition of south Slovakia was Franckenkorn, with the highest yield and other production parameters characteristics and acceptable quality parameters.*

Key words: *spelt, ecological farming system, technological quality, production parameters*

INTRODUCTION

At present there is a considerable interest in consumption of alternative crops (BERTI et al., 2005). The productivity and efficiency of cereals depends on many site-specific factors, such as soil fertility, climate, management style (CZAPKA, 2005 a,b; Kozik et al., 2008). Spelt wheat (*Triticum spelta* L.) is a low-input plant suitable for growing without the use of pesticides, in harsh ecological conditions and in marginal areas of cultivation (BONAFACCIA et al., 2000). Compared with wheat, spelt is taller (150±200 cm), has long, lax ears (15±20 cm), a brittle rachis and adherent glumes (BERTIN et al., 2001; ONISHI et al., 2006). Spelt is harvested as a hulled grain and must undergo a costly dehulling procedure before being introduced into the milling process (RANHORTA et al., 1995). The spelt flour is characterised by the yield of dehulled grains of about 65% (ZIELINSKI et al., 2008). It is caused by a touch spelt hull, which makes it more difficult to process than modern wheat. The hull protects the grain from pollutants and insects and enhances the retention of nutrients in the kernel and improves freshness (ABDEL-AAL et al., 1997). For many years, cultivation of spelt declined, but recent interest in use of spelt for ecologically grown foods has led to resurgence in its cultivation (ZIELINSKI et al., 2008). Organic growing system offers an alternative way how to be environment friendly and satisfy crop production at the same time (MACÁK, 2006).

Spelt has shown good potential in variety of end-uses (ABDEL-AAL and HULC, 2002), depending on genotype, cultivar and processing conditions (ABDEL-AAL, 2007). This cereal is intended both for animal feeding (as a ground grain) and human consumption (BÜREN et al., 2001). The nutritive value of spelt wheat is high and it contains all the basic components which

are necessary for human beings such as sugars, proteins, lipids, vitamins and minerals (BOJŇANSKÁ, FRANČAKOVÁ, 2002).Today, more spelt-based products are available including flour, bread and pasta (MARQUES et al.,2007).

MATERIALS AND METHODS

Field experiments were carried out at Dolná Malanta, western Slovakia from 2005 to 2008. The location belongs to warm agro-climatic region, arid subregion with predominantly mild winter with average temperatures of 19.7ºC in July and -1.7ºC in January, and an average annual precipitation of 561mm. The soil type is a Haplic Luvisol. A randomized block design was used in three replicates. Eight spelt wheat cultivars were cultivated without chemical treatment and fertilization, pre-crop was peas. Conventional soil cultivation was used in order to create suitable conditions for sowing and the following growth of the spelt wheat. Sowing rate was 150-170kg.ha^{-1} of hulled seeds. Mechanical cultivation (spring-tine harrows) was used for weed control.

In this study, the production parameters (yield, TGW, weight of grains per spike, share of glumes, stem length) and indirect baking quality indicators (wet gluten content, swelling of gluten, exstensibility of gluten, falling number gluten index) of eight spelt wheat cultivars are presented. Indicators were evaluated in three replicates, according to Slovak technical and ICC standards.

RESULTS AND DISCUSSIONS

The weight of thousand grains (TGW) is an important yield forming parameter. TGW averaging for spelt wheat about 43.48g. Statistical evaluation of TGW indicated statistically significant influence of the variety and weather conditions. Significantly the highest TGW was observed in Altgold (50.1g) and the lowest in Holstenkorn (38.3g). The TGW lower than 40g was found also in Schwabenkorn (Tab.1). Higher than average TGW was achieved in Franckenkorn, Ostro and Rubiota. When concerned the year of growing, significantly the lowest TGW was found in 2005 (37.4g) when compared with other years. Differences occurred within the years, in 2008 was determined higher TGW at about 24.94% in comparison with 2005.

