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New Promising Varieties of Cultures Bred by Omsk Agrarian Scientific Center

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***Abstract*— Harsh conditions of sharply continental climate of Western Siberia are often the cause of a sharp decrease in yield in the context of the negative development of abiotic factors (instable temperature conditions, soil moisture). A variety is an inexhaustible and renewable reserve for increasing both productive and quality parameters of grain crops (along with widely known and used, such as cultivation technologies). The subject of research includes new promising varieties of spring durum wheat, oats, barley and soybeans bred by Omsk Agrarian Scientific Center. The research was conducted from 2013 to 2018, at the experimental fields of Omsk Agrarian Scientific Center (area of the southern forest-steppe of Western Siberia). Obtained results allow us to recommend the following varieties for cultivation in this area: Omsk Emerald and Omsk Coral for durum wheat; Omsk 101 and Omsk hulless 4 for barley; Siberian Hercules and Tarskiy hulless for oats; Cheremshanka for soybeans. These varieties are characterized by increased productivity and grain quality.**

Keywords—durum wheat, barley, oats, soy, grain quality, yield.

I. INTRODUCTION

One of the most relevant issues of discussion of the present day is the problem of observed and forecasted climate changes that influence both world social processes [1, 2] and agronomy [3]. Climatic metamorphoses over the past decade led to changes in phytocenoses which resulted in the negative productivity of grain crops [4]. In this connection, the problem of developing and using varieties with increased adaptive qualities in agricultural production is of special significance [5].

Harsh conditions of the sharply continental climate of Western Siberia are often the reason for a sharp decrease in productivity in the context of the negative development of abiotic factors. A variety is an inexhaustible and renewable reserve for increasing both productive and quality parameters of grain crops; it now can be called a fundamental condition for increasing yields and its role will increase in future [6]. Therefore, varieties should combine adaptability to limiting environmental factors [7] with responsiveness to improved cultivation conditions

In the Omsk region of Western Siberia, scientifically based selection work started in 1918 with the organization of the West Siberian plant breeding station. To date, the result of 100 years of breeding research is the development and inclusion in the State Register of breeding achievements of the Russian Federation and the Republic of Kazakhstan of more than 200 varieties of different grain, grain-fodder and fodder crops. Currently, in the State Register of Breeding Achievements, more than 100 varieties of agricultural plants bred by "Omsk Agrarian Scientific Center" Federal State Budgetary Scientific Institution are registered, including 5 varieties of spring durum wheat, 11 varieties of barley, 12 varieties of oats, and 8 varieties of soybean [8].

The purpose of this publication is to characterize new promising varieties of spring durum wheat, barley, oats and soybean bred by "Omsk Agrarian Scientific Center" Federal State Budgetary Scientific Institution according to the main parameters of productivity and grain quality.

II. LITERATURE REVIEW

Barley. Spring barley is the second most important and widespread (after wheat) grain crop in Russia. Barley grain is widely used for fodder (over 75%), food (15%) and brewing (8%) purposes [9]. Yield of a variety is the most important parameter in assessing not only the efficiency of variety cultivation, but also of adaptability parameters [10, 11] which allow assessing the responsiveness of a variety to improving cultivation conditions. Attention is currently given to protein content as one of the main parameters of grain quality [12] because, compared to other crops; it is barley that has an undeniable advantage in balanced amino acid composition of protein.

Assessment of barley on the basis of the presence or absence of lemma (hull) is certainly relevant [13] from the point of view of introducing hulless varieties into production; at the moment, it is insignificant but at the same time it is a promising trend in the food industry and animal husbandry for obtaining quality products [14]. At present, original hulless varieties were obtained with the positive characteristic of higher protein nutrition and, as a consequence, increased energy value [15, 16]. Using grains of hulless varieties in food industry allows doing without the laborious technology of hull elimination and increases the yield of cereals from 15 to 20%. In the Russian Federation, planting of this crop is insignificant due to the small number of hulless varieties which could form the yield at the level of the best hulled varieties in combination with resistance to drought, lodging and diseases, as well as high grain quality [17]. In 2018, the State Register of Selection Achievements Accepted for Use in Western Siberia includes 33 varieties of barley, 11 of which were bred by "Omsk Agrarian Scientific Center" Federal State Budgetary Scientific

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Institution, including 2 varieties of hulless barley (Omsk hulless 1 and Omsk hulless 2). New promising Omsk hulless 4 and Omsk 101 varieties are currently undergoing State Variety Testing.

