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COMPARISON OF HYBRID POSTERITY OF WINTER TRITICALE OF SECOND GENERATION WITH PARENTAL FORMS BY THE BIOCHEMICAL PARAMETERS

L.O. FOMENKO

The results of comparison of hybrid posterity of winter triticale of second generation with parental forms by biochemical and technological parameters are presented and three combinations which dominated over parental forms are marked out.

All over the world, scientists are highly interested in triticale, as a culture that combines best parameters of parental forms. Technologies of growing and processing of triticale are improving at present. Triticale is used as a fodder grain for manufacture of feed concentrate [1]. Triticale flour is used mainly in pastry production. In order to satisfy market requirements, technologies using new raw materials are of vital importance, triticale flour plays an important role in solving this problem. Research on influence of triticale flour on the adhesive properties of paste showed increase of adhesion strength of triticale dough comparing to wheat dough [2]. Prospects of baking dietary bread of triticale flour for the people suffering from dysbolism are outlined.

Triticale grain differs essentially from other species of cereal raw. Its usage and processing conditions depends on grain content, its grinding level, biochemical characteristics of components and bread making properties [4].

During the creation of triticale, chromosomes of wheat and rye don't conjugate due to genetic remoteness and as a result, the exchange of genetic material between chromosomes through crossing-over is almost absent, so value of genetic diversity which is valuable for breeding is significantly limited [5]. The research results of triticale grain and its parental forms by electrophoresis showed that the protein of new culture contains proteins of wheat and rye. There are some deviations due to physic-chemical properties that depend on the ploidy level and the interaction protein of two families. In wheat protein dominate alcohol- and acid-soluble fractions (gliadin and glutenin), and in the fractional composition of proteins of rye dominate water- and salt-soluble proteins (albumins and globulins) [6]. Sekalins are reserve proteins of rye. They are divided by the molecular weight on four major groups of polypeptides. Biosynthesis of secalins is encoded by the structural genes of three different locuses (Sec-1 (Gli-R1), Sec-3 (Glu-R1), Sec-5 (Gli-R2)). According to the nutritional value fractions are not equivalent [7].

Genetic variability by allelic composition Gli / Glu and Sec locuses among samples of world triticale collection is formed mainly by alleles of hard wheat and rye, and much less by alleles specific to varieties of baking wheat. Studied samples of world collection, except a few, are heterogeneous by alleles content Gli/Glu and Sec locuses. This encourages the belief, that they will be unstable by the indices of baking quality of flour. [8]

Gliadin and glutenin belong to the class of fibrinous proteins by their technology usage which create extremely important against the quality of bread protein substance, which is called gluten. From its quantity and quality depend physical and technological dough qualities, volume and porosity of bread, pulp condition, appearance, absorption, these figures affect essentially the processes of production and the quality of bakery products, their nutritional value and product assortment [9].

Proteins of rye gluten are not able to form water-insoluble gluten. All kinds of triticale with wheat and rye genome content can synthesize and accumulate gluten, which dissevers during washing with warm water. Determined, that the total number of triticale gluten is appropinquate to the total number of wheat gluten. In separate lines, content of raw and dry gluten is equal or even higher than in wheat grain, but by the physical properties of gluten such as flexibility, strength, ductility, solubility in 2% of acetic acid, triticale knuckles under the strong wheat [10].

In selection on improving the quality of triticale grain should be considered following directions:

a) creation of high-quality forage varieties for dietetic products by selection on quality and high protein content, lysine and other amino acids;

b) creation of bread varieties for pastry by selection on improving technological properties (gluten content, sedimentation index).

At present there isn't enough information to study the hybrid posterity of winter triticale by the complex of biochemical properties, compared to the parental forms, and we have limited information concerning the inheritance properties and genetic control of indices of grain and triticale flour quality, such as: protein and gluten content, sedimentation numbers.

The goal of the study is to compare by biochemical parameters of triticale hybrid posterity with their parental forms and standart, and to carry out the selection of perspective lines for realization of programs of selection on quality.

