

potential for the conditions of the Transcarpathian region, were selected for building up a basic collection and its subsequent use in breeding: Amerikan 311, Bravyi 200, Zhovtolystnyi 36, Makhorkovydni 28, Temp 400, Erho 23, Basma 99, Zahradni 8, Ukrainskyi 12, Ternopilskyi 14, Berley 38, Virginia 27, Venherskyi Ohorodnyi, and Kruprnyolystnyi. Recommendations were given to agrarian enterprises of the Zakarpatska Oblast regarding the tobacco assortment: Amerikan 20, Sobolchskyi 15, Ternopilskyi 7, Ternopilskyi 14, Virginia 27, Temp, Ukrainskyi 18, Ukrainskyi 27, Zakarpatskyi 12, and Kerti.

Key words: *tobacco, variety, seed productivity, breeding, valuable traits.*

UDC 633.15:631.5:581.19

DOI:10.30835/2413-7510.2021.251032

YIELD LEVEL AND STABILITY IN CORN HYBRIDS OF DIFFERENT RIPENESS GROUPS

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The maximum and average yield levels and stability in corn hybrids of different ripeness groups, with high agronomic stability, giving consistently high yields under deteriorating growing conditions, were determined. In 2016–2018, the maximum average yields were produced by mid-early hybrids Vektor (8.13 t/ha), KhA Bolid (8.19 t/ha), Arho (8.13 t/ha), and by mid-ripening hybrid UKhL 228/KhA 408 (7.10 t/ha), which exceeded the corresponding conditional check hybrids by 23–24%. The female form of Vektor and Arho was originated from interline hybrids; and the female form of KhA Bolid and UKhL 228 / KhA 408 - from exotic plasm. Based on trial results, three mid-early corn hybrids, Liubchyk (FAO 240), Stavr (FAO 290) and Vektor (FAO 270) were included in the State Register of Plant Varieties Suitable for Dissemination in Ukraine.

Key words: *corn, yield, hybrid, ripeness group.*

Introduction. The creation of highly heterozygous hybrids is based on diverse starting material, and its effectiveness depends on how well it was studied under specific agro-climatic conditions. The main objective of breeders is to combine valuable economic and biological traits and features in one genotype, which would allow for fulfillment of the genetic potential and ensuring maximum yields with the lowest costs of cultivation [1, 2, 3].

Literature review. Modern heterosis corn breeding aimed at solving the main challenge – to increase yields of hybrids - requires starting material of various origins for breeding programs and development of new approaches to its use [4, 5].

Producers' stringent requirements for current corn hybrids encourage the search for new more efficient breeding technologies, revision and updating of breeding mainstreams, expanding the genetic basis of starting material and prompt response to market demands. Increased yields, reduced harvest moisture in grain, resistance to diseases and pests, and stable reproduction of valuable economic characteristics under widely varying environmental conditions remain the most important trends in breeding [6, 7, 8].

Purpose. To determine the yield and agronomic stability of new corn hybrids bred at the Plant Production Institute named after V.Ya. Yuriev of NAAS under climatic changes.

Materials and methods. The study was conducted in the Laboratory of Corn Breeding and Seed Production of the Plant Production Institute named after V.Ya. Yuriev of NAAS in the scientific

crop rotation fields in 2016–2020. Twenty-eight experimental hybrids derived from lines of different genetic origins were studied. Meteorological assessment was performed using the hydrothermal coefficient (HTC) defined by GT Selyaninov [9]; the farming techniques in the experiments were aimed at providing optimal conditions for plant growth and development and complied with conventional zonal recommendations [10]. Phenological observations, field assessments and records, and laboratory analyses were performed in accordance with the «Guidelines for Field and Laboratory Studies of Corn Genetic Resources» [11]. The agronomic stability (As,%) was calculated by V.V. Hangildin and N.A. Litvinenko’s formulas [12]. To analyze the yield and grain moisture of corn hybrids under different environmental conditions (Steppe, Forest-Steppe, Woodlands), we used free available data from the Ukrainian Institute of Plant Variety Examination (UIPVE) [13].

