Таблиця 3 – Середні показники якості зерна досліджуваних сортів та ліній середньої групи стиглості (2014-2015 р.)

Сорти	Плівчастість,%	Склопо-дібність, %	Тріщину-ватість, %	Загальний вихід зерна, %	Вихід цілого ядра, %
Сорти з коротким типом зернівки					
Україна-96 (St)	16,25	86	1	69,00	94,10
Антей	17,55	99	3	68,35	92,10
Віконт	18,85	99	0	67,10	91,50
Онтаріо	17,00	96	1	68,25	91,15
УІР-9137	21,10	98	2	65,35	84,80
УІР-6764	21,80	99	1	64,45	83,65
УІР-3472	16,50	94	2	72,35	80,20
УІР-7883	17,90	98	4	67,30	84,60
УІР-7849	17,70	99	1	67,80	87,70
УІР-8319	20,15	100	0	66,15	84,65
УІР-7195	19,70	100	0	66,90	88,10
УІР-8308	15,50	95	0	69,25	88,50
УІР-8458	17,75	98	4	67,30	89,45
УІР-6876	17,30	98	6	67,95	88,80
УІР-8366	21,00	98	3	66,35	88,45
Середнє	18,40	98	1,9	67,59	87,85
Сорти з подовженим типом зернівки					
Преміум (St)	20,15	97	2	68,55	89,10
Маршал	17,40	98	1	67,20	83,10
УІР-8317	17,45	99	0	68,25	87,25
Середнє	18,30	98	1	68,00	86,48

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THE ADAPTIVE POTENTIAL OF THE INBRED LINES OF THE CUTTING LETTUCE

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Problem setting. The variability of quantitative traits due to growing conditions and “genotype-environment” interaction always occurs in the process of growing crops. In this connection the matter of environmental stability of crop-growing was always paid special attention [1]. According to A. A. Zhuchenko the possibility of certain species of plants to resist the actions of local environmental stress factors has decisive influence on their geographical distribution and crop structure formation [2]. Therefore, to ensure sustainable harvests of native varieties and F1 hybrids of vegetable plants species it is important to create source material for selection not only with high vegetable productivity and quality potential, but with stable display of valuable traits in varying stress conditions that appear in different ecological and geographical zones of Ukraine.

Objective of the research: to analyze the adaptive properties of inbred lines of leaf variety seed lettuce and allocate valuable sources for varietal selection.

Materials and methods of research. The research object: leaf variety seed lettuce (*Lactuca sativa* L. var secalina). The research subject: 46 inbred lines created as a result of years of individual selection during 1998-2012 in agro-climatic zone of Left-bank Forest-Steppe of Ukraine (town Selektsiine, Kharkiv district, Kharkiv region). Field studies were conducted during 2013-2015 on experimental field of Research station “Maiak” of the Institute of Vegetables and Melons of NAAS in the village of Baklanovo of Nizhyn district of Chernihiv region. By natural conditions the area where the research was carried out is close to Northern Forest Steppes of Ukraine with moderately warm mild enough

climate. Sowing of lettuce seeds was held manually in the second decade of April (April 18, 2013, April 17, 2014 and April 17, 2015) with norm of seeding – 2 kg/ha, with the depth of seeding 1-2 cm. The research was conducted in accordance with VIR (All-Russian Institute of Plant Industry) method for studying collections of rare crops, according to work plans for current standards [3-5].

During the growing period of plants the phonologic observations were carried out: dates of seeding, sprouting, appearance of first true leaf, early (10%) and mass (75%) onset of economic suitability, shooting, flowering, seeds ripening. The lines were evaluated compared to correspondent breed-standard Snizhynka which appears in the State Register.

Research results. The following quantitative traits were studied to determine the adaptive capacity of inbred lines: “Rosette height”, “Rosette diameter”, “Number of leaves on one plant”, “Leaf length”, “Leaf width”, “One plant weight”, “Productivity”. Biometric measurements of lettuce plants were carried out in the period of economic suitability (in the first decade of June). The results of 3-year research on the characteristics of display of quantitative traits of inbred lines were summarized in Table 1. It was established that in investigated sample of inbred lines of leaf lettuce the variations of trait “Rosette height” was within 15.33-23.13 cm, “Rosette diameter” – 21.32-35.02 cm, “Number of leaves on one plant” – 8.34-15.0 pieces, “Leaf length” – 13.06-20.76 cm, “Leaf width” – 6.91-12.47 cm, “One plant weight” – 43-91.67 g, “Productivity” – 4.37-9.54 t/ha.

