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COLLECTION OF SELF-POLLEN LINES OF CORN BY PRODUCTION CHARACTERS

The purpose. To generate collection of lines of corn by productivity and its components, to select standards and sources of economic attributes. **Methods.** Systematization of genetic diversity by production characters. **Results.** Sources and standards of production characters are determined; collection of lines of corn by production characters is formed and registered. **Conclusions.** Sources of production characters are determined and collection which serves as an initial stock at creation of hybrids and lines of corn of new generation is generated.

Key words: corn, collection, self-pollen line, attribute, productivity, standard.

For Ukraine which acts as one of the main countries supplying agricultural products on the world market, implementation of maize hybrids that are in line with international standards on the level of grain yield and its quality is extremely important.

At present, systematic studies are deepening that cover such issues as the ability of plants to adapt to changing weather conditions, genetic and physiological ability to form high and stable yields, high levels of general and specific immunity, the genotypes different by qualitative and quantitative biochemical composition of the grain that are able to satisfy the needs of mixed fodder, alcohol, food, industrial, pharmaceutical and other industries [1, 2].

On a global scale, maize genetic resources are important: inventory and monitoring, purposeful introduction, comprehensive study on economic and biological characteristics, storage in a viable state, genetic authenticity [3, 4, 5].

At the Plant Production Institute nd. a.V.Ya. Yuryev of NAAS (IR) and the National Center for Plant Genetic Resources of Ukraine (NCPGRU) functioning in its structure, have collected a gene pool of maize as much as 6,3 thousand samples covering the diversity for geographical origin, methods of creation, botanical composition and the traits valuable in breeding and genetic aspects. For the most valuable traits, a trait collections are created whose samples are selected for a certain level of phenotypical manifestation of certain features or their combinations [6].

The purpose of our work is to create maize collections based on productivity and its components, the allocation of reference samples and sources of valuable economic characteristics.

Materials, conditions and methods of research. The material used for the study was 703 inbred maize lines of the NCPGRU collection from 12 world countries which were involved to the study in the period of 2010-2016. The study of the maize samples was conducted according to the methodological recommendations [7], distribution of samples by groups for values according to the “Descriptors List and Reference of the species *Zea mays* L." [8].

The sowing was carried out on the experimental field of IR (eastern part of the Forest-Steppe of Ukraine). The soils are black earth powerful weakly drained. The predecessor is peas. Agrotechnics are commonly used for the zone of the Forest–Steppe of Ukraine. In the collection nursery, the samples were planted on a single-row plot with an area of 4.9 m^2, by the standard method. The width of the rows is 70 cm and at a distance of 35 cm between the plants. The standards were placed after every 30 parcels. Statistical processing of experimental results was performed by the method of dispersion analysis according to B. A. Dospekhov [9].

The weather conditions of the research years varied by the levels of humidity and temperature regime. This allowed to assess stability of manifestation of the traits under the influence of environmental factors (Table 1).

During the "sowing - sprouting" period, the temperature was below the average perennials with low humidity in all years, but the supply of winter moisture created favorable conditions for germination of seeds and initial growth.

For the period of "sprouting – flowering of generative organs" in the eastern Forest–Steppe, weather conditions are characterized by excessive temperatures and optimal water supply (2011, 2014, 2016) or lack of moisture (2010, 2012, 2013, 2015).

Table 1

Weather conditions in the years of studying the maize samples collection

Year of study	Sowing - sprouting				Sprouting – flowering of stigma				Flowering of stigma – wax ripeness of grains			
	active t°C		precipitation		active t°C		precipitation		active t°C		precipitation	
	∑	± % to perennial	∑	± % to perennial	∑	± % to perennial	∑	± % to perennial	∑	± % to perennial	∑	± % to perennial
2010	196	-38	54	-45	1223	+24	109	-45	1303	+64	73	-39
2011	159	-53	3	-94	1167	+16	257	+29	1139	+44	112	-8
2012	244	-25	15	-84	1307	+32	76	-62	1159	+45	116	-7
2013	228	-29	11	-89	1199	+19	95	-53	1147	+43	90	-25
2014	167	-48	13	-87	1233	+23	200	0	1077	+35	42	-65
2015	233	-28	7	-92	1310	+33	150	-22	1328	+67	49	-59
2016	227	-29	58	-42	1320	+36	193	-1	1407	+76	164	+37

In the period of "flowering of generative organs – waxy ripeness of grain", in most years, plants suffer from drought. So, very hot (the sum of active temperatures ranging from 1303 to 1407 ° C) with slight precipitation were 2010, 2015 and more humid (164 mm.) - 2016. The sum of temperatures close to the perennial was characterized for 2011, 2012 years, moderately dry in this period were 2013, 2014.

