N E W S
OF THE NATIONAL ACADEMY OF SCIENCES OF THE REPUBLIC OF KAZAKHSTAN
SERIES OF AGRICULTURAL SCIENCES
ISSN 2224-526X
Volume 3, Number 51 (2019), 51 – 58 **https://doi.org/10.32014/2019.2224-526X.35**

UDC 635,658: 632.11

A. Zh. Saykenova[1], T. N. Nurgasenov[1],
M. S. Kudaibergenov[2], S. V. Didorenko[2], B. R. Saykenov[1]

[1]Kazakh National Agrarian University, Almaty, Kazakhstan,
[2]Kazakh Research Institute of Agriculture and Crop Production, Almaty region, Kazakhstan

COMPARATIVE EVALUATION OF DROUGHTABILITY OF VARIETIES OF LENTILES

Abstract. Article results in laboratory experiments to determine the relative drought variety samples method lentil seed germination in the sand in a solution of PEG -10%, 15%. Data on drought tolerance are given. Analysis of lentil samples under conditions of osmotic stress (PEG 10% and PEG 15%) revealed highly dry-resistant samples: K-6, 39113 (Russia).

Keywords: lentils, variety samples, germination, drought resistance, osmotic stress.

Introduction. Lentils are among the most valuable food leguminous crops grown mainly for grain, which is more than a third of protein. Lentil protein contains essential amino acids for the body. Lentil dishes serve for us as suppliers of essential vitamins and minerals that are completely absorbed by the human body. On the content of iron, for example, it has no equal. Lentil has another very valuable property; it does not accumulate in itself any harmful or toxic elements (nitrates, radionuclide's, etc.). Due to this, lentils grown anywhere in the world can be considered an environmentally friendly product [1].

In Kazakhstan, lentils are sown on the territory of the order of 331,566.5 thousand hectares, mostly these plots are located in the north of the republic and are grown in non-irrigated conditions.

In recent years the numbers of dry years are increasing due to the sharp warming on the planet. Drought is a rather frequent phenomenon that disrupts the normal course of physiological and biochemical processes in plants and leads to a decrease in their productivity [6].

Based on the physiological characteristics of plants, the selection of a number of leguminous crops, among other areas, justifies the feasibility of creating genotypes with high intensity of growth processes in the early stages of development to isolate drought-resistant genotypes [3]. Studies conducted on peas have shown that within the optimal length of the stem for a specific soil-climatic zone, genotypes that differ in faster germinal root growth rates have advantages in crop formation [4]. This provides favorable starting conditions for the development of plants, *contributing to the* good rooting of seedlings, an increase in the absorbing surface of the root system, as well as drought tolerance [5]. Currently, there are many physiological methods for assessing the drought tolerance of field crops. The simplest, indirect methods for mass estimation of relative drought tolerance are based on the determination of seed germination and the growth of seedlings in osmotic solutions imitating moisture. The ability of seeds to germinate under these conditions reflects, on the one hand, the hereditary characteristic of germination with relatively less water, on the other, the presence of a high suction force, which ensures the rapid absorption of the requiredamount of water [8]. The high sucking power of the seeds causes not only better germination with a lack of moisture, but also the formation of a more powerful root system (primitive), which is important for the further life of the plants, especially during drought, i.e. properties of the seedling to a large extent affect the formation of drought tolerance in an adult plant [2]. In this regard, it is necessary to select the adaptive and most drought-resistant variety samples.

Methods. The objects of research were 31 collection samples of lentils from different countries. The laboratory studies on the assessment of the drought resistance of lentil plants were carried out in the laboratory "Analysis of grain quality" LLP "Kazakh Research Institute of Agriculture and Crop Production". Drought tolerance relative lentil accessions were evaluated in the early stages of plant growth by seed germination in the sand in 3 cases (PEG-10%, PEG-15%,control isdistilled water) to 3-fold replicates. The seeds were germinated in a thermostat, at a temperature of +20 ^{0} C in the dark. Seed germination was taken into account on day 7. It was dried in a drying cabinet at a temperature of +130 ^{0} C, 40 minutes. According to the methodological guide All-Russian Institute of Plant Industry 1988 Udovenko G.V. [2], solutions with different concentrations of PEG 6000 were prepared according to the method of Michel B. E., KaufmannM. R. [7].

