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Germination of millet genotype seeds under the influences of PEG 6000 solution on the 3^{d} and 6th days

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Purpose. To determine the drought resistance of five millet varieties ('Omriiane', 'Kharkivske 57', 'Konstantinivske', 'IR 5', 'Slobozhanske') "using PEG 6000 as osmotic stress. **Methods.** To obtain the effect of drought, five concentrations of PEG 6000 solutions were used: 0.0% (control), 11.5%, 15.3%, 19.6%, 23.5% and 28.9%, which corresponds to 0.0, 115, 153, 196, 235 and 289 g of solute in 1000 ml of distilled water or 0.0, -1.9, -3.1, -4.8, -6.6 and -9.7 bar. **Results.** Osmotic stress strongly suppressed the germination of millet seeds at -3.1 bars (46.8%) and at -4.8 bars (28.66%) on the third day, but on the sixth day the number of germinated seeds increased to 92.8% and 84.0% respectively. The millet genotypes of differed significantly in the percentage of germination at various concentrations of the PEG 6000 osmotic solution. The minimum germination capacity was observed in variety 'Omriiane' at -3.1, -4.8, -6.6 bars. 'IR 5', 'Konstantynivske' and 'Kharkivske 57' showed higher germination potential at the different concentrations of water stress. A decrease in root elongation in all genotypes compared to control was observed in -1.9 bars osmotic stress and then at -3.1 and -4.8 bars of osmotic stress the root length had the same value from 6.6 mm to 13.5 mm on the 3^{d} day and from 25.3 mm to 34.7 mm on the 6th day. Variety 'Slobozhanske' showed higher mean root length at -3.1 and -4.8 bars of water stress induced by PEG on the 3^{d} day (8,7 mm–12,5 mm) and on the 6th day (35.7 mm–32.3 mm). It is not observed shoot of millet at -9.7 bars on the 3^{d} and on the 6th days. 'Kharkivske 57', 'IR 5', 'Slobozhanske' showed higher individual shoot length of 23.1 mm, 25.5 mm, 25.6 mm, respectively at -4.8 bars of PEG 6000 on the 6th day. At -6.6 bars of osmotic stress 'Konstantynivske' and 'Slobozhanske' had lowest root length/shoot length ratio 2.58 and 2.61, respectively. Variety 'Omriiane' (3.54) and 'IR 5' (3.31) had the maximum deviation from unity (3.54 and 3.31, respectively). **Conclusions.** Genotypes 'Konstantynivske' and 'Slobozhanske', which showed a high level of drought resistance, were selected as a result of this study in breeding for drought resistance. Variety 'IR 5', 'Konstantinivske' and 'Kharkivske 57' were characterized highest seed germination percentage at the different water stress.

Keywords: *millet; drought resistance; seed germination; root and shoot length.*

Introduction

Millet (*Panicum miliaceum* L.) is one of the main cereal crops in Ukraine due to its drought resistance, high production ratio, the ability to form a high yield and straw yield, and resistance to disease in a short growing season. It has become the main food and feed crops in Ukraine because of its wasteless uses of products of millet processing. According to research provided by scientists, the grain of millet contains raw protein 8.8–19.3%, starch – 51–65%, oil – 3.8–5.0%, sugars – 1.5–2.5% [1]. These indexes depend on the varieties and conditions of cultivation. 19 amino acids were found in the millet. Grain also contains mineral salts of potassium, calcium, magnesium, sodium, phosphorus; a large number of trace elements: zinc, cobalt, manganese, bromine, copper; vitamins: thiamine, riboflavin, niacin, tocopherol, provitamin A [2]. The main practical value of millet is that it is the source of nutrients for humans. The millet grain contains various enzymes. Due to the high activity of amylase, millet is a valuable raw material for malt production at distilleries. They use millet in starch, brewing and distillery production. Grain waste products are used for manufacturing of building supplies, as well as in the paint and varnish industry [3].

