International Journal of Genetic Engineering 2022, 10(1): 5-9
DOI: 10.5923/j.ijge.20221001.02

Formation of a Digital Database on Wheat Genotypes Resistant to Salinization

Utkirjon T. Jumanov[1], Khabibjon Kh. Kushiev[2], Abdulaziz O. Abdukarimov[3]

[1]Researcher, Gulistan State University, Gulistan, Uzbekistan
[2]Doctor of Biological Sciences, Professor, Gulistan State University, Gulistan, Uzbekistan
[3]Master's Student, Gulistan State University, Gulistan, Uzbekistan

Abstract This article describes the procedure for using digital technologies in the selection of salinization-resistant genotypes of winter wheat. 268 genotypes of soft wheat (*Triticum aestivum L.*) were obtained as experimental objects. The experiment was carried out on a pilot plot of a lightly salted field. The SSPS-17 program was used for statistical analysis of the primary data of the studied genotypes. With the help of this program, coefficients of variation, correlation and determination were calculated for 10 traits of genotypes. Factor analysis was used in the selection of salinization-resistant genotypes of winter wheat. At the same time, it is noted that productivity and the number of thorns strongly associated with it and the mass of thorns are one of the main criteria for the selection of genotypes resistant to salinization. In the case of gross selection of salt-resistant genotypes, it was recommended to pay attention to productivity, and in the case of individual selection, to the length of the spike and its weight. Using factor analysis, more than 20 mutant genotypes were selected and recommended as the primary source for selection. A digital database was formed on the genotypes of each studied winter wheat.

Keywords Collection sample, Gene pool, Variation, Correlation, Determination, Factor analysis, Factor load, Genotype

1. Introduction

Grain farming is one of the main branches of agriculture and plays an important role in meeting the needs of the population for food. Further development of this sphere is defined as one of the priorities in the "strategy for the development of agriculture of the Republic of Uzbekistan for 2020-2030", which provides for bringing the yield of grain varieties to an average of 70.0 quintals per hectare in the future. For this purpose, the selection and creation of varieties suitable for the soil and climatic conditions of each region remains currently one of the priority tasks of grain breeding.

As you know, the salinity resistance of plants is one of the urgent and complex issues of breeding. The peculiarity of the influence of salinity is explained by a decrease in yield, and the complexity is due to dependence on factors such as soil fertility, degree of salinity, type of salinity. Scientific sources note that in conditions of slightly saline soil, there is a decrease in plant yield by 10-20%, with average salinity-by 20-50%, with strong salinity-by 50-80% [1]. According to these data, although there is an inverse relationship between the degree of salinity of the soil and its fertility, in turn, productivity is the main criterion for the selection of saline-resistant genotypes. This makes it possible to select plant varieties resistant to salinization and create new ones using breeding methods [2]. To do this, it is desirable to select genotypes primarily in a salty environment. A striking example of this is that in Central Asia there are more than 700 species of genotypes resistant to salinization, and 206 of them are endemic to the territory [3].

As it is known, breeding begins with the study of raw materials. However, the selection of initial sources for winter wheat breeding in saline soils, their assessment, especially systematic analytical work, have not been carried out in full. In turn, it should be noted that a large number of genotypes (200-300) are involved in the selection and evaluation of initial sources and complex computational work will need to be performed. In this case, it is desirable to use the capabilities of digital technologies.

It is known from world experience that with the help of digital technologies, raw materials for plant breeding are selected [4-7], the degrees of variability and determinacy of traits are determined [8-10]. At the same time, the possibility of assessing and selecting the plant gene pool using factor analysis was noted and scientifically based indicator signs (biological, ecological, ecobiological, genotypic) were recommended for gross and individual selection [7,11].

The main purpose of this study is to create a system for selecting salinization-resistant genotypes of winter wheat using digital technologies. The main objectives of the study are the recommendations of scientifically based criteria for

Received: Apr. 3, 2022; Accepted: Apr. 25, 2022; Published: Apr. 29, 2022
Published online at http://journal.sapub.org/ijge

the selection and evaluation of salinization-resistant genotypes, the formation of a digital database and recommendations of raw materials for breeding.

