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PADALKA O. I., MUZAFAROVA V. A., RYABCHUN V. K., PETUCHOVA I. A., BOGUSLAVSKYI R. L.
Plant Production Institute nd. a VYa Yuriev,
National Centre for Plant Genetic Resources of Ukraine
142, Moskovskyi ave., Kharkiv,61060,Ukraine
E-mail: ncpgru@gmail.com

SPRING DURUM WHEAT TRAIT COLLECTION BY A SET OF VALUABLE ECONOMIC FEATURES – A SOURCE OF STARTING MATERIAL FOR BREEDING

The National Center for Plant Genetic Resources created passport database for spring durum wheat, which contains information on 1,266 accessions of different eco-geographical origin. Based on multiyear studies of spring durum wheat accessions, a trait collection was formed in terms of a set of valuable economic traits. The collection is of practical value for modern breeding, includes 108 accessions originating from 11 countries and is differentiated by expression levels of 10 traits. Forty references reflecting various expression levels of traits were chosen. The trait collection includes accessions that are valuable starting material for breeding: Naschadok (UKR) - large grain weight per spike (1.8-2.5 g) and high resistance to powdery mildew (7-8 points); Spadschyna (UKR) - spike length (6.1-8.0 cm), medium grain weight per spike (1.2-1.7 g) and late ripening (90-92 days); Daryna (UKR) – medium ripening (85-89 days) and medium yield capacity (210-300 g/m^2); Dynastiia (UKR) – early ripening (79-84 days) and medium height (81-110 cm); Slavuta (UKR) – great grain number per spike (31-45) and very high resistance to powdery mildew (9 points). The trait collection is of significant value for scientific and educational programs, and use of collection accessions will enhance the effectiveness of the breeding process on creating high-yielding and adapted to changing cultivation conditions varieties.

Keywords: *spring durum wheat, accession, trait collection, reference, expression llevel, yield, capacity, ripeness*

INTRODUCTION

Wheat is the most important and ancient crop that emerged in South-West Asia [1]. In the VI-V millennia B.C., this crop was grown in Egypt, Syria and Asia Minor. About 3,000 years B.C. ago wheat was sown in Armenia, Turkmenistan, India and China. Wheat was imported to Ukraine in times of the Trypillian culture - III-II millennia B.C. Wheat was successfully grown by Scythians, and later by Slavs, then it was disseminated to Novgorod and Ladoga (as early as in the of Kyivan Rus times). The rest of the world began to grow wheat much later: Latin America – at the beginning of the XVI century; the United States - at the beginning of the XVII century; Australia - late in the XVIII century; Canada - at the beginning of the XIX century [2].

Durum wheat has the best raw material for pasta industry. Durum wheat pasta is among basic foods with high nutritional value and is considered as the most balanced nutrition product for the daily ration by the world's modern sitiology. Durum wheat grain is superior to bread wheat grain in protein, vitamins B and E, essential amino acids, starch and minerals. The nutritional value of durum wheat protein is close to that of dairy protein, which allows extensive use of this crop grain in infant and dietetic food industry [3].

Ukraine has sufficiently favourable conditions for growing spring durum wheat that is why it is becoming an important crop enhancing the food security [4, 5]. Spring durum wheat breeding at

Kharkiv Experimental Station started back in 1911. The first cultivars of this crop, Arnautka Kochina and Hordeiforme 802, were created by morphological characteristic-oriented selection [6].

Starting material that meets the requirements of breeding is a prerequisite for creation of new cultivars. The world's wheat breeding practice proves that the greates advances in breeding were achieved, when eco-geographically distant forms were crossed. The effectiveness of domestic breeders' creation of new competitive cultivars with high performance and top-quality products mainly depends on well-chosen and comprehensively analyzed staring material. This can be achieved owing to the spring durum wheat collection of the National Centre for Plant Genetic Resources of Ukraine (NCPGRU). Currently, 1,266 accessions have been were collected and certificated with the NCPGRU. Based on the rich genetic diversity of spring durum wheat, it was necessary to form a trait collection by economic features, which would include high-yielding accessions with high adaptability to changing cultivation conditions, resistance to different biotic and abiotic factors and with various expression levels of desirable economic features. .

Purpose and Objectives. The purpose of our study was to evaluate the genetic diversity of spring durum wheat accessions, to systematize them and to identify references of valuable economic traits as well as to form a spring durum wheat trait collection by a set of economic traits.

MATERIALS, METHODS AND RESEARCH CONDITIONS

The study material in 2011-2015 was 614 spring durum wheat accessions. During this period, 311 accessions were introduced. Accessions were studied for three years by conventional methods and in compliance with the classifier [7-9].