Of all the cultivating crops, millet has been known well about the high properties of

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drought resistance [4, 5]. However, drought is one of the main stress factors that limit plant growth and millet development. The main water-saving cultivating techniques include agricultural technology: land consolidation, saving-water irrigation, saving-water planting, water-fertilizer coupling and the use of drought resistant varieties [6]. The Most drought-sensitive stage is during sowing to elongation and the grain filling stage. Plant height, number of leaves per plant, weight of 1000 seeds of millet were diminished with increase in water deficit [7]. Drought resistance is a complex trait, expression of which depends on action and interaction of different morphological, physiological and biochemical characters. Morphological mechanisms of drought resistance are earliness, reduced leaf area, leaf rolling, wax content, efficient rooting system, stability in yield [7–10].

The territory of Ukraine is in unstable climatic conditions. Water-limiting period of sowing and germination inhibits the growth and development of millet plants and delays seed germination. Although millet is drought resistant, different varieties have different resistance to water deficit. The study of the influence of the water stress using osmotic solutions is one of the methods in the study of resistant varieties during the germinal phase [11]. Early and rapid elongation of roots is important indication of drought resistance. Ability of continued elongation of root and shoot under situation of water stress was remarkable character of millet to drought condition. Earlier studies of effect of polyethylene glycol (PEG) on seed germination percentage, on root length, on shoot length and other the drought – resistance indexes of different crops were done by many scientists [9, 11–13]. Chines scientists studied the relationship of morphological indexes and physiological and biochemical indexes with drought resistance of millet with simulate water stress by 0.25 g/mL PEG 6000. Their results showed that leaf water loss destroyed the water balance of cell inside and outside, increased cell membrane permeability resulting to membrane lipid peroxidation and the reduction in leaf photosynthesis efficiency. The protective enzyme activities were inhibited, which prevented the cell membrane lipids from injury and strengthened the ability of membrane lipid oxidation [9]. Other scientists proved in their research that the use of osmotic stress PEG for the experimental control of external water potential is very effective method for studying the effect of water stress on seed germination and seedling growth characters [11, 12]. Their study revealed that drought stress (PEG 6000) can negatively affect germination percentage, followed shoot and root length of pearl millet. The genotypes of pearl millet can germinate even in a potential of -10.0 bar [11]. Effect of PEG-induced osmotic stress on growth of sorghum was studied at 2.5%, 5%, 10%, 15%, 20% concentrations [13]. The only plants of sorghum in the 20% PEG group suffered significant physiological stress.

Our *research was aimed* to assess the effect of osmotic solution polyethylene glycol on root and shoot trait in seedlings of millet varieties and to identifying the superior germplasm for drought resistance.

Materials and methods

This study was done during January-March, 2019 in Plant Production Institute named by V. Ya. Yuriev of NAAS. Experimental material comprised of five Ukraine millet varieties: 'Omriiane', 'Kharkivske 57', 'Konstantynivske', 'IR 5', 'Slobozhanske'. Water stress was applied through six concentrations of PEG (6000 MW) (0,0% (control), 11.5%, 15.3%, 19.6%, 23.5% and 28.9%), with osmotic stress 0.0 (control) -1.9, -3.1, -4.8, -6.6 and -9.7 bars, respectively. 115, 153, 196, 235 and 289 grams of PEG 6000 were dissolved in 1000 ml of distilled water respectively according to tables provided by Michel and Kaufmann [15] and placed in a shaker bed for 16h. Fifty randomly chosen seeds of each germplasm were placed on filter paper in Petri dishes. After three and six days of incubation in dark at a temperature of 25 °C, the shoot and the root length of seedlings were measured. The experiment was designed as a completely randomized design with three factors. The first factor was the germplasm, the second factor was days and the third one was the drought stress treatments. Data were analyzed with ANOVA, and means were separated by an LSD using $P<0.05$. All the analyses were done by using «Statistica 13 Trail».