Oats. Oats are considered to be one of the main grains and forage crops in the conditions of Western Siberia; it is widely used in food production not only due to irreplaceable forage and nutritional qualities, but also due to the stable yield in the difficult climatic conditions of Siberia – unlike other grain-forage crops. Among oats varieties planted in the Omsk Region, the share of varieties bred by "Omsk Agrarian Scientific Center" Federal State Budgetary Scientific Institution ("Siberian Scientific Research Institute of Agriculture" Federal State Budgetary Scientific Institution) is about 95%.

Difficult current soil and climatic conditions necessitate increasing yield and grain quality, as well as the stability of these effects. To solve this problem, a comprehensive assessment of the breeding material by adaptability parameters is required that allows finding promising varieties [18]. Hulless oats are becoming increasingly important for production and processing industry due to the high concentration of protein substances in its grain.

Soybean. One of the ways to solve the problem of producing high-protein grain both for food purposes [19] and balanced fodder for livestock breeding can be expanding the planting of a high-quality leguminous crop, i.e. soybean [20]. Currently, the main seeds of soybeans are located in the Far Eastern region (86%) and the Southern Federal District (13%). Sharply continental climatic conditions of Western Siberia cause special requirements for cultivated varieties due to the direct connection between climatic conditions during growing season and yield. In particular, the conditions of the Omsk Region are suitable for early-ripening, cold-tolerant, high-yield and high-quality soybean varieties. Soybean is rightfully considered the most important leguminous crop all over the world due to the high content of proteins, oil, and important elements [21]. Soybean oil is considered to be the most valuable vegetable oil, as it is has increased biological activity and digestibility. Currently, soybean selection for increased protein content is of the same importance [22]. However, taking into account the inverse relationship between the yield and quality of soybean grain, and also between quality parameters (protein content and oil content) [23], selection of productive and at the same time high-quality varieties is a very difficult task.

Durum wheat. Durum wheat is currently considered an indispensable raw material in food industry. Couscous and bulgur which are prepared from the grain of this culture are especially popular. Despite the fact that these cereals belong to the middle and expensive segments, they are gaining an increasing share in the Russian market gradually replacing pasta of a relatively low price category. However, pasta remains the most popular and affordable food product of different segments of population due to its numerous positive properties: easy transportation, long-term storage (more than a year) without deterioration of appearance and loss of taste and nutritional qualities, various ways and ease of cooking, high nutritional value (13% protein and 70-75% starch) and digestibility (1% fat) [24, 25].

Protein content in durum wheat grain is a fundamental component of quality that determines the milling properties of grain and the nutritional value of final products. Maximal permissible level of protein concentration in grain is considered to be 12.0%; with a decrease in this parameter there are problems with grain milling and middling extraction. The main factor that determines cooking and culinary properties of pasta is the quality of gluten that is functionally associated with the low molecular weight component of gluten in of the second type (LMG2) [26, 27]. As a rule, the content of protein and gluten in grain is more dependent on environmental conditions, while the quality of gluten is characterized by a high proportion of genotype in the total phenotypic variability [28]. Parameters with the same importance for the quality of durum wheat are the parameters of grain hardness along with the natural mass; they determine the class of durum wheat and the milling properties of grain. This feature strongly depends on environmental conditions during the filling and ripening of grain. In years with high humidity when ripening grain and harvesting, there is a significant decrease in hardness.

III. METHODS

For breeding study of the material, the method of State Variety Testing was used [29]. Research on promising new varieties in the field was carried out from 2013 to 2018 in the experimental fields of the Omsk Agrarian Scientific Center (area of the southern forest-steppe of Western Siberia). Main parameters of grain quality were defined using modern and traditional methods and technologies [30].