Collection accessions were estimated for resistance to major diseases on natural background in compliance with "Methods of Breeding and Evaluation of Wheat and Barley Resistance to Diseases in Countries - CMEA Members" [10]. Data were statistically processed by the BA Dospekhov method [11].

Accessions were sown in the special experimental crop rotation fields of the Institute (urban-type settlement Elite, Kharkiv district, Kharkiv region; location 49°59′02N, 36°27′51E, 195 m above sea level). Soil was deep mildly alkaline chernozem; predecessor - pea. Farming techniques were conventional for the Forest-Steppe of Ukraine. Accessions were sown on 2-m^2 plots by the standard method in the optimal for this crop time. Standard 'Spadschyna' was planted between every 20 collection accessions.

The weather conditions of the study years varied by temperature and watering, making it possible to assess the impact of weather conditions on valuable economic characteristics of modern cultivars of spring durum wheat. The weather conditions in 2011 were unfavourable for the crop growth and development. The lack of rain during the "emergence-leaf-tube formation" period negatively affected plant tillering and growth, and high air temperature during grain filling reduced yields. The droughts in the 2nd and 3rd 10-day periods of May (precipitation amount 4.9 - 14.9 mm, temperature 16.8 - 20.1°C) as well as in the 1st 10-day period of June (precipitation amount 0.3 mm, temperature 21.4°C) suppressed plants and prevented forming even dense haulm stand and long multi-flower spikes, which negatively affected grain yields.

The meteorological conditions in 2012 were characterized by high air temperature and droughts of various lengths. In April, the precipitation amount was 1.1 mm at 13.4°C, but the deposit of productive moisture in soil accumulated over the winter was sufficient for even sprouts. Then the weather changed towards sufficient moistening (precipitation amount in May-July was 95.8 mm), which contributed to the normal plant growth and development of plants and made it possible to obtain good grain yields.

High air temperature during the "leaf-tube formation and anthesis" period was a peculiarity of 2013, which adversely affected the plant growth and caryopsis setting. Drastic increase in temperature during maturation led to low grain plumpness, so that yields were lower than the expected ones. The air temperature at the end of April reached high values of 26 - 29°C, and the surface soil was heated to 45°C, which adversely affected the sprout state and growth. Lack of rainfall and strong dry winds were observed in May (average temperature -20.8°C, maximum

temperature – 30.5° C). Hence, tillering, gain in the plant height and spike formation were inhibited. In the 2nd half of June and in July, precipitation fell unevenly, as showers (the monthly amounts were 52.3 and 66.6 mm, respectively). These conditions resulted in a significant reduction in spring durum wheat yields.

The conditions in 2014 were characterized by sufficient and sometimes excessive humidity. In April, the average daily temperature was 10°C, the amount of rainfall was 47 mm. At the end of the month the water content in soil on all crops decreased significantly, but it did not affect even emergence of spring crops. The first half of May was dry. In the last days of the 2nd ten-period of May, rains, mainly showers, were noted. In June, the precipitation was uniform; the monthly amount was 156 mm, therefore, moistening of soil was satisfactory. Such weather conditions were favourable for spring wheat growth and development, which allowed us to identify accessions with potentially high yields. The conditions in 2014 were favourable for spring wheat growth and development with optimal duration of individual phases of the growing season, ensuring the highest yield.

2015 was dry, which adversely affected the plant development. In April, the precipitation amount was higher than the norm by 50.8 mm, and the average daily temperatureswas higher by 0.9°C. Starting with the 3rd 10-day period of May to the 1st 10-day period of June, moistening of soil on all crops decreased significantly; very little precipitation fell (7.8 - 16.4 mm). Enhancement in moistening in the 3rd 10-day period of June was ineffective, rains were uneven (the precipitation amount was 74.5 mm at 22.2°C). The conditions in this year allowed getting medium grain yields.

RESULTS AND DISCUSSION

Today, the NCPGRU collected 1,266 spring durum wheat accessions and described pedigrees and parents of 835 accessions. The collection also comprises accessions that consistently expressed a certain trait on the same level for 3 years. Basing on assessments, we selected 108 spring durum wheat accessions covering 10 traits and 40 expression levels. The collection includes accessions originating from 11 countries; the largest number of accessions (35) is from Ukraine; 26 – from Russia; 15 - from Kazakhstan; 14 - from Canada; 6 – from France; 4 - from Austria; 2 - from Syria, USA, Chile each; and 1 – from Germany and Italy each. The trait collection is represented by 8 varieties: *hordeiforme, candicans, pilosocaerulescens, leucurum,melanopus, muticohordeiforme,leucomelan, obscurum*.