Results and discussion

Results of this study revealed that different levels of water stress had significant negative effects on seed germination percentage on the 3^{d} and the 6^{th} days (fig. 1). However, germination of these genotypes did not show differences between 0.0 and -1.9 bars on the 3^{d} and the 6^{th} days (germination was 100%). On the 3^{d} day at -3.1 bars it was observed sharp drop germination. Level of water stress induced by PEG 6000 -9.7 bars reduced germinations per-

centage to zero as on the 3d day so and on the 6th day. At water potential from -3.1 to -6.6 bar it was observed smoother drop germinations percentage of millet on the 6th day. Thus, despite on that fact, PEG solution strongly suppressed seed germination on the 3d day but on the 6th day the number of germinated seeds increases (at -3.1 bars common seed germination on the 3d day was 46.8% and on the 6th day was 92.8%; at -4.8 bars common seed germination on the 3d day was 28.66% and on the 6th day was 84%; at -6.6 bar common seed germination on the 3d day was 14.17% and on the 6th day was 43.6%).

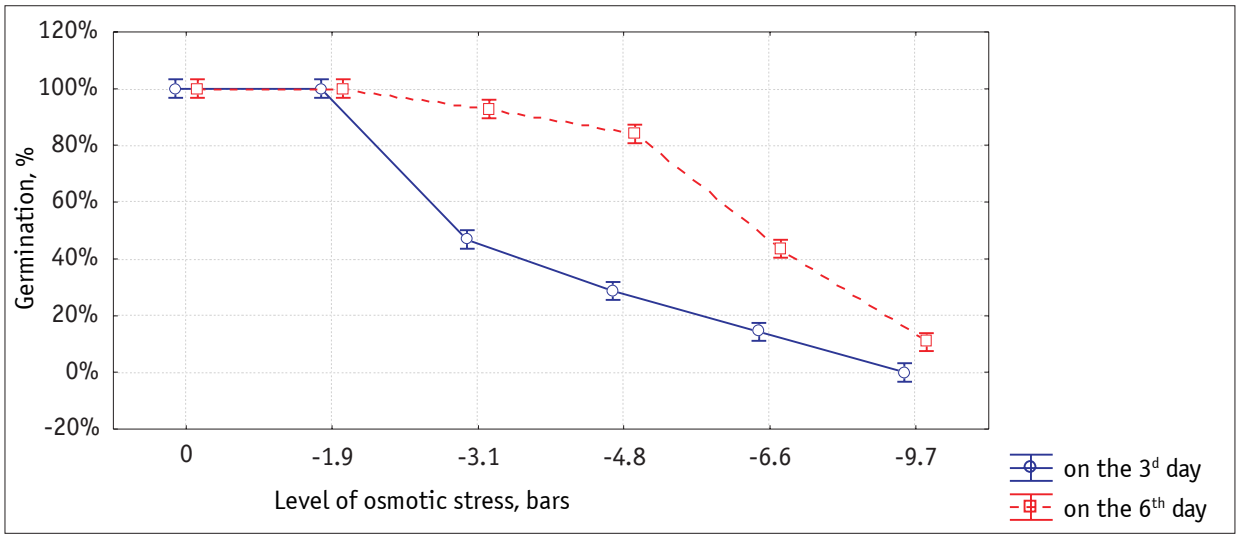

Fig. 1. Germination capacity seeds genotypes of millet on the 3d and on the 6th days
($LSD_{0.05}$ genotypes × treatment (G × T) on the 3 day – 3.3; $LSD_{0.05}$ (G × T) on the 6 day – 3.0; $LSD_{0.05}$ (G × T) beatween on the 3 day and on the 6 day – 2.27)