A phytopathological assessment of the collection and breeding material of durum spring wheat to local populations of leaf and smut diseases was carried out with the creating of artificial infectious background in the field. Criteria for evaluating the resistance of varieties to rust types are the type of damage and the degree of leaf blade damage as a percentage according to CIMMYT method [31]. The type of reaction of the plant to the introduction of pathogen was defined with powdery mildew in points. To enhance the provocative background for this disease, the affected leaves of winter wheat were laid out in spring sowing without creating a wet chamber. For smut, the number of sick spikes or heads was expressed as a percentage of the total number of stems of analyzed sample. Contamination of wheat seeds with stinking smut was carried out by spraying spores before sowing according to Borggardt - Anpilogov method [32, 33].

Statistical data processing was carried out in Excel for PC [34]. Ecological plasticity parameters were determined by Eberhart and Russell method [35] using specially developed programs in Excel.

Years of research (2013-2018) were characterized by contrasting conditions what is typical for the sharply continental conditions of the Omsk Region. Vegetation period of 2014 was registered as dry (HTI = 0.92), of 2015 – as dry and cold (HTI = 0.70), of 2013 and 2018 – as sufficiently moistened (HTI = 0.99). In the third ten-day period of July and the beginning of August, a grain is formed at the spike of the plant; therefore, climatic parameters of these periods have a direct effect on yield. Specified time interval was characterized by heavy precipitation in July during the entire period of our studies, as well as in August 2013 – 2015, 2018. (29.3-84.0 mm, i.e. 2-4 times higher than long-term annual average values) (Fig. 1). Rainfall shortage was observed in 2016 and 2017 (by 0.4 and 2.7 mm lower than long-term annual average values what amounted to 97.8 and 84.0%). In

this context, a lack of heat was observed in July 2013-2015 and 2018. (1.0-3.0°C below normal temperature), as well as August 2015 (0.5°C below the norm).

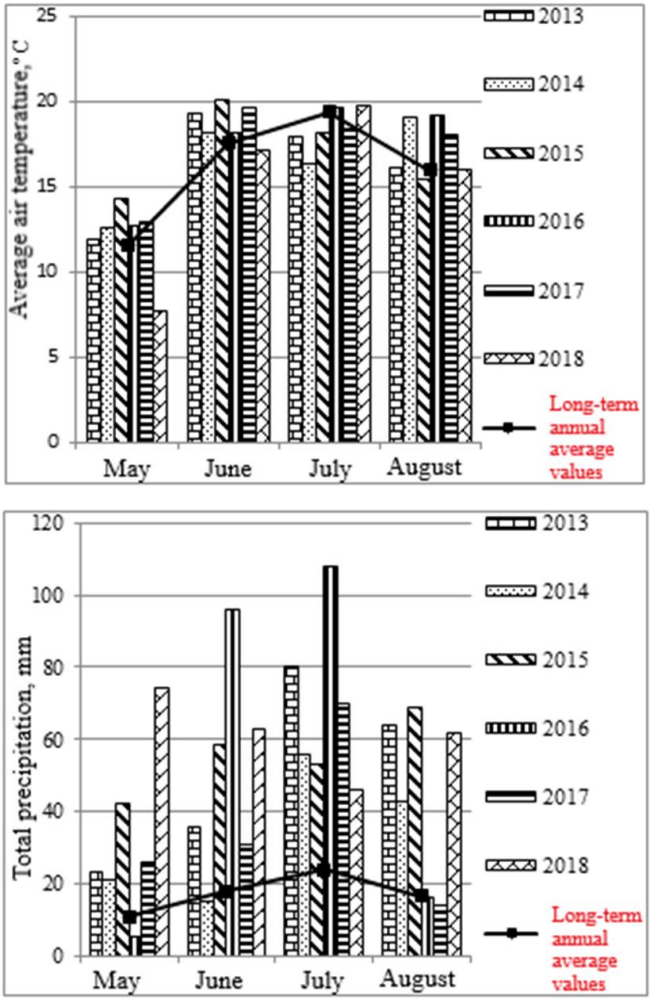

Fig. 1. Description of the climatic conditions of vegetation periods from 2013 to 2018, Omsk HMS

Subject of research:

Durum wheat – Omsk Emerald variety of spring durum wheat (registered in the State Register of Selection Achievements of the Russian Federation in 2014, patent No. 6952 as of July 17, 2013. Since 2016, the variety has been included in the State Register of the Republic of Kazakhstan and is recommended for cultivation in the North Kazakhstan Region. Patent of the Republic of Kazakhstan No. 838, 06 June, 2018.)

