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ENVIRONMENTAL CROP VARIETY TESTING OF SPRING SMALL CEREALS IN NORTHERN STEPPE OF UKRAINE

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The results of the analysis of available variety assortment and grain yields of different varieties of spring small cereals: barley, oat, wheat and triticale in the environmental crop variety testing, depending on the changing hydrothermal conditions are presented. Marked the varieties, which characterized by stable realization of genetic potential of grain yield in a wide range of variation of average air temperatures and conditions water provision.

Key words: *spring: (barley, oat, wheat, triticale), variety, climate, grain, crop yield.*

Every year in Ukraine created and registered a lot of varieties and hybrids of agricultural crops, which can fully provide the production by food and feed grain and raw materials for industry. Modern varieties can generate high crop yields and with adherence of growing technology, the average crop yields of spring small cereals in Ukraine could reach 4,0–6,0 t/ha, as it is in European countries. A characteristic feature the grain production of spring cereals: barley, oat, wheat and triticale in Ukraine have always been varying the levels of crop yields and gross grain yields due to instability of growing conditions [1, 2].

The adaptive potential of spring cereals varieties as their ability to survive and generate through the constant improvement of adaptation to abiotic and biotic environmental factors was determined on base the relative properties of biological characteristics and agronomic attributes, that are listed in the State Register of plant varieties suitable for dissemination in Ukraine. Varieties choice of spring small cereals wide enough and updated every year by a significant number of promising new products. Thus, in the State Register in 2014 included 93 varieties of spring barley, 24 – of oat, 37 – of spring wheat (29 – soft and 8 – hard) and 12 varieties of spring triticale.

Therefore, the focus of breeding and technological programs for spring small cereals has always prevailed tasks aimed at increasing and stabilizing crop yields. Particularly, in conditions of economic instability the variety value as a factor to increase production efficiency is quite high. Introduction of the newest varieties, which, along with high yield and grain quality, characterized by rational use of nutrients, as well as increased resistance to stressful environmental conditions, makes it possible to significantly reduce the production costs of labor and resources at growing crops and increase the sustainability of grain production. Growing highly well-adapted varieties is one of the cheapest ways to meet the challenges of saving as well as provides an opportunity to increase crop yield and improve its quality with little additional cost. Important in such event an environmental crop variety testing of spring small cereals, which are made annually by institutions and organizations of different ownership forms [3, 4].

The aim of our research was to study the effect of environmental factors on degree of implementation the genetic potential productivity of different varieties of spring small cereals from leading national breeding centers (Plant Production Institute nd. a. V. Ya. Yuriev of NAAS, Plant Breeding and Genetics Institute – National center of seed and cultivar investigation, JSC «Selena», Kirovograd and Donets'k State Agricultural Experimental Station, Institute of Agriculture of Steppe zone of NAAS).

The study was conducted at the Erastivka Experimental Station of the Institute of Agriculture of Steppe zone of NAAS during 2011–2013, according to generally known methods [5, 6]. Soil of experimental field – ordinary chernozem, low-humic, loamy. The humus content in arable soil layer (0–30 cm) – 4,0–4,5 %, total nitrogen – 0,23–0,26 %, phosphorus – 0,11–0,16 %, potassium – 2,0–2,5 %, pH of water extract – 6,5–7,0.

Field experiments were laid after winter wheat on a background of $N_{45}P_{45}K_{45}$. Seeding rate of barley and oat was 4,5, triticale and wheat – 5,0 million of grains/ha. In experiments

seeded varieties of spring small cereals various breeding centers. Soil preparation, sowing, care of crops and harvesting were carried out according to the zonal recommendations. Variants in a field experiment designed systematically, with three replications. Accounting plots area – 25 m^2.

Arid conditions of Ukraine's Steppe zone is quite complex. Two-thirds of land in Ukraine, according to the FAO, referred to zone of risky agriculture, but even here you can use 30–50 % and more of varieties capacity, in consideration of importance the local gene pool in creating highly adapted varieties based on local varieties, that are resistant to dry conditions.