The minimum germination capacity was observed in variety 'Omriiane' at water stress induced by PEG 6000 -3.1 and -4.8 bars (seed germination – 22.0%, 16.0% on the 3d day; 92.7%, 79.3% – on the 6th day) (table 2). Variety 'IR 5' of millet is characterized high level drought resistance of seed germination in saccharose solution [16] and it showed the highest seed germination in this researches (seed germination percentage 36.0% in -4.8 bars and 16.0% in -6.6 bars – on the 3d day; 90.0% in -4.8 bars, 56.0% in -6.6 bars – on the 6th day). Among the genotypes tested varieties 'Konstantynivske' (at -3.1 bars – 62.6%; -4.8 bars – 38.0% on the 3d day; -3.1 bars – 98.0%; -4.8 bars – 86.0%; -6.6 bars – 43.3% on the 6th day) and 'Kharkivske' 57 (-3.1 bars – 97.3%; -4.8 bars – 87.6% on the 6th day) showed better germination potential at the different water stress. The lowest germination percentage was observed in varieties 'Slobozhanske' and 'Omriiane' (at -3.1 bars -92.7% and 92.0%; at -4.8 bars – 79.3% and 78.0%; at -6.6 bars – 44.7% and 37.3%, respectively on the 6th day). At water potential -9.7 bars germination percentage was the lowest on the 6th day and only variety 'Kharkivske 57' had the highest mean of germination – 18% that showed high drought resistance of this variety to strong limiting of water in soil. As our results showed in breeding of millet there are genotypes significant differenced to water stress and can get new varieties with high level to drought resistance.

Drought resistance is a complex trait, which expression depends on efficient rooting system. Root elongation and root numbers of crop plants are controlled by dominant alleles and thick root tip by recessive alleles [8]. Early and rapid elongation of root system is important indication of drought tolerance. The root length is also the main character of resistance to water-limiting condition. That is why in the present investigation we studied ability of continued elongation of root under different levels of water stress [11]. In moisture condition (in control) in seedling of millet varieties 'Konstantynivske' and 'IR 5' formed the longest root system (63.33 mm and 63.0 mm, respectively on the 6th day) and variety 'Omriiane' characterized by weak formed root length (47.0 mm). Thus, the length of the root system of millet is determined by varietal features.

Although at -1.9 bars all genotypes had 100% germination but significant reduction in root elongation was observed in all varieties at this low osmotic stress (table 3). Only the root length of 'Kharkivske 57' less than others varieties changed this index and this value was

Table 2

Germination of five genotypes on the 3d and on the 6th days at osmotic stress

Genotypes	Days	Seed germination, % at osmotic stress, bar					
		0.0	-1.9	-3.1	-4.8	-6.6	-9.7
'Omriiane'	on the 3d	99.3	100.0	22.0	16.0	10.3	0.0
	on the 6th	99.3	100.0	92.7	79.3	44.7	8.6
'Kharkivske 57'	on the 3d	100.0	100.0	49.3	27.3	13/5	0.0
	on the 6th	100.0	100.0	97.3	87.6	36.6	18.0
'Slobozhanske'	on the 3d	98.6	100.0	55.3	26.0	10.6	0.0
	on the 6th	98.6	100.0	92.0	78.0	37.3	12.6
'Konstantynivske'	on the 3d	100.0	100.0	62.6	38.0	11.3	0.0
	on the 6th	100.0	100.0	98.0	86.0	43.3	4.0
'IR 5'	on the 3d	100.0	100.0	44.7	36.0	16.0	0.0
	on the 6th	100.0	100.0	95.3	90.0	56.0	10.0
$LSD_{0.05}$	on the 3d	–	–	1.97	2.78	1.94	–
	on the 6th	–	–	2.56	2.82	2.29	1.56

the highest. At higher water stress induced by PEG 6000 -9.7 bars, seedlings were not observed on the 3rd day, they appeared only on the 6th day, and their length was the same for all genotypes (10.38–12.0 mm).

In this research at different concentration of PEG 6000 (-3.1 and -4.8 bars) on on the 6th days root length of varieties 'Omriiane', 'Kharkivske 57' and 'Slobozhanske' was characterized the highest indexes and varied in the same value from 35.77–29.70 mm.