One of the important traits that determine the productivity of leaf lettuce plants is “Leaf length” and “Leaf width”. Investigated inbred lines can be divided into the following groups by leaf length and width.

1. Group of samples with very short leaf length up to 15 cm. 9 samples were selected by such manifestation of this trait: Kucheriavets (K-7055); Mistsevyi-3 (individual selection) (K-7053); Dudai melagagut (K-7031); Dudai melagagut (individual selection) (K-7032); Radacryzetni (K-7038); Malgpachavatua (K-7077); Krolowa Majowych (K-7064); Joclowa (K-7065); Grande (K-7044).

2. Group of samples with short leaf length within 15-20 cm. 37 samples were selected by such manifestation of this trait: Snizhynka, st (K-7035); Spalakh (K-7040); Mistsevyi (K-7087); Mistsevyi-2 (K-7051); Mistsevyi-3 (K-7052); Mistsevyi-4 (K-7068); Mistsevyi-6 (K-7056); Mistsevyi-7 (K-7057); Mistsevyi-7 (individual selection) (K-7058); Mistsevyi-8 (K-7059); Mistsevyi-9 (K-7060); Mistsevyi-10 (K-7062); Mistsevyi-12 (K-7067); Dyvohrai (K-7063); Eva (K-7074); Velmozha (K-7088); Midia (K-7048); Antina (K-7069); Verpig (K-7078); Janra (K-7081); Morine (K-7082); Rofos (K-7034); Fame (K-7037); Karrent (K-7041); Ylanks (K-7045); Columbus (K-7072); VDB 8/858 (K-7079); Zao-shou jian-ye (K-7039); Dalas (K-7075); Risnusag (K-7085); Oparesky (K-7046); Grand Rapids (K-7036); Cosor Romonil (K-7084); Wanderful (K-7083); Bibb (K-7043); Zheleznaia Gabba (K-7049), Arktika (K-7050).

One sample was found – Ried Kredo (K-7070) the leaf length of which exceeded the length of 20.76 cm, while the leaf length of breed-standard Snizhynka was 15.72 cm (Table. 1).

3. Group of samples with leaf width up to 10 cm. 20 samples were selected by such manifestation of this trait: Spalakh (K-7040); Mistsevyi (K-7087); Mistsevyi-3 (K-7052); Mistsevyi-4 (K-7068); Mistsevyi-3 (individual selection) (K-7053); Mistsevyi-6 (K-7056); Dyvohrai (K-7063); Velmozha (K-7088); Verpig (K-7078); Morine (K-7082); Fame (K-7037); Ylanks (K-7045); VDB 8/858 (K-7079); Zao-shou jian-ye (K-7039); Dalas (K-7075); Oparesky (K-7046); Krolowa Majowych (K-7064); Joclowa (K-7065); Cosor Romonil (K-7084); Wanderful (K-7083).

4. Group of samples with leaf width more than 10 cm. 27 samples were selected by such manifestation of this trait: Snizhynka, st (K-7035); Kucheriavets (K-7055); Mistsevyi-2 (K-7051); Mistsevyi-7 (K-7057); Mistsevyi-7 (individual selection) (K-7058); Mistsevyi-8 (K-7059); Mistsevyi-9 (K-7060); Mistsevyi-10 (K-7062); Mistsevyi-12 (K-7067); Eva (K-7074); Midia (K-7048); Antina (K-7069); Janra (K-7081); Rofos (K-7034); Karrent (K-7041); Columbus (K-7072); Dudai melagagut (K-7031); Dudai melagagut (individual selection) (K-7032); Risnusag (K-7085); Radacryzetni (K-7038); Malgpachavatua (K-7077); Grand Rapids (K-7036); Bibb (K-7043); Grande (K-7044); Zheleznaia Gabba (K-7049); Arktika (K-7050); Ried credo (K-7070). Maximum size of leaf width was found in sample Mistsevyi-7 (individual selection) (K-7058).

