Research Article

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Ekin
Journal of Crop Breeding and Genetics

(2015) 1-2:70-77

The formation and study in the culture of genetic resources of forage crops by the expeditionary collection of wild forms from the natural landscapes of Kazakhstan

Meirman G. Tulendinovovich[1] **Yerzhanova S. Tanyrbergenovna**[1*]

[1] Kazakh Scientific Research Institute of Agriculture and Plant Growing
040909, Kazakhstan Almaty region, Karasai distr, Almalybak village, Str. Erlepesov
[*] Corresponding author e-mail: sakyshyer@mail.ru

Citation:
Tulendinovovich MG, Tanyrbergenovna YS 2015. The formation and study in the culture of genetic resources of forage crops by the expeditionary collection of wild forms from the natural landscapes of Kazakhstan. Ekin J Crop Breed and Gen 1-2:70-77.

Received: 17.07.2014 ***Accepted: 18.11.2014*** ***Published Online: 30.07.2015*** ***Printed: 31.07.2015***

ABSTRACT

Diversity of plant genetic resources is the main basis of breeding. Gene pool of crops, including fruit, in Kazakhstan consists of 79,400 samples. In this, the proportion of forage crops is 12.8 thousand samples. Experiments were carried out by the method of scientific research institute of agriculture and crop N.I. Vavilov. The questions replenish the gene pool of forage grasses by collecting expedition in Kazakhstan and the results of the study on the productivity of forage alfalfa 1578 collection samples representing 12 of its species, including wild.

Keywords: the gene pool, forage crops, alfalfa, the wild specimens

Introduction

Biological diversity in the form of genetic resources, cultivated plants, is the primary basis of breeding, to improve agronomic traits, product quality, stress resistance and adaptability to specific agro-ecologies of new varieties as well as adapt to climate change.

Currently, the gene pool of crops in Kazakhstan consists of 79.4 thousand samples. Out of these, the proportion of forage crops is 16.2% (12, 834 samples). In the structure of the gene pool of forages alfalfa accounts for (60%) followed by wheat grass (32%). It should be noted that the exclusive role of forming the gene pool of forage crops belongs to by Russian Scientific Research Institute of plant production named N.I. Vavilov .

Wild gene pool of other forage crops consists of 70 species belonging to 29 genera. Flora of Kazakhstan has a unique variety of species composition and ecotypes of forage crops that are of interest for use in breeding. The main ones are: ***Medicago*** **L**.: *M.coerulea, M. difalcata, M. falcata, M.sativa, M.tianchanic, M. Trautvetteri; Melilotus: M. albus Dest. , M. officinalis Dest.,sp.vilgicus, M. varia; Trifolium: M. medium, M. pretense* L. ; ***Onobrychis****: O. arenaria, O. inermis, O.viciafolia scop, O.antasiatic;* ***Astragalus****: A.alopecias, A. anungdalinus, A.chionantus, A. flexus, A.globiceps, A.sieversianus, A. turszaninovii, A. unifolatus, A. vulpinu* ***Vicia*****. L.***: V.sativa* L., *V. Villosa, V. kronenburgii, V. Juncea, V. Lanuginose,* ***Phleum*** **L***: L. Paniculatum, L. phleoides., L. Alpinum, L. Pretense,* ***Roshevitzii****; Agropyron: A.cristatum, A.cristatum subsp., A. desertorum, A. fragile sups.;* ***Dastylis*** **L***.: L. glomerata;* ***Bromus*** **L***.: B. inermi, B. occidentalis, B. turkestanicus, B.gracillimus, B.sterilis, B. tectorum,B.secalinum, B. Danthoniae, B. popovii Drob, B.severtzovii., B. sepparius, B.macrostachys Dest.* and others (Meyirman et al., 2013).

For expansion of existing gene pool; the wild forms of species are the valuable source of genetic resources for further expansion of the gene pool of forage crops. In evolutionary terms, many forage crops have wild relatives and, of course, these can be used as a donor of important characteristics for improvement of cultivated ones. Those valuable features and their inclusion in the selection process can be a starting point to achieve breakthrough success in breeding.

The territory of Kazakhstan, unlike other countries, covering different ecological zones, subzones of steppe, semi-desert landscape, as well as powerful mountain ranges - Tarbagatai, Tien Shan, Altai, Mugaljar and various soil - climatic conditions with its environmental pressure, which contributed to the formation of highly diverse ecotypes. On the other hand, the industrial civilization: the development of large areas under agricultural crops, production of hydrocarbons, construction of various facilities, geological exploration studies, as well as global climate change cause extinction of some species and limit their distribution in nature.