2. The Main Results and Findings

286 genotypes (varieties, selection material and collection samples) of soft wheat (*Triticum aestivum L.*) varieties were obtained as experimental objects. The study was conducted in 2019-2021 at the lightly salted Field experimental site of the Scientific and Practical Center for technologies for growing and processing plant products. All phenological observations and calculation work were carried out on the basis of methodological guidelines issued by UzIICS. When calculating the correlation coefficients (r), determination (r^2) and variation (cv,%) between the studied features, the statistical program SPSS-17 was used [7,12].

When describing genotypes, external morphological signs of the plant and mainly plant growth are most often recorded as the main indicators. The primary data obtained for 268 studied mutton wheat genotypes are shown in Table 1. Based on the data in the table, it can be noted that the average height of the plant is 95.51 cm. In the studied genotypes, the minimum growth rate of the plant was 60 cm, the maximum was 165 cm. This indicates a strong variability of this trait. The number of spikes (per 1 sq. m of area) was 308 pieces. According to this indicator, there was also a strong variability (25-576 pcs.). The mass of the spike (1 sq. m) averaged 663.19 g/m2, the yield was 490.36 g/m2. From these data it can be seen that in saline soils, the yield of winter soft wheat varieties averages 490.36 g/m2. Grain yield is 73.53%, grain weight in one spike is 1.64 g.ga became equal. The length of the spike was 10.34 cm, the weight of 1000 grains was 41.91 g, the yield index was 0.39, and the amount of grain in the spike was 39 pieces.

From these data it can be seen that the studied signs of winter wheat and their quantitative indicators have a variable character. This is also evidenced by the minimum and maximum indicators of signs. This served as the basis for the analysis of the features of variation of these features. These data are shown in table 1. From the table data, it was found that the number of spikes (2), the weight of spikes (3) and the number of grains (4) vary greatly and are deterministic. These symbols are located on the right and top of the diagram. Note that the determinant-r^2 *is the square of the correlation coefficient, meaning that the sign is bounded. These signs will depend not only on the genotype and the external environment*. Their variations were carried out in connection with other signs. Consequently, although productivity varied greatly, its variability became dependent on other characteristics. The fertility of the genotype in this salty environment indicates its resistance to salinization. The weight of grain in one spike (6), the amount of grain in one spike (10) were found to be moderately variable and deterministic.

Table 1. Primary data on the characteristics of genotypes of winter soft wheat and their statistical indicators

Statistical indicators	Height of the plant cm	Number of spikes per 1 sq. m	Weight of the spike g.	Weight of the grain g.	Grain yield %	Weight of a grain in one spike g.	Spike length, cm	Weight of 1000 grains, g.	Yield index	The amount of grain in one spike, pcs.
Average indicator	95.51 ± 0.78	308.36 ± 7.33	663.19 ± 14.51	490.36 ± 11.05	73.53 ± 0.27	1.64 ± 0.02	10.34 ± 0.08	41.91 ± 0.25	0.39 ± 0.02	39.51 ± 0.53
Minimum	60,00	25,00	56,00	32,00	55,56	0,54	5.60	30,41	0,16	11,07
Maximum	165,00	570,00	1280,00	978,00	104,08	2,80	14.80	54,68	0,45	66,45