Interesting, that all studing genotypes decreased significantly root length at osmotic stress -1.9 and -3.1 bars on the 6th days but 'IR 5'. Root length of variety 'IR 5' was 27.0–27.9 mm at these osmotic stresses, they reduced the -6.6 bars on the 3d day at -1.9 bars osmotic stress and then the means of root length at -3.1 bars osmotic stress.

Genotype 'Omriiane' showed higher velues at -6.6 bar of water stress induced by PEG – 25.0 mm on the 6th day.

Thus, root length of genotypes of millet is low variable and in breeding for drought resistance is need further investigation to find germplasms with higher mean root length.

Table 3

Root length of seeds on the 3d and on the 6th days at different concentration of PEG 6000

Genotypes	Days	$LSD_{0,05}$	Root length of seeds (mm) at osmotic stress, bar					
			0.0	-1.9	-3.1	-4.8	-6.6	-9.7
'Omriiane'	on the 3d	2.61	27.40	20.00	10.15	6.63	5.89	0.00
	on the 6th	2.91	47.00	34.40	29.70	34.70	25.04	10.38
'Kharkivske 57'	on the 3d	2.55	40.80	23.20	13.50	8.27	7.29	0.00
	on the 6th	2.75	56.00	51.00	30.70	33.47	19.31	11.07
'Slobozhanske'	on the 3d	2.42	34.80	12.17	12.50	8.68	6.47	0.00
	on the 6th	2.43	56.67	41.00	32.31	35.77	22.07	11.37
'Konstantynivske'	on the 3d	2.31	26.40	17.40	10.37	8.81	5.18	0.00
	on the 6th	2.69	63.00	22.14	25.30	30.43	16.17	11.17
'IR 5'	on the 3d	2.53	41.60	31.67	9.77	10.24	5.65	0.00
	on the 6th	2.67	63.33	27.00	27.90	31.77	21.12	12.00
$LSD_{0.05}$	on the 3d	–	2.64	2.53	2.24	1.65	2.45	–
	on the 6th	–	3.20	3.03	2.98	2.76	2.55	2.46

The shoot as well as aerial parts of the plant is affected to drought condition too [8, 11]. The shoot parameters will also help the breeder while selecting the drought resistance genotypes. Indicating that, the drought stress induced by PEG had inhibited shoot elogation of pearl millet at higher rate than the root growth [11]. These results of studies were similar to our researches. Shoot length of millet is more affected by osmotic stress than root length (table 4). In this investigation, shoot length was decreased with an increasing in external water stress. At -9.7 bars of PEG on the 3d and on the 6th days it is not observed shoot. At -6.6 bars osmotic stress shoot appeared only on the 6th day and their length was from 4.77 mm to 6.2 mm.

Under optimum (water-stress-free) condition all varieties had the same mean of shoot length from 26.20–22.40 mm on the 3d day. But 'Konstantynivske' which is a early ripe variety, had more quickly development root and shoot system then others on the 3d day (shoot length – 26.20 mm). 'Kharkivske 57',

'Slobozhanske', 'Konstantynivske' characterized by the the highest individual mean shoot length in optimum condition on the 6th day. At -1.9, -3.1 and -4.8 bars of osmotic stress had significant negatively effects on shoot length of all genotypes on the 3d and on the 6th days. In present investigation, at the lowest concentration of PEG 6000 all varieties decreased shoot length about in two times on the 6th day. Varieties 'Kharkivske 57', 'Omriiane' and 'Slobozhanske' was the lowest affected by external water stress of -1.9 bars on the 6th day – 46.00 mm, 36.00 mm, 37.00 mm, respectively. At -3.1 and -4.8 bars induced by PEG it was observed smooth decrease shoot length of all genotypies. 'Omriiane', 'Slobozhanske', 'IR 5' showed higher individual mean shoot length 26.27 mm, 30.59 mm and 30.87 mm, respectively at -3.1 bars of PEG 6000 on the 6th day and 'Kharkivske 57', 'Slobozhanske', 'IR 5' had higher individual mean shoot length 23.17 mm, 25.63 mm, 25.57 mm respectively at -4.8 bars of osmotic stress on the 6th day