Average productivity indicator in the years of research in breed-standard Snizhynka was 6.6 t/ha (Table. 1). The following samples statistically significantly exceeded this indicator: VDB 8/858 (K-7079) – 9.54 t/ha; Mistsevyi-7 (ind.vidbir) (K-7058) – 8.52 t/ha; Grande (K-7044) – 8.33 t/ha; Dudai melagagut (Ind. Selection) (K-70320) – 8.17 t/ha; Columbus (K-7072) – 8.16 t/ha; Midia (K- 7048) – 8.04 t/ha; Mistsevyi-7 (K-7057) – 8.04 t/ha; Fame (K-7037) – 7.67 t/ha; Karrent (K-7041) – 7.63 t/ha; Rofos (K-7034) – 7.6 t/ha; Risnusag (K-7085) – 7.55 t/ha; Dudai melagagut (K-7031) – 7.45 t/ha; Mistsevyi-12 (K- 7067) – 7.44 t/ha; Dalas (K-7075) – 7.4 t/ha; Grand Rapids (K-7036) – 7.08 t/ha. VDB 8/858 (K-7079) sample showed maximum productivity – 9.54 t/ha.

In recent years, due to global climate change, there are significant variations in hydrothermal indicators by years of research even in the same soil and climatic location [6]. This requires considerable attention to the adaptive capacity of created varieties of vegetable species. Highly-adaptive varieties are the key to obtaining stable yield in changing weather conditions and various eco-geographical zones. The basis of adaptive selection is understanding the sense and laws of manifestation of genetic mechanisms that cause macrosystems response to the changes of environmental conditions (response norms) [2, 6].

To determine the adaptive capacity of inbred lines of leaf lettuce our study used the following parameters: GAC (general adaptive capacity); SAC (specific adaptive capacity); Rgs (relative genotype stability); bi (genotype regression coefficient on environment or plasticity coefficient); GBV (genotype breeding value). As a result of statistical calculations of the results of 3-year field research 7 inbred lines which exceeded breed-standard Snizhynka in terms of GBV (Table 2) have been allocated for further breeding. Lettuce samples are placed in Table 2 in the order of productivity decreasing, starting with the highest.

Table 1. – Economically valuable quantitative traits of inbred lines of leaf lettuce (average through 2013-2015)