The percentage of germinated seeds (P) is determined as follows:

The number of seeds germinated in the control is taken as 100%, the average number of seeds germinated in an osmotic stress medium (PEG 15% and PEG 10%) (a)is expressed as a percentage of the number of seeds germinated in the control (b) thus formula 1:

$$P = \frac{a}{b} * 100\% . \quad (1)$$

The higher the percentage of seed germination in the PEG nutrient medium is 15%, the more drought-resistant the sample.

To determine depression of growth processes (Index of tolerance), the average dry weight of the seedlings in the control is taken as 100% (x), the average dry weight in the osmotic stress medium (PEG 10% and PEG 15%) (y) is determined in percent of dry weight by seedlings with increased osmotic pressure (z) is determined by the formula 2:

$$Z = 100 - y/x * 100 . \quad (2)$$

In more drought tolerance, the accumulation of seedlings of biomass is inhibited to a lesser extent.

Results. In determining the germination of various levels of osmotic stress of lentils, no significant differences were found. To characterize the drought tolerance of plants, these lengths and numbers of germinal roots were used, since the ability to form a powerful primary root system plays an important role in drought conditions.

The lack of water caused by various concentrations of PEG led to a decrease in stem height, root length and seedling mass, for different lentil samples (figure).

a b c

Seedlings on day 7: a – control, b – PEG-10%, c – PEG -15%

In control, stem height and root length was longer than sprouts in an osmotic stress environment.

Table 1 – Characteristics of drought resistance at stem height and germ-length roots

Sample name	Stemheight, cm			Germ length, cm		
	Control	PEG 10%	PEG 15%	Control	PEG 10%	PEG 15%
4605	10	4.1	3.5	4.2	3.4	2.8
K-184	10	6.2	4.	4.5	3.6	2.5
LC046000246L	10	4.3	3.2	4.5	3.7	2.3
39113	9.9	4.9	3.1	3.9	3.3	2.4
LC04600023L	9.6	4.3	3.5	4.1	2.8	2.8
K-2849	9.5	4.6	3.4	4.8	3.7	2.9
LC04600017L	9.4	4.4	4.1	3.8	3.8	3.2
LC04600068L	9.2	3.9	3.2	3.3	3	2.9
23108	9.2	4.9	3.8	4.3	3.2	2.9
Vekhovskaya	9.1	3.9	2.7	5.1	3.7	3.2
LC046000213L	9.1	4.3	3.5	3.7	3.3	3
23208	8.9	4.8	3.3	4.3	3.3	1.9
39126	8,8	4.1	3.3	3.9	3.5	3.3
K-1975	8.7	4.7	3.7	3.5	2.8	2.5
LC046000103L	8.7	4.5	2.8	4.9	3.6	3.3
23209	8.7	3.9	3.2	3.3	3.3	3.2
LC046000270L	8.6	5.5	4.1	4.4	4.2	3.4
K-2017	8.5	5.2	3.6	3.7	3.1	1.9
39119	8.5	3.6	3.5	3.9	3.4	3.1
23202	8.4	4.2	3.3	3.8	3.5	2.3
LC046000150L	8.4	3.8	3.3	3.3	3.5	3
31215	8.2	4.4	4.	3.5	3.2	2.9
LC046000156L	8.2	4.1	2.4	3.5	3.1	2.7
39203	8.1	4.6	4.2	3.5	2.9	2.9
LC046000223L	8.1	4.1	4.1	3.4	3.5	3.4
LC04600010L	7.9	4.5	3.7	3.5	3.3	3
K-6	7.9	7.5	4.1	5.9	2.9	2.5
LC046000170L	7,8	3.8	3.3	3.1	3.1	2.7
LC046000202L	7.7	4.1	3.1	3.97	2.4	2.4
39227	7	3	2.6	2.7	2.6	2.4
39229	7.1	4.3	3.3	3.4	2.8	2.2

The height of the stem under the conditions of osmotic PEG-10% allocated breeding numbers (7.5-5.2 cm): K-184, LC046000270L, K-2017, K-6, with PEG-15% stood out (4.2-4 cm): K-184, LC04600017L, LC046000270L, 31215, 39203, LC046000223L, K-6.