Results and discussion. From lines of different genetic origin, which had been distinguished by combining ability and other morpho-biological traits in previous studies [14], 28 experimental hybrids were created, which were studied in competitive trials in 2016-2018.

The weather in the study years differed significantly in rainfall and temperature. The optimal conditions for the growth and development of corn plants were in 2016: the HTC was 1.0. 2017 and 2018 were unfavorable for yield because of high air temperature and water deficit during the critical periods of the growth and development of corn plants; the HTC in these years was 0.4 and 0.3, respectively. Significantly excessive temperature and water deficit during the anthesis in 2017 and 2018 disrupted flowering and pollination processes, leading to high numbers of unseeded cobs, consequently, to reduced yields.

In 2016, the average yield of early-ripening and mid-early hybrids was 7.73 t/ha and 8.45 t/ha, respectively, with harvest moisture in grain of 25% and 26%, respectively. The range of harvest moisture was considerable across ripeness groups and years. This indicator was the most variable in the **middle**-early group in 2016 (18–35%, Table 1). In 2017 and 2018, the yields were significantly lower in all ripeness groups.

Table 1

Characteristics of hybrids of different ripeness groups in the competitive trials						
Ripeness group	Hybrid number	Year	Grain yield with 14 % moisture, t/ha		Harvest moisture in grain, %	
			Mean	Min–Max	Mean	Min–Max
Early-ripening	4	2016	7.73	6.91–8.41	25	20–32
		2017	3.97	3.31–5.72	16	14–23
		LSD _{0.05}	0.25	–	1.20	–
	2	2017	4.87	4.94–7.73	21	16–28
		2018	5.55	5.35–5.76	22	19–25
		LSD _{0.05}	0.24	–	0.08	–
Mid-early	3	2016	8.45	5.49–10.34	26	18–35
		2017	5.55	5.35–5.76	22	19–25
		LSD _{0.05}	0.75	–	1.52	–
	4	2016	7.47	5.49–10.34	26	18–35
		2018	5.32	3.76–6.35	17	14–19
		LSD _{0.05}	0.65	–	0.70	–
10	2017	4.74	5.47–7.77	19	14–24	
	2018	5.17	4.21–6.88	18	16–22	
	LSD _{0.05}	0.13	–	0.71	–	
Mid-ripening	5	2017	5.70	4.95–6.66	25	20–33
		2018	5.48	4.40–6.28	21	17–26
		LSD _{0.05}	0.25	–	1.82	–

It was found that fluctuations in the grain yield and harvest moisture in grain within the ripeness groups under adverse conditions were narrower than under favorable conditions in 2016.

The contrasting weather in the study years allowed evaluating the hybrids by reaction norm and identifying combinations that markedly respond to improvements of growing conditions, i.e. intensive hybrids, as well as stable hybrids, which stabilize yields under adverse conditions due to compensatory effects.

Adaptive traits of any organism and their expression in a plant coenosis are controlled by genotype. Therefore, hybrids with a broad genetic basis are more adapted to adverse environmental factors. Of the hybrids tested in the competitive trials, eight mid-early and two mid-ripening hybrids that were superior to the conditional check hybrids in terms of yield by 0.42 t/ha (5%) to 2.32 t/ha (24%) were identified (Table 2).

In addition to yield, harvest moisture in grain is an important criterion for evaluating hybrids. In all study years, the harvest moisture in grain of the corn hybrids was at or below that the standard.

When analyzing the results, we noted that the most favorable conditions for high yields from the corn hybrids were in 2016. The largest surplus over the check hybrids in this year was observed in Vektor, KhA Bolid and Arho (by 2.35, 2.03 and 1.74 t/ha, respectively).