Thirty-three accessions-references were established for 10 traits. They meet basic degrees of expression of spike length, grain number per spike, grain weight per spike, growing season, yield capacity, plant height, lodging resistance, resistance to powdery mildew, 1000-grain weight, and protein content in grain.

Let us consider the main traits, which formed the collection. The growing season length is an important feature, because it determines the time of grain formation and filling. To ensure successful breeding, it is desirable to use accessions covering a wide range of this trait. The growing season of spring durum wheat ranged from 78 to 95 days. We identified 5 expression levels with corresponding references. The ultra-early ripening group includes 1 accession, which is also the reference. It is 08-1081 (UKR), and its growing season lasted 78 days. Twenty-one accessions were early-ripening with duration of the "emergence-maturing" period of 79-84 days. They are Zhizel, Kuchumovka (UKR); Omskiy Izumrud (RUS); Korona (KAZ); LIARETA (CHL) and others. The reference for this grade was Dynastiia (UKR), (Table. 1). The mid-ripening group consists of 35 accessions with the growing season length of 85 - 89 days. These accessions are mainly from Ukraine and Kazakhstan: Kharkivska 15, Metyska (UKR); Altyn-dala, Kustanayskaya 1 (KAZ), the reference of this expression level is Daryna (UKR) with the growing season length of 89 days. The late-ripening group includes 30 accessions: 5 - from France; 7 - from Ukraine; 11 – from Russia; 2 – from the USA, Canada, Syria each; and 1 - from Kazakhstan. In particular, they are Kharkivska 33, Bukuriia (UKR); Saratovskaya Zolotistaya (RUS); Biodur (FRA); Kazakhstanskaya Yantarnaya (KAZ); Korifla (SYR) and others. The reference of this grade was highlighted: Spadschyna (UKR) with the growing season length of 92 days. The ultra-late-ripening group consists of 21 accessions:

Table 1. **Diversity of the spring durum wheat trait collection by traits and their expression levels**

Trait	Group, expression grade	Reference accession (name, national catalogue number, country of origin)
1	2	3
1. Growing season, days	Ultra-early-ripening < 78	UA0201465 08-1081, UKR
	Early-ripening 79-84	Dynastiia, UA0201436, UKR
	Mid-ripening 85-89	Daryna, UA0201005, UKR
	Late-ripening 90-92	Spadschyna, UA0201075, UKR
	Ultra-late-ripening >92	Zolotaya Volna, UA0201037, RUS
2. Plant height, cm	Dwarf < 50	Candura, UA0201508, CAN
	Semi-dwarf 51-80	Korotkostebelnaya 13, UA0200411, RUS
	Mid-high 81-110	Dynastiia, UA0201436, UKR
	High 111-140	Kandikans 12, UA0200083, RUS
3. Yield capacity, g/m^2	Very low < 120	Omrabi 5, UA0200695, SYR
	Low 120-200	Belladur, UA0200961, AUT
	Medium 210-300	Daryna, UA0201005, UKR
	High 310-400	Korona, UA0201456, KAZ
	Very high > 400	Diana, UA0201453, UKR
4. Spike length, cm	Very short < 3.0	Astrodur, UA0200941, DEU
	Short 3.0-4.5	Bukuriia, UA0200923, UKR
	Medium 4.6 – 6.0	Kharkivska 37, UA0200522, UKR
	Long 6.1 – 8.0	Spadschyna, UA0201075, UKR
	Very long > 8	Kostanayskaya 12, UA0201399, KAZ
5. Grain number per spike	Small 16 – 20	Astrodur, UA0200941, DEU
	Medium 21 – 30	Khurly, UA0201431, KAZ
	Large 31 – 45	Slavuta, UA0201201, UKR
6. Grain weight per spike, g	Low 0.7-1.1	Kiyevlyanka, UA0200937, FRA
	Medium 1.2-1.7	Spadschyna, UA0201075, UKR
	High 1.8-2.5	Naschadok, UA0201214, UKR
7. Resistance to powdery mildew, points	Low 4	Zolotko, UA0201229, UKR
	Medium 5-6	Shovkovysta, UA0201029, UKR
	High 7-8	Naschadok, UA0201214, UKR
	Very high 9	Slavuta, UA0201201, UKR
8. Lodging resistance, points	Low 3	Zolotaya Volna, UA0201037, RUS
	Medium 5	Saratovskaya Zolotistaya, UA0200775, RUS
	High 7	Kharkivska 41, UA0201033, UKR
	Very high 9	Kiyevlyanka, UA0200937, FRA
9. 1000-grain weight, g	Low 27-34	Belladur, UA0200961, AUT
	Medium 35-45	Chado, UA0201034, UKR
	High 46-54	Luhanska 7, UA0200464, UKR
10. Protein content in grain, %	Low < 12	Kustanayskaya 28, UA0201435, KAZ
	Medium 12-14.5	Kharkivska 27, UA0201223, UKR
	High 14.6-16	Tera, UA0201451, UKR
	Very high > 16	Novatsiia, UA0201452, UKR