Research results. Productivity is a complex quantitative trait that characterizes the contribution of a single plant to yield. This trait can be considered as a combination of cobs number per plant and mass of their grains or the number of grains per cob and mass of one grain [10, 11]. The productivity depends on the grain size, weight of 1000 grains, grain yield from one cob, cob length, number of rows per cob, number of cobs per plant, intensity of dry matter accumulation in the grain.

We have carried out distribution of the inbred lines by the classes of productivity and its components depending on the group of ripeness according to the

Descriptors lists, what is relevant for solving breeding issues. A significant number of Ukrainian and foreign maize lines are classified into an average-group - 102 lines (14.5%) with average productivity (51-75 g); 96 lines (13.6%) with increased productivity (76-100 g) and 110 lines (15.6%) with a high productivity of more than 100 g. Late ripening lines from abroad could not always realize the potential level of the trait unlike to the lines of Ukrainian origin. Among the late-ripening forms from Ukraine, 88 lines (12.6%) with elevated and 97 lines (14.0%) with high productivity were allocated. The mid–early group includes the same numbers of lines with low, medium, high level of manifestation of the productivity.

For the differentiation of the collection samples by productivity, the lines–references of different manifestation levels of the six traits were selected. The diversity covers 24 manifestation levels (Table 2).

Table 2

Reference lines for the level of productivity and its components

Trait	Manifestation level of the trait	Score according to the Descriptors Lists	Number in the National Catalogue	Name of reference sample	Group by ripening
Grain productivity per plant, g	<50	1	UB0105174	UP 239	early ripening
			UB0105057	ND 260	mid-early
		3	UB0105191	3K 146	early ripening
			UB0100037	S 61	mid-ripening
	76-100	5	UB0103240	UHK 439	mid-ripening
			UB0104943	UP 153	mid-late
	101-110	7	UB0102880	LK 11248	mid-early
	>110	9	UB0105067	WG 4	mid-late
Cob length, cm	9-10	3	UB0102672	UHK 392	mid-early
	11-14	5	UB0103239	UHK 438	mid-ripening
	15-18	7	UB0103246	UHK 445	mid-ripening
	>18	9	UB0100288	A 357	mid-early
Grain number per cob, pcs.	100-200	3	UB0104881	UP 76	mid-early
	201-400	5	UB0103226	UHK 423	mid-ripening

	401-500	7	UB0103239	UHK 438	mid-ripening
	>500	9	UB0103240	UHK 439	mid-ripening
1000 grains weight, g	101-200	3	UB0103367	UHK 425	mid-ripening
	201-250	5	UB0103226	UHK 423	mid-ripening
	251-300	7	UB0102880	LK 11248	mid-early
	301-500	9	UB0105094	VC 150	mid-ripening
Grain row number on a cob, pcs.	10-12	3	UB0102046	SM 7 3M	mid-early
	14-16	5	UB0103240	UHK 439	mid-ripening
	18-20	7	UB0108629	UHK 530	mid-late
	22-26	9	UB0106372	K 17	mid-late
Cobs number per plant, pcs.	1,0-1,4	3	UB0103226	UHK 423	mid-ripening
	1,5-1,9	5	UB0103367	UHK 425	mid-ripening
	2,0-2,5	7	UB0108238	UHS 125	mid-ripening
	>2,5	9	UB0107124	SL 73-99-2	mid-ripening

One of the main components of productivity is the grains number per cob which is closely related to the cob length and grain rows number per cob. It should be noted that the increased rows number contributes to the better adaptability of the lines to stress conditions, and the cob length as a more variable trait can be used to increase productivity at intensive growing technology.