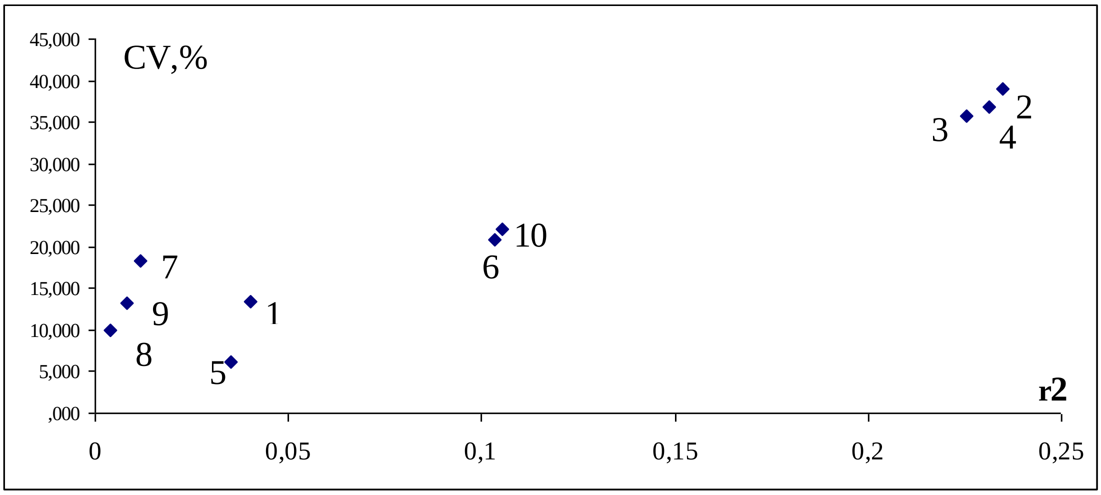


Figure 1. Degrees of variability (Cv,%) and determinism (r^2) of quantitative indicators of traits of winter soft wheat (**Note.** *(the numbers represent the traits): 1 - plant height, cm; 2-number of Spikes, pcs./ 1 sq. m; 3-spike weight, g/ sq.m; 4-grain weight, g/sq. m; 5-grain yield, %; 6-grain weight in one spike, g; 7-Spike length, cm; 8-weight of 1000 grains, g; 9-yield index; 10-number of grains in one spike, pcs.*)

It was noted that plant height (2), grain yield (5), spike length (7), weight of 1000 grains (8) and yield index (9) were less variable and weakly deterministic. Variations of these signs were carried out independently of others. Therefore, this sign can be considered as relatively stable signs.

Above, we provided data on the strong and weak determinism of the signs. It depends on the degree and structure of correlations between these features. These data are shown in Figure 2. From these data, it was noted that the height of the plant (1) weakly correlates (r=0.3-0.5) with the number of spikes (2), the weight of spikes (3) and the weight of grain (4), as well as with the yield index (9). We would like to remind that in the figure-1, these signs were found to be weakly variable and weakly deterministic. This was due to the fact that there was a weak correlation between these signs.

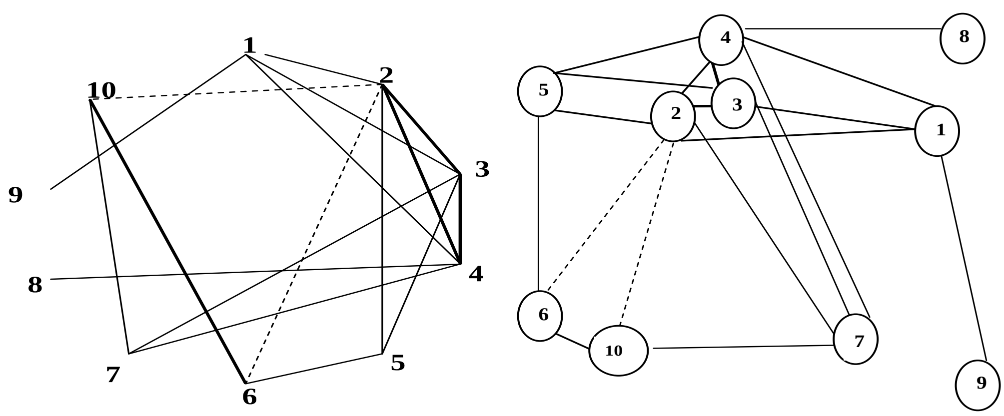
These data suggest that tall plants will be productive. A strong correlation was noted (r=>0.7) between the number of spikes (2), the weight of the spikes (3) and productivity (4). Above (Fig. 1) we called these signs highly deterministic. This was caused by a strong correlation between the two.