Weather conditions during the investigation were different, which made it possible to fully assess its impact on grain productivity potential of spring small cereals. Thus, in 2011, during the growing season dropped 245,3 mm of rainfall, which is 25 mm more than the average longterm rate, the average temperature was +17,7 ºC, hydrothermic index (GTI) during the growing season was 1,33. Extremely dry was 2012 (GTI = 0,61), which was characterized by higher temperatures (24,1 ºC, which is 9,1 ºC high than norm) and a deficit of rainfall (during the growing season dropped 172 mm of rainfall, 50 mm less the norm). Weather conditions in 2013 included both periods of drought and periods of abundant moisture (GTI = 0,77). The total depth of precipitation during the growing season in 2013 amounted to 141,2 mm and average atmospheric temperature +17,6 ºC (table 1).

1. Combination of weather factors during the vegetation period of spring small cereals

Inter-stage periods	Precipitation, mm				Temperature, ºC			
	year			rate	year			rate
	2011	2012	2013		2011	2012	2013	
Sowing – emergence	0,4	6,3	11,3	10	14,8	13,1	10,6	12
Emergence – tillering	16,5	5,8	0	20	12,2	20,6	16,2	11
Tillering – stem elongation	9,0	49,1	0	30	18,7	20,7	18,1	16
Stem elongation – earing (paniculation)	12,4	32,3	67,4	60	20,8	19,9	19,9	16
Heading (paniculation) – full ripeness	207,0	16,8	62,5	100	21,9	22,5	23,2	19
Sowing – full ripeness	245,3	110,3	141,2	220	17,7	19,4	17,6	15

The table shows that the air temperature and precipitation are the critical factors for normal growth and development of spring cereals, that is attach conditions to diversify and enrich varietal composition of these crops.

The spring small cereals in 2011 were seeded on April, 19; 2012 – on April, 13; and in 2013 – on April, 12. Stored of productive moisture before seeding of spring crops in 2011 we-re satisfactory for even stands, in soil layer (0–10 cm) it was 19,0 mm, 0–30 cm – 55,9 in the 0–120 cm – 195,1 mm. Sprouts of all varieties of spring cereals appeared simultaneously – on April, 28; tillering phase also occurred simultaneously in all barley varieties – on May, 10; in oat – 13; and in triticale and wheat – on May, 15. Stem elongation in barley varieties differed by only 2–3 days. Earing stage in different barley varieties also varied in terms (table 2).

The earliest heading stage were marked in varieties: Adapt (6.06) for 2 days later – Stalker, Selenit, Enei, Sozonivs'kyi, Sovira and Ilot (8.06). Varieties of spring triticale formed ear (8.06) and spring wheat for 2 days later (10.06). Well after paniculation stage observed in oats – on June, 11. Further growth and development of spring small cereals was held according to their biological and varietal characteristics and so full ripeness of grain in different varieties marked in differ-rent terms. The fastest (15–16.07) ripened grain of barley varieties: Adapt, Stalker, Sozonivs'kyi, SN-28, Sovira and Ilot, and the latest (on July, 19) – in Dzherelo, Vakula and Gelios. Full grain ripeness of spring triticale and wheat varieties and occurred on July, 18; in oat variety Synelnykivs'kyi 1321 – on July, 21 and in Skakun – on July, 23.

Lack of rainfall and elevated temperatures in the early phase of earing materially affected the conditions of spring crops. The index of productive tillers was highest in barley varieties Stalker, Vodograi, Galaktyk (1,64–1,80) and lowest (1,12–1,14) in – Ilot and Dzherelo and in spring wheat and triticale – 1,01–1,08. Ear length of spring barley depending on the variety

was 5,3–6,8 cm, triticale – 4.7 and spring wheat – 5.1 cm.

As the grain content, per ear/panicle distinguished the common barley Vakula and Helios – (31,9–32,9 kernels), while the of two-row varieties – from 14,9 to 25,6 kernels. The smallest grain content was in spring triticale – 8 and in spring wheat – 14,2, and they had the lowest weight, respectively – 19,3 and 21,0 g. Greatest weight of 1000 kernels formed plants of barley varieties: Stalker and Sozonivs'kyi (55,7 and 56,2 g), and least – Zorianyi (44,8 g).