Materials of the study

As materials of the study were used descendants of 11 hybrid combinations of the second generation of winter triticale, as parental forms were used: Magnat, Sorrento (Ltd. "Danko plant growing") Poland; Avangard, Valentine 90, Conveyor, Soyuz (State Scientific Institution, Krasnodar Scientific Research Institute of Agriculture), Don Kornet (Don Zonal Institute, Scientific Research Institute of Agriculture) Russia, ADM 11, Amur, Izomer, Sharm (Myronivka Institute of Wheat named by V.M. Remeslo of NAASU) Papsuevska (Ltd. Research and Production Agrocorporation "Stepova"), Purpurnyy (SFG "Roden 10") Ayax (PE "Variety"), Interest (Ltd. "Lugansk seeds") Ukraine).

Methods of investigation

Research was carried out from 2009 to 2011 in the department of winter wheat selection and primary seed growing of NSC "Institute of Agriculture of NAAS of Ukraine" (Makariv district, Kyiv region). Soil and climatic conditions respond selection programs requirements on winter triticale for Polissya and Northern Forest-Steppe of Ukraine.

Biochemical parameters (protein, gluten, test Zeleni) were determined by infrared radiation on grain analyzer Infratec 124 and sedimentation on the SDS – 30 device [11].

Results of investigation. The protein content in the grain of hybrid populations of the second generation and their parental forms ranged from 13.0 to 17.7%, with an average index of 14.7% (Table). The highest amount of protein was formed in a variety Sorrento of Polish selection.

Protein, gluten content and Green test in hybrid combinations F_2 (2010)

Origin	Content, %			Mass of 1000 grains, gr
	Protein	Gluten	Green test	gr
	F2-2010p	F2-2010p	F2-2010p	F2-2010p
Kornet ♀	14,0	23,7	45,0	44,0
Kornet / Purpurnyy	16,6	26,9	56,6	41,0
Purpurnyy ♂	15,5	25,2	51,5	41,6
Valentine 90 ♀	16,5	27,1	60,0	37,9
Valentine 90 / Kornet	13,5	22,2	42,0	47,0
Kornet ♂	14,0	23,7	45,0	44,0
ADM 11♀	15,3	27,3	54,3	47,7
ADM 11 / Conveyer	14,9	24,2	47,6	37,0
Conveyer ♂	14,7	28,2	56,0	30,9
Sharm ♀	13,0	27,2	58,6	59,0
Sharm / Soyuz	13,6	22,4	38,6	43,0
Soyuz ♂	13,5	28,3	54,0	51,4
Valentine 90 ♀	16,5	27,1	60,0	37,9
Valentine 90 / Don	15,0	24,8	47,4	60,6
Don ♂	14,3	27,5	41,5	58,8
Conveyer ♀	14,7	28,2	56,0	30,9
Conveyer / Sorrento	14,6	24,2	43,7	52,0
Sorrento ♂	17,7	29,1	68,6	34,0
ADM 11 ♀	15,3	27,3	54,3	47,7
ADM 11 / Sharm	13,2	21,6	37,6	55,0
Sharm ♂	13,0	27,2	58,6	59,0
Amur ♀	13,9	23,7	38,0	48,0
Amur / Avangard	13,5	21,8	37,5	50,0
Avangard ♂	14,5	24,5	43,5	37,5
ADM 11♀	15,3	27,3	54,3	47,7
ADM / Soyuz	14,1	23,2	42,0	45,0
Soyuz ♂	13,5	28,3	54,0	51,4
Avangard ♀	14,5	24,5	43,5	37,5
Avangard / Purpurnyy	13,4	21,9	39,7	42,0
Purpurnuy ♂	15,5	25,2	51,5	41,6
Popsuevska ♀	16,2	26,9	59,5	54,3
Popsuevska / Don	14,9	24,7	48,8	43,0
Don ♂	14,3	27,5	41,5	58,8
Average	14,7	25,7	50,5	46,8
V,%	7,9	8,1	14,1	17,6
HIP_{05}	0,6	1,1	3,9	4,5

Were observed hybrid combinations with protein content that predominates both parents, had less content, and were on the same level with them. Also were observed combinations, which content of protein occupied an intermediate position between the parental forms or were on level with one of the parents, and smaller or larger comparing with another one.

According to the regularities between the mass of 1000 grains and protein content, there is a clear expressed inverse dependence. Therefore, comparing the posterities of hybrid combinations with parental forms on the protein content, it is necessary to consider the mass of 1000 grains.