The length of the root in the osmotic medium PEG-10% stood out (4.2-3.5 cm): LC046000270L, when PEG-15% stood out (3.4-3.1 cm): 39126, LC046000103L, LC046000270L, LC046000223L sorrow samples.

Table 2 –Evaluation of drought tolerance by green and dry weight of lentil seedlings

Sample name	Green mass, g			Dry weight, g		
	Control	PEG 10%	PEG 15%	Control	PEG 10%	PEG 15%
4605	5.8	2	1.9	1.2	0.8	0.5
K-184	1.5	1.4	1.2	0.3	0.4	0.4
LC046000246L	2.5	2	1.5	0.7	0.7	0.5
39113	2.3	1.6	1.6	1.	0.5	0.4
LC04600023L	1.8	1.6	1.6	0.7	0.6	0.4
K-2849	2.6	2.1	1.6	0.8	0.6	0.6
LC04600017L	1.7	1.5	1,3	0.6	0.5	0.3
LC04600068L	2.3	1.6	1.4	0.7	0.6	0.6
23108	1.2	1.	0.9	0.3	0.5	0.4
Vekhovskaya	4.8	1.79	1.2	1.2	0.7	0.5
LC046000213L	2.7	2.1	1,3	0.9	0.7	0.5
23208	1.87	1.5	1.8	0.5	0.5	0.6
39126	1.7	1.6	1.1	0.6	0.5	0.4
K-1975	1,3	1.29	1.2	0.6	0.2	0.4
LC046000103L	1.97	1.6	1.6	0.8	0.7	0.4
23209	2.1	1.9	1.9	0.9	0.9	0.5
LC046000270L	2.1	1.5	1.6	0.9	0.6	0.5
K-2017	2.8	2.2	1.7	0.6	0.4	0.3
39119	1.8	1.7	1.5	0.8	0.5	0.5
23202	2.4	1,3	1.9	0.7	0.6	0.6
LC046000150L	1.7	1.5	1.4	0.6	0.6	0.5
31215	1.6	1.5	1.2	0.6	0.5	0.3
LC046000156L	3.7	2.3	1.7	0.7	0.6	0.45
39203	1.4	0.9	0.9	0.5	0.4	0.2
LC046000223L	1.7	1.7	1.6	0.6	0.6	0.5
LC04600010L	1.7	1.5	1.5	0.8	0.6	0.5
K-6	5.9	5.3	2.1	1.1	0.3	0.3
LC046000170L	4.	2.54	2.1	0.9	0.6	0.9
LC046000202L	1.8	1.7	1.56	0.9	0.6	0.4
39227	7,6	3.9	1.4	0.5	0.6	0.6
39229	4.01	2.8	1.4	0.4	0.4	0.3

According to the green mass in the osmotic medium PEG 10% stood out (0.9-5.3 g): K-6, LC046000170L, 39227, with PEG-15% (0.9-2.1 g): K-6, LC046000170L variety samples.

By dry mass, promising in an osmotic medium is 10% PEG-e (0.4-1.2 g): K-6, LC046000170L, with PEG-15% (0.3-0.9 g): K-6, LC046000170L variety samples.

In more drought-resistant varieties, the accumulation of seedlings of biomass is inhibited to a lesser extent.

Table 3 – Analysis of the resistance index of lentil samples with osmotic stress PEG-10%

Name of variety samples	Origin	Sustainability Index %
		PEG 10%
Resistant variety samples		
K-6	Russia	72.7
K-1975	Canada	66.7
39113	Russia	50
Medium StableSamples		
Vekhovskaya	Russia	41.7
39119	Russia	37.5
4605	Russia	33.3
K-2017	Canada	33.3
LC046000202L	Syria	33.3
LC046000270L	Syria	33.3
K-2849	Russia	25
LC04600010L	Syria	25
LC046000213L	Syria	22.2
39203	Russia	20
39126	Russia	16.7
LC04600017L	Syria	16.7
31215	Russia	16.7
LC04600023L	Syria	14.3
23202	Russia	14.3
LC04600068L	Syria	14.3
LC046000156L	Syria	14.3
LC046000103L	Syria	12.5
Sensitive variety samples		
23208	Russia	0
LC046000246L	Syria	0
LC046000223L	Syria	0
LC046000150L	Syria	0
23209	Russia	0
39229	Russia	0
39227	Russia	-20
K-184	Russia	-33,3
23108	Russia	-66,7