2. Formation the structure elements of crop yield of spring small cereals varieties in 2011

Variety	Plant height, cm	Index of productive tillers	Ear/panicle length, cm	Grain content, per ear/panicle	1000-kernel weight, g	Grain yield, t/ha
BARLEY						
Adapt	56,4	1,32	6,7	20,5	52,4	3,10
Komandor	54,6	1,30	6,3	20,6	47,1	2,88
Stalker	53,3	1,77	6,1	25,6	55,7	3,45
Selenit	49,7	1,15	6,0	21,0	47,3	2,62
Get'man	56,6	1,50	6,0	24,1	47,7	2,98
Vodograi	45,6	1,64	6,8	25,3	52,9	3,13
Zorianyi	48,6	1,43	5,3	16,5	44,8	2,46
Sviatogor	54,2	1,41	5,4	17,8	46,3	3,16
Kazkovyi	44,4	1,48	5,6	20,1	46,0	3,33
Charivnyi	48,0	1,65	6,4	29,6	48,3	3,29
Galaktyk	55,9	1,80	6,5	24,6	51,0	2,95
Vakula	47,8	1,26	4,9	32,9	45,1	3,18
Gelios	51,3	1,20	5,6	31,9	46,5	3,15
Vsesvit	52,8	1,24	6,4	22,4	46,9	3,43
Enei	51,5	1,45	6,3	25,1	48,9	3,04
Sozonivs'kyi	56,9	1,24	5,9	17,6	56,2	3,53
SN-28	57,2	1,34	5,6	16,8	52,2	3,23
Statok	54,4	1,41	6,4	18,3	45,9	3,48
Sovira	52,3	1,26	5,4	16,9	50,0	3,40
Ilot	51,9	1,14	5,4	14,9	51,0	3,17
Dzherelo	53,4	1,12	6,3	17,5	47,5	3,03
OAT						
Synel'nykivs'kyi 1321	61,9	1,85	11,0	18,0	17,8	2,77
Skakun	62,4	1,82	11,6	25,9	22,9	3,01
WHEAT						
Kharkivs'ka 30	60,6	1,08	5,1	14,2	21,0	1,01
TRITICALE						
Aist kharkivs'kyi	63,4	1,01	4,7	8,0	19,3	0,71

The highest grain yield in 2011 provided by a barley variety: Sozonivs'kyi – 3,53, Statok – 3,48 t/ha (originator – Kirovograd SAES) and varieties Stalker – 3,45 and Kazkovyi – 3,33 t/ha (originator – Plant Breeding and Genetics Institute). Of the oat varieties the best grain yield results was variety Skakun – 3,01 t/ha. Varieties of spring triticale and wheat formed the lowest crop yield – 1,01–0,71 t/ha.

Stored of productive moisture before seeding of spring crops in 2012 were slightly lower than in 2011, but still satisfactory for even stands. In soil layer (0–10 cm) it was 15,6 mm, 0–30 cm – 49,1 in the 0–100 cm – 139,3 mm. Sprouts of all varieties of spring small cereals appeared simultaneously – on April, 20; tillering phase also occurred simultaneously in all varieties of barley and triticale – on May, 8; in oats and wheat – on May, 10. Earing phase in barley varieties varied in terms of occurrence. Earlier earing stage marked in varieties: Adapt, Sozonivs'kyi, SN-28 and Gatunok (28.05) and also Stalker (29.05), Krok (30.05), other varieties soon after – on June, 1–5; depending on their biological characteristics. Varieties of spring triticale formed ear 1–4.06; spring wheat – 2–4.06 and panicle of oats – on June, 3–5.

Further growth and development of spring small cereals was held according to their bio-

logical and varietal characteristics and therefore the full grain ripeness in different varieties observed in different terms. Previously, others for 2–4 days, matured grain of barley varieties: Adapt, Stalker, Sozonivs'kyi, SN-28 (6.07). Full grain ripeness of spring triticale and wheat varieties marked on July, 9–10; oat variety Skakun – 11.07. Grain of naked oats – Skarb Ukrainy and Samuel matured for 2 days earlier (9.07) than in hulled variety Skakun.