Omsk Coral variety (submitted to State Variety Testing in 2018). Pearl of Siberia variety was used as a standard. This variety is included in the State Register of the Russian Federation for 9, 10 and 11 regions. Patent No. 3087 was registered in the State Register of the Russian Federation on April 10, 2006. Since 2009, the variety has been zoned in the North Kazakhstan region of the Republic of Kazakhstan, patent of the Republic of Kazakhstan No. 763, 15May, 2017.

Barley – Omsk 101 two-row hulled variety of spring barley, submitted to State Variety Testing in 2018. Omsk 95 was taken as a standard (patent No. 3102 as of 26 April, 2006).

The characteristics of Omsk hulless 4 multi-row hulless variety of barley submitted to State Variety Testing in 2017 are also presented. Omsk hulless 2 variety was taken as a standard for these studies (patent No. 4075, registered on May 29, 2008).

Oats – Siberian Hercules hulled variety (patent No. 9503 as of February 12, 2018). The standard for this research was Orion variety (patent No. 0327 as of 22 April, 1999).

Tarskiy hulless variety of hulless group (patent No. 10618 as of 20 May, 2019). The standard was Siberian hulless variety (patent No. 42285 as of 2008).

Soybean – Cheremshanka variety (patent No. 9651 as of 05 June, 2018).

IV. Results

A. Durum wheat

Omsk Coral variety. It is a mid-season variety with average vegetation period of 94 days (from 80 to 96 days). The variety with a high stable yield, resistant to drought and lodging, is characterized by large grain (1,000 grains weight 44.0 g). Average grain-unit during research period was 786 g/L, hardness – 65%, protein content – 14.3%, color score of pasta – 3.5 points. The comparative characteristics of the varieties (Table 1) showed that new promising Omsk Coral variety exceeded standard Pearl of Siberia variety in yield (+1.08 t/ha) and weight of 1000 grains (+ 6.4 g). This variety is normally resistant to brown and stem rust of the local population and UG 99 in Kenya, and is less affected by stinking smut and powdery mildew.

Omsk Emerald variety. Growing season depending on growing conditions can vary from 81 to 99 days (average of 92 days). The variety is highly resistant to lodging, drought (4.8 points in the field), normally resistant to brown rust and stinking smut. Average yield is 3.13 t/ha. Weight of 1,000 grains in this new variety averaged 37.7 g. Color of dried pasta corresponds to the standards (average score is 3.2 points).

TABLE I. Comparative characteristics of spring durum wheat varieties, on average for 2013-2018

Parameter	Pearl of Siberia	Omsk Emerald	Omsk Coral
Growing period, days	89	92	94
Yield at fallow, t/ha	2.93	3.13	4.01
Weight of 1,000 grains, g	38.7	37.7	44.1
Grain-unit, g/L	768	786	786
Hardness, %	65	67	65
Protein content, %	15.4	14.2	14.3
Gluten content, %	28.5	29	28.4
Color of dry pasts, score	3.3	3.2	3.5
Lodging resistance, score	4.8	5.0	4.9
Damage by brown rust, natural background,%	10	10	0
Damage by stem rust, natural background, %, min/max	30/70	20/50	0/5
Damage by stem rust *UG99*, natural background (Kenya)	40SS	15MS	5-10R
Damage by stinking smut, infectious background, %	8.2	6.1	5.7
Damage by loose smut, natural background, %	0	0	0
Damage by powdery mildew, score	5	6	6

B. Barley

Omsk 101 variety of medicum type belongs to the forest-steppe ecological group. Positive characteristics of this

variety: mid-season ripening, resistance to drought and lodging. Distinctive features: average height; half-upright stem of medium thickness and strength; brown color of stem nodes; average leaf width; lack of pubescence on the sheaths of lower leaves; the presence of wax plaque; two-row hulled awned spike of cylindrical shape, of medium length, loose; gradual transition of lemma to awn; poorly expressed nervation; awns are long, smooth, parallel to the spike, of medium roughness; possible anthocyanin coloration of tips and serration, hairy seta; the grain is yellow, hulled, semi-elongated, large.