During the period (1969-1978) by territory of Kazakhstan was the expedition researchers of Russian Research Institute of plant production named N.I. Vavilov to collection of wild species of plants. World collection of Russian Research Institute of plant production was enriched with in 2446 by Kazakhstan samples of forage plants, among which - 209 samples are of various types of alfalfa (Ivanov and Kolos, 1980).

In order to confirm the significance of the problem it is relevant to note the participation of one of the author of this article Meyirman GT expedition in Almaty region with Canadian scientists Lorenz for collection of nodule bacteria that settled in the root system of cultivated and wild legumes. This approach is very important in the selection of the nitrogen-fixing ability to raise pulses, thereby stabilize the environmental situation in agriculture by reducing the consumption of such mobility in soil mineral nitrogen. This approach is very important in breeding to enhance nitrogen-fixing ability of legumes, thereby stabilize the environmental situation in agriculture by reducing the consumption of such mobility in soil mineral nitrogen.

There are many examples in the world where wild collected specimens (ecotypes) or local ecotypes in Kazakhstan became the ancestor of many commercial varieties. Thus, the known varieties of cultivated alfalfa in America, originated from Turkestan lucerne. Collected samples (ecotypes) of yellow alfalfa (*Medicago falcata* L.), lomkokolosnik Sitnikov (*Psathyrostachys juncea*) and wheatgrass (*Agropyron desertorum*) from the territory of the former Semipalatinsk region by Canadian scientists in the last century (1930) became the basis of genetic plasma in breeding varieties of alfalfa type Rambler, drought-resistant varieties of lomkokolosnik Sitnikov -Bozoysky

Of perennial forage grasses greatest fame and distribution received alfalfa. Its gene pool in Kazakhstan refers to one of the richest regions of - Central Asia, which is considered the primary focus of origin alfalfa: of the Alatau mountains, eastern Tien Shan and Jungar Alatau.

Variety of original forms of alfalfa, especially local varieties generated by factors morphogenesis and differentiation, increased dramatically thanks to the many separate geographical areas, each of which has its own set of sorts.

Genetic composition of species and varietal potential alfalfa directly related to habitat ecology, methods of cultivation and use. In nature, the localization characteristics and properties depending on the ecological and geographical areas of origin of the samples.

Currently, based on the generalization of the results of studying an extensive set of world collection of alfalfa Scientific Research Institute of Agriculture and crop production by N.I. Vavilov (VIR) mapped the localization of geneplasms important characteristics and properties of alfalfa perennial species of subgenus Falcago the centers of origin of plants (Ivanov, 1976).

Materials and methods

Bookmark technique of field experience

Objects of study were 1078 samples of alfalfa. These types and samples of alfalfa were studied in nurseries during different years of sowing by comparing them with standard variety. As standard variety ; local Semirechinsk that is widely cultivated in Kazakhstan, occupying an area of about 1 million hectares, was used for comparisons. Bookmark nurseries carried out by the method of All-Russian Institute of Plant named after N.I. Vavilov (Methodological guidance on perennial grasses, 1981) with the placement of standard variety after every 6 to 10 studied samples, with 1-3 replicates and high bay arrangement plots.

Plots dimensions 1m^2 - (length 1.7 m, width 0.6 m). Sowing - Terraced row spacing of 15 cm with norms a sowing of 2 g of seeds per 1 m^2. The distance between plots - 0.6 m study and evaluation of the samples were carried out 2-4 hay harvest for economically - valuable attributes and properties of interest for breeding: the productivity of green and dry weight, height, tillering, number of leaves of plants, symbiotic nitrogen fixation activity chemical composition of forage, resistance to major diseases. This article presents the results of studies on dry weight yield of alfalfa.

Agro-technical measures - recommended for the area (cropping system in the Almaty region, 2005.). Phenological observations were carried out in the morning. Structural analysis. Korsakov Nikolai, Makasheva AD, Adam OP Method of study collections legumes - A ,: WRI, 1968. - 175s. Harvesting was done with mini harvesters SAMPO or Hege following the procedure with ICG / crop variety trials // Methods public from / crops. Vol. 2. Grains, oilseeds and fodder crops. M., 1956. -229 p.