Table 4

Shoot length of millet of five genotypes on the 3d and on the 6th days under osmotic stress

Genotypes	Days	$LSD_{0.05}$	Shoot length of seeds (mm) at osmotic stress, bar					
			0.0	-1.9	-3.1	-4.8	-6.6	-9.7
'Omriiane'	on the 3d	2.16	22.40	12.50	5.78	2.58	1.40	0.00
	on the 6th	2.75	53.00	36.00	26.27	21.53	5.69	0.38
'Kharkivske 57'	on the 3d	2.44	22.20	19.00	8.53	5.94	0.95	0.00
	on the 6th	2.89	59.00	46.00	25.63	23.17	4.98	1.37
'Slobozhanske'	on the 3d	1.97	20.80	18.33	9.53	6.88	0.88	0.00
	on the 6th	2.72	60.00	37.00	30.59	25.63	6.20	0.26
'Konstantynivske'	on the 3d	2.42	26.20	22.00	9.03	7.92	0.88	0.00
	on the 6th	2.24	58.00	31.43	26.43	21.30	4.77	1.67
'IR 5'	on the 3d	1.95	19.80	15.00	8.40	8.05	0.00	0.00
	on the 6th	1.92	53.67	25.00	30.87	25.57	5.09	0.00
$LSD_{0.05}$	on the 3d	–	2.64	1.23	2.23	2.07	1.69	–
	on the 6th	–	2.69	3.07	3.07	2.65	2.66	1.91

In breeding for drought resistance root length/shoot length ratio, balanced root and shoot growth can be another index characterizing resistance to water stress. Root/shoot ratio demonstrated direct drought tolerance assessment for scientists. In pearl millet the ratio ranged from 1.2 to 3.5 in the control and with increasing osmotic stress root length/shoot length ratio improved this index [11]. Results of this study revealed that in millet in the control this index is one (fig. 2). At osmotic stresses index of root length/shoot length ratio is change. With increasing concentration of PEG 6000 solution in water, indexes of root length/shoot length ratio deviates from one. At -6.6 bars of osmotic stress 'Konstantynivske' and 'Slobozhanske' had the lowest root length/shoot length ratio 2.58 and 2.61, respectively. 'Omriiane' (3.54) and 'IR 5' (3.31) had maximum deviation from one.