There were isolated from the collection 101 lines in which the grain number per cob exceeded 500 pcs. at a high and stable level of productivity, among which 27 lines had a long cob (17-19 cm) and 56 lines – 18-22 rows of grains per cob. High grain number per cob (641-736 pcs.) had the lines UH 872, UHK 585, UHK 596, UHF 10, UHF 13 (IP), ZK 317 (Transcarpathian State Agricultural Research Station), PTF 38 (Skvirskaya Experimental Station). Very long cob (19 cm) formed the lines UCS 143, RLW 550/12 and 20-22 rows had the four lines: UH 872, UHK 530, UHF 10, UHF 43 created in the IR.

The grain weight of maize is determined by its size, nature of surface and consistency. The contribution of this feature in the formation of productivity is quite large. However, during the filling of grain, it is influenced by environmental conditions. We have allocated 23 lines in which high productivity (more than 100 g per plant) is combined with an increased weight of 1000 grains (300-370 g): UHK 532, UHK 541, UHI 3, UHI 44, UHS 93, UHS 137 (IR); ADCH 3M, DK 205/710 SV (Institute of Grain Crops); UCH 254, UCH 256, UCH 278 (Bukovinska State Agricultural Research Station) and other lines that can be used in breeding in regions with optimal ecological conditions for the cultivation of maize hybrids.

The use of foreign inbred lines in heterosis breeding has allowed to significantly expand the genetic potential of domestic hybrids, increase their yield, resistance to stress conditions, pests and diseases, and obtain hybrids adapted to modern agrotechnologies.

There were highlighted 27 lines from European countries, Canada and the USA which had productivity at the level of 80-137 g. The high productivity (above 100 g) was inherent to the lines 6396/11 (Germany), B 205, B 247, VIR 44, GK 26 (Russia), S 35 (Poland), Sun 5 b (Croatia), A 357, P 346, RF 90, W 83 (USA). In the main, these lines had a cob length of 14 cm to 17 cm, but in lines W 83, A 357 - 20 cm and 18 cm, respectively. The lines BM 263 (Kazakhstan), BC 5 b (Croatia), UB01008125 (Serbia), P 502, RF 90 (USA) had 16-18 rows of grains per cob. High grain number per cob (more than 500 pcs.) is characteristic for lines from Kazakhstan - BM 263; Russia-214; Germany-6396/11; Serbia – the line UB01008125; USA – A 395, RF 90, P 502, W 83. By weight of 1000 grains (275-330 g), the lines KS 232 (Russia), UB01008125 (Serbia), VS 5 b (Croatia) are selected.

The intensity of dry matter accumulation in grain is characteristic for the lines UH 878, UHS 120, UHK 596, UHK 607, AK 145, UHF 94, UCH 273, ZK 317 (Ukraine); GK 26 (Russia); W 83 (USA) with a productivity of 119-200 g with and intensity of dry matter accumulation of 3,5-5,1 g / day.

21 high-yielding lines from Ukraine, six from Russia and three from the USA are classified as highly productive. So, in the lines with 2,0-2,4 cobs on the main stem, the first cob had 516-630 grains. Similarly, presence of several cobs did not reduce the weight of 1000 grains. The weight of 1000 grains in the lines with 1,6-2,1 cobs per plant – UH 816, UHS 113, UHS 141, UCH 278, AK 159, ZK 315, (Ukraine), KIN 018 (Russia), BC 5 b (Croatia) , A 357 (USA) – was 250-320 g. The

lines UHI 23, UHF 163, AK 145, (Ukraine), GK 26 (Russia), RF 90, (USA) characterized by bushiness and had 0.6-0.9 cobs on the extra stems; we recommend to use them in breeding hybrids of silage use.

Due to the intensive growing hybrids and their initial forms, considerable attention is paid to the resistance to common diseases and pests. As a result of the generalization of the data about the level of affection and harmfulness of diseases, we managed to allocate the lines with complex resistance to diseases and pests that have a breeding significance. Thus, 185 lines of Ukraine and 43 lines from foreign countries are attributed to a group of the lines high resistant to a boil smut and a maize butterfly with a high level of productivity.

