izmantot sakarību, ka pastāv ļoti cieša korelācija starp daudzu pazīmju izpausmi bioloģiskajos un konvencionālajos audzēšanas apstākļos. Kartupeļu klonu 4. un 5. gada pavairojums 2006. un 2007. gadā tika izvērtēti bioloģiskajos un konvencionālajos augšanas apstākļos. Klonu izvēle pamatojās uz iepriekš konvencionālajos augšanas apstākļos noteiktajām pazīmēm un to iespējamās atbilstības bioloģiskajiem audzēšanas apstākļiem: aplapojuma, veģetācijas perioda ilguma, lapu izturības pret lakstu puvi. Kartupeļu klonu izturība pret lapu slimībām lauka apstākļos, veģetācijas perioda garums, raža, cietes saturs un citas pazīmes tika novērtētas un salīdzinātas abos audzēšanas apstākļos. Jaunu šķirņu selekcija bioloģiskajai lauksaimniecībai varētu tikt daļēji veikta jau esošās konvencionālās selekcijas programmas ietvaros. Izmēģinājuma rezultāti pierāda, ka bioloģiskajos laukos noteikti jāveic īpaša klonu atlase, jo konvencionālajā laukā selekcionētie labākie kloni ar bioloģiskajiem apstākļiem it kā piemērotām pazīmēm ne vienmēr izrādījās piemēroti bioloģiskajiem audzēšanas apstākļiem.

EVALUATION OF MAIN TRAITS AND THEIR RELATIONSHIPS OF SPRING WHEAT

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Abstract
Study was carried out at the State Stende Cereal Breeding Institute in 2005-2007. There were included 10 spring wheat varieties registered in Latvian Catalogue of Plant Varieties. The morphological and agronomical traits of the varieties and influence of weather conditions on yield and quality were evaluated. Yield, grain quality and correlation between traits were significantly influenced by meteorological conditions of year. On evaluation data the yield potential was on the level 5-8 t ha^{-1}, but there was a great influence on grain yield and quality traits of year. The grain yield was influenced by variety – 20.64%, but by meteorological conditions 54.02%, interaction of both factors was 16.38%. Significant positive correlation between the yield and the 1000 kernel weight was found, but the significant negative- between the 1000 kernel weight and the volume weight; the starch content and the Zeleny index; the starch content and the protein content; the protein content and the 1000 kernel weight. New variety 'Uffo' was created at State Stende Cereals Breeding institute during 1992-2004, included in the Latvian Catalogue of Plant Varieties from 2008. The variety 'Uffo' is characterizing with high yield potential (6-8 t ha^{-1}), grain quality is suitable for bread making.

Key words: spring wheat, varieties, yield, grain quality

Introduction
In Latvia spring wheat became more popular crop by the last decade of 20th Century. Growing area ranged between 50-60000 ha in each year, but there is a tendency to increase the sowing area and the production. Traditionally the spring wheat has a lower grain yield, but better grain quality (Blakman and Payne, 1987). Spring wheat is used mostly for food, less for feed or bioethanol production. The most popular spring wheat is used for conventional farming, but there are varieties suitable for organic farming too (Belederok *et al.*, 2000).

Spring wheat breeding programme was renewing in State Stende Cereals Breeding Institute in 1990, starting with renovation and evolution of the genetic resources. The main goals of breeding program were to create new varieties, characterizing with the high yield, grain quality conform with the requirements of producers, resistance to lodging and main diseases.

The aim of this study was to evaluate the main morphological and agronomical traits of spring wheat varieties and to find their relationships as well as to establish influence of weather conditions on yield and quality, and to select promising genotypes recommending for farmers.

Materials and Methods

The trials of 10 spring wheat varieties were set up at the State Stende Cereals Breeding Institute during 2005 –2007. There were included varieties registered in Latvian Catalogue of Plant Varieties. Trials were carried out in conventional cereal breeding crop rotation field. The soil at the experimental site was sod-podzolic sandy loam, soil pH $_{KCl}$ –5.6, humus content – 15 mg kg^{-1}, P_20_5 –203 mg kg^{-1}, K_20- 194 mg kg^{-1}. The precrop was winter rapeseed, NPK 18:9:9 500 kg ha^{-1} was applied. Check variety – 'Vinjett'. The plot size was 10 m^2 in 4 replications.

The agronomical and economical traits were evaluated in the trial: period of maturity, plant height, ear length, grain yield, 1000 kernel weight, volume weight, resistance to lodging and to diseases, grain quality (protein, starch, gluten content, Zeleny index, Falling number).

