ISOFAR International Society of Organic Agriculture Research

***PROCEEDINGS** of the*
***Third Scientific Conference of* ISOFAR**

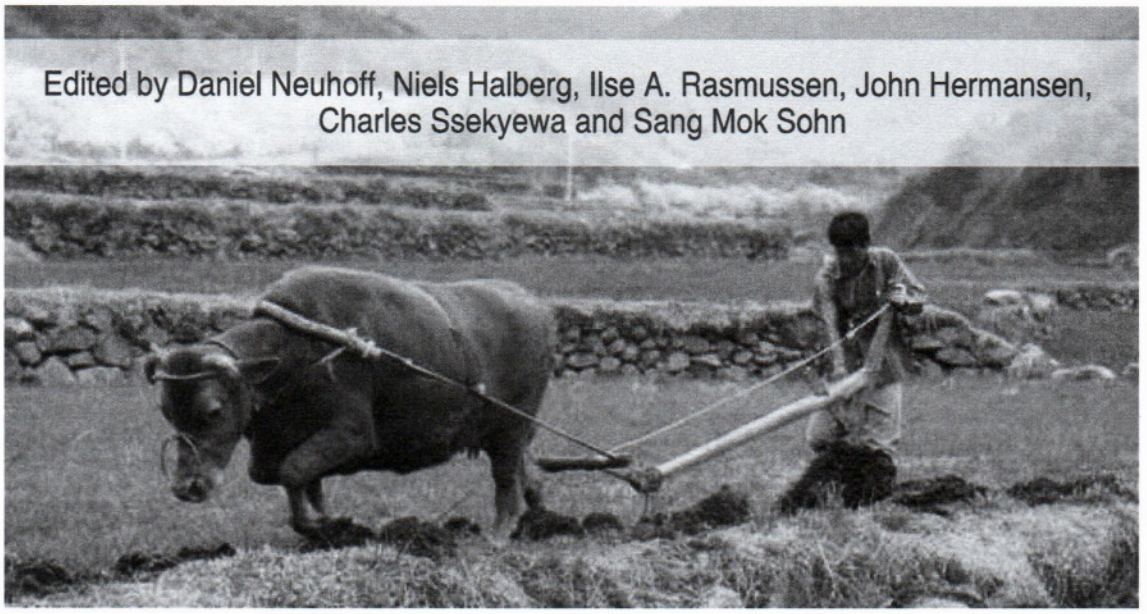
ORGANIC IS LIFE - KNOWLEDGE FOR TOMORROW

28 September - 01 October 2011 in Namyangju / Republic of Korea

Vol.1: Organic Crop Production

Organic is Life
17th IFOAM OWC2011
GYEONGGI PALDANG, KOREA

Edited by Daniel Neuhoff, Niels Halberg, Ilse A. Rasmussen, John Hermansen, Charles Ssekyewa and Sang Mok Sohn



Should the publication of corrigenda become necessary, these will be posted at the conference homepage http://www.isofar.org/kowc2011

The 3rd Scientific Conference of the International Society of Organic Agriculture Research (ISOFAR) was held from 28. September to 1. October 2011 in Namyangju, Republic of Korea, in the frame of the 17th Organic World Congress of the International Federation of Organic Agriculture Movements (IFOAM), organised by the Korean Organizing Committee (KOC).

Daniel Neuhoff, Sang Mok Sohn, Charles Ssekyewa, Niels Halberg, Ilse. A. Rasmussen and John Hermansen (Editors) (2011):

Organic is Life - Knowledge for Tomorrow. Volume 1 - Organic Crop Production. Proceedings of the Third Scientific Conference of the International Society of Organic Agriculture Research (ISOFAR)

Cover: Christian Dahn, IOL, Bonn, Germany

Layout: Beke Katharina Jeschkies, IOL, Bonn, Germany

Printed in Korea

Distribution: Paper copies may be ordered from ISOFAR via email to: info@isofar.org

A PDF version can be downloaded free of charge for ISOFAR members via the member area of www.isofar.org.

