The Yield Formation in the Alternative Varieties of Wheat

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Abstract: The alternative varieties are special forms of varieties of cultural plants that can be sown in autumn as well as in the spring. We established small-plot trial in field conditions to study selected physiological characteristics of alternative wheat forms. Land races Česká přesívka (Czech alternative variety), Chlumecká 12 and Postoloprtská přesívka (Postoloprtska alternative variety) were included in the trial as well as the varieties now newly bred: Anemos, Kalistos, Melon, Naxos, Thasos and Velos. The historical varieties conclusive retrenched number spike on average plant in comparison with new varieties of alternative varieties. The number of spikes on some plant was highest by cultivars Anemos (3.19 piece) and lowest in cultivars Česká přesívka (1.27 piece). Also weight of grains in the spike was lowest at Česká přesívka (average weight was 0.53 g). On the side second highest average weight of grains at Anemos (1.04 g). The 1000-seed weight was lowest off variety Chlumecká 12 (30.32 g) and highest near variety Velos (35.67 g). The yield of grain was near historical selection variety from 3.97 t/ha (Chlumecká 12) to 4.32 t/ha (Postoloprtská přesívka) and straw in interval values 5.19 t/ha (Postloprtská přesívka) to 5.77 t/ha (Chlumecká 12). On the side second at new species was grains' yield 3.98 t/ha (Kalistos) to 5.32 t/ha (Velos) and straw in interval values from 4.98 t/ha (Naxos and Velos) to 5.41 t/ha (Kalistos). Among historical variety was not found statistically significant differences. Analogous result was found in yield of grain and straw by new variety. Statistically significant difference in yields were found among by both monitored files variety. Lower grains' yield was assessed at historical variety but they have had higher yield of straw.

Keywords: alternative varieties; wheat; yield; yield formation

Alternative varieties are special forms of varieties of cultivated plants that can be sown in autumn as well as in the spring. They overwinter well (like winter forms) during autumn sowing and in spring sowing they produce generative organs and bring an economic contribution like spring varieties do. These forms, particularly cereal forms, can be found in many countries, what can be documented by their separate names, e.g. Poland term is "pzewodki", Russian term is "dvurutschki", Hungarian name is "járó", German word for it is "die Wechselweizen", in French "le blé alternative" and "alternative varieties" in English. Nowadays, a lot of new varieties of this character have been appeared in Central Europe or new varieties denoted in this way, respectively, with significantly higher production capacity than it was in the last century.

The properties of alternative varieties brought an attention in the last century mainly in two periods. Firstly in the 1920s (Servít 1913; Fruwirth 1914, 1918; Stehlík & Tymich 1920; Lewitzki 1927; Flagsberger 1929 and others). The study in those times was oriented to land races, which were manifested in the region of Central Europe just like alternative and semi-winter forms. Their percentage in the set of cultivated wheat varieties reached more than 70% (30 registered alternative varieties were cultivated, i.e. 43%). The other cultivated

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varieties were of foreign origin, mostly German winter and spring varieties. Considering such high percentage of these forms, it had been concluded that they are "a product" of transitive climate of Bohemia. It can be supported also by Flaksberger's opinion (Flaksberger 1929) who considered even some historical varieties, e.g. spelt wheat (*Triticum spelta* L.) and einkorn varieties (*Triticum monococcum* L.) from these regions, as alternative varieties. In the region of Moravia alternative varieties were not found, the varieties here were strictly winter ones, more bound to continental climate. Winter and spring characters of varieties are given genetically and controlled also by certain genes. In true alternative varieties genetic predisposition can be presupposed, what was proved by Fruwirth (1914, 1918). This author used in his experiment a pure line of the Czech alternative variety and proved that after seven-year cultivation in autumn and spring sowing, and spring cultivation of identically long time and autumn sowing, its character was not changed. The stand from the seed originating from spring sowing overwintered well and the stand from the seed of autumn sowing was heading normally.