Table 2

Yields of the best corn hybrids of different ripeness groups in the competitive trials

Hybrid	Origin		Year	Grain yield		Harvest moisture in grain, %	Agronomic stability coefficient As, %
	♀	♂		t/ha	+ to the conditional check hybrid		
Mid-early							
UKhL 267 /	Exotic	Synthetic	2016	8.28	0.78	20	78.79
Kahrkivska 657	plasm	plasm	2017	6.12	0.42	16	
Kahrkivska 126 /	Exotic	Synthetic	2016	8.42	0.92	20	84.12
Kahrkivska 657	plasm	plasm	2017	6.72	1.02	17	
Vektor ¹⁾	Interline	Synthetic	2016	9.85	2.35	20	70.19
	hybrid	plasm	2017	6.42	0.72	18	
KhA Bolid ²⁾	Exotic	Synthetic	2016	9.53	2.03	21	76.86
	plasm	plasm	2017	6.85	1.15	18	
Liubchyk ¹⁾	Interline	Synthetic	2016	8.48	0.98	20	85.98
	hybrid	plasm	2017	6.95	1.25	17	
Stavr ¹⁾	Line	Synthetic	2016	8.02	0.52	20	83.56
		plasm	2017	6.35	0.65	19	
Arho ³⁾	Interline	Synthetic	2016	9.24	1.74	19	80.69
	hybrid	plasm	2017	7.02	1.32	17	
UKhL 317 \	Synthetic	Synthetic	2016	7.92	0.42	20	84.22
KhA 402	plasm	plasm	2017	6.33	1.04	19	
Conditional check hybrid			2016	7,50	–	20	–
			2017	5,70	–	16	–
LSD _{0,05}				0,35		0,18	–
Mid-ripening							
UKhL 228 /	Exotic	Synthetic	2017	7.35	1.28	23	93.14
KhA 408	plasm	plasm	2018	6.67	1.31	20	
UKhL 302 /	Synthetic	Synthetic	2017	6.86	0.79	25	95.31
KhA 402	plasm	plasm	2018	6.42	1.06	21	
Conditional check hybrid			2017	6,07	–	23	–
			2018	5,36	–	20	–
LSD _{0,05}				0,25		0,15	–

Note. ¹⁾ Included in the State Register of Plant Varieties of Ukraine; ²⁾ undergoing the qualifying examination; ³⁾ submitted to the state trials.

Vektor and Arho's female was originated from an interline hybrid, and the male form - from synthetic plasm. KhA Bolid's female form was created from exotic plasm, and the male form - from synthetic plasms. In the dry 2017, mid-early hybrids Liubchyk and UKhL 317 / KhA 402 were able to fulfill their potentials, as their yields greater exceeded that of the check hybrid than in the optimal 2016.

Mid-ripening hybrid UKhL 228 / KhA 408 gave consistently high yield of 7.35 t/ha and 6.67 t/ha in 2017 and 2018, respectively, which was higher than the yield given by the check hybrid of this ripeness group by 1.28 t/ha and 1.31 t/ha in 2017 and 2018, respectively.

The maximum average yield in 2016–2018 harvested from mid-early hybrids Vektor - KhA Bolid and Arho was 8.13, 8.19 and 8.13 t/a, respectively, the maximum average yield from mid-ripening hybrid UKhL 228 / KhA 408 amounted to 7.10 t/ha, which was higher than the maximum average yield from corresponding conditional check hybrids by 23–24%. Vektor and Arho's female form was based on interline hybrids, while KhA Bolid's and UKhL 228 / KhA 408's female form - on exotic plasm.

