

QUANTITATIVE CHARACTERS AND CHEMICAL COMPOSITION OF SPELT WHEAT CULTIVARS GROWN IN SOUTHERN SLOVAKIA

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Summary

During 1996-1999 a field experiment with different varieties of *Triticum spelta* (L.) was carried out of brown loamy arable soil within an ecological system in Nitra region. The yield formation characters and the crop yield itself were investigated by three spelt wheat cultivars (Bauländer Spelz, Schwabekorn, Roquin) and compared with common wheat. The achieved results revealed that the agroecological conditions of Nitra region are most suitable for the Bauländer Spelz cultivar of German origin, with the highest crop yield of 6.06 t.ha⁻¹, i. e. 92.2% of common wheat yield. This cultivar reached the lowest percentage of glumes (26.13%), the highest TGW (49.29 g), the longest spike (112.45 mm), the highest number of fertile spikelets (14.32) and the highest weight of grains per spike (1.33 g). All of the spelt wheat cultivars had lower productive density of stand (501.3 to 518.7 productive stems per square meter) than common wheat (605.3 productive stems per square meter). Spelt cultivars mainly differed from common wheat cultivar for higher contents of P, S, some of them for Ca, Na. Spelt cultivars were higher in sugars, fat and lower in starch content.

Key words: cereals, spelt wheat, crop yield, yield formation characters, ecological farming system

Introduction

The spelt wheat is one of the oldest cultural cereals, which is originated from crossing of *Aegilops squarrosa* (L.) with *Triticum dicoccon* (Schrank.). Subsequent mutation resulted in the most spread and valuable *Triticum aestivum* (L.). Both have equal genomes, with 42 chromosomes.

Findings of carbonised pieces of spikes, spikelets and kernels are known in the region of Slovakia from the end of 5th millennium BC. The importance of *Triticum spelta* (L.), as grown cereals, was variable. During the Early Bronze Age its occurrence varied around 25% of grown cereals. At the end of Bronze Age, in Lusation culture, the share of *Triticum spelta* (L.) on growing cereals achieved as much as 60%. In Celts culture spelt wheat was grown in lowland regions and mountains basins of north Slovakia as well (Hajnalová, 1993). No evidence has been reported on growing spelt wheat to the beginning of 19th century.

Since the beginning of the 20th century, the spelt wheat has been bred. In Germany the first crossing is reported in 1903. The cultivar Bauländer spelz of pre-war time is the most famous. Originated from the selection of Muellers Gaiberger Landspelz. Further cultivar Schwabekorn originated by screening of a land race, was registered in 1978. Belgian cultivar Roquin is crossing of spelt cultivar Ardenne and Altgold, and common wheat cultivar Lignee`24. It was registered in 1979. The European spelt cultivars are medium high to high, with good winter hardiness, with lower or medium lodging resistance, they are rather late, more resistant to sprouting, variously resistant to powdery mildew, rusts and foot-stem diseases (Vlasák, 1996).

In Slovakia, no cultivar has been registered since 1918. In the last 20 years, the growing area of *Triticum spelta* (L.) has been increasing due to higher demand of diversified food (whole-grain bread, specific flavour), increasing of ecological agriculture, also overproduction in western Europe. These trends influenced our interest in an experimental evaluation of some cultivars originated from Germany and Belgium in Slovakian conditions.

Materials and methods

The objective of this study was to evaluate the quantitative characters and basic chemical composition of three spelt wheat cultivars Bauländer spelz, Schwabekorn, Roquin (*Triticum spelta* L.) and were compared with common wheat cultivar Samanta (*Triticum aestivum* L.).

The experiments were established in south region of Slovakia, in four replicate blocks, during 1996-1999 growing seasons, without fertilisation and any chemical treatments.

Pedo-climatic conditions: average air temperature during vegetative period 16.4°C, normal annual precipitation 532.5 mm, soil type: brownsoil, texture: clay-loamy. The level of nutrients in the soil was very good. Sowing rate: 210 kg.ha⁻¹ of both *Triticum* species.

The characters determined for every cultivar were: average year's yield, number of productive stems, weigh of 1000 grains, % of glumes, stem length, spike length, number of total spikelets, % fertile spikelets, weigh of grains per spike.

After ashing the flour samples, calcium, potassium and sodium were determined by flame emission spectrophotometry, total phosphorus was determined by spectrophotocolorimetry using Spekol, sulphur was measured by nephelometry, starch by polarimetry, sugars according to Somogyi, crude fat by extraction according to Soxhlet (in Davídek et al., 1985).

Results and discussion

All spelt cultivars were lower in yields of naked grains than comparative common wheat cultivar Samanta (Table 1). The highest yield reached German cultivar Bauländer spelt, 6.06 t.ha⁻¹, i. e. 92.2% of common wheat. The lowest yield achieved Belgian cultivar Roquin, 5.07 t.ha⁻¹, i. e. 77.2% of common wheat. Schwabenkorn was intermediate and reached 5.23 t.ha⁻¹, i. e. 79.6% of common wheat.