The second period of more intensive study of peculiarities of alternative forms took place after 1950. In this period Glásnerová and Teltscherová (1953); Teltscherová (1956); Petr (1960); Hoffmann (1944); Hänsel (1948); Könnecke (1953), and others were dealing with alternative varieties. Many successes of these transformations were just connected with alternative character of transformed forms. The best known example are winter barley varieties where it was clearly proved that spring barley Kruglik 021 and Krasnodarskij 514 overwinter well, because they are alternative varieties. The situation was similar with the barley variety Pallidum 17 or Odeskij 17 (Fedorov 1956; Skripčinskij 1956). Fedorov (1999) marked the Czech alternative variety as a true one, fully clear-cut alternative variety. The latter author spread the study of individual development of winter character and alternative variety character in many other plant species and he reached very interesting knowledge with forage grasses, clover crops and many other feed crops.

These forms are known for a long time also in France (Chouard 1951; Mathon 1972) as "le blé alternative", and considering moderate maritime and moderate winters of southern France, many varieties may be of such character. In England, too, they are known as "alternative varieties", the varieties with this character, not only in cereals. Besides overwintering and now winter varieties of oats, here, namely in Wales, there are the so-called winter faba been, pea and field pea varieties, and a lot of herbage grasses. Their character is, however, very extensive from overwintering spring crops through alternative forms to semi-winter forms. Considering the conditions that do not bring any problems with overwintering, there are not many studies on physiological principle of these forms.

Regarding biology of these crops we decided to study the yield formation.

METHODOLOGY

We established small-plot trial in field conditions in the years 2001 and 2002 to study selected physiological characteristics of alternative wheat forms. Land races Česká přesívka (Czech alternative variety), Chlumecká 12 and Postoloprtská přesívka (Postoloprtska alternative variety) were included in the trial as well as the varieties now newly bred: Anemos, Kalistos, Melon, Naxos, Thasos and Velos.

Plants were grown on the experimental plot of the Faculty of Agrobiology, Food and Natural Resources (Faculty of Agronomy) of the Czech University of Agriculture in Prague where is a loamy soil (luvisol) and it is a sugar-beet-wheat-growing subtype. The size of the experimental plot was 2 m^2.

To compare temperatures and precipitation in different months of the given year we chose the configuration of thermopluviogram. It is based on internationally recommended standardised criteria (temperature deviations from normal or long-term average and relative expression of precipitation using percentage of normal (Klabzuba *et al*. 1999).

In year 2002 the months September, October and December belonged among humid and cool months, as it can be seen from Figure 2. It is also visible from the given graph that January, May and July were dry and warm months, whereas February, March, April, June, August and November were humid and warm months.

In monitored year 2003 was most months warm and arid. The months February and October was expressive dryness and coldness months. On the other hand months January, May and July were warm and dampness.

The months January and April of the year 2004 were cool and humid. To the category warm and arid months coincide more part of the year, so months February, July, August, September and October. The month May was cool and dry. Warm and humid months of the year 2004 were March, June, November and December.

By select variety of alternative varieties we are monitored choice characteristics of formation of yield. In full maturity (91.DC) we are followed number of spikes to average plant, weight of grains in spike, 1000-seed weight and yield of grain and straw. Grain' yield was monitored near humidity 14%.

Statistic program STATISTICA Cz, version 6.1 was used for statistical evaluation of the results obtained.

RESULTS AND DISCUSSION

It is evident from the results is perceptible statistically conclusive influence of year on formation yield and higher yield of grains and straw. From the results evidently but the lowest values monitored characteristics were gained in the year 2002 and highest in the year 2003.

The conclusive differences was not found among years 2003 and 2004. The statistically conclusive unswayed term of sowing rate of monitored characteristics. I nevertheless it is possible claim but higher values were measured near autumn sowing rate in comparison with spring's sowing rate.

These results bear witness to thesis e.g. García Del Moral *et al*. (1991), Shpiler and Blum (1991), Simane *et al*. (1993), Giunta *et al*. (1993) and Blum *et al*. (1994). Citation authors statement of fact but genotype x environment interaction is differential genotypic expression across environments and largely arises from the diverse response of genotypes to climatic variables (mainly temperature and rainfall) and soil characteristics during plant growth and development.

The number of spikes (Figure 1) by historical varieties ranged from 1.29 pieces (the variety Česká přesívka) to 1.95 pieces in the variety Postoloprtská přesívka. The number of spikes was by new varieties in interval of the values from 2.19 pieces (Melon) to 3.19 pieces of the variety Anemos. Decrease in the value of the number of spikes can be recorded by historical varieties in comparison the new varieties.