Combination Cornet / Purpurnyy with 16.6% of protein content significantly (HIP_{05} = 0,6) exceeded parental forms: Cornet variety contains 14.0% of protein and Purpurnyy variety – 15.5%. As the mass of 1000 grains in this combination was on the level of the parental forms, we can conclude that the difference in protein content between the hybrid combinations and its parents was formed under the influence of genotype.

Posterities of hybrid populations (ADM 11 / Sharm, Conveyor / Sorrento, Valentine 90 / Cornet, Amur / Avangard) had a protein content at the level of one parental form (HIP_{05} = 0.6) and showed a lower rate compared to another. Avangard, ADM11, Sorrento, Valentine 90 – had 1000 grains mass significantly (HIP_{05} = 4,5) lower compared to their posterities, so they accumulated more protein.

The protein content of hybrid combination Charm / Souz prevailed over variety Charm and accumulated less protein content compared to Souz variety. Charm variety had high mass of 1000 grains and formed smaller amount of protein. A third part of hybrids by the number of protein occupied an intermediate position in comparison to the parental forms. Weight of 1000 grains significantly predominated in variety Soyuz compared with the combination of ADM 11 / Soyuz and Don variety compared with the combination Popsuevska / Don and Valentine 90 / Don, which promoted lower rate of protein in them relatively their posterities. Variety Valentine 90 formed smaller mass of 1000 grains concerning the hybrid population Valentine 90 × Don and therefore, had higher protein content.

Posterities of hybrid second-generation populations ADM 11 / Conveyer had protein content (14.9%) at the level of the parents ADM 11 (15.3%) and Conveyer (14.7%). But the mass of 1000 grains in Conveyer variety was significantly lower, which should promoted increase of protein content relatively to hybrid combination.

Gluten is a protein mass that can absorb, swell and increase in volume, convert into elastic formation, which can stretch like rubber. The quantity and quality of gluten dependent on physical and technological qualities of flour, bread size and its porosity, state of pulp, appearance and digestibility, these indices essentially effect the technological processes of production and the quality of the bakery products.

Amount of gluten in the hybrids of second generation and their parental forms ranged from 21.6 to 28.3% with an average of 25.7%. The variation of this indicator was 8.1%.

In F_2 after hybridization of Conveyer / Sorrento, indicator of protein content is 14.6% with 24.2% of gluten index and its parental forms: variety Conveyer compared with the hybrid combination had protein content at the level and accumulated higher

gluten content 28.2%, variety Sorrento formed higher protein content (17.7%) and gluten (29.1%) at the level of Conveyer variety. Our studies confirm the data of researchers [8] that the increased protein content in grain does not mean high quantity and quality of gluten.

During engaging in crossbreeding varieties with low or average quality of grain (Charm, Cornet, Avangard, Conveyer, Soyuz, Amur, Don) in the second generation there is high reliability of receiving forms with poor quality indices. Thus, indicator of protein content in F_2 from crossbreeding Charm / Soyuz, Amur / Avangard, Valentine / Cornet, Conveyer / Sorrento, ADM 11 / Charm and gluten content in F_2 hybrids from crossbreeding Charm / Soyuz, Amur / Avangard, Valentine / Cornet, Conveyer / Sorrento, ADM 11 / Sharm gradually deteriorate and are getting close to the worst of the parental forms.

By the number of gluten was identified hybrid population Cornet / Purpurnyy, which significantly (HIP_{05}=1,1) dominated over both parental forms: variety Cornet with gluten content 23.7%, and variety Purpurnyi – 25.2%. (Table)

One of the most reliable and available indices in evaluating the quality of grain on baking value of flour is determination of SDS index of sedimentation, which is a complex indicator of the grain quality.

The denotation of sedimentation (interpretation of results):

– less than 20 ml – poor quality;
– 20-34 ml – satisfactory quality;
– 35-50 ml – good quality;
– > 50 ml – very good quality [11].