The stem length of spelt cultivars ranged from 0.79 to 1.08 m (Table 2). It is lower than in western Europe, because of more dry conditions of southern Slovakia. All of them showed good resistance to lodging. The highest differences in stem length reached Schwabenkorn, i. e. 0.24 m within years, Bauländer spelt 0.2 m and Roquin was the most stabilised one (0.95-1.05 m). The weight of 1000 grains (TGW) averaging for spelt wheat about 47.83 g, all of them exceeded common wheat cultivar Samanta. The highest TGW was observed in cultivar Bauländer spelt, some cultivar differences occurred within the years. The average % of glumes after harvest ranged from 26.13% for Bauländer spelt to 27.93% for Schwabenkorn. The length of spike was similar as in common wheat, ranged from 105.5 to 112.5 mm. The highest weight of grains per spike was achieved by Bauländer spelt, 1.33g. The density of stand was lower, with 501.3 productive stems per m² by Schwabenkorn cultivar, and the highest, with 518.7 by Bauländer spelt.

All spelt cultivars exceeded common wheat cultivar Samanta in phosphorus and sulphur levels, averaging about 479.2 mg/100g and 217.3 mg/100g respectively (Table 3). In potassium content spelt cultivar Bauländer spelt was at the same level as common wheat. The other spelt wheats were lower in potassium. Calcium ranged from 38 to 78 mg/100g, with Schwabenkorn having the highest concentration. Sodium also showed differences among spelt wheat cultivars, ranged from 4.6 to 6.1 mg/100g. All three spelt cultivars were lower in starch content than common wheat Samanta. Soluble sugars concentrations occurred in inverse proportions to starch levels. More crude fat was determined for spelt cultivars, averaging about 2.72%, suggesting that there may also be differences in proportion of germ in the kernels.

Considering the results of this study, preliminary recommendation of spelt wheat cultivar Bauländer spelt is possible. It reached the highest yield of naked grains, medium stem length, and highest stability within the years. This cultivar formed the yield mainly on the basis of spike productivity. Spelt cultivars mainly differed from common wheat cultivar for higher contents of P, S, some of them for Ca, Na. Spelt cultivars were higher in sugars, fat and lower in starch content.

References

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Table 1: Crop yield of spelt wheat and winter wheat from 1996 to 1999 [t.ha⁻¹]

Cultivar	Year				Average	Comparison with winter wheat [%]
	1996	1997	1998	1999		
Bauländer Speltz ^a	6.82	6.24	6.93	4.25	6.06	92.2
Schwabenkorn ^a	5.10	7.30	5.66	4.85	5.23	79.6
Roquin ^a	4.79	6.93	4.10	4.45	5.07	77.2
Samanta ^b	7.15	6.85	6.95	5.34	6.57	100.0

^a *Triticum spelta* (L.); ^b *Triticum aestivum* (L.)

Table 2: Yield formation characters of spelt wheat and winter wheat from 1996 to 1999

Year	Cultivar	No of productive stems.m ⁻²	TGW [g]	% of glumes	Stem length [m]	Spike length [mm]	No of spikelets		Weight of grains per spike [g]
							Total	Fertile of total spikelets	
1996	Bauländer Spelz ^a	440.0	50.14	21.88	0.83	119.8	19.7	16.3	1.55
	Schwabenkorn ^a	392.0	46.70	24.99	0.84	93.4	16.5	14.3	1.30
	Roquin ^a	420.0	51.85	23.66	0.95	110.2	18.0	15.6	1.14
	Samanta ^b	752.0	35.41	-	-	-	-	-	0.86
1997	Bauländer Spelz ^a	600.0	47.09	29.81	0.79	99.4	13.4	7.4	1.04
	Schwabenkorn ^a	716.0	50.00	32.35	1.08	100.8	13.1	6.9	1.02
	Roquin ^a	788.0	42.58	32.22	1.05	103.3	13.1	5.9	0.88
	Samanta ^b	628.0	47.74	-	-	-	-	-	1.26
1998	Bauländer Spelz ^a	680.0	54.27	26.65	0.93	114.0	20.4	16.7	1.51
	Schwabenkorn ^a	524.0	47.46	26.52	0.97	102.0	18.9	14.0	1.08
	Roquin ^a	452.0	46.26	23.99	1.01	92.0	18.6	12.1	0.91
	Samanta ^b	556.0	43.82	-	-	-	-	-	1.25
1999	Bauländer Spelz ^a	354.7	45.64	26.18	0.99	116.6	21.4	16.9	1.20
	Schwabenkorn ^a	373.3	46.36	27.85	0.97	125.8	21.6	17.8	1.30
	Roquin ^a	362.0	45.61	28.20	0.95	124.3	20.9	17.8	1.23
	Samanta ^b	485.0	45.91	-	-	-	-	-	1.19
average 96-99	Bauländer Spelz ^a	518.7	49.29	26.13	0.89	112.5	18.7	14.3	1.33
	Schwabenkorn ^a	501.3	47.63	27.93	0.97	105.5	17.5	13.2	1.17
	Roquin ^a	505.5	46.57	27.02	0.99	107.5	17.6	12.8	1.04
	Samanta ^b	605.3	43.22	-	-	-	-	-	1.14

^a *Triticum spelta* (L.); ^b *Triticum aestivum* (L.)

Table 3: Mineral content and chemical composition of spelt and common wheat's meals (on dry basis)

Cultivar	P	K	S	Ca	Na	Digestible carbohydrates [%]		Crude fat[%]
						Starch	Sugars	
	[mg/100g]							
Bauländer Spelz ^a	487	297	222	38	4.6	56.0	2.55	2.53
Schwabenkorn ^a	475	264	200	78	6.1	56.4	2.45	2.60
Roquin ^a	475	262	230	47	4.8	56.9	2.55	3.04
Samanta ^b	375	291	136	45	4.3	60.2	2.30	2.01

^a *Triticum spelta* (L.); ^b *Triticum aestivum* (L.)