The differences among varieties follow from graph 1. From this graph follows also the fact that historical varieties, compared with present ones, have lower number of spikes in comparison the new varieties. The historical varieties had statistically lowest average number of spikes (1.54 spikes) and the new varieties had number of spikes (2.58 spikes). The lowest average number of spikes was taken in varieties Česká přesívka (1.29 spikes). On the other side, highest values of spikes were found in the varieties Anemos (3.19 pieces). Statistical evaluation of the effect of variety on the number of spikes is

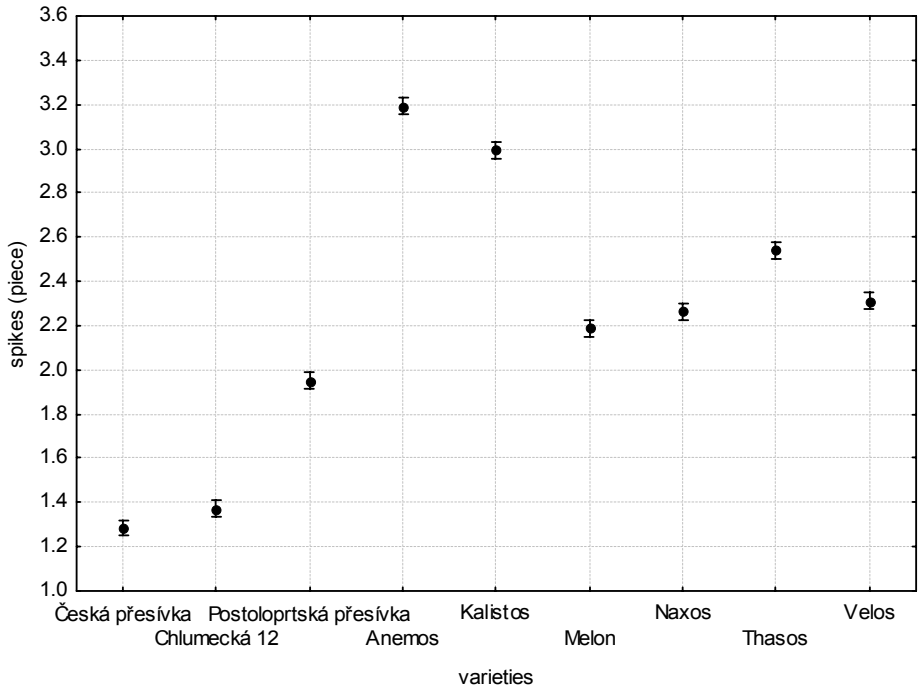

Figure 1. The number of spikes (piece) on some plants by varieties alternative varieties. The vertical columns denote 0.95 intervals of reliability