3. Formation the structure elements of crop yield of spring small cereals varieties in 2012

Variety	Plant height, cm	Index of productive tillers	Ear/panicle length, cm	Grain content, per ear/panicle	1000-kernel weight, g	Grain yield, t/ha
BARLEY						
Adapt	56,8	1,65	7,3	22,7	40,0	2,84
Vodograi	59,2	1,62	6,5	23,8	41,3	3,32
Komandor	59,6	1,25	6,0	16,2	36,9	2,14
Stalker	59,7	2,08	7,1	28,3	45,5	3,34
Selenit	60,3	1,54	6,3	19,3	36,5	2,57
Get'man	61,8	1,55	6,4	21,3	38,0	3,16
Zorianyi	62,9	1,37	6,1	19,2	35,3	2,60
Sviatogor	65,4	1,72	7,6	25,9	36,7	3,25
Kazkovyi	51,2	1,54	5,8	18,1	34,7	2,55
Charivnyi	50,4	1,60	5,9	20,3	35,8	3,29
Galaktyk	57,2	1,54	6,5	21,8	41,6	3.15
Vakula	61,1	1,40	5,8	36,0	36,7	2,94
Gelios	65,0	1,41	5,8	39,6	38,0	3,24
Enei	60,4	1,80	7,0	22,0	39,8	3,32
Osnova	50,7	1,11	4,8	21,5	35,4	1,99
Sozonivs'kyi	59,5	1,68	7,0	28,0	48.6	3,49
SN-28	65,1	2,02	7,1	27,0	46,7	3,19
Statok	61,6	1,62	6,6	21,6	44,9	3,31
Gatunok	58,4	1,82	6,6	19,1	40,2	2,82
Krok	61,5	1,94	5,9	22,3	45,1	3,20
Sovira	57,6	1,65	6,3	20,2	40,0	2,95
Ilot	53,2	1,51	5,8	20,3	38,8	3,05
Dzherelo	65,7	1,22	6,1	25,6	37,3	2,56
Aspekt	60,2	1,35	6,4	24,6	37,7	2,70
Parnas	56,9	1,41	6,3	21,2	37,0	2,57
Vyklyk	54,6	1,69	6,6	24,8	39,8	2,88
Etyket	62,0	1,38	6,4	24,5	38,0	2,45
OAT						
Skakun	81,8	1,49	13,9	51,1	29,3	2,59
Skarb Ukrainy	75,6	1,26	9,2	27,8	18,5	2,44
Samuel'	79,1	1,44	12,3	28,7	18,1	2,18
WHEAT						
Kharkivs'ka 30	79,8	1,18	6,4	19,1	35,3	2,24
Naschadok	65,4	1,15	5,6	12,1	33,0	1,96
Spadschyna	88,2	1,21	5,8	15,2	31,3	1,75
Chado	80,0	1,13	5,4	15,3	32,8	1,82
TRITICALE						
Korovai kharkivs'kyi	87,3	1,19	7,7	20,8	28,4	1,20
Avias kharkivs'kyi	88,9	1,22	7,5	20,1	27,6	1,03
Legin' kharkivs'kyi	91,5	1,21	7,0	22,1	27,6	1,16
Oberig kharkivs'kyi	89,6	1,10	7,6	21,1	28,1	1,08
Hlibodar kharkivs'kyi	95,4	1,37	8,4	21,7	29,0	1,29

Elevated temperatures and lack of rainfall in the early phase of earing affected the formation of yields structure parameters. The index of productive tillers was highest in barley

varieties Stalker (2,08) and SN-28 (2,04), slightly lower – (1,80–1,94) were in Enei, Gatunok and Krok, and the lowest – in Komandor (1,25), Dzherelo (1,22), and in alternative variety – Osnova (1,11). The index of productive tillers in spring wheat and triticale was lower than in spring barley – 1,10–1,37, oat took an intermediate stage – from 1,26 to 1,49 (table 3).