Spring forms of spelt landraces (*Triticum spelta* L.) and their suitability for Organic Farming

Konvalina, P. [1], Capouchová, I. [2], Stehno, Z. [3], Moudrý, J. jr. [1] & Moudrý, J. [1]

Key words: spelt, characteristics of landraces, spring form, organic farming

Abstract

Organic farmers are interested in the growing of spring spelt wheat forms (Triticum spelta L.). Therefore, the important agronomical characteristics and baking quality of six spring spelt wheat landraces were studied and evaluated. The studied and evaluated cultivars were inclined to lodging and wheat diseases. Their yield rate is determined by the length of the spike and the weight of one thousand grains. The grain yield and the crude protein yield per hectare achieved the same level in organic farming. The spring spelt wheat forms stand out in high protein content and wet gluten content; the gluten was, nevertheless, weaker and less swollen.

Introduction

Spelt wheat (*Triticum spelta* L.) is a relatively common crop in current organic farming and a valuable material for the production of favourite cereal organic products. When comparing it with common wheat (*Triticum aestivum* L.), we appreciate a higher proportion of proteins, fibres and some mineral elements (zinc, selenium, lithium, phosphorus, magnesium) in the spelt wheat plants (Abdel-Aal & Hucl 2005). It tolerates worse environmental conditions and thus provides a more stable yield rate, even in less favourable areas for farming (Rüegger *et al.* 1990). Concerning the growing of spelt wheat, it has some advantages which determine it to be a suitable crop for the organic farming system. Thanks to a better ability to form tillers and sprouts (Suchowilska *et al.* 2009), it competes well against weeds. However, thanks to this ability, it may form a higher number of unproductive tillers and sprouts (Abdel-Aal and Hucl 2005). The good health of plants is another positive trait of spelt wheat (Schmid *et al.* 1994). Varieties (a group of varieties) have to be studied very carefully as there may be more or less resistant varieties to the most important wheat diseases (Abdel-Aal & Hucl 2005). For example, an inclination to lodging is one of the disadvantages of spring wheat forms (Suchowilska *et al.* 2009). Winter spelt wheat forms are more common in Europe (Abdel-Aal & Hucl 2005). However, spring wheat forms are becoming more interesting too as they could substitute damaged wheat crop stands in winter. This article presents the results of an analysis of particular agronomically significant traits and the baking quality of six landraces of spring spelt wheat.

[1] University of South Bohemia in České Budějovice, Faculty of Agriculture, Studentská 13, 37005 České Budějovice, Czech Republic, E-Mail konvalina@zf.jcu.cz

[2] Czech University of Life Sciences, Kamýcká 120, 16521 Prague 6, Czech Republic, E-Mail capouchova@af.czu.cz

[3] Crop Research Institute, Drnovská 507, 161 06 Prague 6, Czech Republic, E-Mail stehno@vurv.cz

Materials and methods

Precise small-plot trials were established in three replications on a certified organic parcel of the University of South Bohemia (Faculty of Agriculture) in České Budějovice (JU ZF) in 2008 and 2009. From the genetic resources were selected six spring spelt accesions. Common wheat varieties - Jara (an obsolete Czech cultivar), Granny and SW Kadrilj (modern top spring varieties) were chosen as the control. Lucerne was used as a forgoing crop. The treatment of the crop stands respected the principles of organic farming in the growing period – the crop stands were harrowed in the tillering period. An evaluation of the crop stands was carried out during the growing period and also after the harvest. Post-harvest analyses of the plants and spikes were carried out as well. The evaluation was based on a specific methodology by Konvalina *et al.* (2008). Standard methods were applied in the analysis of baking quality (proportion of nitrogenous elements in the dry matter of grains – CSN/ISO norm 1871, wet gluten content in the dry matter of grains - CSN/ISO norm 5531, and gluten index, SDS test by Axford CSN 46 1100-2. A statistical evaluation of the data was carried out in the Statistica 9.0 program (an elementary statistical evaluation and the Tukey HSD test).