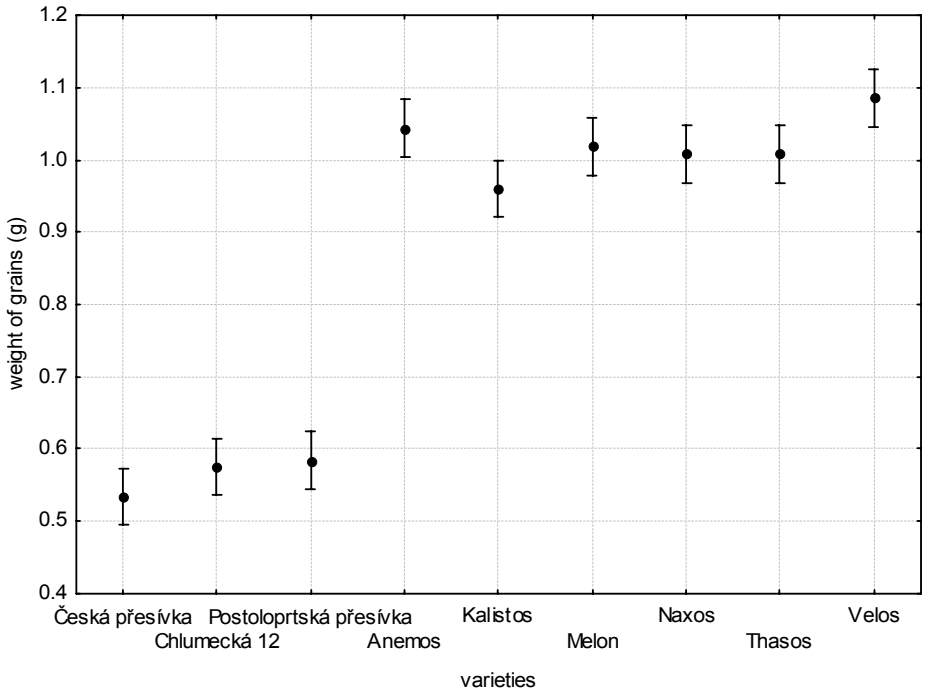

Figure 2. The weight of grains (g) in the spike by varieties alternative varieties. The vertical columns denote 0.95 intervals of reliability

summarised in graph 1. It follows from the given fig. that lowest number of spikes was shown by the variety Česká přesívka (1.29 pieces) and highest one by the variety Anemos (3.19 pieces).

The results obtained are in congruency with the conclusion made by Dotlačil *et al*. (2003). The results obtained are not in congruency with the conclusions made by Fukushima *et al*. (2001). These authors said that the number of spikes was not greatly different between cultivars.

As it can be seen from the results obtained, amount of weight of grains in spike in experimental varieties (Figure 2). The weight of grains by historical varieties was between value 0.53 g (variety Česká přesívka) till 0.58 g (variety Postoloprtská přesívka). The taken values of weight of grains are given in Figure 2. The weight of grains by new varieties was lowest by variety Kalistos and highest by variety Velos. The weight of grains in spike was between values from 0.96 g to 1.09 g.

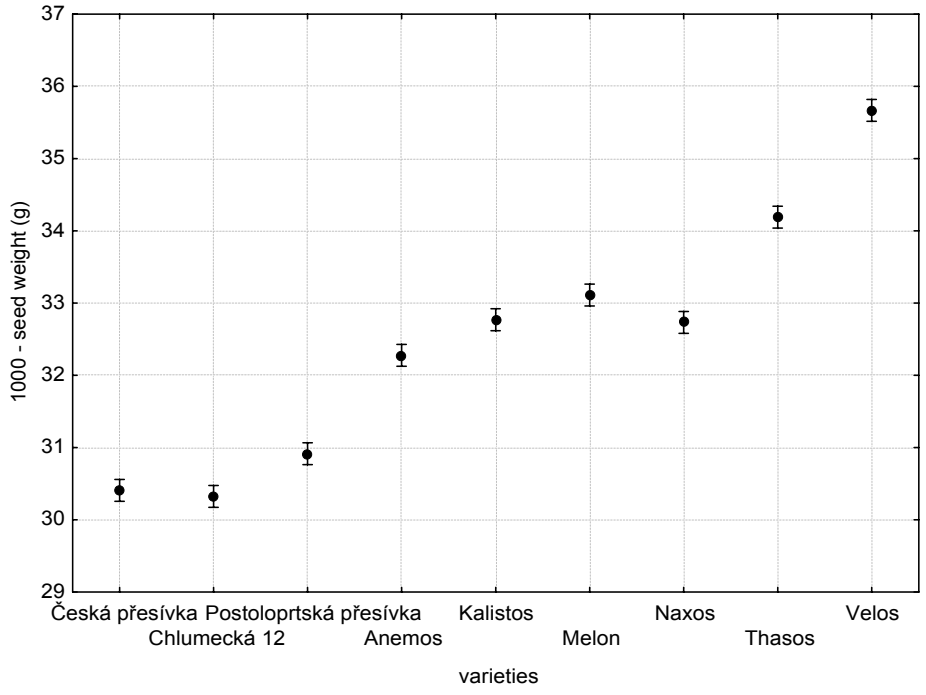

Figure 3. The 1000-seed weight (g) by varieties alternative varieties. The vertical columns denote 0.95 intervals of reliability

The highest weight of grains was found by variety Velos and lowest by variety Česká přesívka. The statistical differences was found between historical varieties and new varieties. The average weight of grains by historical varieties was 0.56 g and by new varieties 1.02 g.