6 - from Canada; 7 - from Russia; 4 - from Austria; and 1 - from Ukraine, France, Italy and Germany each. The duration of the "emergence- maturing" period in this group ranged from 93 to 95 days. They are Sceptre (CAN), Mondur (FRA), Extradur (AUT), Shovkovysta (UKR), NIK (RUS); the standard is Zolotaya Volna (RUS).

Plant height is a major economic characteristic, since high and stable yields are impossible without increased lodging resistance under enhancing intensity of agriculture. The trait collection of spring durum wheat represents four grades of plant height. The dwarf group (shorter than 50 cm) includes reference Candura (CAN). The semi-dwarf group includes 36 accessions, of them 8 – from Canada and Ukraine each; 5 - from France; 4 - from Austria; 3 - from Russia; 2 - from Chile, Syria and the USA each; and 1 - from Italy and Germany each. The plant height in this group was 51 - 80 cm. These are the following accessions of spring durum wheat: AC Navigator (CAN), Liareta (CHL), Norba (ITA), Topdur (AUT), Multidur (FRA), Slavuta (UKR), Bezenchukskaya 205 (RUS). The reference for this expression grade is Korotkostebelnaya 13 (RUS) (71 cm). The next group is 68 mid-high accessions. Their countries of origin are distributed as follows: the largest number of accessions, 26, are from Ukraine; 21 - from Russia; 15 – from Kazakhstan; 5 - from Canada; and 1 - from France. Mid-high accessions were 81 – 110 cm tall. Diana, Chado, Aidarlynka (UKR), Kazakhstanskaya Yantarnaya, Asangali (KAZ); Omskaya Stepnaya (RUS) are among mid-high accessions. The reference of this group (93 cm) is Dynastiya (UKR). The high group contains 3 accessions: Shovkovysta (UKR) - 113 cm, Yelizavetinskaya (RUS) - 113 cm and reference Kandikans 12 (RUS) with the height plantof 120 cm.

Accessions were categorized into 4 groups by lodging resistance. Group 1 consists of 3 accessions with 4-point resistance: Nyk, Zolotaya Volna, Yelizavetinskaya (RUS). The reference of this group is Zolotaya Volna. There are 18 accessions (9 from Ukraine and Russia each) in the group with medium lodging resistance (5.6 points). Saratovskaya Zolotistaya, RUS was selected as the reference of this group. We distinguished 58 accessions with high lodging resistance; of them 21 - from Ukraine; 14 – from Kazakhstan; 12 – from Russia; 6- from Canada; 2 -from France; 2 - from Syria; and 1 - from Italy.

Yield capacity is the main economic feature that defines the entire value of an accession. Spring durum wheat collection accessions are distributed into 5 expression levels from very low to very high yield capacity. Omrabi 5 (SYR) has a very low yield capacity (100 g/m^2) and is the reference (see Table 1). The low yield capacity group includes 27 accessions. The yield capacity in this group according to the classifier is 120-200 g/m^2; the reference is Belladur (AUT). The medium yield capacity group consists of 52 accessions: 16 - from Ukraine; 13 – from Russia; 9 – from Canada; 7 - from Kazakhstan; 2 - from Austria, Chile, France each; and 1 - from the USA. Their yield capacity was within 210 -300 g/m^2. These accessions are Kharkivska 41, Kharkivska 46, Prykrasa (UKR), Hordeiforme 1462-B-1, Voronezhskaya 11 (RUS), Nurly, Altyn-shygys (KAZ), AC Napoleon, Duraking (CAN). The reference of this grade is Daryna (UKR). Twenty seven accessions with high yield capacity were selected: 10 – from Ukraine; 10 - from Russia; and 7 - from Kazakhstan. The yield capacity of accessions in this group was 310 - 400 g/m^2. These accessions are Zhisel, Tera, Kharkivska 23, 08-807 (UKR), Bezenchukskaya Stepnaya, Omskaya Stepnaya (RUS), Bolashak, Raya (KAZ); the reference of this expression level is Korona (KAZ). The very high yield capacity group includes 2 accessions from Ukraine: Novatsiia (402 g/m^2) and reference Diana (453 g/m^2).