Yield is a fundamental agronomic parameter that determines the effectiveness in any research. This is an integral feature that depends on numerous components (biotic and abiotic factors, conditions of agriculture intensifying, special characteristics of cultivated variety). According to the data presented in Table 2, yield variability of studied varieties during cultivation in different areas was significant (CV> 20%).

Omsk 101 variety refers by yield to the high-yielding varieties in the conditions of Western Siberia. On average during the research period, this variety significantly exceeded the standard by 0.38 t/ha when sown in steppe zone, and by 0.55 t/ha as the fourth crop after fallow in southern forest-steppe zone (r = 0.965). We may also assume an increased potential yield in steppe zone and in winter in the southern forest-steppe (r = 0.970), however, in our experience, the increase to the standard in these zones is insignificant and lies within margin of error. Accordingly, it can be assumed that in order to increase the yield of this variety, the improvement of cultivation conditions (intensification) is required; this is confirmed by further calculations. Analysis of barley grain quality reveals that new Omsk 101 barley variety, on average over the study period, was characterized by protein content of 14.05% what significantly exceeds that of standard Omsk 95 variety (+0.96%). There was also an increased starchiness of the grain of new variety – 58.52% (+1.33% to the standard). Crude fat content was 2.11%, i.e. at the standard level. New Omsk 101 variety is characterized by increased grain size, with the weight of 1,000 grains of 48.52 g (+5.35 g to the standard).

TABLE II. YIELD OF OMSK 101 BARLEY VARIETY, ON AVERAGE FOR 2013-2018, T/HA

Variety	Southern forest-steppe						Steppe		CV, %
	Fourth culture after fallow		*Fall sowing*		*Fallow sowing*				
	$\bar{x}$	*Lim.*	$\bar{x}$	*Lim.*	$\bar{x}$	*Lim.*	$\bar{x}$	*Lim.*	
Omsk 95, st.	4.23	2.24 - 5.80	6.03	4.68 - 7.39	6.94	6,57 - 7,32	3,50	1,93 - 4,20	30,6
Omsk 101	4.78	3.15 - 6.52	6.05	4.73 - 7.36	7.10	7,11 - 7,09	3,88	2,31 - 4,50	25,9
Average	4.57	2.95 - 6.29	5.94	4.68 - 7.23	6.85	6,65 - 7,05	3,72	2,13 - 4,45	-
HCP_{05}	0.17		0.09		0.18		0.07		-

Underestimating the importance of studies on the ecological plasticity of varieties can be often result in such a negative – from the point of view of breeding practice – phenomenon as the low realization of yield in difficult climatic conditions. Moreover, taking into account strong connection of ecological plasticity of the variety and its productivity (r > 0.7), we may evaluate the responsiveness of this variety to changes (positive or negative) in the cultivation conditions. Improving the environmental sustainability of varieties which means increasing their ability to ensure a high and stable yield regardless of growing conditions is the fundamental task of selection. Specified ability is determined by the response rate of variety genotype to environmental factors. If there is no genetic reaction of the variety to soil and climatic conditions (low environmental sustainability), this variety is characterized as resistant to different biotic and abiotic stresses. Variety assessment by plasticity is carried out by many years of research in contrasting environmental conditions. According to S.A. Eberhart and W.A. Russell, variety with high plasticity (bi> 1) is characterized as responsive [35]. The opposite reaction is observed at bi <1. The full correspondence of yield to fluctuation of climatic factors is observed at bi = 1.00 ± 0.06.

Our studies performed using this method suggest that the studied Omsk 101 variety showed a positive response to improved growing conditions (bi = 1.1). Stability of the reaction of varieties (σ^2_d) characterizes their variability level. Low σ^2_d values mean minimal difference between theoretical and practical yield parameters, i.e. higher stability of this attribute. According to our research, Omsk 101 variety in terms of stability (σ^2_d = 0.10) significantly exceeded the standard (σ^2_d = 2.80).