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Determination of the main nutrients in the soil under the relevant state standards: Total nitrogen, total phosphorus, total potassium in plants was determined after the wet incineration plant material from a single sample. Further, total nitrogen content by Kjeldahl, phosphorus by colorimetric method and , potassium by flame photometer were measured following methodology described by // Mineev (2001)

Ratios of nitrogen and phosphorus fertilizer difference was calculated by the formula: C = (VNR - B0) / N. 100, where the BNP - Nutrient on plots with N or P; B0 - Tap on plots without fertilizer; N, P - application rate of fertilizer nitrogen or phosphorus.

The total grain nitrogen was determined by Kjedahl method and the protein content in grain was estimated by multiplying total grain nitrogen by a factor of 5.71 as descibed by Pleshkou BP, Workshop on Plant Biochemistry, Moscow, (1976)

Results

The long-term studies on the collection of samples from different years in the nursery seeding at 2-4 mowing hay annually for 3-4 years it was possible to identify high-yield samples that served as the original forms in breeding synthetic varieties. They have been used in breeding populations by partitioning on genotypes and bookmark inbred lines to the second and third generations. On the basis of inbred lines with high general combining ability high productive new varieties such as Darkhan 90, Turkestan 15, Kokoray, Osimtal and Kokbalausa were synthesized .

Breeding - genetic basis of studying the problem and the choice of the starting material of alfalfa should be ecological principles to better use in the selection of a single advantage of eco - geographical groups, each ecotype.

Given the importance of proper selection of the starting material in the creation of new varieties, 1078 samples of alfalfa (Table 1) related in 12 species, which cover 32 eco-geographical groups of 34 were studied according to the classification of Russian Research Institute of plant production named N.I. Vavilov. Samples were grown on irrigation (961) and without irrigation (117) (Meyirman et al., 1979). Standard varieties were - Semirechinskaya a local type.

Yellow alfalfa in the collection was represented by 58 specimens belonging to 7 ecotypes, and other wild species - 35 samples.

Using fodder as criterion in alfalfa and volatile 47 samples and wild species only 2 samples with efficiency exceeding the standard variety (spot of the Semirechinsk) more than 20%, 49 samples - from 6 to 20%, 85 samples at the level of the standard could be identified, while for the 754 sample productivity was below standard. More productive samples were isolated more often from plain - Turkestan, Semirechinsk, Southern European and North African ecology - geographical groups.

In one of the collection of nursery a large set of alfalfa gene pool consisting of 500 accessions belonging to alfalfa and changeable was studied. Based on the study for the first three years of use, 31 accessions were isolated on yield of green mass, and 4-6 years of use - 16 accessions, exceeding the standard by more than 20% were selected . In accordance with the scheme of crop rotation in irrigated agriculture alfalfa, as a rule, use no more than 3 years by leveraging its biological features. The samples were studied by the yield of green mass and hay, foliage, weight and height of vegetation, plants infection by brown and yellow spotted askohitozom, mildew and other viral diseases, the rate of regrowth and growth, the passage of the main phases of plant development.

Many farmers working in the south and south-east of Kazakhstan tend to keep as long as possible stands of alfalfa that is to use old-growth crops with reduced harvest.

In our experiments (Meyirman et al., 2012) we tracked productivity of green mass from the first to the sixth year of use in order to allocate more productive perennial alfalfa accessions (Table 2). Virtually all high-yielding accessions, subsequently reduced yield of green mass.

If at the end of the study in the first three years they exceeded standard - Semirechensk local average by 15-35% with yields 7,63-8,96 kg/m^2, then the further use of the grass in 4-6 years of use, the excess over standard in some samples was 5-32% with a yield of 2,48-3,14 kg/m^2, and many accessions sharply reduced productivity.

Discussion

In Kazakhstan, for conducting research on the formation of the gene pool of forage crops: 12834 samples have been registered, of them alfalfa - 60%, wheatgrass - 32% and for other types of herbs - 8%. Win forage crops in the volume of the gene pool of crops including fruit is 16.2%. In yield of alfalfa forage allocated 78 accessions at three annual herbage use and 16 accessions with many years' use (4-6 years), which exceeded the standard variety of more than 20%. They are used in the program to create synthetic varieties.