The grain quality determined by grain analyser 'Infratec 1241'.

Statistical analyses were performed using Agrobase 4 software package. Analysis of variance (ANOVA).

The average of temperatures and amount of precipitation was different during 2005, 2006, and 2007. In 2005 meteorological conditions were suitable for spring wheat sowing and growing. In August amount of precipitation was very high and the sprouting of kernel was recorded. For this reason the grain quality was lower as usually.

In 2006, meteorological conditions were suitable for spring wheat sowing, but during the growing period amount of precipitations was lower than norm. In the first decade of July the mean air temperature was 20^o C, but amount of precipitation was 0.7 mm. In July the total amount of precipitations was 42.4 %. For this reason the size of spring wheat kernels were smaller than usually.

In 2007 meteorological conditions were particularly suitable for obtaining the high spring wheat yield with good grain quality. In June the average of air temperature was 2,2^o C above long term and amount of precipitation to compare with long term was less (72%). Sufficient soil humidity and air temperature was favourable for plant development. Spring wheat heading and anthesis was recorded 10 days earlier than in 2005 and 2006. In July the air temperature was –0,1^{o}C below long term, but amount of precipitation was higher than long term (120,1%). In August total amount of precipitation was 129,4% comparing with long term, for this reason the spring wheat yield harvesting was delayed and started in the third decade of August.

Results and Discussion

Grain yield. In 2005 the grain yield was from 4.02 to 5.45 t ha^{-1}. The highest grain yield had varieties 'Triso', 'Fasan' and 'Eta' (5.45, 5.36, 5.21 t ha^{-1}), but it was on the standard 'Vinjett' (5.23 t ha^{-1}) yield level. In the 2006 the grain yield was from 5.87 to 7.20 t ha^{-1}. Significant higher yield had varieties 'Eta' (+0.62 t ha^{-1}), 'Uffo' (+0.36 t ha^{-1}) and 'Picolo' (+0.34 t ha^{-1}) (LSD $_{0,05}$= 0,31). The highest yield level was reached in 2007; grain yield was from 5.57 to 8.83 t ha^{-1}. Significant higher yield had variety 'Uffo' (+1.09 t ha^{-1}), (LSD $_{0,05}$ =0,49).

In years 2005-2007 on average grain yield of spring wheat varieties ranged from 5.19 tha^{-1} to 6.96 tha^{-1}. Among varieties the highest yield had varieties 'Uffo' and 'Eta', but difference compared with standard was not significant. Significant lower yield showed variety 'Aniniina' (-1.41 t ha^{-1}), which characterized with short vegetation period and varieties 'Picolo' and 'Munk' (-0,50 t ha^{-1}) (Table 1).

Table1.Grain yield of spring wheat varieties

Variety	Origin	Grain yield, t ha^{-1}							
		2005	+/- t ha^{-1}	2006	+/- t ha^{-1}	2007	+/- t ha^{-1}	Average	+/- t ha^{-1}
Vinjett	SE	5.23	-	6.84	-	7.74	-	6.60	-
Zebra	SE	4.69	-0.54	6.83	-0.01	7.35	-0.39	6.29	-0.31
Triso	DE	5.45	+0.22	6.21	-0.63	7.86	+0.12	6.50	-0.10
Fasan	DE	5.36	+0.13	6.75	-0.09	7.48	-0.26	6.53	-0.07
Picolo	DE	4.97	-0.26	7.18	+0.34	6.15	-1.59	6.10	-0.50
Munk	DE	4.81	-0.42	5.87	-0.97	7.63	-0.11	6.10	-0.50
Eta	PL	5.21	-0.02	7.46	+0.62	8.06	+0.32	6.91	+0.31
Jasna	PL	4.37	-0.86	6.70	-0.14	8.19	+0.45	6.42	-0.18
Aniniina	FI	4.02	-1.21	5.97	-0.87	5.57	-2.17	5.19	-1.41
Uffo	LV	4.86	-037	7.20	+036	8.83	+1.09	6.96	+0.36
LSD_{05}		0.43	0.31	0.49	0.37				

Statistical analysis showed, that the grain yield was influenced by variety – 20,64 %, but by meteorological conditions 54,02 %. Interaction of both factors was 16,38 %. It confirms the results of other authors (Sofield *et al.*, 1977; Lapinski *et al*., 1988).

Relationship of morphological and agronomical traits.Genes controlling the plant height, ear shape and length or period of vegetation may be of interest for their direct and indirect effects on the varieties yield potential (Worland, *et al.*, 1987).