The collection accessions were categorized into 3 groups by 1000-grain weight. Thus, group 1 with low 1000-grain weight (27-34 g) comprised 10 accessions: 4 of them - from Ukraine, 2 - from, 1 - from France, Austria, Kazakhstan and Syria each; the reference accession is Belladur - 32,5 g (AUT). The group with medium 1000-grain weight numbers 94 accessions. Most of the accessions of this group (27) originate from Ukraine, 24 - from Russia, 14- from Kazakhstan and Canada each, 5 - from France, 3 - from Austria, 2 - from the USA and Chile each, 1 - from Syria, Italy and Germany each. The medium 1000-grain weight (35-45 g) was typical for the following accessions: Shovkovysta, Izolda (UKR), Hordeiforme 1462-B-1, Altayskiy Yantar (RUS); Asangali (KAZ); Arcola (CAN); G8972-AG2-NG (USA), Rodur (FRA) et al., The standard is like Chado

(UKR) 1000 grain weight of 41.3 g group with high weight of 1000 grains (46-54 g) are four samples from Ukraine, Kharkiv 23 (46.4 g) , Luhanskaya 7 (reference group - 47.0 g), 07-2004 (47.4 g), 08-763 (48.3 g).

The protein content in grain plays a key role in determining the value of wheat. This parameter varies widely on average from 9 to 15%, depending on a wheat cultivar, growing conditions, available nitrogen in soil, etc. The spring durum wheat accessions in the collection were divided into 4 groups by protein content in grain. There are 2 accessions from Kazakhstanwith a low protein content (<12%): Kustanayskaya 28 (11.5%; the reference of this group) and Altyn-Shyhыs (11.5%). The group with a medium protein content in grain (12-14.5%) consists of 32 accessions, of which the majority originates from Russia (13 accessions), 8 – from Kazakhstan, 6 – from Ukraine, and 5 - from Canada. These are the following wheat accessions: Slavuta, Metyska (UKR); Elizavetinskaya, Orenburgskaya 21(RUS); Bolashak, Nurly (KAZ); Commander, AS Pathfinder (CAN) and others; the reference accession of this group is Kharkivska 27 (UKR). A high protein content of 14.6-16.0% was recorded for 39 accessions of the collection; of them 19 accessions are from Ukraine, 9 - from Russia, 4 - from Canada, 3 – from Kazakhstan, and 2 - from Syria. These are such spring durum wheat accessions as Naschadok, Kharkivska 46 (UKR); Saratovskaya Zolotistaya, Atlant 24 (RUS); Korona (KAZ); Sceptre (CAN); Topdur (AUT) and others; the reference of this group is accession Tera (UKR) with protein content of 16.0%. We distinguished 28 accessions with a protein content in grain of >16.0%. They make up group 4 with very high protein content. These accessions were sorted by countries of origin as follows: 5 wheat accessions came from Ukraine, France and Canada each, 3 - from Austria, 2 – from the US and Chile each, 1 - from Germany and Italy each. This group includes such accessions as 08-1081, Dynastia (UKR); Lilyok (RUS); Neodur (FRA); Liareta (CHL); AC Melita (CAN) and others; the reference accession of this group is Novatsiia – 16.6% (UKR).

The collection accessions were divided into 4 groups according to levels of resistance to the powdery mildew pathogen. Thus, 11 accessions showed low resistance to the pathogen of 4 points. They are 4 accessions from Russia, 3 – from Canada, and 2 - from Ukraine and France each. Among them are accessions Kharkivska 33 (UKR), Bezenchukskaya 200 (RUS), AC Avonlea (CAN); the reference is Zolotaya Volna (RUS). The medium resistance group includes 36 accessions; most of them (12) are from Ukraine; 9 -from Russia; 4 - from France and Canada each; 3 - from Kazakhstan; and 1 - from the USA, Syria, Italy and Germany each. The resistance of this group was within 5-6 points. The following accessions were assigned to this level: Kharkivska 15, Luhanska 7 (UKR); Atlant 24, Altayskiy Yantar (RUS); AC Melita (CAN), and others. The reference of this grade is Saratovskaya Zolotistaya (RUS). Fifty-three spring durum wheat accessions of the collection showed high resistance, ie 17 accessions from Ukraine; 11 - from Kazakhstan and Russia each; 7 - from Canada; 3- from Austria; 2- from Chile; and 1 -from the USA and Syria each. Resistance to powdery mildew in accessions of this group was within 7-8 points. These are such accessions as Izolda, Naschadok, 07-2004 (UKR), Pamyati Vavilova, Omskiy Korund (RUS); Commander (CAN), Corcolen (CHL), the reference accession is Kharkivska 41 (UKR). The group with very high resistance to powdery mildew (9 points) contains 8 accessions: Extradur (AUT), Tera, Novatsiia, Diana (UKR), Bashkirskaya 27 (RUS), Kustanayskaya 12 (KAZ); the reference of this resistance level is Slavuta (UKR).