The longest ear of spring barley (7,0–7,6 cm) formed varieties: Sviatogor, Adapt, SN-28, Enei and Sozonivs'kyi. In spring wheat for this indicator the advantage has variety Kharkivs'ka 30 (6,4 cm), and spring triticale – Hlibodar kharkivs'kyi (8,4 cm). Grain content, as in previous years, distinguished common barleys Vakula and Gelios. Their ear, consist an average of 36,0–39,6 kernels, whereas the of two-row varieties – from 16,2 to 28,3. The smallest grain content formed in spring wheat – 12,1–19,1 kernels. In spring triticale ear had 20,1–22,1 grains, but their weight was lower compared with wheat to 3,7–6,3 g. Among barley varieties more filled was grain in varieties: Sozonivs'kyi (1000-kernel weight – 48,6 g), SN-28 – 46,7; Stalker – 45,5; and Krok – 45,1 g. Minimum weight of 1000 grains formed in barley varieties: Kazkovyi (34,7 g), Zorianyi (35,3 g), Os-nova (35,4 g) and Charivnyi (35,8 g). Spring wheat varieties had a greater weight of 1000 kernels (31,3–35,3 g) compared with triticale (27,6–29,0 g) and oat (18,1–29,3 g). Naked oats in 2012 had the lowest weight of 1000 grains – 18,1–18,5 g.

The differences in structure productivity indices of plant influenced the grain yield of spring cereals. The highest crop yield in 2012 provided barley variety Sozonivs'kyi – 3.49 t/ha. Good grain yield also provided varieties: Stalker – 3,34, Vodograi and Enei – 3,32 and Statok – 3,31 t/ha. The best result in oat was variety Skakun – 2,59 t/ha. Naked oat varieties reduced crop yield, compared with the Skakun: Skarb Ukrainy – to 2,44 and Samuel – to 2,18 t/ha. Among spring wheat varieties the better grain yield provided Kharkov 30 – 2,24 t/ha, other varieties formed a lower yield – 1,75–1,96 t/ha, which is less than the oats yield, but higher than yield of spring triticale (1,03–1,29 t/ha).

Stored of productive moisture before seeding of spring crops in 2013 were satisfactory for even stands, in 0–10 cm soil layer it was 18,8 mm; 0–30 cm – 52,2; in 0–100 cm – 148,1 mm. Shoots of spring crops appeared simultaneously – on April, 23. Tillering stage of barley observed, depending on the variety, on May, 8–12; in oats – 11-12; wheat – 13–17 and triticale – on May, 15. Earing stage in different barley varieties varied in terms of occurrence. Earliest, as in 2012, form ear varieties: Adapt, Sozonivs'kyi, SN-28 – on May, 25–26.05 and 28–30.05 – Galaktyk, Krok, Vodograi, Donets'kyi 15, Voievoda. Other varieties, soon after – on June, 4–7. Spring triticale varieties formed ear 27.05; spring wheat – 27–30.06; and oat – on June, 5–7. Further growth and development of spring cereals was held according to their biological and varietal characteristics and therefore the full grain ripeness in different varieties noted in different terms. Before the rest for 3–4 days, matured grain of barley varieties: Adapt, Stalker, Sozonivs'kyi, SN-28, Krok (28–29.06). Ot-her varieties of barley finished the growing season on July, 1–2. Full grain ripeness of spring wheat and triticale varieties marked 5–7, and oat – on July, 6–8. In general, the growing season in spring barley varieties was 80–82 days, oat – 86-88, spring wheat – 84–86, and spring triticale – 86 days.

Elevated temperatures and lack of rainfall in the early phase of earing affected the formation of structural indicators of spring crops – plant height of different barley varieties was varied within 57,8–69,3 cm, oat – from 87,4 cm (Skakun) to 92,9 cm (Skarb Ukrainy). Wheat and triticale had plant height 81,3–87,1 and 86,6–89,3 cm respectively (table 4).