Fulfillment of yield potential and economic value of hybrids are fully characterized by the agronomic stability coefficient (As,%). Hybrids with the agronomic stability coefficient of over 70% are the most valuable ones for production. Assessment of agronomic stability showed a fairly high level of fulfillment of the yield potential of the studied hybrids, ranging 70.1% to 95.31% (Table 2). The agronomic stability coefficient was found to be higher in hybrids with smaller fluctuations in their yields across the years. Therefore, hybrids with high or moderate yields and high agronomic stability should be preferred. Such hybrids will ensure consistently high yields under deteriorating growing conditions.

In our study, the mid-early group of hybrids was widely represented, namely by Vektor, KhA Bolid, Liubchyk, and Stavr. Therefore, it was expedient to analyze results of their trials in different growing areas, in particular in the Steppe, Forest-Steppe and Woodlands, where data on the grain yield and moisture were obtained (Table 3). Thus, of the hybrids under investigation, the highest yield of grain was obtained from Vektor (7.77 t/ha) and Stavr (7.26 t/ha) with the grain moisture of 17.3% and 17.7%, respectively, on average across the growing locations.

Table 3

Yields of mid-early corn hybrids in different environmental zones, 2018–2020 (UIPVE's data *)

Hibrid	Yield of grain with 14 % moisture content, t/ha			Harvest moisture in grain, %		
	Steppe	Forest-Steppe	Woodlands	Steppe	Forest-Steppe	Woodlands
Vektor	6.75	9.49	7.08	14	18	20
KhA Bolid	5.58	8.04	7.40	18	20	20
Liubchyk	5.09	8.73	6.74	15	16	20
Stavr	4.89	9.59	7.29	16	18	19
Mean	5.58	8.96	7.13	15.8	18.0	19.8

Note:* – <http://sort.sops.gov.ua/search/search>.

When analyzing the yields of the corn hybrids by growing location, we noted that Vektor, KhA Bolid, Liubchyk, and Stavr gave yields of 5.58, 8.96 and 7.13 t/ha, respectively. Of these hybrids, Vektor and Stavr gave the highest yields of 9.49 t/ha and 9.59 t/ha, respectively, with the grain moisture of 18% in the Forest-Steppe.

Based to the trial results, three mid-early corn hybrids, Liubchyk (FAO 240), Stavr (FAO 290) and Vektor (FAO 270), were included in the State Register of Plant Varieties Suitable for Dissemination in Ukraine. Two hybrids are undergoing the qualifying examination: mid-early KhA Bolid (FAO 280) and mid-ripening Novator (FAO 320); in 2020, two hybrids were submitted for the qualifying examination: mid-early Hart (FAO 280) and mid-ripening Arho (FAO 300).

Conclusions. The yield level and stability in the corn hybrids of different ripeness groups were evaluated. The hybrids gave high or moderate yields and were noticeable for high agronomic stability, providing consistently high yields under deteriorating growing conditions. Based to the trial results, three mid-early corn hybrids, Liubchyk (FAO 240), Stavr (FAO 290) and Vektor (FAO 270), were

included in the State Register of Plant Varieties Suitable for Dissemination in Ukraine. Two hybrids are undergoing the qualifying examination: mid-early KhA Bolid (FAO 280) and mid-ripening Novator (FAO 320); in 2020, two hybrids were submitted for the qualifying examination: mid-early Hart (FAO 280) and mid-ripening Arho (FAO 300).

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РІВЕНЬ ТА СТАБІЛЬНІСТЬ УРОЖАЙНОСТІ ГІБРИДІВ КУКУРУДЗИ РІЗНИХ ГРУП СТИГЛОСТІ В УМОВАХ СХІДНОЇ ЧАСТИНИ ЛІСОСТЕПУ

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Мета дослідження. Визначення рівня врожайності та агрономічної стабільності нових гібридів кукурудзи селекції Інституту рослинництва імені В.Я. Юр'єва НААН в умовах змін клімату.