Accessions are valuable, if they are references of levels of several of economic features, which enables rational assessments by planting fewer references-accessions. For example, accession Naschadok (UKR) is the reference of high grain weight per spike (1.8-2.5 g) and high resistance to powdery mildew (7-8 points); Spadschyna (UKR) is the reference of spike length (6.1-8.0 cm), medium grain weight per spike (1.2-1.7 g) and of late ripening (90-92 days); Daryna (UKR) – of mid-ripening (85-89 days) and medium yield capacity (210-300 g/m^2); Dynastiia (UKR) – of early-ripening (79-84 days) and medium height (81-110 cm); Slavuta (UKR) – of a large grain number per spike (31-45) and very high resistance to powdery mildew (9 points).

The trait collection includes 12 accessions registered with the NCPGRU, including Aidarlynka, Metyska, Tera, Diana, Kharkivska 23, Kharkivska 27, Kharkivska 39 and others.

CONCLUSIONS

The multi-year studies of the spring durum wheat collection in the NCPGRU formed the trait collection by economic features consisting of 108 accessions of different eco-geographical origin from 11 countries. The largest number of accessions (35) are from Ukraine; 26 - from Russia; 15- from Kazakhstan; 14 - from Canada; 6 -from France; 4 - from Austria; 2 - from Syria, the USA, Chile each; and 1 - from Germany and Italy each. The trait collection is represented by 8 varieties: *var. hordeiforme, var. candicans, var. pilosocaerulescens, var. leucurum, var. melanopus, var. muticohordeiforme, var. leucomelan, var. obscurum*. The collection covers diversity of 10 economic characteristics (growing season length, plant height, yield capacity, 1000-grain weight, lodging resistance, resistance to powdery mildew, protein content) expressed at 40 levels. The trait collection is of significant value for science and education. Use of collection accessions will accelerate the breeding of cultivars that would be high-yielding and adapted to variable climatic conditions of cultivation and enhance its efficiency.

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Падалка О.І., Музафарова В.А., Рябчун В. К., Петухова І.А., Богуславський Р. Л.
Інститут рослинництва ім. В. Я. Юр'єва НААН
Національний центр генетичних ресурсів рослин України
Московський пр., 142, Харків, 61060, Україна,
E-mail: ncpgru@gmail.com

ОЗНАКОВА КОЛЕКЦІЯ ПШЕНИЦІ ТВЕРДОЇ ЯРОЇ ЗА КОМПЛЕКСОМ ЦІННИХ ГОСПОДАРСЬКИХ ОЗНАК – ДЖЕРЕЛО ВИХІДНОГО МАТЕРІАЛУ ДЛЯ СЕЛЕКЦІЇ

Ефективність створення вітчизняними селекціонерами нових конкурентоспроможних сортів, з високим рівнем продуктивності, якості продукції в основній мірі залежить від добре підібраного і всебічно проаналізованого вихідного матеріалу. Досягнути цього можна завдяки колекції пшениці твердої ярої, що зосереджена в Національному центрі генетичних ресурсів рослин України (НЦГРРУ). У НЦГРРУ на даний час зібрано та паспортизовано 1266 зразків походженням з 53 країн. На основі багатого генетичного різноманіття пшениці твердої ярої сформовано ознакову колекцію за господарськими ознаками, яка включає зразки з високою урожайністю, адаптивністю до змін умов вирощування, стійкістю до біотичних та абіотичних чинників різного походження та з різними рівнями прояву необхідних господарських ознак.

Мета. Метою нашої роботи було оцінити генетичне різноманіття зразків пшениці твердої ярої, систематизувати їх, виділити еталони цінних господарських ознак та сформувати ознакову колекцію за комплексом господарських ознак.