In spring barley the ear length was greater varieties: Stalker, Adapt, Statok (6,6–6,7 cm) and also – in Vodograi, Vsesvit, Sozonivs'kyi, Vzirets' and Yukatan (6,1–6,4 cm). In oats, it was almost equal in all varieties (15,1–15,8 cm). In spring wheat in 2013 formed the smallest ear among spring crops (4,1–4,8 cm). For this indicator distinguished Spadschyna (5,1 cm). Triticale had the longest ear – 6,2–7,4 cm. Most grain content per ear was formed in common barley varieties: Vakula and Gelios – 33,2 and 28,4 respectively, and also oats variety Spurt – 33,2 kernels. Among the two-row barley varieties more grains per ear formed Sozonivs'kyi – 24,5; Vsesvit and Galaktyk – 22,6. In spring wheat more grains per ear was formed in Kharkivs'ka 39 and Spadschyna – 19,3 and 18.9 kernels, respectively, and the minimal: Kharkivs'ka 30 – 10,8;

Yevdokia – 13,2 and Heroinia – 13,5. In the ear of spring triticale formed from 10,8 to 16,7 kernels, almost as much as in spring wheat, but much less than in spring barley.

Index of productive tillering was highest in barley varieties: Donets'kyi 12, Donets'kyi 14, Sozonivs'kyi, SN-28 and Galaktyk – (1,7–1,9). Slightly lower indices of productive tillering (1,6) had: Vodograi , Voievoda, Statok, Donets'kyi 15, Vzirets' and Yukatan, and the lowest – (1,0–1,1) in varieties: Enei, Vsesvit and in alternative – Osnova. Index of productive tillering in spring wheat was 1,0–1,3; in spring triticale – 1,4–1,5, while in oat – 1,4–1,6.

4. Formation the structure elements of crop yield of spring small cereals varieties in 2013

Variety	Plant height, cm	Index of productive tillers	Ear/panicle length, cm	Grain content, per ear/panicle	1000-kernel weight, g	Grain yield, t/ha
BARLEY						
Adapt	62,5	1,5	6,6	21,3	39,4	3,43
Vodograi	63,7	1,6	6,3	21,0	42,6	3,37
Stalker	65,8	1,4	6,7	20,2	44,3	3,33
Voievoda	62,2	1,6	5,7	21,0	34,8	3,33
Get'man	59,6	1,3	5,5	18,4	33,8	2,79
Galaktyk	66,3	1,8	5,7	22,6	39,4	3,57
Vakula	62,2	1,3	5,7	33,2	33,5	3,13
Gelios	59,6	1,3	5,3	28,4	33,8	3,04
Enei	62,8	1,1	5,8	21,4	35,0	3,43
Vsesvit	66,7	1,1	6,4	22,6	35,2	3,50
Osnova	61,9	1,0	5,6	21,0	30,8	2,80
Sozonivs'kyi	69,3	1,8	6,3	24,5	45,7	3,34
SN-28	72,2	1,7	6,2	21,2	35,6	3,31
Statok	68,6	1,6	6,7	21,0	45,8	3,47
Krok	67,5	1,5	5,6	21,3	44,0	3,12
Sovira	57,8	1,4	5,1	20,4	36,3	3,01
Ilot	60,5	1,5	5,3	20,3	38,5	3,26
Dniprovs'kyi	64,2	1,4	5,6	21,0	39,9	3,15
Donets'kyi 12	65,4	1,8	5,2	19,0	36,6	2,87
Donets'kyi 14	62,9	1,9	5,5	22,1	38,9	3,18
Donets'kyi 15	62,3	1,6	5,6	20,5	44,3	3,21
Shidnyi	61,4	1,4	5,4	20,0	43,0	3,14
Partner	63,6	1,5	5,3	20,0	43,2	3,05
Modern	66,9	1,4	5,9	21,0	41,1	3,11
Vzirets'	61,3	1,6	6,2	20,9	40,5	3,14
Hadar	60,2	1,4	5,7	21,1	39,1	3,26
Yukatan	58,3	1,6	6,1	20,3	36,3	3,18
OAT						
Skarb Ukrainy	92,9	1,5	30,6	15,8	24,3	3,01
Skakun	87,4	1,5	32,8	15,4	31,3	3,16
Synel'nykivs'kyi 1321	91,8	1,6	30,6	15,3	30,2	3,08
Busol	90,1	1,4	32,3	15,4	30,8	3,46
Spurt	91,3	1,5	33,2	15,1	30,6	3,39
WHEAT						
Kharkivs'ka 30	80,0	1,0	10,8	4,1	23,6	0,84
Kharkivs'ka 39	87,1	1,3	19,3	4,8	30,2	1,82
Geroinia	84,6	1,0	13,5	4,4	25,8	1,36
Naschadok	82,8	1,2	17,1	4,8	29,3	1,60
Spadschyna	85,3	1,3	18,9	5,1	34,7	1,84
Chado	86,1	1,2	17,8	4,7	31,8	1,73
Yevdokia	81,3	1,0	13,2	4,0	20,4	0,75
TRITICALE						
Hlibodar kharkivs'kyi	86,6	1,5	10,8	7,4	22,3	0,72