The results showed that osmotic stress has a significant impact on early vegetative developmental stages; the effect depended on the degree of stress. By definition, depression of growth processes with an osmotic stress concentration of PEG of 10%, according to the tolerance index, was divided into 3 groups:

Resistant variety samples are K-6, K-1975, 39113. Mediumly resistant variety samples are Vekhovskaya, 39119, LC046000170L, 4605, K-2017, LC046000202L, LC046000270L, K-2849, LC04600010L, LC046000213L, 39203, by the index, by the text, by the text, by the text; 23202, LC04600068L, LC046000156L, LC046000103L. Sensitive is 23208, LC046000246L, LC046000223L, LC046000150L, 23209, 39229, 39227, K-184, 23108 are variety samples.

Table 4 – Analysis of the stability index of lentil samples with osmotic stress PEG-15%

Name of variety samples	Origin	Sustainability Index %
		PEG 15%
Resistant variety samples		
K-6	Russia	72.7
39113	Russia	60
39203	Russia	60
4605	Russia	58.3
Vekhovskaya	Russia	58
LC046000202L	Syria	55.5
K-2017	Canada	50
LC046000103L	Syria	50
LC04600017L	Syria	50
31215	Russia	50
Medium StableSamples		
LC046000213L	Syria	44.4
LC046000270L	Syria	44.4
23209	Russia	44.4
LC04600023L	Syria	42,8
LC04600010L	Syria	37.5
39119	Russia	37.5
LC046000156L	Syria	35.7
K-1975	Canada	33.3
39126	Russia	33.3
LC046000246L	Syria	28.6
K-2849	Russia	25
23202	Russia	14.3
LC04600068L	Syria	14.3
39229	Russia	25
LC046000150L	Syria	16, 7
LC046000223L	Syria	16.7
23202	Russia	14.3
LC04600068L	Syria	14.3
Sensitive variety samples		
LC046000170L	Syria	0
23208	Russia	-20
39227	Russia	-20
K-184	Russia	-33,3
23108	Russia	-33,3

According to the definition of depression, growth processes with an osmotic stress concentration of PEG of 15% were divided into 3 groups:

Sustainable variety samples are K-6, 39113, 39203, 4605, Vekhovskaya, LC046000202L, K-2017, LC046000103L, LC04600017L, 31215. Mediumly resistant variety samples areLC046000213L, LC046000270L, 23209, LC04600023L, LC04600010L, 39119, LC046000156L, K-1975, 39126,

LC046000246L, K-2849, 39229, LC046000150L, LC046000223L, 23202, LC04600068L. Sensitive is LC046000170L, 23208, 39227, K-184, 23108 are variety samples.

Conclusion. The results showed that osmotic stress has a significant impact on early vegetative developmental stages; the effect depended on the degree of stress.

Analysis of lentil variety samples under osmotic stress conditions (PEG 10% and PEG 15%) revealed highly drought-resistant variety samples: K-6, 39113.

These samples will be used as a starting material for breeding work on drought tolerance.

А. Ж. Сайкенова[1,2], Т. Н. Нургасенов[1], М. С. Кудайбергенов[2], С. В. Дидоренко[2], Б. Р. Сайкенов[1]

[1]Қазақ ұлттық аграрлық университет, Алматы, Қазақстан,
[2]Қазақ егіншілік және өсімдік шаруашылығы ғылыми зерттеу институты, Алматы облысы, Қазақстан

ЖАСЫМЫҚ СОРТҮЛГІЛЕРІН ҚҰРҒАҚШЫЛЫҚҚА ТӨЗІМДІЛІГІН САЛЫСТЫРМАЛЫ БАҒАЛАУ

Аннотация. Мақалада жасымық сортүлгілерін құрғақшылыққа төзімділігін құмда ПЭГ-10%, 15% ерітінділерімен зертханалық тәжірибе арқылы анықтау. Құрғақшылыққа қатысты деректер келтірілген. Осмотикалық стресс (ПЭГ 10% және ПЭГ 15%) талдауы бойынша жасымық сортүлгілерінен құрғақшылыққа өте төзімді үлгілері анықталды: К-6, 39113 (Ресей).