Результати досліджень та їх обговорення. За результатами оцінки виділено 108 зразків пшениці твердої ярої, які охарактеризовані за 10 ознаками та 40 рівнями прояву. Колекція включає зразки, що походять з 11 країн світу, найбільша кількість зразків походженням з України – 35, Росії – 26, Казахстану – 15, Канади – 14, Франції – шість, Австрії – чотири шт., по два зразки з Сирії, США, Чилі і по одному з Німеччини та Італії. Ознакова колекція репрезентована вісьмома різновидностям: *hordeiforme, candicans, pilosocaerulescens, leucurum, melanopus, muticohordeiforme, leucomelan, obscurum.* Виділено зразки, які є еталонами прояву кількох ознак, так зразок Нащадок (UKR) є еталоном рівнів прояву двох ознак – велика маса зерна з колоса (1,8–2,5 г) та висока стійкість до борошнистої роси (7–8 балів); Спадщина (UKR) – за довжиною колоса (6,1–8,0 см), середній рівень маси зерна з колоса (1,2–1,7 г), пізньостиглість (90–92 доби); Дарина (UKR) – середньостиглість (85–89 діб) та середній рівень урожайності (210–300 г/м^2); Династия (UKR) – ранньостиглість (79–84 доби), середньорослість (81–110 см); Славута (UKR) – велика кількість зерен в колосі (31–45 шт.), дуже висока стійкість до борошнистої роси (9 балів). До складу ознакової колекції включено 12 цінних зразків зареєстрованих у НЦГРРУ, серед них Айдарлинка, Метиска, Тера, Діана, Харківська 23, Харківська 27, Харківська 39 та інші.

Висновки. У результаті багаторічного вивчення колекції пшениці твердої ярої в НЦГРРУ було сформовано ознакову колекцію за господарськими ознаками, до складу якої входять 108 зразків з 11 країн світу різного еколого-географічного походження. Колекція охоплює різноманіття за 10 господарськими ознаками (тривалість вегетаційного періоду, висота рослин, урожайність, маса 1000 зерен, стійкість до вилягання, стійкість до

борошнистої роси, вміст білку) охарактеризована за 40 рівнями прояву. Ознакова колекція представляє значну цінність для наукового та навчального процесу. Використання зразків з колекції дозволить прискорити ефективність селекційного процесу по створенню високопродуктивних та адаптованих до мінливих кліматичних умов вирощування.
Ключові слова: *пшениця тверда яра, зразок, ознакова колекція, еталон, рівень прояву, урожайність, стиглість*

Падалка Е.И., Музафарова В.А., Рябчун В.К., Петухова, И.А., Богуславский Р.Л.
Институт растениеводства им. В.Я. Юрьева НААН
Национальный центр генетических ресурсов растений Украины
Московский пр., 142, Харьков, 61060, Украина
E-mail: ncpgru@gmail.com

ПРИЗНАКОВАЯ КОЛЛЕКЦИЯ ПШЕНИЦЫ ТВЕРДОЙ ЯРОВОЙ ЗА КОМПЛЕКСОМ ЦЕННЫХ ХОЗЯЙСТВЕННЫХ ПРИЗНАКОВ – ИСТОЧНИК ИСХОДНОГО МАТЕРИАЛА ДЛЯ СЕЛЕКЦИИ

Эффективность создания отечественными селекционерами новых конкурентоспособных сортов, с высоким уровнем продуктивности, качества продукции в основной степени зависит от хорошо подобранного и всесторонне проанализированного исходного материала. Достичь этого возможно благодаря коллекции пшеницы твердой яровой, которая сосредоточена в Национальном центре генетических ресурсов растений Украины (НЦГРРУ). В НЦГРРУ в настоящее время собрано и паспортизовано 1266 образцов происхождением из 53 стран. На основе генетического разнообразия пшеницы твердой яровой необходимо сформировано признаковую коллекцию по хозяйственным признакам, которая включает образцы с высокой урожайностью, адаптивностью к изменениям условий выращивания, устойчивостью к биотическим и абиотическим фактором различного происхождения и с различными уровнями проявления необходимых хозяйственных признаков.

Цель. Целью нашей работы было оценить генетическое разнообразие образцов пшеницы твердой яровой, систематизировать их, выделить образцы ценных хозяйственных признаков и сформировать признаковыми коллекцию по комплексу хозяйственных признаков.