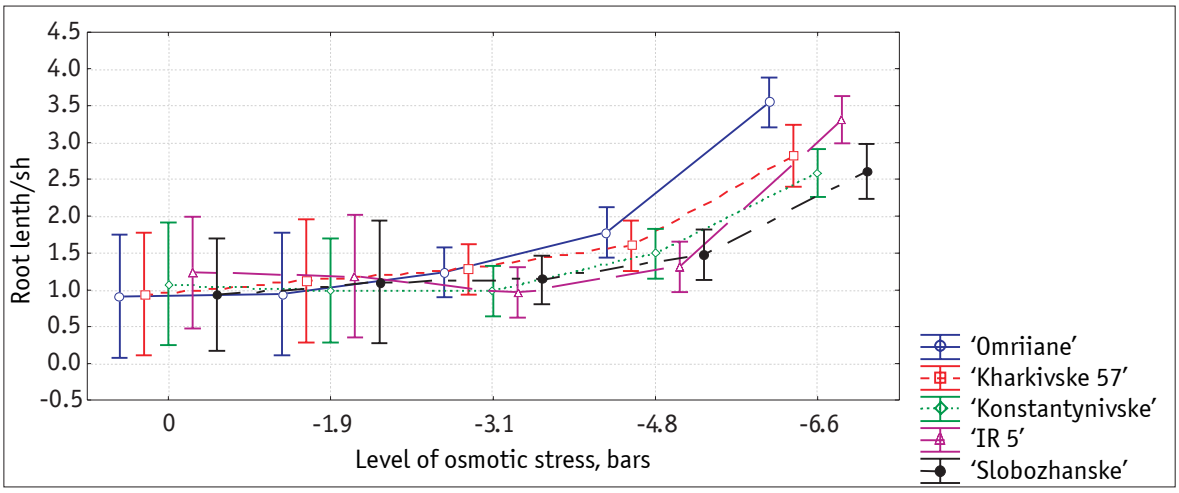

Fig. 2. Relationship between root length and shoot length of seedlings of millet genotypes at PEG 6000 concentration on the 6th day ($LSD_{0.05}$)

Conclusion

Water stress had significant negative effects on seed germination, root and shoot system of millet on the 3d and the 6th days. Genotypes had significantly differed to water limits and in breeding for drought resistance can developed new varieties with high level resistance to water stress. Varieties 'IR 5', 'Konstantynivske' and 'Kharkivske 57' showed higher germination potential at the different water stress.

Although at low osmotic stress (-1.9 bars) all genotypes had 100% germination but it was observed significant reduce the root and shoot elongation in all varieties. The shoots of millet plant suffer more than root from exposure to moisture stress. At -3.1 and -4.8 bars of PEG 6000 on the 6th days root length of varieties 'Omriiane', 'Kharkivske 57' and 'Slobozhanske' were characterized by the highest indexes. 'Slobozhanske', 'IR 5' showed higher individual mean shoot length at -3.1 and -4.8 bars of osmotic stress on the 6th day. One of the drought resistance index is root length/shoot length ratio. In the control this index is one. With increasing concentration of PEG 6000 solution in water, root length/shoot length ratio deviates from one. At -6.6 bars of osmotic stress 'Konstantynivske' and 'Slobozhanske' had the lowest root length/shoot length ratio 2.58 and 2.61.

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Мета. Визначити посухостійкість п'яти зразків проса ('Омріяне', 'Харківське 57', 'Константинівське', 'IR 5', 'Слобожанське'), використовуючи як осмотик ПЕГ 6000 **Методи.** Для отримання ефекту посухи використовували п'ять концентрацій розчину ПЕГ 6000: 0,0% (контроль), 11,5%, 15,3%, 19,6%, 23,5% та 28,9%, що відповідає 0,0, 115, 153, 196, 235 та 289 г розчиненої речовини в 1000 мл дистильованої води або 0,0, -1,9, -3,1, -4,8, -6,6 та -9,7 барам. **Результати.** Осмотичний стрес сильно пригнічував проростання насіння проса при -3,1 барах (46,8%) і -4,8 барах (28,66%) на третю добу, але на шосту добу кількість насіння, що проросло, збільшилась до 92,8% і 84,0%, відповідно. Генотипи проса значно відрізнялись за відсотком проростання у різних концентраціях осмотичного розчину ПЕГ 6000. Так, мінімальна схожість спостерігалась у сорту 'Омріяне' при концентрації ПЕГ 6000 -3,1, -4,8 і -6,6 барів. 'IR 5', 'Константинівське' і 'Харківське 57' показали вищий потенціал проростання насіння при різних концентраціях водного стресу. Зменшення довжини коренів порівняно з контролем спостерігалось у всіх генотипів при осмотичному стресі -1,9 бар, при ПЕГ 6000 -3,1 і -4,8 бар довжина кореня коливалась від 6,6 мм до 13,5 мм на третю добу і від 25,3 до 34,7 мм – на шосту добу. 'Слобожанське' показало вищу середню довжину кореня при -3,1 і -4,8 бар водного стресу на третю добу – 8,7–12,5 мм і на шосту добу – 35,7–32,3 мм. При -9,7 бар концентрації ПЕГ 6000 не спостерігалось проростків проса як на третю, так і на шосту добу. 'Харківське 57', 'IR 5', 'Слобожанське' характеризувались довшими проростками – 23,1; 25,5; 25,6 мм, відповідно, при -4,8 бар ПЕГ 6000 на шосту добу. При -6,6 барах осмотичного стресу 'Константинівське' і 'Слобожанське' мали найменше значення відношення довжина кореня/довжина проростка – 2,58 і 2,61, відповідно. 'Омріяне' і 'IR 5' мали максимальне відхилення від одиниці – 3,54 та 3,31, відповідно. **Висновки.** Унаслідок дослідження в селекції на стійкість до посухи було виявлено генотипи 'Константинівське' і 'Слобожанське', які показали найвищий рівень стійкості до посухи. Сорти 'IR 5', 'Константинівське' і 'Харківське 57' характеризувались найвищим відсотком схожості насіння при різній концентрації ПЕГ 6000 у водному розчині.