Түйін сөздер: жасымық, сортүлгілері, өнгіштік,құрғақшылыққа төзімділік, осмотикалық стресс.

А. Ж. Сайкенова[1,2], Т. Н. Нургасенов[1], М. С. Кудайбергенов[2], С. В. Дидоренко[2], Б. Р. Сайкенов[1]

[1]Казахский национальный аграрный университет, Алматы, Казахстан,
[2]Казахский научно-исследовательский институт земледелия и растениеводства, Алматинская область, Казахстан

СРАВНИТЕЛЬНАЯ ОЦЕНКА ЗАСУХОУСТОЙЧИВОСТИ СОРТООБРАЗЦОВ ЧЕЧЕВИЦЫ

Аннотация. В статье приведены результаты лабораторных опытов по определению относительной засухоустойчивости сортообразцов чечевицы методом проращивания семян на песке в растворе ПЭГ - 10%, 15%. Приводятся данные по засухоустойчивости. Анализ сортообразцов чечевицы в условиях осмотического стресса (ПЭГ 10% и ПЭГ 15%) выявил высокозасухоустойчивые сортообразцы: К-6, 39113 (Россия).

Ключевые слова: чечевица, сортообразцы, всхожесть, засухоустойчивость, осмотический стресс.

Information about authors:

Saikenova Alma Zhumabayevna, PhD student of 3 year-study at the Kazakh National Agrarian University, Almaty, Kazakhstan; alma.arai@mail.ru; https://orcid.org/0000-0002-9211-1415

Nurgasenov Taken Nurgasenovich, Professor, Doctor of Agricultural Sciences, Kazakh National Agrarian University, Almaty, Kazakhstan; nurgasenov.t@mail.ru; https://orcid.org/0000-0002-1441-9596

Kudaibergenov Mukhtar Sarsenbekovich, Doctor of Biological Sciences, Academician ASKhN RK, Kazakh Research Institute of Agriculture and Crop Production, Almaty region, Kazakhstan; muhtar.sarsenbek@mail.ru; https://orcid.org/0000-0002-8185-3990

Didorenko Svetlana Vladimirovna, Candidate of Biological Sciences, Head of Leguminous Crops Department, Kazakh Research Institute of Agriculture and Crop Production, Almaty region, Kazakhstan; svetl_did@mail.ru; https://orcid.org/0000-0002-2223-0718

Saykenov Bakytzhan Rahmetollinovich, Associate Professor, Candidate of Agricultural Sciences, Kazakh National Agrarian University, Almaty, Kazakhstan; saikenov67@gmail.ru

REFERENCES

[1] The market for lentils of Russia in 2011-2013, January-March 2014 [Electronic resource], access mode: http: // www. stgetman. narod. ru / checheva. html.

[2] Udovenko G.V. Diagnostics of plant resistance to stress: Methodical manual. VIR. Leningrad, 1988. 226 p.

[3] Debely G.A. Leguminous crops in the Nechernozemny zone of the Russian Federation. M.: Nemchinovka, 2009. 260 p.

[4] Novikova N.E. Study of the interrelated relations between the aerial part and the root system near the mountains in connection with the tasks of selection // Biological and economic potential of leguminous, cereal crops and the ways of its realization. Orel, 1999. P. 62-66.

[5] Novikova N.E., Uvarov V.N., Kondykov I.V. Use in the selection of peas of a new method of selection according to the parameters of plant growth at the early stage of ontogenesis // Vestnik RAAS. 2007. N 6. P. 43-46.

[6] Naumkin V.N., Naumkin L.A., Kurenskaya O.Yu., Artyukhov A.I., Lukashevich M.I., Ageeva P.A. Comparative assessment of the drought resistance of varieties and varieties of forage lupine // Plant. 2015. N 3. P. 10-11.

[7] Michel B.E., Kaufmann M.R. (1973). The Osmotic Potential of Polyethylene Glycol6000 // Plant Physiology. 51: 914-916.

[8] DauzovaA.M., Dyrka S. The definition and essence of land relations as an economic category // 2018. Vol. 6, N 376. P. 67-73. ISSN 2518-1467.29 (onlain). ISSN 1991-3494 (Print). https://doi.org/10.32014/2018.2518-1467.29