The results of tests on samples of alfalfa confirmed low productivity of wild species, although they differ in individual securities characteristics and properties important for breeding. Thus, according to the salt tolerance of alfalfa samples highlighted blue (*M. coerulea Less.),* For drought tolerance - *(M. difalcata Sin., M. falcata* L.*)* and others, resistance to disease - almost all kinds of wild alfalfa. Therefore, the wild species are of interest as sources and donors to improve alfalfa cultivars based backcross crosses given the ploidy level and the need to transfer from diploid species to tetraploid level to overcome uncrossability among species, or by the use of genetic engineering techniques.

Table 1. Level of harvest of alfalfa samples in the context of eco - geographical groups

Ecological- geographic group	Number studied samples	Of these samples compared with the harvest standard grade			
		exceeding over 20%	guides exceeding 6-20%	at the level 95-100%	yield
1	2	3	4	5	6
Alfalfa (*M. sativa* L.) sowing and variable (*M. varia Mart.*)					
Khiva	11	-	1	-	10
Plain- Turkestan	85	6	10	16	53
Semirechinskaya	66	9	6	12	39
Turkmenskaya	21	2	3	2	14
North Kazakhstanskaya	17	1	4	4	8
China Plain	18	1	2	3	12
Chinese foothill	9	1	1	2	5
Kashgarskaya	10	-	1	3	6
Kandahar- kabulskaya	11	-	-	2	9
Transcaucasian flat	38	2	2	10	24
Asia Minor	9	-	3	1	5
West European	136	6	12	32	86
South European	80	2	7	24	47
Ukrainian	59	1	6	9	43
North Caucasus	50	2	3	4	41
North Caucasian	11	-	1	1	9
South East	17	2	2	3	10

Continuing table 1

Ecological- geographic group	Number studied samples	Of these samples compared with the harvest standard grade			
		exceeding over 20%	guides exceeding 6-20%	at the level 95-100%	yield
1	2	3	4	5	6
Alfalfa (*M. sativa* L.) sowing and variable (*M. varia Mart.*)					
Northwestern	7	-	-	-	7
Fair Russian	19	1	1	1	16
East Siberian	21	1	1	1	18
West Siberian	15	-	1	-	14
C North American	95	1	4	17	73
Canada	8	-	-	2	6
Chilean- peruvian	28	-	2	5	21
Mexico -Brazilian	25	-	2	3	20
Argentine	9	-	-	3	6
Indian	28	2	4	3	19
North	42	4	3	10	25
Mesopotamian	9	1	-	3	5
Syrian	7	1	2	-	4
Yemen	7	-	1	2	4
Ladakhi	17	1	-	1	15
Total	985	47	85	179	674
Ecotypes of wild yellow alfalfa (*M. falcata* L.)					
Ukrainian steppe	3	-	-	-	3
North Caucasian	16	1	-	-	15
De Sales steppe	4	-	-	-	4
South-east	16	-	-	2	14
North Russian	1	-	-	-	1
West Siberian	7	-	-	-	7
East Kazakhstan	11	-	-	-	11
Total	58	1	-	2	55
Other wild alfalfa					
Alfalfa blue (*M. coerulea Less.*)	12	-	-	-	12
A.polutsiklicheskaya (*M. hemicycla Grossh*)	3	-	-	1	2
A.adhesive (*M. glutinosa M.B.*)	2	-	-	-	2

Continuing table 1

Ecological- geographic group	Number studied samples	Of these samples compared with the harvest standard grade			
		exceeding over 20%	guides exceeding 6-20%	at the level 95-100%	yield
1	2	3	4	5	6
Other wild alfalfa					
A.colored (Subsp. Poluchroa Sinsk.)	10	1	-	2	7
A.Tien Shan (M. tianshanica Vass.)	2	-	-	1	1
A.Lavrenko (M. Lavrenko Vass.)	1	-	-	1	-
A.pyreynaya (M. agropyretorum Vass.)	2	-	-	2	-
A.Trautfettera (M. Trautvetteri Sumn.)	2	-	-	2	-
A. glandular (M. glandulosa David)	1	-	-	-	1
Total	35	1	-	9	25
Total	1078	49	85	190	754

Table 2. The change of productivity of green mass of high-yielding examples of alfalfa with many years use of grass