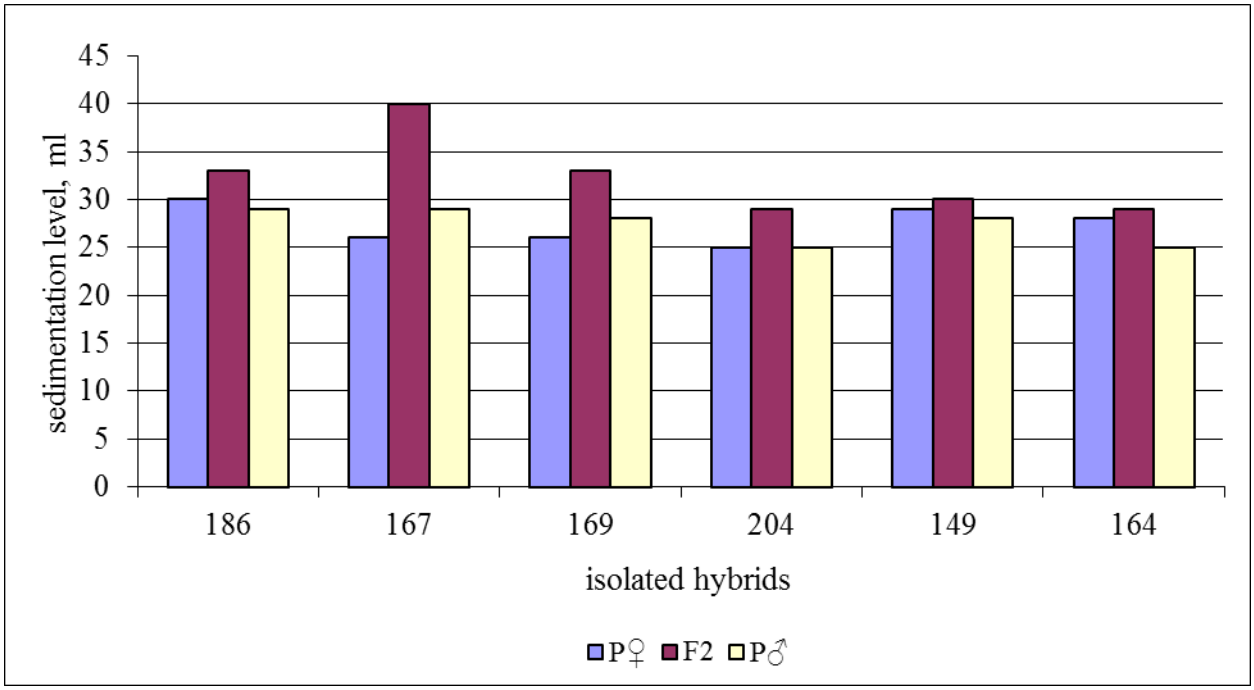
Test Zeleni and SDS-sedimentation revealed variations from 34.9 to 66.1 ml and from 25 to 40 ml, accordingly. Indicators of SDS-sedimentation and test Zeleni in F2 hybrids compared to parents are given in Table.

By the indicator of SDS-sedimentation were identified second-generation hybrid populations (ADM 11 / Charm, ADM 11 / Soyuz, Valentine 90 / Cornet, Interes / Sorrento) which significantly dominated over two parental forms, and the combination of crossbreeding of Charm / Soyuz was on the level with parents. The best was a combination of crossbreeding of ADM 11 / Sharm (Pic.).

In the second generation, with a low content of gluten in combinations from crossbreeding of Charm / Souz (22.4%), ADM 11 / Charm (21.6%), Amur / Avangard (21.8%) was observed low test Zeleni of Charm / Souz (38.6%), ADM 11 / Charm (37.6%), Amur / Avangard (37.5%) and after increase of gluten (Cornet / Purpurnyy (26.9%), Popsuevska / Don (24.7%), ADM 11 / Conveyer (24.2%) test Zeleni (Cornet / Purpurnyy (56.6%), Popsuyevska / Don (48.8%), ADM 11 / Conveyer (47.6%) was observed accordingly. In our studies there is a tendency of positive interaction between sedimentation index and test Zeleni with gluten content.

Conclusions. Comparing hybrid posterity of winter triticale of second generation with parental forms by the biochemical parameters, in general there was a tendency of decreasing indicators of quality engaging in crossbreeding varietal samples with low or average quality. Posterity of 70% hybrid combinations by protein content are getting close to the worst of the parental forms. Three combinations: ADM11/Conveyer, Valentine / Kornet, Kornet / Purpurnyy, which

significantly exceeded the parental forms by complex of parameters such as protein content, gluten, sedimentation level and test Zeleni.



Pic. The level of sedimentation of hybrid populations compared to the parental forms and standard

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Фоменко Л.А.