Spring wheat varieties suitable for growing in the Latvian agroclimatical conditions should be characterized with early or middle-early growing period. Varieties with long period of vegetation prevent the sowing time of winter crops; also meteorological conditions in harvest time often are not suitable for obtaining high grain quality.

In our trials the mean vegetation period was 133 days in 2005, 119 days in 2006 and 135 days in 2007. The growing period of standard variety 'Vinjett' varied from 116 to130 days during 2005-2007. Variety 'Aninnina' had shorter vegetation period, but varieties 'Eta' and 'Munk ' characterized with longer growing period.

Lelley, 1976, noted that correlation between growing period and wheat grain yield potential is not proven. In our investigations the correlation between grain yield and growing period was positive in the all years, but significant in 2007 ($r_{0,05}$=0.87). In this year the duration of period from the anthesis to the maturity or grain filling period was longer compared to 2005 and 2006 and due to the yield was higher than in previous years. There were the significant correlation between yield and period of anthesis in 2006 ($r_{0,05}$ =0.81) and correlation between period of anthesis and 1000 kernel weight in 2007 ($r_{0,05}$ =0.61).

Worland, *et al.*, 1987, noted that many genetic factors, which regulate development and morphology, would have effects on final plant height. Reducing plant height also frequently reduce grain yield (Law, *et al.*, 1978). The positive correlation was found between yield and plant height, but it was significant only in 2005 ($r_{0,05}$=0.68). Plant optimal height (90-100 cm) is very important trait for varieties used for organic farming. There was not significant correlation between the growing period and the plant height, and the growing period and ear size. Ear size determines mostly genotype but less affects by environment (Rajaram, 1994b). There was not found correlation between the yield and the ear size.

Grain size is one of the most important traits and had direct effect on grain yield. In our study the significant coefficient of correlation was found between yield and 1000 kernel weight in 2005 ($r_{0,05}$ =0.78), in 2006 ($r_{0,05}$ =0.77) and in 2007($r_{0,05}$ =0.76). There was no significant correlation between volume weight and yield.

Significant negative correlation between the volume weight and the 1000 kernel weight was found in all years in 2005($r_{0,05}$ =-0.58), in 2006 ($r_{0,05}$= -0.61) and in 2007($r_{0,05}$ =-0.61).

It is very important to unite high yield with high grain quality. Usually negative correlations between the protein content and the grain yield was found (Worland, *et al. 1987*). All genes affecting yield influence protein levels in the grain. Both genotype and environment have influence

on the grain quality of wheat. Problem in breeding is to produce cultivars with good an even quality from year to year (Johanson and Svenson, 1998; Johanson *et al*., 2001).

In our investigations the average protein content of spring wheat varieties ranged from 107 g kg^{-1} (variety 'Eta') to 158 g kg^{-1} (variety 'Aniniina'). Each year more even protein content had varieties 'Zebra', 'Triso', 'Fasan', 'Picolo' and 'Aniniina'. Standard variety 'Vinjett 'protein content varied from 119 g kg^{-1} to 146 g kg^{-1}.

The significant negative correlation between yield and protein content was in 2005 ($r_{0,05}$= -0.78) and in 2007 ($r_{0,05}$= -0.84), also negative correlation in all years was between protein and 1000 kernel weight in 2005 ($r_{0,05}$ = -0,85), in 2006 ($r_{0,05}$ = -0.81) in 2007 ($r_{0,05}$ = -0.81). Positive correlation was between yield and starch content, significant in 2007 ($r_{0,05}$ =0.71).

There was a significant negative correlation between protein content and starch content in 2005 ($r_{0,05}$= -0.80) in 2006 ($r_{0,05}$ = -0.59) and starch content and Zeleny index in 2005 ($r_{0,05}$ = -0.66), in 2006 ($r_{0,05}$= -0.61) (Table 2).