Omsk hulless 4 variety (a type of celeste) belongs to the forest-steppe ecological group. Positive characteristics of this variety: mid-season ripening, resistance to drought and lodging. During threshing of spikes, 20% of grain is allowed which can remain in hull that is not fused with the grain. Distinctive features: mid-height of plants (69-87 cm) and strong straw; spike is six-rowed, awned, cylindrical, of medium length, straw yellow, loose; awns are long, jagged, rough, glossy, parallel to spike; in particular years with anthocyanin color which disappears upon maturation; narrow short-haired seta; gradual transition of lemma to awn; lemma do not grow fuse with the seed; the grain is light yellow, bare, semicircular, medium-sized.

Protein content, as one of the main parameters of grain quality, is currently under great attention. Analysis of grain quality shows that the new variety, on average over the research period, contained 13.6% protein (Lim. = 12.4-15.1%) what is at the level of the standard Omsk hulless 2 variety (13.8%) In the sense of the energy value of grain, that is, first of all, fat content, Omsk hulless 4 had a significant advantage (+0.4% to the standard). Increased starchiness of the grain of a new variety (+0.5% to the standard) was also observed which indicates the nutritional and feed qualities of barley. Average weight of 1,000 grains was 41.7 g (+1.4 g to the standard).

Omsk hulless 4 variety refers by yield to the high-yield varieties in the conditions of Western Siberia. On average during the research period, this variety had a significant excess in yield over the standard variety both in steppe area (+0.3 t/ha) and in southern forest-steppe area when sown as the fourth crop after fallow and in fall (+0.2 and +0.5 t/ha,

respectively); maximal increase was observed for a fallow (+1.2 t/ha), Tab. 3.

Analysis of regression coefficient (bi) allows us to state that, when growing conditions are improved, Omsk hulless 2 and Omsk hulless 4 varieties tend to increased yield (intensive type at bi > 1). These varieties were also characterized by high stability ($\sigma^2_d = 0.00 \div 0.16$).

TABLE III. YIELD OF OMSK HULLESS 4 VARIETY, ON AVERAGE FOR 2013-2018, T/HA

Variety	Southern forest-steppe						Steppe		CV, %
	Fourth culture after fallow		*Fall sowing*		*Fallow sowing*				
	$\bar{x}$	*Lim.*	$\bar{x}$	*Lim.*	$\bar{x}$	*Lim.*	$\bar{x}$	*Lim.*	
Omsk hulless 2, st.	3,1	1,8-4,0	3,2	2,7-3,7	4,2	2,9-5,5	2,8	2,6-3,0	18,3
Omsk hulless 4	3,3	2,2-4,4	3,7	3,5-3,8	5,4	4,0-6,9	3,1	2,9-3,2	27,0
Average by varieties	3,2	2,0-4,2	3,5	3,1-3,8	4,5	3,5-6,2	3,0	2,8-3,1	-
HCP_{05}	0,17		0,09		0,18		0,07		-

C. Oats

Siberian Hercules variety (a type of inermis). It is a mid-season variety, resistant to lodging and drought, valuable for its quality. Distinctive features: half-upright bush with medium-sized plants; half-sided head, cernuous spikes; long gluma, strong wax coating; week awnedness; grain of medium size, no hull.

At present, it is difficult to overestimate the importance of high-quality grain for food and livestock industries. Accordingly, the requirements for cultivated varieties are increasing. Biochemical analysis of oat grains showed that the new variety of oats, Siberian Hercules, on average over the research period, contained 11.6% of protein what exceeds this of standard Orion variety by 0.5%.

An important parameter that determines the value of oat grain in biological and nutritional sense is oil content. If the breeding of oats is at a high level, much attention is paid to this parameter. This problem is of great importance in the USA, Norway and some other countries where the task is set to make oats an oilseed crop. Currently, varieties with up to 7% fat are bred. It was established that the genetic control of this trait is different, and the selection of transgressive forms obtained as a result of crossing and subsequent backcrosses makes it possible to increase its content to 14-16%. This idea seems to be attractive because fat is contained in the endosperm of grain and, after its extraction, oats seed cake can be used for the production of cereals, fodder and other purposes. Results of our studies showed that crude fat content in the grain of Siberian Hercules variety was 5.0% (+ 1.1% to the standard). Grain yield of Siberian Hercules variety varied from 3.09 to 5.75 t/ha what exceeded the standard value by an average of 0.8 t/ha.