Результаты исследований и их обсуждение. По результатам оценки выделены 108 образцов пшеницы твердой яровой, которые охарактеризованы по 10 признаками и 40 уровнями проявления. Коллекция включает образцы из 11 стран мира, наибольшее количество образцов из Украины - 35, России - 26, Казахстана - 15, Канады - 14, Франции - шесть, Австрии - четыре, по два образца из Сирии, США, Чили и по одному из Германии и Италии. Признаковая коллекция представлена восемью разновидности: *hordeiforme, candicans, pilosocaerulescens, leucurum, melanopus, muticohordeiforme, leucomelan, obscurum.* Выделены образцы, которые являются эталонами проявления нескольких признаков, так образец Нащадок (UKR) является эталоном уровней проявления двух признаков - большой массы зерна с колоса (1,8-2,5 г) и высокой устойчивости к мучнистой росе (7-8 баллов); Спадщина (UKR) - по длине колоса (6,1-8,0 см), среднему уровню массы зерна с колоса (1,2-1,7 г), познеспелостю (90-92 суток); Дарина (UKR) - среднеспелость (85-89 суток) и средний уровень урожайности (210-300 г/м^2); Династия (UKR) - раннеспелость (79-84 суток), среднерослость (81-110 см); Славута (UKR) - большое количество зерен в колосе (31-45 шт.), очень высокая устойчивость к мучнистой росе (9 баллов). В состав признаковой коллекции включены 12 ценных образцов зарегистрированных в НЦГРРУ, среди них Айдарлинка, Метиска, Тера, Диана, Харьковская 23, Харьковская 27, Харьковская 39 и другие.

Выводы. В результате многолетнего изучения коллекции пшеницы твердой яровой в НЦГРРУ было сформировано признаковую коллекцию по хозяйственным признакам, в состав которой входят 108 образцов из 11 стран мира различного эколого-географического происхождения. Коллекция охватывает многообразие за 10 хозяйственными признаками (продолжительность вегетационного периода, высота растений, урожайность, масса 1000 зерен, устойчивость к полеганию, устойчивость к мучнистой росе, содержание белка) охарактеризирована по 40 уровням проявления. Признаковая коллекция представляет значительную ценность для научного и учебного процесса. Использование образцов из коллекции позволит ускорить эффективность селекционного процесса по созданию высокопродуктивных и адаптированных к меняющимся климатическим условиям выращивания.

Ключевые слова: *пшеница твердая яровая, образец, признаковая коллекция, эталон, урівень проявления, урожайность, спелость*

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КОЗАЧЕНКО М. Р., КОМПАНЕЦЬ К. В.
Інститут рослинництва ім. В. Я. Юр'єва НААН
Московський пр., 142, Харків, 61060, Україна
E-mail: yuriev1908@gmail.com

МОРФО-БІОЛОГІЧНІ ОСОБЛИВОСТІ СОРТІВ – ДЖЕРЕЛ ЦІННИХ ОЗНАК ЯЧМЕНЮ ЯРОГО

У статті наведено результати визначення в 2014–2016 рр. морфо-біологічних і господарських особливостей остистих і безостих сортів ячменю ярого та їх батьківських форм за кількісними ознаками. Установлено неоднаковий рівень урожайності, продуктивності рослин, її структурних елементів та інших кількісних ознак 11 сортів залежно від умов років їх вирощування. Виділено сорти-джерела цінних ознак для комбінаційної селекції. Виділено безості і остисті сорти – джерела цінних ознак ячменю ярого, які мали достовірно вищі показники порівняно з національним стандартом Взірець за кількісними ознаками, що має значення в комбінаційній селекції: за продуктивністю рослин – у 2014-2016 рр. сорт Джерело; за продуктивною кущистістю – у 2014 р. і 2016 р. сорт Звершення; за кількістю зерен у колосі в 2014-2016 рр. – Бадьорий та Вітраж; за масою 1000 зерен за три роки досліджень – Джерело, Бадьорий, Етикет, Модерн та Вітраж. Визначено ознаки рослин з низькою варіабельністю в 2014–2016 рр., за якими сорти є більш стійкими в різних умовах вирощування. Установлено рівень ознак рослин сортів у порівнянні з батьківськими сортами, на основі схрещування яких їх створено. Визначено, які рівні ознак передано сортам від їх батьківських форм. Показано, що не лише нові сорти ячменю ярого, а й їх батьківські форми є джерелами окремих ознак, цінних для комбінаційної селекції. У гібридних комбінаціях, одержаних від схрещування досліджених сортів за діалельною схемою, дібрано 2798 рослин для оцінки їх потомств в 2017 р., а також створено 214 цінних ліній, які оцінено і виділено в селекційному розсаднику першого року в 2016 р і їх буде досліджено в 2017 р. в селекційному розсаднику другого року.

Ключові слова: *ячмінь ярий, остистий і безостий сорт, продуктивність рослини, структурний елемент продуктивності, кількісна ознака, джерело цінної ознаки*