Table 2. Coefficients of correlation of spring wheat traits

Traits	2005	2006	2007
Yield-growing period	0.45	0.42	0.87**
Yield- period of anthesis	0.09	0.29	0.81**
Yield- plant height	0.80**	0.41	0.41
Yield-ear size	0.28	-0.003	-0.08
Growing period-plant height	0.06	0.26	0.27
Growing period-ear size	0.45	0.56	0.21
Period of anthesis-1000 kernel weight	0.34	0.37	0.61*
Yield- 1000 kernel weight	0.78**	0.77**	0.76**
Yield-volume weight	0.20	-0.17	0.41
Yield-protein content	-0.78**	-0.48	-0.84**
Yield-starch content	0.44	0.52	0.71**
Volume weight-1000 kernel weight	-0.58*	-0.61*	-0.61*
Protein content-1000 kernel weight	-0.85**	-0.81**	-0.81**
Protein content - starch content	-0.80**	-0.59*	-0.52
Starch content- Zeleny index	-0.66*	-0.61*	-0.54
Starch content-1000 kernel weight	0.67*	0.20	0.52
Volume weight-starch content	0.46	0.29	0.24

Significant * at $r_{0,05}$= 0.576; ** $r_{0,01}$=0,708 ; n=10

New variety 'Uffo'. Variety 'Uffo' (Eta/Sigma) was developed at the State Stende Cereals Breeding Institute during 1992-2004. Variety is a middle-early (three days later comparing with standard 'Vinjett'), characterizing with high yield potential (6-8 t ha^{-1}) moderate resistance to lodging (5-7), plant height – 93-100 cm. Also have moderate resistance to *Blumeria graminis f.sp. tritici*, *Puccinia triticina*, *Septoria tritici*, susceptible to *Drechslera tritici-repentis*. Grain quality is suitable for bread making. Variety 'Uffo'is registered in the Latvian Catalogue of Plant Varieties from 2008.

Table 3. Characteristic of spring wheat variety 'Uffo', 2005 –2007

Variety	Grain yield, t ha^{-1}	+/- standard	1000 kernel weight, g	Volume weight, g l^{-1}	Protein content, g kg^{-1}	Zeleny index, ml	Gluten content, %
Standard 'Vinjett'	6.60	-	39.03	778	130	47	28
'Uffo'	6.96	+ 0.36	40.1	782	128	43	25
$LSD_{0,05}$	0,37						

Conclusion

On evaluation data of 10 spring wheat varieties in 2005-2007 the yield potential was on the level 5-8 t ha^{-1}, but there was a great influence on grain yield and quality traits of year. The grain yield was

influenced by variety – 20.64%, but by meteorological conditions-54.02%, interaction of both factors was 16.38%. Significant positive correlation between the yield and the 1000 kernel weight was found, but the significant negative- between the 1000 kernel weight and the volume weight; the starch content and the Zeleny index; the starch content and the protein content; the protein content and the 1000 kernel weight.

New variety 'Uffo' was created at the State Stende Cereals Breeding Institute during 1992-2004, included in the Latvian Catalogue of Plant Varieties from 2008. The variety 'Uffo' is characterizing with high yield potential (6-8 t ha^{-1}), grain quality is suitable for bread making.

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VASARAS KVIEŠU AGRONOMISKĀS UN MORFOLOĢISKĀS PAZĪMES UN TO MIJIEDARBĪBA

Strazdiņa V.

Izmēģinājumi ar desmit Latvijas Augu katalogā reģistrētajām vasaras kviešu šķirnēm bija iekārtoti Valsts Stendes graudaugu selekcijas institūtā. Laikā no 2005.-2007.gadam tika izvērtētas šķirņu morfoloģiskās un agronomiskās īpašības (veģetācijas perioda ilgums, augu un vārpas garums, 1000 graudu masa, tilpummasa, graudu kvalitātes rādītāji- proteīna saturs , lipekļa saturs un kvalitāte, cietes saturs, krišanas skaitlis), kā arī noskaidrota šo īpašību savstarpēja mijiedarbība. Konstatēts, ka meteoroloģiskie apstākļi būtiski ietekmē graudu ražu un tās kvalitāti (54.2%), šķirnes ietekme bija 20.64%, bet abu faktoru savstarpējā mijiedarbība bija 16.38%.

Būtiski pozitīva korelācija bija starp graudu ražu un 1000 graudu masu, bet būtiski negatīva korelācija starp 1000 graudu masu un tilpummasu, kā arī starp cietes saturu un proteīna saturu, cietes saturu un Zeleny indeksu, kā arī proteīna saturu un 1000 graudu masu.

Vasaras kviešu selekcijas darba rezultātā no 1992.-2004.g. izveidota jauna šķirne 'Uffo', kas raksturojas ar augstu graudu ražu (vidēji 3 gados 6,96 t ha^{-1}), vidēju izturību pret veldri un bīstamākajām kviešu lapu slimībām, graudu kvalitāte piemērota maizes cepšanai. Šķirne reģistrēta Latvijas Augu šķirņu katalogā no 2008.gada.