The variety's value for production is determined not only by high grain quality parameters and yield, but also by their stability. According to our studies, Siberian Hercules was characterized with high responsiveness to improved environmental conditions and high stability of the reaction to environmental changes (at bi > 1, σ^2_d <1) according to the content of protein, starch and crude fat in grain, as well as yield stability (σ^2_d <1).

Tarskiy hulless variety (a type of inermis). It is a mid-season variety, resistant to lodging, with average resistance to drought, valuable for its quality parameters. Distinctive features: half-upright bush; slight pubescence of upper stem node; half-sided head with cernuous spikes; gluma of medium length with very strong wax coating; no or very low awnedness; grains of medium size, no hull.

At present, in processing industry, hulless oats are of particular importance due to such positive qualities as high protein content in grain. Average protein content in the grain of this new variety was 17.2% (Lim. = 15.0 ÷ 19.7%) what exceeds the standard variety by an average of 0.8%. Tarskiy hulless variety is also characterized with increased starchiness of grain (+1.75% to the standard).

Average yield of Tarskiy hulless variety was 2.2 t/ha what is 0.14 t/ha higher than this of standard Siberian hulless variety.

Adaptability assessment showed that the regression coefficient of new Tarskiy hulless variety is close to 1 (bi = 0.99) what indicates that the yield is fully consistent with changes in growing conditions. This variety is also characterized as a stable one (σ^2_d <1).

D. Soybean

Cheremshanka variety. This variety is characterized by an indeterminate type of development; ripening period can vary from very early to early one. Distinctive features: average height of plants 65.3 cm; tan colored pubescence of main stem; compound leaf, its lateral foliole is of pointed ovoid shape; purple flower; seeds of medium size, elongated and flattened, yellow with a yellow hilum.

An important technological feature of soybean is variety's suitability for mechanized harvesting, as indicated by the height of attachment of a lower bean to plant. This place in Cheremshanka variety is located at the level of 12.0 cm.

Average yield of this new variety was 3.76 t/ha what was 1.25 t/ha higher than that of standard variety. Taking into account negative correlation of yield with one of the grain quality parameters (protein content), we can assume a decrease in this parameter for this variety. So, in terms of proteinity, Cheremshanka variety is at the standard level (39.56 %). Furthermore, taking into account negative association of protein and oil content, we observe increased content of crude fat in the grain of this variety (17.33% on average) which exceeds the standard by 0.8 %.

Analysis of the regression coefficients for the main parameters of grain quality and yield showed the following results: in terms of yield and crude fat content in grain, Cheremshanka is an extensive type (bi < 1). In terms of protein content, this variety is characterized by high responsiveness to improved environmental conditions and high stability of the reaction to environmental conditions (at bi > 1, σ^2_d <1).

V. CONCLUSIONS

1) Under existing agroecological conditions of the research period from 2013 to 2018, new promising varieties of barley are recommended for production. Hulled Omsk 101 variety was characterized by maximal yield (+ 0.38 ... +0.55 t/ha to the standard); it belongs to intensive varieties. Omsk hulless 4 variety (+0.2 ÷ 0.5 t/ha to the standard) is high-quality, stable and responsive to improving environmental conditions (bi > 1 and σ_d^2<1).

2) Among oats varieties, Siberian Hercules variety (+0.8 t/ha to the standard) is noteworthy which is characterized by high grain quality and responsiveness to improved environmental conditions with high stability of the reaction to environmental changes (at bi> 1, σ^2_d <1) in the sense of protein, starch and crude fat in grain, as well as yield stability (σ^2_d <1). Tarskiy hulless variety is also noted as productive (+0.14 t/ha to the standard) and stable by this parameter (σ^2_d <1).

3) Cheremshanka soybean variety is of extensive type, highly responsive to improved environmental conditions and stable (at bi> 1, σ^2_d <1), with high oil content (+0.8% to the standard).

4) Omsk Coral and Omsk Emerald durum wheat varieties are characterized by high stable yield, pasta quality and disease resistance that significantly exceed these of the standard variety.

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