Сравнение по биохимическим показателям гибридных потомков тритикале озимого второго поколения с родительской формой

Целью исследований было сравнить по биохимическим показателям гибридные потомки 11 комбинаций второго поколения тритикале озимого и их родительских форм. Исследования проводились с 2009 по 2011 год в ННЦ «Институт земледелия НААНУ». Биохимические показатели определяли методом инфракрасного облучения на анализаторе Infratec 124. При вовлечение в схрещивание сортообразцов с низким или средним качеством зерна (Шарм, Корнет, Авангард, Конвейер, Союз, Амур, Дон) во втором поколении получают формы с показателями низкого качества. Показатель содержания белка в F2 от схрещивания Шарм / Союз, Амур / Авангард, Валентин / Корнет, Конвейер / Сорренто, АДМ 11 / Шарм и содержание клейковины у гибридов F2 от схрещивания Шарм / Союз, Амур / Авангард, Валентин / Корнет, Конвейер / Сорренто, АДМ 11 / Шарм ухудшается и приближается к худшей из родительских форм. Наши исследование подтверждают данные исследователей о том, что повышенное содержание белка в зерне не приводит к высокому количеству и качеству клейковины. В F2 от схрещивания Конвеэр / Сорренто показатель содержания белка составлял 14,6% при показателе клейковины 24,2%, а его материнская форма сорт Конвейер имела содержание белка на уровне и накопила выше содержание клейковины 28,2%,отцовская форма сорт Сорренто сформировал выше содержание белка (17,7%), а клейковины (29,1%) на уровне с сортом Конвейер. Тест Зелени и SDS-седиментация обнаружено колебание от 34,9 до 66,1 мл и от 25 до 40 мл соответственно. В наших исследованиях наблюдается тенденция снижения показателей качества при вовлечении в скрещивания сортообразцов с низким или средним качеством. Во втором поколении гибридов выделили комбинации (АДМ 11 / Конвейер, Валентин / Корнет, Корнет / Пурпурный), которые существенно превысили родительские формы по комплексу таких признаков как содержание белка, клейковины, уровень седиментации.

***Ключевые слова**: тритикале, биохимическиепоказатели, белок, клейковина, тестЗеленые, седиментация.*

Fomenko L.A.

A comparison of the biochemical parameters of winter triticale hybrid offsprins of the second generation with the parent form

The purpose of the research is to compare in the biochemical parameters of 11 combinations of second generation of winter triticale and their parental forms. The research was carried from 2009 to 2011 in the NSC "Institute of Agriculture of NAAS", department of winter wheat selection and primary seed. Biochemical parameters was determined by infrared irradiation on grain analyzer Infratec 124. With engaging in crossbreeding of variety samples with low or average quality of grain (Sharm, Kornet, Avangard, Conveyer, Soyuz, Amur, Don) there is a great possibility of acquiring forms with low quality grain. Thus, indicator of protein content of F2 from crossing Sharm / Soyuz, Amur / Avangard, Valentyn 90/ Kornet, Conveyer / Sorrento, ADM 11 / Sharm and gluten content in hybrids F2 from crossing Sharm / Souz, Amur / Avangard, Valentyn 90 / Kornet, Conveyer / Sorrento, ADM 11 / Sharm is getting gradually worse and approaching to the worse from the parental forms. Our research confirms literature data that increased protein content doesn't mean high quantity and quality of gluten. For example hybrid F2 from crossing Conveyer × Sorrento, indicator of protein content was 14,6% with gluten content - 24,2%, and its parental form — variety Conveyer in comparing with crossing combination had appropriate level of protein content and higher level of gluten — 28,2%, Sorrento variety has formed higher protein content (17,7%), and gluten (29,1%) at the level of Conveyer variety. During the Zeleny test and identification of SDS-Sedimentation was detected variation from 34,9 to 66,1 ml and from 25 to 40 ml. In general there is the tendency of decreasing quality indicators with engaging in crossing process varieties with low or average quality. In the second generation of hybrids were identified next combinations: ADM11 / Conveyer, Valentine 90/ Kornet, Kornet / Purple, which significantly exceeded the parental forms for complex parameters such as protein content, gluten and sedimentation levels.

***Key words**: triticale, biochemical indices, protein, gluten, test Zeleni, sedimentation.*