Ключові слова: *просо; посухостійкість; проростання насіння; довжина кореня та проростка.*

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Цель. Определить засухоустойчивость пяти образцов проса ('Омріяне', 'Харківське 57', 'Константинівське', 'IR 5', 'Слобожанське'), используя в качестве осмотика ПЭГ 6000 **Методы.** Для получения эффекта засухи использовали пять концентраций растворов ПЕГ 6000: 0,0% (контроль), 11,5%, 15,3%, 19,6%, 23,5% и 28,9%, что соответствует 0,0, 115, 153, 196, 235 и 289 г растворенного вещества в 1000 мл дистиллированной воды или 0,0, -1,9, -3,1, -4,8, -6,6 и -9,7 барам **Результаты.** Осмотический стресс сильно подавлял прорастание семян проса при -3,1 барах (46,8%) и при -4,8 барах (28,66%) на третьи сутки, но на шестые сутки количество проросших семян увеличилось до 92,8% и 84,0%, соответственно. Генотипы проса значительно различались по проценту прорастания в различных концентрациях осмотического раствора ПЭГ 6000. Так, минимальная всхожесть семян наблюдалась у сорта 'Омріяне' при концентрации ПЭГ 6000 -3,1, -4,8 і -6,6 баров. 'IR 5', 'Константинівське' и 'Харківське 57' показали более высокий потенциал прорастания семян при различных концентрациях водного

стресса. Уменьшение длины корней проростков по сравнению с контролем наблюдалось у всех генотипов при осмотическом стрессе -1,9 бар, а при осмотическом стрессе -3,1 и -4,8 бар длина корня колебалась от 6,6 мм до 13,5 мм на третьи сутки и от 25,3 до 34,7 мм – на шестые сутки. 'Слобожанське' показало более высокую длину корня при -3,1 и -4,8 бар водного стресса на третьи сутки – 8,7–12,5 мм и на шестые сутки – 35,7–32,3 мм. При -9,7 бар не наблюдалось проростков проса как на третьи, так и на шестые сутки. 'Харківське 57', 'IR 5', 'Слобожанське' характеризовались более длинными проростками – 23,1 мм, 25,5 мм, 25,6 мм, соответственно, при -4,8 бар ПЭГ 6000 на шестые сутки. При -6,6 барах осмотического стресса у сортов 'Константинівське' и 'Слобожанське' наблюдали низкое соотношение длина корня/длина проростка – 2,58 и 2,61, соответственно. 'Омріяне' и 'IR 5' имели максимальное отклонение от единицы – 3,54 и 3,31, соответственно. **Выводы.** В результате исследования в селекции на устойчивость к засухе выделены генотипы 'Константинівське' и 'Слобожанське', которые показали высокий уровень устойчивости к засухе. Сорта 'IR 5', 'Константинівське' и 'Харківське 57' характеризовались высоким процентом всхожести семян при различной концентрации ПЭГ 6000 в водном растворе.

Ключевые слова: *просо; засухоустойчивость; всхожесть семян; длина корня и проростка.*

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