Conclusions. The approach developed in these experiments allowed to create for the first time an ecologically oriented trait collection of maize lines for productivity with different ways of its formation. It consists of 223 inbred lines from 13 world countries (Ukraine, Russia, Moldova, Germany, Poland, France, Spain, Hungary, the Netherlands, Serbia, Croatia, USA, Canada) belonging to different sub-species and mature groups characterized by an elevated level of five elements of productivity (cob length, number of grain rows on cob, grain number per cob, weight of 1000 grains, cobs number per plant). The lines are classified according to different types of productivity formation.

These extraordinarily valuable lines are diverse in geographical origin and in terms of ripeness. Ukrainian lines are well adapted to growing conditions. Most of the lines from European countries have increased productivity, rows and grain number in cob. These lines can be used as sources with high levels of traits manifestation directly when creating hybrids and as improvers for creating a lines of new generation.

Bibliography

1. Kyrychenko V. V. Novitni metody vyvchennia efektu heterozysu ta stvorennia hibrydiv kukurudzy / V. V. Kyrychenko, L. M. Chernobai, S. H. Ponurenko, S. S. Babanina, O. V. Sikalova // Osnovy upravlinnia produktsiinym

protsesom polovykh kultur: monohrafiia; za redaktsiieiu V. V. Kyrychenka. - Kh.; FOP Brovin O. V., 2016. - S. 449-480.

2. Shmaraev G. E. Kukuruza / G. E. Shmaraev, G. V. Matveeva // Identifitsirovannyiy genofond rasteniy i selektsiya // S-Peterbug, 2005. - S. 831-833.

3. Hurieva I. A. Henetychni resursy kukurudzy v Ukraini / I. A. Hurieva, V. K. Riabchun .-Kharkiv, 2007. - 392 s.

4. Kyrychenko V. V. Rol’ henetychnykh resursiv u vykonanni derzhavnykh prohram /V. V. Kyrychenko, V. K. Riabchun, R. L. Bohuslavskyi // Zb. Henetychni resursy roslyn. - 2008, №5. - S.7-9.

5. Aleksanyan S. M. Strategiya sohraneniya geneticheskih resursov i sistema upravleniya imi v usloviyah globalizatsii / Avtor. disser. dokt. biolg. nauk.- S-Peterburg, 2004. - 42 s.

6. Hurieva I. A. Metodychni pidkhody do formuvannia bazovoi ta oznakovykh kolektsii kukurudzy /I. A. Hurieva, V. K. Riabchun, N. V. Kuzmyshyna // Zb. Henetychni resursy roslyn. - Kharkiv.-2008. - №5. - S. 69-76.

7. Hurieva I. A. Metodychni rekomendatsii poliovoho ta laboratornoho vyvchennia henetychnykh resursiv kukurudzy / I. A. Hurieva, V. K. Riabchun, P. P. Litun, V. P. Stepanova, S. M. Vakulenko, N. V. Kuzmyshyna ta in. // Kharkiv.-IR im. V. Ya. Yurieva UAAN, 2003. - 43 s.

8. Kyrychenko V. V. Klasyfikator vydu Zea mays L. / V. V. Kyrychenko, I. A. Hurieva, V. K. Riabchun, N. V. Kuzmyshyna, S. M. Vakulenko, V. P. Stepanova // Kharkiv. - IR im. V. Ya. Yurieva UAAN, 2009. - 83 s.

9. Dospehov B. A. Metodika polevogo opyita / Agropromizdat, 1985. - 351s.

10. Ovsiannikova N. S. Vzaiemozviazok mizh produktyvnistiu i elementamy yii struktury u linii kukurudzy z riznoiu henetychnoiu osnovoiu // Selektsiia i nasinnytstvo. - Kharkiv. – 2000. - №84. – S. 72-76.

11. Goncharova E. A. Retrospektiva issledovaniy vodnogo statusa kulturnyih rasteniy na baze kolektsii geneticheskih resursov VIR /E. A. Goncharova, Yu. V. Chesnokov, M. N. Sitnokov // Trudyi Karalskogo nauchnogo tsentra RAN. - 2013. - №3. - S. 10-17.