The weight of dry matter of grains by historical varieties had average value 0.56 g. This value is rather 45.10% lower then new varieties. The statistically difference was found between varieties of trial (Figure 2).

The 1000-seed weight was another measured characteristics. The 1000-seed weight was between values from 30.32 g (Chlumecká 12) to 35.67 g (Velos) (Figure 3).

The highest 1000-seed weight by historical varieties was found by variety Postoloprtská přesívka (30.91 g) and lowest by variety Chlumecká 12 (30.32 g). The statistical differences was not found between all of historical varieties. The average 1000-seed weight by historical varieties was 30.55 g.

The lowest 1000-seed weight by new varieties was by variety Anemos – 32.28 g and highest weight was by variety Velos – 35.67 g. The statistical differences was found between Anemos, Kalistos, Melon, Naxos and Thasos, Velos. The statistical differences was not found between varieties Anemos, Kalistos, Melon, Naxos (the weight was from 32.28 g – Anemos to 33.11 g – Melon). The average 1000-seed weight by new varieties was 33.46 g.

The statistical differences was found between historical and new varieties. The 1000-seed weight by historical varieties was rather 8.70% lower then new varieties.

The results obtained are in congruency with the conclusions made literature date.

Fischer's LSD test on the level of significance $\alpha = 0.05$ was used for statistical analysis of the effect of variety on the yield of grains and straw. Statistical evaluation can be found in Figure 4 and 5.

It can be seen from the mentioned figs that lowest yield of grain of historical alternative varieties was recorded with the variety Chlumecká 12 (3.97 t/ha) and on the other side, highest grains' yield was reported for the variety Postoloprtská přesívka (4.32 t/ha). There are significant differences among the mentioned historical varieties. The variety Postoloprtská přesívka (5.19 t/ha) had the lowest yield of straw and the highest by the variety Chlumecká 12 (5.76 t/ha).

The highest yield of grain was found by new alternative variety Velos and lowest by variety Kalistos. The statistical differences was found between varieties Velos and Kalistos. The yield of grain by Velos was 5.32 t/ha and by variety Kalistos 3.98 t/ha (Figure 4).

The results obtained are partly in congruency with the conclusions made for example by Petr and

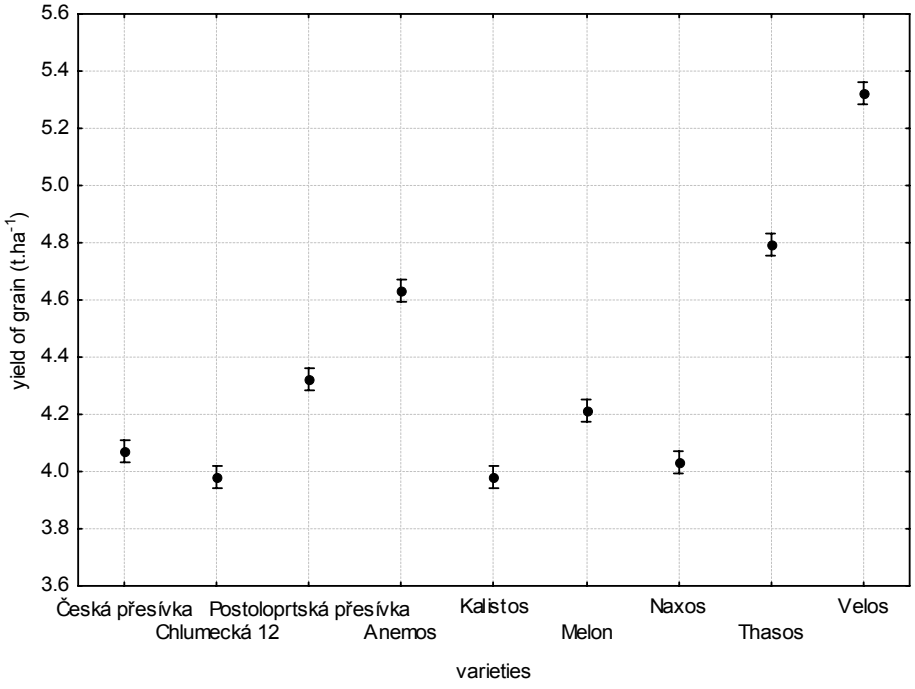

Figure 4. The yield of grain (t/ha) by varieties alternative varieties. The vertical columns denote 0.95 intervals of reliability