No.	Sample	Origin	Cat. No.	Rosette, cm		Number of leaf, peaces	Leaf, cm		One plant mass, g	Productivity, t/ha
				Height	Diameter		Length	Width		
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
1.	**Snizhynka, st**	**Ukraine**	**K-7035**	**17.21**	**28.32**	**13.63**	**15.72**	**10.76**	**70.00**	**6.6**
2.	Spalakh	Ukraine	K-7040	15.33	26.34	11.89	15.86	8.11	59.67	5.56
3.	Kucheriavets	Ukraine	K-7055	17.49	25.16	11.76	14.04	10.46	63.67	6.09
4.	Mistsevyi	Ukraine	K-7087	20.21	28.03	13.02	17.84	8.98	70.00	6.62
5.	Mistsevyi -2	Ukraine	K-7051	15.56	26.78	12.06	16.72	10.1	61.67	5.7
6.	Mistsevyi -3	Ukraine	K-7052	17.07	28.67	13.24	15.17	9	51.33	4.84
7.	Mistsevyi -4	Ukraine	K-7068	20.06	26.57	11.23	15.05	9.16	43.00	4.37
8.	Mistsevyi -3 (individual selection)	Ukraine	K-7053	16.87	29.2	13	14.83	8.3	67.33	6.43
9.	Mistsevyi -6	Ukraine	K-7056	17.24	26.67	12.52	16.31	9.71	74.00	6.95
10.	Mistsevyi -7	Ukraine	K-7057	19.37	28.93	14.27	15.27	10.6	86.67	8.04
11.	Mistsevyi -7 (individual selection)	Ukraine	K-7058	18.45	29.57	15	15.65	12.47	91.67	8.52
12.	Mistsevyi -8	Ukraine	K-7059	18.6	28.97	14.13	15.38	10.01	65.00	6.13
13.	Mistsevyi -9	Ukraine	K-7060	19.06	28.14	11.17	16.28	11.55	86.00	7.39
14.	Mistsevyi -10	Ukraine	K-7062	18.92	30.16	13.6	17.21	11.2	78.33	7.29
15.	**Mistsevyi -12**	**Ukraine**	**K-7067**	**17.6**	**27.24**	**11.78**	**16.03**	**10.9**	**59.33**	**7.44**
16.	Dyvohrai	**Ukraine**	K-7063	19.23	26.8	12.12	15.92	9.63	65.00	6.13
17.	Eva	**Ukraine**	K-7074	20.39	29.21	12.53	17.64	10.03	72.67	6.58
18.	Velmozha	**Ukraine**	K-7088	18.67	26.94	11.34	15.47	9.84	60.67	5.71
19.	Midia	France	K-7048	18.93	28.84	10.96	18.17	10.45	87.33	8.04
20.	Antina	France	K-7069	22.47	33.3	10.8	18.91	11.45	61.33	5.83
21.	Verpig	France	K-7078	17.6	21.32	12.17	13.89	8.28	59.67	5.77
22.	Janra	France	K-7081	21.94	32.17	10.99	19.52	10.72	68.00	6.32
23.	Morine	France	K-7082	17.97	27.14	9.86	15.87	9.93	57.00	5.29
24.	Rofos	Netherlands	K-7034	21.94	33.05	14.16	15.03	10.06	82.00	7.6
25.	Fame	Netherlands	K-7037	17.04	25.68	13.27	14.69	9.06	79.33	7.67
26.	Karrent	Netherlands	K-7041	17.87	30.44	11.59	19.57	10.88	82.67	7.63
27.	Ylanks	Netherlands	K-7045	20.04	28.98	10.96	17.51	9.16	57.67	5.39
28.	**Columbus**	**Netherlands**	**K-7072**	**20.89**	**33.64**	**12.34**	**17.99**	**10.42**	**79.67**	**8.16**
29.	**VDB 8/858**	**Netherlands**	**K-7079**	**16.03**	**25.16**	**10.54**	**16.16**	**9.53**	**89.33**	**9.54**
30.	Dudai melagagut	Hungary	K-7031	20.67	26.11	9.13	13.44	11.32	76.67	7.45
31.	Dudai melagagut (individual selection)	Hungary	K-7032	21.52	28.97	9.73	13.37	11.73	85.33	8.17
32.	Zao-shou jian-ye	Hungary	K-7039	19.62	22.42	8.84	15.27	6.91	68.67	6.62
33.	**Dalas**	**Hungary**	**K-7075**	**17.75**	**25.91**	**14.33**	**15.09**	**9.47**	**71.67**	**7.4**
34.	Risnusag	Hungary	K-7085	19.08	27.23	11.51	16.9	11.13	77.00	7.55
35.	Radacryzetni	Czech Republic	K-7038	16.07	27.57	14.26	14.13	11.61	57.67	5.48
36.	Oparesky	Czech Republic	K-7046	17.34	27.17	14.17	16.84	9.6	69.00	6.52
37.	**Malgpachavatua**	**Czech Republic**	**K-7077**	**16.43**	**26.93**	**13.53**	**13.04**	**10.2**	**62.33**	**5.94**
38.	Krolowa Majowych	Poland	K-7064	20.34	26.13	10.27	14.45	9.7	73.00	6.94
39.	Joclowa	Poland	K-7065	15.36	26.53	11.67	13.42	9.29	45.67	4.43
40.	Grand Rapids	USA	K-7036	23.13	27.58	14.79	15.89	10.82	75.67	7.08
41.	Cosor Romonil	USA	K-7084	19.75	28.53	11.36	16.54	9.31	62.33	5.97
42.	Wanderful	Denmark	K-7083	19.19	26.02	8.34	15	9.66	64.67	6
43.	Bibb	Canada	K-7043	20.11	31.16	13.25	19.47	10.57	67.33	6.62
44.	Grande	Germany	K-7044	17.49	26.89	13.05	14.39	10.94	87.33	8.33
45.	Zheleznaya gabba	Belarus	K-7049	16.99	26.98	9.84	15.72	10.36	68.67	6.58
46.	**Arktika**	**Russia**	**K-7050**	**18.21**	**25.63**	**11.13**	**15.82**	**10.83**	**73.33**	**6.92**
47.	**Ried Kredo**	**Moldova**	**K-7070**	**20.81**	**35**	**13.47**	**20.76**	**11.27**	**58.33**	**6.49**
$LSD_{0.05}$				2,2	1,23	1,09	1.64	0.73	4.59	0.41

Table 2 – Characteristics of best inbred lines of leaf lettuce by indicators of adaptive capacity and stability (average through 2013-2015)