Legin' kharkivs'kyi	89,3	1,5	12,4	6,3	22,4	0,78
Lebid' kharkivs'kyi	87,7	1,4	16,7	6,2	23,5	0,98

Among the barley varieties more filled was grain in varieties: Statok and Sozonivs'kyi, 1000-kernel weight was respectively – 45,8 and 45,0 g, slightly less – in Stalker and Donets'kyi 15 – 44,3 g. Minimum weight of 1000 grains formed in alternative barley variety – Osnova (30,8 g) and common barley varieties: Vakula and Gelios – 33,5 and 33,8 g, respectively. Among the oats varieties in 2013 the smallest weight of 1000 grains was in naked variety Skarb Ukrainy – 24,3 g, while other varieties formed 30,2–31,3 g.

In spring wheat greater mass of 1000 grains was variety Spadschyna (34,7 g), the least – Yevdokia (20,4 g) and Kharkivs'ka 30 (23,6 g); in spring triticale – at a rate of 22,3–22,5 g.

The differences in the structural parameters of plants affected the grain yield of spring crops. The highest crop yield in 2013 provided the barley varieties: Galaktyk (3,50 t/ha) and the Vsesvit (3,57 t/ha). Good grain yield of barley varieties are also provided Statok – 3,47, Adapt and Enei – 3,43 t/ha. Close to these figures formed productivity varieties: Vodograi – 3,37, Stalker, Voievoda – 3,33 and SN-28 – 3,31 t/ha. Among the oats varieties the best yields results were: Busol – 3,46 t/ha, among the spring wheat – Spadschyna and Kharkivs'ka 39 – 1,84 and 1,82 t/ha, respectively. Other varieties of spring wheat formed lower crop yields – 1,36–1,73 t/ha and particularly low – Yevdokia (0,75 t/ha) and Kharkivs'ka 30 (0,84 t/ha). Spring triticale varieties, as in 2011 and 2012, had the lowest grain yield – 0,72–0,98 t/ha.

In view of the above said it will be observed that in terms of the recent years due to increased air temperatures, lack of moisture (especially in the first half of the growing season) spring plant growth is accelerated for 6–7 days, and the full ripeness in some varieties marked at the end of June.

The weather conditions in different years of investigation also influenced the formation of crop yield structural indicators of spring cereals and the level of productivity their varieties. Higher crop yields (3,31–3,53 t/ha) during the investigation period formed varieties of spring barley: Stalker, Statok, Sozonivs'kyi and Vsesvit. Slightly below productivity level (2,84–3,57 t/ha) formed varieties: Adapt, Sovira, Galaktyk, SN-28, Enei, Vodograi and Charivnyi.

Among the oats varieties the best crop yield provided: Skakun, Busol and Spurt – 3,01–3,46 t/ha and on this indicator was at a rate of the best varieties of barley. Within the spring wheat the better crop yield resulted varieties: Kharkivs'ka 30, Naschadok and Spadschyna (1,36–1,84 t/ha), but yet formed the less yield as compared to spring barley. Spring triticale, due to the low weight of 1000 grains and the lack of their number in the ear, provided the lowest grain yield among spring crops (0,71–1,29 t/ha).

Therefore, taking into consideration all of the above should be noted, that the maximum realization of the genetic potential of varieties that contribute to the formation of stable high yields of grain, it is necessary: to increase the acreage of highly productive spring small cereals, to accelerate introduction of a new generation of varieties adapted to the agro-ecological growing conditions with valuable economic properties and characteristics. Only correct approach to the cultivation of spring barley in the Steppe and the Ukraine as a whole will increase the sustainability of crops to adverse environmental conditions, increasing grain production of adequate quality products.

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