№ Catalogy of VIR	Origin	Green weight from 1 kg/m²									
		years of use			average for the first 3 years of use	in % of standard	years of use			average for the 4-6 years of use	in % of standard
		1	2	3			4	5	6		
1	2	3	4	5	6	7	8	9	10	11	12
45335	Kyrgyzstan	3.5	15.1	7.9	8.82	132	4.0	3.5	1.3	2.94	124
46528	Estonia	2.6	14.7	9.6	8.96	135	3.5	3.0	1.7	2.73	115
36049	Kazakhstan	3.4	15.3	8.4	9.0	135	2.8	3.0	1.2	2.33	98
43782	Ukraine	2.2	14.7	8.7	8.49	127	3.5	2.7	1.9	2.7	114
43821	Georgia	1.6	15.0	9.5	8.71	131	5.2	2.1	0.2	2.5	105
44568	Russia	3.3	13.3	8.5	8.36	126	3.7	3.6	1.1	2.8	118
43784	Russia	3.4	12.6	9.6	8.51	128	3.1	3.4	1.3	2.6	110
47050	Russia	2.7	14.4	8.5	8.52	128	3.0	3.7	1.1	2.59	109
47049	Russia	2.9	13.9	9.1	8.63	130	2.5	3.5	1.5	2.48	105
43777	Russia	2.3	12.2	10.1	8.19	123	3.8	3.6	1.2	2.85	120
43779	Russia	2.3	13.4	9.5	8.39	126	3.5	2.6	1.9	2.66	112

Continuing table 2

№ Catalogy of VIR	Origin	Green weight from 1 kg/m²									
		years of use			average for the first 3 years of use	in % of standard	years of use			average for the 4-6 years of use	in % of standard
		1	2	3			4	5	6		
1	2	3	4	5	6	7	8	9	10	11	12
44419	USA	2.2	12.9	9.2	8.1	122	4.3	3.4	1.2	2.95	124
45369	Kazakhstan	3.4	14.4	8.5	8.74	131	2.4	2.7	1.8	2.29	97
45036	Armenia	3.0	12.7	8.0	7.9	119	4.1	3.5	1.2	2.93	123
6231	Russia	1.9	13.3	8.1	7.76	117	4.1	4.1	1.1	3.1	131
62097	Kazakhstan	3.4	11.4	9.1	7.95	119	3.9	3.0	1.9	2.93	123
47492	Kazakhstan	3.3	10.4	9.3	7.63	115	4.4	3.0	2.0	3.14	132
22571	Russia	3.0	11.1	9.3	7.82	117	4.1	2.8	1.9	2.92	123
44566	Russia	3.4	11.6	9.8	8.25	124	4.4	1.6	1.6	2.51	106
33481	Finland	3.0	14.3	8.1	8.45	127	3.1	2.4	1.4	2.27	96
39952	Russia	2.9	12.5	9.0	8.13	122	4.0	2.3	1.2	2.51	106
6015	Malaysia	2.1	12.8	9.3	8.05	121	3.0	2.7	2.0	2.53	107
44032	Russia	3.4	10.9	8.8	7.71	116	3.4	2.8	2.0	2.75	116
30830	Ukraine	2.6	13.1	8.8	8.17	123	3.2	3.0	0.8	2.34	99
46529	Ukraine	3.1	13.3	9.5	8.62	129	2.9	0.9	1.3	1.67	70
46249	USA	2.6	15.9	6.8	8.44	127	3.0	1.2	1.3	1.82	77
30071	Russia	3.2	13.8	8.0	8.31	125	2.1	2.8	0.8	1.9	80
6014	Malaysia	2.5	13.6	9.1	8.37	126	3.1	1.3	0.9	1.75	74
45860	Russia	1.6	15.7	7.9	8.4	126	2.8	0.9	1.3	1.65	70
47705	USA	3.2	14.0	7.0	8.05	121	3.5	0.7	1.5	1.91	80
45712	USA	2.6	15.3	6.4	8.1	122	3.1	0.9	1.3	1.73	73
45081	Georgia	2.8	12.9	8.6	8.12	122	2.7	0.8	1.1	1.53	64
28460	Ukraine	3.6	11.3	9.4	8.07	121	3.1	1.5	0.3	1.62	68
34627	Kazakhstan	2.3	13.0	9.0	8.1	122	2.3	1.9	0.4	1.53	64
46270	Ukraine	3.0	13.2	7.8	8.01	120	2.5	0.7	1.3	1.45	61
Standard		2.3	10.2	7.5	6.66	100	3.2	2.4	1.5	2.37	100

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