The weight of grains per spike is also characterized as the yield component and could predict the wheat production. This quantitative parameter was statistically significantly depended on variety and weather conditions. The highest weight of grains per spike, 1.4g was achieved by Rubiota, the second highest was determined in Franckenkorn. Significantly the lowest was found in Schwabenkorn and Bauländer Spelz (1.1g). The weather conditions of 2006 and 2008 positively affected the grain development what was reflected into higher weight of grains per spike and the yield of spelt as compared to the other years of growing (Tab.1). The average yield of *Triticum spelta* was 5.84t.ha^{-1}. Significantly the highest yield was found in Franckenkorn (6.76t.ha^{-1}). The lowest yield had Altgold and Ostro.

Important factor according to lodging resistance is the length of stem. In more dry condition of southern Slovakia, as compared with western Europe, the stem length of spelt varieties ranged from 0.94 (Altgold) to 1.00m (Schwabenkorn).

Triticum spelta is hulled wheat species in which the grain is strongly closed in glumes. Glumes protect the grain against diseases, but when concerned the grain processing, the grain is hardly threshed from the glumes. Statistical analysis confirmed significant influence of the year on share of glumes. The variety did not affect this parameter. The share of glumes was in average 30.87%. Significantly the highest was found in 2007 (32.0%).

The amount of wet gluten is closely connected with the baking quality of bread grain. The demand for food wheat is minimum 25%. The average wet gluten content in eight spelt

wheat cultivars was 42.9% and ranged from 37.4% (Rouquin) to 49.8% (Rubiota). The differences between varieties were significant, average wet gluten content lower than 40% was determined in Rouquin and Hostenkorn, varieties Rubiota, Altgold, Ostro exceed 45% of wet gluten content. Franckenkorn, Schwabenkorn and Bauländer Spelz were intermediate. Wet gluten content was significantly influenced also by the year of growing,that means by the weather conditions during vegetative period (Tab.2). The highest wet gluten was found in 2007 and 2008, when the weather conditions with higher temperatures and insufficient (2007) or normal distribution of rainfalls (in 2008) caused the highest gluten formation.

Table 1

Yield forming parameters of spelt wheat varieties (2005-2008)

VARIETY/YEAR	WEIGHT OF GRAINS PER SPIKE (g)	TGW (g)	STEM LENGTH (m)	SHARE OF GLUMES (%)	YIELD (t.ha^{-1})
Altgold	1,18 ab	50,1 e	0,94 a	34,0 bc	5,38 a
Bauländer Spelz	1,11 a	40,4 b	0,99 bc	28,9 a	5,75 ab
Franckenkorn	1,33 cd	44,3 c	0,94 a	29,5 a	6,76 c
Holstenkorn	1,15 a	38,3 a	0,96 ab	31,2 ab	5,63 ab
Ostro	1,29 bc	46,8 d	0,98 bc	34,7 c	5,49 a
Rouquin	1,19 ab	40,7 b	0,99 bc	28,7 a	6,13 b
Rubiota	1,40 d	47,9 d	0,99 bc	31,2 ab	6,03 ab
Schwabenkorn	1,10 a	39,3 ab	1,00 c	28,7 a	5,54 a
average	**1,22**	**43,48**	**0,97**	**30,87**	**5,84**
2005	0,89 a	37,4 a	1,00 b	30,6 ab	5,35 a
2006	1,42 c	40,9 b	0,95 a	31,4 b	5,94 b
2007	1,01 b	41,8 b	0,99 b	32,0 b	5,06 a
2008	1,40 c	49,8 c	0,97 a	28,5 a	6,90 c
standard error	±0,28	±6,69	±0,06	±4,22	±1,16

Table 2

The indicators of indirect baking quality of spelt wheat (*Triticum spelta* L.), average values for 2005-2008