So it turns out that the yield primarily depends on the amount of spike and its weight. There was also a strong correlation between the weight of grain in an spike (6) and the number of grain in one spike (10). This suggests that the weight of the grain on the spike primarily depends on its quantity.

The genotypes of winter wheat differed not only in the degree of correlation between the traits, but also in the structure. This is also evident from the information presented on the right in Figure 2. The correlations between the studied winter wheat traits and their quantitative indicators made up one strongly correlated group, called "productivity". The center of this group consisted of such features as the number of spikes (2), the weight of spikes (3) and the weight of grain (4). It is noted that such signs as plant height (1), spike length (7), grain yield (6) are also associated with this group. This indicates the influence of geotypes on productivity. An inverse correlation was noted between the number of spikes (2), the weight of one spike (6) and the number of grain in one spike (10). This means that an increase in the amount of spike, in turn, led to a decrease in the amount of grain and its weight.

The interrelation of features is the main object of factor analysis. This is also evident from the data in Table 2. At the same time, according to the first factor, the number of spikes (1 sq.m) (0.770), grain weight (0.803) was obtained with a high load. These signs determined the productivity of the genotypes of winter wheat. This group can be called the "productivity" group. This is the result that was recorded when determining the structure of correlations between the characteristics of winter wheat (Fig. 2).

According to the second factor, such signs as the weight of one spike (0.427), the weight of grain in one spike (0.451) and the amount of grain in one ear (0.333) received a heavy load. This group can be called the "weight of the spike". Signs such as grain yield according to the third factor (0.488), weight of 1000 grains according to the fourth factor (0.603) and ear length according to the fifth factor (0.481) received a higher load. So, according to the first factor, genotypes with productivity can be selected, according to the second - the weight of the Ear, according to the third-the yield of grain, according to the fourth-the weight of 1000 grains, according to the fifth factor-the length of the spike. Based on the table data, productive genotypes for the first and second factor were selected from 268 studied genotypes of winter wheat. Because the first and second factors gave a lot of information. This is also evident from the data in Table 2. The first factor gave data of 23.35%, and the second factor -9.96%. Therefore, it is advisable to choose genotypes based on the first and second factors.



Degree of correlation connection

Figure 2. Degree and structure of correlations between quantitative indicators of traits of winter wheat genotypes (Note. *the numbers represent the traits: 1 - plant height, cm; 2-number of Spikes, pcs./ 1 sq. m; 3-spike weight, g/ sq.m; 4-grain weight, g/sq. m; 5-grain yield, %; 6-grain weight in one spike, g; 7-Spike length, cm; 8-weight of 1000 grains, g; 9-yield index* ——— *r=0.3-0.5;* ——— *r=0.5-0.7;* ——— *r=>0.7* - - - - - - - *r=-0.3-0.5*)

According to the data from Table 3, in the control variety of winter wheat – "Dustlik", the load of the first factor was equal to (-1.317), while the load of the selected genotype D-9 was equal to 1.095. This suggests that this genotype has a relatively high burden on control. This indicates its productivity. At the same time, the height of the plant in the control was 90 cm, and in the selected genotype-95.0 cm.

Table 2. Load of traits of winter wheat by factors

K№	Traits	Factors and their loads				
		1	2	3	4	5
1	Plant height, cm;	0,147	**0,243**	-0,17	-0,059	-0,775
2	Number of spikes, pcs./ 1 sq. m	**0,770**	-0,419	-0,01	0,042	-0,296
4	Weight of one spike, g	-0,440	**0,427**	0,181	**0,567**	-0,060
5	Grain weight, g	**0,803**	-0,359	0,088	0,224	-0,099
6	Grain yield, %	0,290	0,050	**0,488**	0,004	0,482
7	Grain weight in one spike, g	-0,322	**0,451**	0,320	**0,578**	0,142
8	Spike length, cm	0,181	-0,265	0,240	-0,464	**0,481**
13	Weight of 1000 grains, g	-0,150	-0,002	0,072	**0,603**	0,005
17	Yield index	-0,009	-0,073	-0,197	-0,179	**0,539**
18	Amount of grain in one spike, pcs	-0,267	**0,333**	-0,113	**0,399**	**0,455**
	Dispersion,%	**23.35**	**9.96**	**6.39**	**5.71**	**4.41**