Results and Discussion

Concerning common wheat diseases, the resistance to brown rust (*Puccinia recondita*) and mildew (*Blumeria graminis*) were studied and evaluated. All the spelt wheat varieties were as or less tolerant to these diseases than SW Kadrilj, a control variety (Table 1). The spring spelt wheat forms were much longer and taller (138 - 146 cm) than SW Kadrilj (100 cm). Therefore, the spelt wheat plants better competed against weeds than the control variety (Eisele & Köpke, 1997). Meanwhile, they were inclined more to lodging (it was also confirmed by the Tukey HSD test) (Table 1). There were negligible differences between the varieties. The degree of the inclination to lodging was in a negative correlation to the harvest index (r=0,56) which was caused by the fact that plants having weak stalks achieve higher values of the harvest index but they are more lodged, on the other hand. Concerning spike productivity, the varieties were characterised by sparse spikes and all productivity was enhanced by the length of the spikes. The weight of grains in the spikes was lower than the ones of the control varieties (Table 1). The harvest index rate was similar to one of the control varieties. The modern common wheat varieties were characterised by a reduced harvest index which was provoked by a lack of accessible nutrients (the nutrients of nitrogen) in the soil. A plant forms conditions for better production of phytomass at the beginning, but the nutrients contained in the plant are not further distributed to grains (Baresel et al. 2005). The grain yield rate achieved the same level as the control varieties (Tukey HSD test) (Table 2). The comparison of the crude protein yield per hectare also showed very interesting findings (the spelt wheat varieties achieved the same crude protein yield per hectare as the control bread wheat varieties, on average). As a lot of authors have confirmed (Abdel-Aal & Hucl 2005, for example), spring and winter spelt wheat forms contain a high proportion of protein in the grain. As our research showed, a mean difference in the proportion of protein in the grain between the spelt and common wheat, achieved 4.2 % in favour of the spelt wheat (Table 2). The spelt wheat plants also contained more wet gluten (35 – 48 %) than the plants of the control varieties (21 - 33%). The gluten index was reduced in the spring spelt wheat plants (GI = 37 - 50) so the gluten was weaker and it was more difficult to work it by baking. Concerning the swelling of proteins (it is expressed by the SDS test), there were more significant differences in the spelt wheat plants (39 - 66 ml) than in the plants of the control common wheat varieties (58 - 83 ml). Scientific literature also makes remarks about the worse swelling of the spring spelt wheat forms

(Abdel-Aal & Hucl 2005). Therefore, a mixture of spelt wheat flour (weaker and less swelling gluten, high proportion of proteins) and common wheat flour (more solid gluten, more swelling proteins, low proportion of proteins) is considered as a prospective material for the production.

Table 1: Selected Agronomic Traits of Spelt Landraces (mean/standard deviation) (2 years, 3 replications)

Variety	Rust1	Mildew1	Plant height (cm)	Index of lodging1	Weight of grains per spike (g)	Spike length (cm)	Spike density2
Spelta (Triticum spelta L.)							
SP1	6,5±1,6ab	6,2±0,5de	146±2,6bc	6,6±0,7a	0,7±0,1a	11±1,3a	13±0,3b
SP2	7,1±1,4ab	8,1±0,7ab	140±2,9abc	6,8±1,0a	0,7±0,2a	9±0,6b	16±0,9bc
SP3	7,0±1,3ab	8,8±0,3b	136±4,4ab	6,9±0,5a	0,7±0,1a	9±0,2b	15±0,8ab
SP4	6,5±0,8ab	5,9±0,3d	146±2,1c	7,0±1,2a	0,8±0,2a	11±0,3a	14±0,3ab
SP5	5,8±0,8a	7,8±0,6ac	140±2,1abc	6,9±0,5a	0,9±0,1a	11±0,6a	14±0,5ab
SP6	6,8±1,4ab	7,8±0,8ac	138±4,8abc	6,5±0,8a	0,8±0,2a	9±0,5bd	16±0,8ac
Control – Bread wheat (*Triticum aestivum* L.)							
Jara	7,5±0,8ab	7,1±0,5ce	130±13,6a	8,5±0,6b	1,3±0,2b	10±0,2cd	18±3,2c
Granny	5,5±0,8a	8,8±0,5ab	96±0,8d	9,0±0,0b	1,3±0,4b	10±0,1ac	18±0,9c
Kadrilj3	8,5±0,8b	8,6±0,3b	100±0,8d	9,0±0,0b	1,1±0,1ab	7±0,3e	22±2,1d

19 = resistant or no lodging; 2number of spikelets.10cm^{-1}; 3SW Kadrilj. $P < 0.05$; Different letters document statistical differences between varieties for Tukey HSD test, $P < 0.05$

Conclusions

Some of the tested and evaluated varieties are suitable for the organic farming system. Material resistant to brown rust and mildew has to be chosen carefully for growing in organic farming. The resistance to lodging should be one of the most important criteria of selection. The selection of the varieties being characterised by a high weight of one thousand grains may contribute to an enhancement of the spike productivity (and enhance the yield formation). Spring spelt wheat forms provide the same grain yield, but after the dehulling of grains, total yield will be lower. But spelt grain have better quality (a high proportion of the crude protein in grain). The spelt wheat grains are valuable materials for the production of healthy regional and local products.