Матеріали і методи. Матеріалом для досліджень були 28 експериментальних гібридів, створених за участю ліній різного генетичного походження. Польові досліді проведено відповідно до загальноприйнятих методик

Обговорення результатів. Серед гібридів, що проходили випробування, було виділено вісім середньоранніх та два середньостиглих гібриди, що перевищували умовний стандарт за врожайністю від 0,42 т/га до 2,32 т/га. Важливим критерієм оцінки гібридів, окрім врожайності, є збиральна вологість зерна. В усі роки вивчення збиральна вологість зерна у гібридів кукурудзи була на рівні або нижчою за стандарт. Максимальним рівнем врожайності в середньому за 2016–2018 рр. відзначалися середньоранні гібриди Вектор – 8,13 т/га, ХА Болід – 8,19 т/га, Арго – 8,13 т/га, та середньостиглий УХЛ 228 / ХА 408 – 7,1 т/га, що перевищили відповідний умовний стандарт на 23–24 %. При аналізі врожайності гібридів кукурудзи залежно від зони вирощування, а саме Степу, Лісостепу та Полісся відмічено, що середня їх врожайність була на рівні 5,58 т/га, 8,96 та 7,13 т/га відповідно до зони. Серед гібридів, що вивчалися, найбільший рівень врожайності мали Вектор – 9,49 т/га та Ставр – 9,59 т/га з рівнем вологості зерна 18% у Лісостеповій зоні.

Висновки. Визначено рівень та стабільність гібридів кукурудзи різних груп стиглості з високим і середнім значенням урожайності та високою агрономічною стабільністю, які

забезпечують отримання стабільно високого врожаю при погіршенні умов вирощування. За результатами випробовування до Державного реєстру сортів рослин, придатних до поширення в Україні внесено три середньоранніх гібриди кукурудзи Любчик (ФАО 240), Ставр (ФАО 290) і Вектор (ФАО 270).

Ключові слова: кукурудза; урожайність; гібрид; група стиглості.

УРОВЕНЬ И СТАБИЛЬНОСТЬ УРОЖАЙНОСТИ ГИБРИДОВ КУКУРУДЫ РАЗНЫХ ГРУПП СПЕЛОСТИ В УСЛОВИЯХ ВОСТОЧНОЙ ЧАСТИ ЛЕСОСТЕПИ

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Цель исследования. Определение уровня урожайности и агрономической стабильности новых гибридов кукурудзы селекции Института растениеводства имени В.Я. Юрьева НААН в условиях изменения климата.

Материалы и способы. Материалом для исследований были 28 экспериментальных гибридов, созданных с участием линий разного генетического происхождения. Полевые опыты проведены в соответствии с общепринятыми методиками.

Обсуждение результатов. Среди гибридов, проходивших испытание, было выделено восемь среднеранних и два среднеспелых гибрида, превышающих условный стандарт по урожайности от 0,42 т/га до 2,32 т/га. Важным критерием оценки гибридов, кроме урожайности, является уборочная влажность зерна. Во все годы изучения уборочная влажность зерна у гибридов кукурудзы была на уровне или ниже стандарта. Максимальным уровнем урожайности в среднем за 2016–2018 гг. отмечались среднеранние гибриды Вектор – 8,13 т/га, ХА Болид – 8,19 т/га, Арго – 8,13 т/га и среднеспелый УХЛ 228 / ХА 408 – 7,1 т/га, что превысило соответствующий условный стандарт на 23–24 %.

При анализе урожайности гибридов кукурудзы в зависимости от зоны выращивания, а именно Степи, Лесостепи и Полесья отмечено, что их средняя урожайность была на уровне 5,58 т/га, 8,96 и 7,13 т/га в соответствии с зоной. Среди изученных гибридов наивысший уровень урожайности имели Вектор – 9,49 т/га и Ставр – 9,59 т/га с уровнем влажности зерна 18% в Лесостепной зоне.