No.	Sample	Origin	Cat. No.	Productivity, t/ha	bi	GAC	SAC	Rgs, %	GBV
1.	Snizhynka, st	Ukraine	К-7035	6.6	1.44	-0.08	0.91	14.44	**3.75**
2.	VDB 8/858	Netherlands	К-7079	9.54	1.79	**2.85**	**1.95**	14.65	**5.36**
3.	Columbus	Netherlands	К-7072	8.16	2.02	**1.47**	**2.03**	17.47	**3.9**
4.	Mistsevyi-12	Ukraine	К-7067	7.44	1.09	0.75	1.09	14.06	**4.31**
5.	Dalas	Hungary	К-7075	7.4	1.15	0.71	0.8	12.07	**4.73**
6.	Arktika	Russia	К-7050	6.92	**0.74**	0.24	0.25	**7.23**	**5.43**
7.	Ried Kredo	Moldova	К-7070	6.49	**0.9**	-0.19	0.36	**9.25**	**4.7**
8.	Malgpachavatua	Czech Republic	К-7077	5.94	**0.83**	-0.74	0.31	**9.42**	**4.27**

The response of inbred lines by the trait "Productivity" was determined by the overall adaptive capacity, which ranged from -0.08 to 2.85. The highest overall adaptive ability indicates the ability of a genotype to maintain the characteristic value of phenotypic manifestations of the trait in different conditions. It was the most expressed in samples VDB 8/858 (K-7079) – 2.85 and Columbus (K-7072) – 1.47. For breed-standard Snizhynka overall adaptive capacity was – 0.08. Samples VDB 8/858 (K-7079) – 1.95 and Columbus (K-7072) – 2.03 also had high specific adaptive capacity. Sample Arktika (K-7050) had the lowest specific capacity – 0.25, in breed-standard Snizhynka this parameter was equal to 0.91.

Relative genotype stability (Rgs) allows comparing the results of studies conducted on different types of vegetables and their individual genotypes under different conditions [1]. In fact Rgs is analogous to the coefficient of variation in the study of genotypes in different environments. Samples Arktika (K-7050); Ried kredo (K-7070); Malgpachavatua (K-7077) had the lowest value (<10%) of Rgs. Sample Columbus (K-7072) had the greatest value of Rgs – 17.47%.

The reaction of genotype on improving environmental conditions can be determined by the value of genotype regression coefficient on environment (coefficient of plasticity) *bi*. It is considered optimal when *bi* = 1 if the productivity is higher than the population average. If we consider *bi* as plasticity indicator, then genotype with *bi* = 1 has average plasticity. According to the obtained results with the value of coefficient *bi* > 1 samples VDB 8/858 (K-7079) – 1.79; Columbus (K-7072) – 2.02; Mistsevyi-12 (K-7067) – 1.09, Dalas (K-7075) – 1.15 and breed-standard Snizhynka (K-7035) – 1.09 distinguished (data of Table 2). These inbred lines belong to the forms of intensive type with hypersensitivity to favourable growing conditions and high agricultural background. Samples Arktika (K-7050), Ried kredo (K-7070) and Malgpachavatua (K-7077) distinguished by the value of coefficient *bi* < 1, thus these genotypes demonstrated low response to growing conditions and environmental influence in conducted studies.

In terms of GBV, which is the criterion of adaptability of a certain trait, the studied sample of inbred lines ranged from 3.75-5.43%. All selected inbred lines prevailed breed-standard Snizhynka (K-7035) by this indicator. The largest it was in sample Arktika (K-7050) – 5.43 (Table 2), the lowest in sample Columbus (K-7072).

Biochemical analysis of the best samples of leaf lettuce in terms of adaptive capacity (Table 3) was conducted. 2 samples were selected by dry matter content over 10%: Mistsevyi-12 (K-7062) and Ried kredo (K-7070). The total sugar content ranged from 1.43-2.21% depending on the sample, the highest rates were in: breed-standard Snizhynka (K-7035), Arktika (K-7050) and Mistsevyi-12 (K-7070). 3 samples were selected by vitamin C content over 30 mg/100 g: breed-standard Snizhynka (K-7070), Mistsevyi-12 (K-7062), VDB 8/858 (K-7079). All analyzed adaptive samples of lettuce on the content of biochemical components in terms of nitrate content did not exceed medically acceptable standards in the conditions of their cultivation in open ground (MPC over 2000 mg/kg). The best result by the complex of biochemical indicators was showed by inbred line derived from a variety of leaf lettuce Mistsevyi-12 (K-7070).

Conclusions. As a result of 3-year research (2013-2015) seven promising inbred lines of leaf variety seed lettuce were selected that exceeded breed-standard Snizhynka by productivity, distinguished by high levels of adaptability by productivity and are promising source material for use in selection programs.

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