Table 3. Genotypes of winter wheat selected by factor analysis

	Varieties and collection samples	**Factor loads**	Plant height, cm;	Number of spikes, sq. m	Weight of spike, g	Grain weight, g	Grain yield, %	Grain weight in one spike, g	Spike length, cm	Weight of 1000 grains, g	Yield index, the ratio of grain to sheaf	Amount of grain in one spike, pcs
1	Dustlik - 297	-1.317	90,00	238,00	588,00	364,00	61,90	1,53	11,20	38,54	0,36	39,68
2	KGU-D- 9	1.095	95,00	565,00	1076,00	808,00	75,09	1,43	10,80	43,66	0,38	34,38
3	KGU -Agro-25	0.910	100,00	400,00	950,00	746,00	78,53	1,87	11,80	47,60	0,38	42,72
4	KGU - Agro -20	0.889	110,00	402,00	838,00	658,00	78,52	1,64	9,00	48,55	0,42	34,07
5	KGU - Agro- 9	0.895	110,00	468,00	974,00	756,00	77,62	1,62	11,00	46,07	0,43	37,39
6	KGU - D- 16 IOF$_6$	1.280	100,00	363,00	864,00	650,00	75,23	1,79	10,60	43,60	0,37	43,27
7	D- 24 IOF$_6$	1.382	100,00	495,00	1190,00	918,00	77,14	1,85	8,80	38,00	0,43	39,53
8	D- 43 IOF$_6$	1.521	100,00	487,00	932,00	684,00	73,39	1,40	9,20	36,46	0,41	30,69
9	D- 8 IOF$_6$	1.437	110,00	545,00	1236,00	938,00	75,89	1,72	10,60	46,36	0,42	45,29
10	D- 5 IOF$_6$	1.077	110,00	510,00	1170,00	844,00	72,14	1,65	11,00	38,70	0,40	45,39
11	D- 57 IOF$_6$	1.007	110,00	443,00	914,00	672,00	73,52	1,52	11,60	43,10	0,43	39,20
12	D- 39 IOF$_6$	0.953	90,00	456,00	1030,00	794,00	77,09	1,74	10,80	42,91	0,45	34,07
13	D- 50 IOF$_6$	1.763	110,00	524,00	1080,00	804,00	74,44	1,53	11,60	44,45	0,36	33,17
14	D- 38 IOF$_6$	1.542	115,00	462,00	928,00	694,00	74,78	1,50	11,20	46,27	0,45	30,69
15	D- 73 IOF$_2$	1.784	110,00	556,00	1000,00	776,00	77,60	1,40	10,40	41,36	0,42	36,17
16	D- 98 IOF$_2$	1.070	115,00	531,00	974,00	728,00	74,74	1,37	9,00	41,24	0,42	33,28
17	D- 1 IOF$_2$	1.058	110,00	458,00	900,00	674,00	74,89	1,47	10,60	39,69	0,40	34,79
18	D- 2 IOF$_2$	1.821	100,00	506,00	1178,00	894,00	75,89	1,77	9,40	41,27	0,48	32,31
19	D- 78 IOF$_2$	1.294	105,00	469,00	950,00	706,00	74,32	1,51	11,80	46,79	0,38	36,48
20	D- 50 IOF$_2$	2.089	95,00	510,00	982,00	712,00	72,51	1,40	11,00	38,43	0,41	29,84
21	D- 71 IOF$_2$	1.242	95,00	486,00	1020,00	760,00	74,51	1,56	10,60	41,70	0,39	34,29