Выводы. Определены уровень и стабильность гибридов кукурудзы разных групп спелости с высоким и средним значением урожайности и высокой агрономической стабильностью, обеспечивающих получение стабильно высокого урожая при ухудшении условий выращивания. По результатам испытания в Государственный реестр сортов растений, пригодных к распространению в Украине внесены три среднеранних гибрида кукурудзы Любчик (ФАО 240), Ставр (ФАО 290) и Вектор (ФАО 270).

Ключевые слова: кукуруза; урожайность; гибрид; группа спелости.

YIELD LEVEL AND STABILITY IN CORN HYBRIDS OF DIFFERENT RIPENESS GROUPS

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Purpose. To determine the yield and agronomic stability of new corn hybrids bred at the Plant Production Institute named after V.Ya. Yuriev of NAAS under climatic changes.

Materials and methods. Twenty-eight experimental hybrids derived from lines of different genetic origins were studied. The field experiments were carried out in compliance with conventional techniques.

Results and discussion. Of the hybrids tested, eight mid-early and two mid-ripening hybrids were distinguished, as their yields were higher than those of the conditional check hybrids by 0.42–2.32 t/ha. In addition to yield, the harvest moisture in grain is an important criterion for evaluating hybrids. In all study years, the harvest moisture in grain of the corn hybrids was at or below the standard. The maximum average yields in 2016–2018 were produced by mid-early hybrids Vektor (8.13 t/ha), KhA Bolid (8.19 t/ha), and Arho (8.13 t/a) and by mid-ripening hybrid UKhL 228 / KhA 408 (7.1 t/ha), exceeding the corresponding conditional check hybrids by 23–24%. When analyzing the corn hybrid yields depending on the growing zone, namely Steppe, Forest-Steppe and Woodlands, we noted that their average yield was 5.58, 8.96 and 7.13 t/ha, respectively. Of the hybrids studied, Vektor and Stavr provided the highest yields of 9.49 t/ha and 9.59 t/ha, respectively, with the grain moisture of 18% in the Forest-Steppe.

Conclusions. The yield level and stability in the corn hybrids of different ripeness groups were evaluated. The hybrids gave high or moderate yields and were noticeable for high agronomic stability, providing consistently high yields under deteriorating growing conditions. Based to the trial results, three mid-early corn hybrids, Liubchyk (FAO 240), Stavr (FAO 290) and Vektor (FAO 270), were included in the State Register of Plant Varieties Suitable for Dissemination in Ukraine.

Key words: corn, yield, hybrid, ripeness group.

UDC 633.853.52:632.4:632.3

DOI:10.30835/2413-7510.2021.251033

RESISTANCE OF SUNFLOWER LINES AND HYBRIDS TO MAJOR PATHOGENES IN THE NORTHERN STEPPE OF UKRAINE

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The Institute of Oil Crops of NAAS has created field infectious backgrounds for common pathogens of sunflower in the region: downy mildew (*Plasmopara helianthi* Novot.), dry head rot (*Rhizopus nigricans* Ehrend), and embellisia blotch (*Embellisia helianthi* (Hansf.) Pidolp. The infection levels in 2005–2020 were determined. The results of comprehensive evaluation of sunflower hybrids and their parents bred at the Institute of Oil Crops of NAAS and the Plant Production Institute named after V.Ya. Yuriev of NAAS in 2017–2020. Accessions high resistance to major pathogens and of high economic value have been selected.

Key words: sunflower, hybrid, line, resistance, selection, infectious background, pathogen, harmfulness, yield

Introduction. Biological and genetic features of sunflower, diversity of natural conditions in agronomic zones of its cultivation, as well as agricultural and industrial requirements determine the versatility and specificity of objectives in this crop breeding. Breeding is focused on creation of highly productive hybrids, which are ecologically stable and plastic and show group immunity against diseases.

Literature review and problem articulation. At present, the area sown with sunflower significantly exceeds the scientifically substantiated norms, leading to a significant decrease in qualitative and quantitative indicators of commercial seeds. Due to reduced crop rotations, dis-