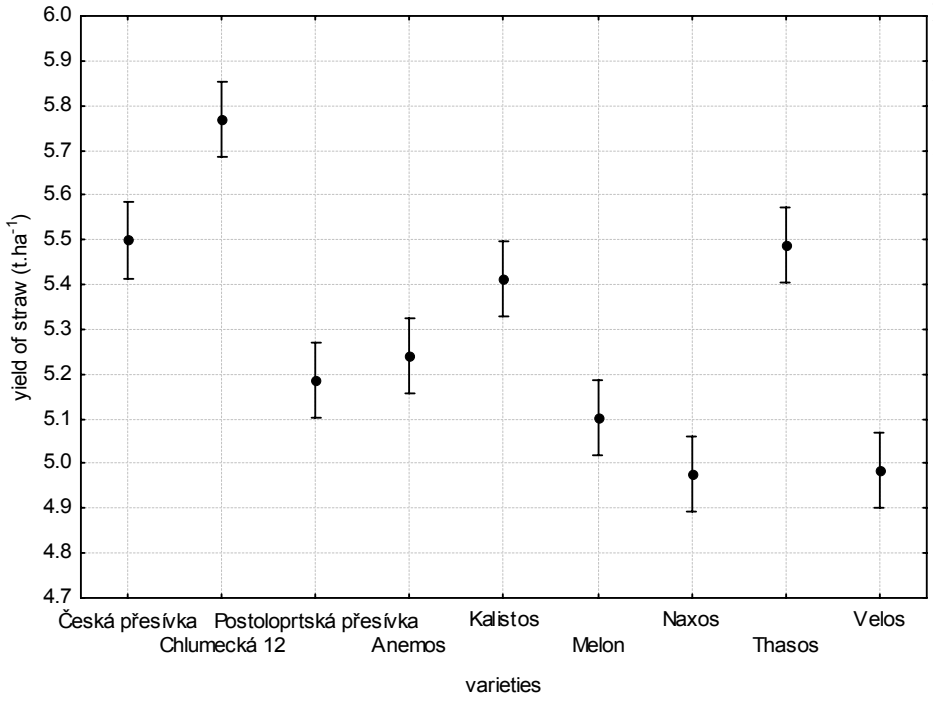

Figure 5. The yield of straw (t/ha) by varieties alternative varieties. The vertical columns denote 0.95 intervals of reliability.

Škeřík (1999). These authors said that in 1994 average yield of all varieties of winter wheat amounted to 7.92 t/ha, in 1995 7.51 t/ha what were markedly higher yields than in the other years. Significantly lowest yield in 1996 was 4.58 t/ha likewise in 1998. The plant of winter wheat was growing in conditions of ecological cultivation. The results obtained are in congruency with the conclusions made by Hnilička (1999).

It is evident from Figure 5 that the yield of straw was between value 4.98 t/ha (variety Naxos) till 5.49 t/ha (variety Thasos). The statistical differences of straws yield was found between varieties Naxos, Velos and other new alternative varieties.

The statistically significant difference in yields were found among by both monitored files variety. Lower grains' yield was assessed at historical variety but they have had higher yield of straw. The average yield of grain by historical alternative varieties was 4.12 t/ha and yield of grain by new alternative varieties was 4.50 t/ha. It is evident from Figure 5 the highest yield of straw was in the historical alternative varieties (5.48 t/ha) and lowest by new varieties (5.20 t/ha).

The results obtained are in congruency with the conclusions for example made by Hnilička (1999) and Hnilička *et al*. (2000). The obtained by results in differences among variety are conformable with literary particulars – Petr and Škeřík (1999), Hnilička *et al*. (2000), Motzo *et al*. (2001).

In conclusion it can be said that the historical varieties conclusive retrenched number spike on average plant, weight of grains in spike and the thousand seed weight in comparison with new varieties of alternative varieties. Among historical variety was not found statistically significant differences in yield of grain and straw. Analogous result was found in yield of grain and straw by new variety. Statistically significant difference in yields were found among by both monitored files variety. Lower grains' yield was assessed at historical variety but they have had higher yield of straw.

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