The genotype selected from these data did not differ from the control one. The number of spikes per m2 in the control was 238, and in the genotype-565. From these data it can be seen that the selected genotype prevails over the control one. Such results were recorded by ear weight (1076 g) and grain weight (808.0 g), while it was noted that the selected genotype prevails over the control one. The weight of grain in one spike was equal to 1.53 g in the control and 1.43 g in the selected genotype. Although the weight of grain in one spike was greater than the control one, but due to the larger number of spikes, this genotype turned out to be more productive compared to the control one. The amount of grain in one spike was 38 in the control, and in the genotype D-9-43.

3. Conclusions

In general, as a result of studying 268 genotypes of winter wheat in saline soils, the following conclusions were made:

1. It was noted that the number of spikes per 1 sq.m of winter wheat, the weight of the spike and the weight of the grain are strongly deterministic and variable traits. It was noted that the height of the plant, the length of the spike are stable traits. Productivity and related signs are recognized as eco-biological, and the length of spikes and height of plants are biological indicators.
2. There was a strong correlation between plant height, number of spikes, spike weight, spike length, average weakness, number of spikes, spike weight and amount of grain.
3. The results of factor analysis showed that productivity is one of the main criteria when choosing genotypes resistant to salinization. According to productivity, the selection of salt-resistant genotypes was considered expedient.
4. A digital database has been formed on the studied gentians of winter wheat in saline soils. Promising genotypes were selected and winter wheat was recommended as a starting material for breeding.
5. When gross choosing in saline soils, it was recommended to pay attention to the yield, and when choosing single ones - to the length of the spike and its weight.

REFERENCES

[1] Л.А. Чудинова, Н.В. Орлова. Физиология устойчивости растений. Перм. ун-т. –Пермь, 2006. – 124с.

[2] Удовенко Г.В., Олейникова Т.В., Кожушко Н.Н. и др. Методика диагно стики устойчивости растений (засухо-, жаро-соле-и морозоустойчивости). Л.: Изд-во ВИР, 1970. –С. 74.

[3] Акжигитова Н.И. Галофильная растительность Средней Азии и ее индикационные свойства. Ташкент, «Фан» 1982. -С.189.

[4] А.Ф. Мережко. Система генетическго изучения исходного материала для селекции растений. Ленинград, ВИР, 1984. С.5-10.

[5] Анащенко А.В., Ростова Н.С. Корреляционный и факторный анализ морфологических и хозяйственных признаков рапса // Сельскохозяйственная биология. 1991. № 4. С. 129-135.

[6] Шпота С.В. Исходный материал для селекции рапса и сурепицы. -Автореферат дисс…канд.с.-х.наук. - Л., 1988. -С.17.

[7] Ростова Н.С. Корреляции: структура и изменчивость . СПб.: Изд-во С.-Петерб.ун-та, 2002. Т.94. С.-308.

[8] Ростова Н.С., Курцева А.Ф., Аристархова М.Л. Применение математических методов в классификации проса обыкновенного // Тр. по прикл. ботанике, генетике и селекции. 1986. Т. 105. -С. 96-103.

[9] Брач Н.Б. Корреляционный и факторный анализ некоторых признаков льна-долгунца//Науч.-техн.бюл. Всесоюз. науч. -исслед. ин-та растениеводства. 1989а. Т. 188. С. 15-21.

[10] Кулиев Т. Изменчивость и детерминированность признаков подсолнечника в условиях почвенного засоления // Научный журнал. № 1(3). 2015. –Томбов: 84-90 с.

[11] Kuliev T.X., Sultonova K.R., Bakeev R.S., Ismoilova K.M. Statistical basis for determination of genotype to environmental adaptation/ “ASJ” American Scientific Journal. № (41). 2020. P.4-7.

[12] Шишлянникова Л.М. Математическое сопровождение научной работы с помощью статистического пакета SPSS for Windows 11.5.0 // Учебно-методическое пособие М., 2005. С.-107.