VARIETY/YEAR	WET GLUTEN (%)	GLUTEN INDEX (%)	FALLING NUMBER (s)	SWELLING (cm^3)	EXSTENSIBILITY (cm)
Altgold	46,4 e	54,1 f	300 b	2,9 a	19,6 d
Bauländer Spelz	40,8 c	48,7 d	322 e	6,6 d	15,0 ab
Franckenkorn	42,5 d	50,8 e	304 c	6,0 c	14,8 ab
Holstenkorn	38,1 b	53,5 f	303 bc	6,6 d	14,5 a
Ostro	47,7 f	41,1 a	278 a	4,3 b	20,3 d
Rouquin	37,4 a	56,7 g	314 d	7,7 e	16,2 c
Rubiota	49,8 g	42,6 b	282 a	6,0 c	15,8 bc
Schwabenkorn	40,7 c	43,9 c	328 f	6,7 d	16,5 c
average	42,9	48,9	304	5,8	16,6
2005	36,7 a	49,7 b	375 c	8,1 d	14,5 a
2006	39,1 b	56,7 c	293 b	6,7 c	15,9 b
2007	44,8 c	60,0 d	423 d	5,5 b	17,1 c
2008	46,8 d	30,7 a	157 a	4,5 a	17,4 d
standard error	±5,9	±14,5	±111	±1,9	±2,8

The gluten index (GI) was in average 48.9%. Statistical analysis showed high influence of the variety and year of growing on this quality indicator. GI ranged from 41.1%

(Ostro) to 56.7% (Rouquin). GI higher than 50% was determined in Altgold, Franckenkorn, Holstenkorn and Rouquin. Concerning the weather conditions, the highest GI was observed in 2007, when higher air temperature in combination with drought caused higher formation of storage proteins. In 2008, lowest GI, indicating worst gluten quality, was caused by wet July, when excessive rainfalls before harvest caused lodging of spelt varieties (except Franckenkorn).

The falling number which is the indicator of enzymatic activity (alpha-amylase) was influenced mainly by the variety and year of growing. Average value of the falling number was 304s and ranged from 278s (Ostro) to 328s (Schwabenkorn). Based on this, we can confirm that average enzymatic activity of all evaluated varieties was satisfactory, even values above 300s are considered as too high. A shortage of activity can be solved technologically by addition of amylolytic enzymes. Regarding the weather conditions, in all evaluated years there were significant differences between the values of this qualitative indicator. The lowest enzymatic activity was detected in 2007 (x=423s), caused by higher air temperature and drought during grain maturing. Very high enzymatic activity (x=157s) was determined in 2008, when wet weather conditions influenced negatively this quality indicator.

Gluten extensibility is an important factor for dough processing. It could be used for prediction of flour utilization in baking process. Gluten with an extensibility over 15cm is more difficult to process, the dough is sticky, and mainly suitable for biscuits preparation. For baking industry recommended values ranged between 5-15cm. Extensibility of gluten was significantly influenced by variety and year of growing. Max. 15cm extensibility was found in varieties Holstenkorn, Franckenkorn and Bauländer Spelz. The most tensile gluten was determined in Ostro and Altgold. The best gluten extensibility was determined in 2005, with normal air temperature as well as precipitation in May. The worst extensibility was found in 2008.

The quality of bread wheat gluten depends on its swelling. For elite flour this value should be more than 13ml, in standard flour gluten swelling ranged from 9-11ml. In samples of spelt varieties the swelling varied between 2.9-7.7ml, which are lower values than the requirement for baking. The highest swelling was recorded in 2005, when also satisfactory extensibility was achieved. Because of the low swelling ability of spelt gluten, this wheat would be more suitable for pasta production than for bakery industry.

CONCLUSIONS

Weather conditions during experimental years showed higher influence on selected production and quality parameters, than tested varieties. The most suitable weather conditions of 2008 positively affected the grain development what was reflected into higher TGW (49.8g) and the yield of spelt wheat (6.9t.ha^{-1}) when compared to the other years of growing. The average yield of *Triticum spelta* was 5.84t.ha^{-1}, TGW averaging about 43.48g and weight of grains per spike was 1.22g. All evaluated indirect baking quality parameters were also depended on variety and weather conditions. Spelt wheat was rich in the content of wet gluten. More than 45% was found in Altgold, Ostro and Rubiota. Very tensile gluten of spelt wheat was of standard quality. GI higher than 50% was determined in Altgold, Franckenkorn, Holstenkorn and Rouquin. The best adoptable spelt wheat variety for the growing conditions of the south Slovakia was Franckenkorn variety, which was characterized with the highest yield and also other production characteristics and acceptable quality parameters.

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