Acknowledgments

This work was supported by the research project No. NAZV QH82272 and No. NAZV QI111B154 of the National Agency for Agricultural Research of the Ministry of Agriculture of the Czech Republic.

Table 2: Economic Traits and Baking Quality of Spelt Landraces (mean/standard deviation) (2 years, 3 replications)

Variety	Harvest index	Grain yield (t.ha-1)	Protein yield (t.ha-1)	Protein content (%)	Wet gluten content (%)	Gluten index	SDS test (ml)
Spelta (Triticum spelta L.)							
SP1	0,39±0,0a	3,0±1,2a	0,52±0,2a	17,9±0,8a	47±0,2ab	50±11,0a	39±1,5c
SP2	0,39±0,0a	3,4±1,6a	0,64±0,3a	18,6±0,4a	48±2,4b	50±26,6a	65±0,8a
SP3	0,38±0,0a	3,2±2,1a	0,61±0,4a	18,8±0,1a	47±2,9ab	49±39,2a	66±1,7a
SP4	0,38±0,1a	2,5±1,2a	0,43±0,2a	17,9±0,9a	35±12,4abc	37±5,7a	39±4,2c
SP5	0,40±0,0a	3,5±2,5a	0,65±0,5a	18,5±0,4a	39±13,5ab	41±8,9a	51±9,7c
SP6	0,43±0,1a	3,4±2,4a	0,62±0,4a	18,0±0,1a	47±4,5ab	43±25,2a	56±55,8bc
Control– Bread wheat (*Triticum aestivum* L.)							
Jara	0,38±0,0a	3,9±2,3a	0,57±0,3a	14,7±0,4b	32±9,8ac	68±6,9a	58±4,7abc
Granny	0,38±0,1a	3,9±3,1a	0,52±0,4a	13,2±0,5c	21±13,1c	53±15,8a	63±16,7ac
Kadrilj1	0,42±0,0a	4,7±2,5a	0,65±0,3a	14,3±0,9b	33±1,3abc	71±9,9b	83±1,5e

1 SW Kadrilj; Different letters document statistical differences between varieties for Tukey HSD test, $P < 0.05$

References

Abdel-Aal, E-S.M., Hucl, P. (2005): Spelt: A Speciality Wheat for Emerging Food Uses. In Abdel-Aal E-S.M., Wood P. (eds.): Speciality Grains for Food and Feed. Minnesota, AACC, p. 109-142.

Baresel, J. P., Reents, H. J., Zimmermann, G. (2005): Field Evaluation Criteria for Nitrogen Uptake and Nitrogen Efficiency. In: Proceedings of Workshop on Organic Plant Breeding Strategies and the Use of Molecular Markers. Driebergen, The Netherlands, pp. 49-54.

Eisele, J. A., Köpke, U. (1997): Choice of Cultivars in Organic Farming: New Criteria for Winter Wheat Ideotypes. Pflanzenbauwissenschaften, 2:84-89.

Konvalina P, Stehno Z, Capouchová I, Moudrý J (2008): Methodology of Selection and Evaluation of Spring Forms of Neglected Species of Wheat Genotypes, Suitable for Sustainable Farming Systems. University of South Bohemia, České Budějovice.

Rüegger, A. Winzeler, H., Noseberg, J. (1990): Die Ertragsbildung von Dinkel (Triticum spelta L.) and Weizen (Triticum aestivum L.) Unter Verschiedenen Umweltbedingungen im Freiland. J Agron Crop Sci 164:145-162.

Schmid, J. E., Winzeler, M., Winzeler, H. (1994): Analysis of Disease Resistance and Quality Characteristics of F_1 Hybrids Crosses Between Wheat (Triticum aestivum L.) and Spelt (Triticum spelta). Euphytica 75:105-110.

Suchowilska, E., Wiwart, M., Borejszo, Z., Packa, D., Kandler, W., Krska, R. (2009): Discriminant Analysis of Selected Yield Components and Fatty Acid Composition of Chosen *Triticum Monococcum*, *Triticum Dicoccum* and *Triticum Spelta* Accessions. Cereal Sci 49:310-315.