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Formation of the Genetic Resources of Forage Crops Kazakhstan: Luzerna and Wheatgrass

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ABSTRACT

Formation, analysis, documentation and study of the gene pool of forage crops by mobilizing the cultivars of the world collection and the collection of wild specimens, which are valuable sources for selection remains highly relevant direction and has a significant influence on the development of selection - genetic science with the expected effect on the breeding of new varieties. These varieties will have ecological and social effects in food safety.

Keywords: Forage Crops, Expedition, Wild Growing Species, Gene Pool, Screening.

1. Introduction

Flora of Kazakhstan has a unique diversity of ecotypes and species composition of forage crops that are of interest for use in breeding. It is proposed to collect roughly the following general and species: Lucerne (*MedicagoL*): *M. coerulea, M. difalcata, M. falcata, M. sativa, M. tianchanic, M. Trautvettei*; Clover (*Melilotus*): *albus Dest, officinalis Dest., sp. vilgicus, varia; S*weet clover (*Trifolium*): *medium, pretense* L; Sainfoin - (*Onobrychis*): *arenaria, inermis, viciafolia scop, antasiatic Khim*; *Astragaly* (*Astragalus*): *alopecias, anungdalinus, chionantus, flexus, globiceps, sieversianus, turszaninovii, unifolatus, vulpinu* Wikis (*Vicia. L.*).: *sativa L., villosa Roth.;* Lomkokolosnik (*Psafhyrostachys*): *kronenburgii, juncea, lanuginose Nevski*; Timofeevka - Russian wildrye (*Phleum* L): *paniculatum Huds.Mereu, phleoides Korst., Alpinum L., Pretense L., Roshevitzii Pav.*; *W*heatgrass (*Aguopyron*): *cristatum, cristatum subsp., desertorum, fragile sups.*; Orchard grass (*Dastylis* L.): *Glomerata* L.; *Bromus* L.: *inermis* L., *occidentalis Pavl., turkestanicus, gracillimus, sterilis* L., *tectorum* L., *secalinum* L., *danthoniae Thin, popovii Drob, severtzovii Rgl., sepparius L., macrostachys Dest.*

Wild species and wild congeners as a genetic resource, which created in the unique conditions of Central Asia, are able to solve the problems of resistance to disease, pests, cold, drought, to expand inevitably limited genetic base of modern varieties, post-upgrade of agriculture. Getting hold of such material is only possible through the collection. (R. Urazaliev, M.Yessimbekova, 1995, 2005 and 2007) [5].

In evolutionary plan, many forage crops have kept their wild congeners and, of course, they can be a valuable source and donor to improve the culture of the individual economic - essential attributes and properties. These are the carriers of valuable features and their inclusion in the selection process can be a starting point to achieve breakthrough success in breeding.

There are many examples in the world practice where wild-growing samples (ecotypes) or local ecotypes in the territory of Kazakhstan became the ancestor of many commercial varieties. For instance, known varieties of Lucerne grown in America, take their origin from Turkestan's Lucerne. Samples (ecotypes) of yellow Lucerne (*Medicago falcate* L.) from the territory of the former Semipalatinsk region, Russian wildrye (*Psathyrostachys Juncea*) and wheatgrass (*Agropyron desertorum*) collected by Canadian scientists in the last century (1930) became the basis of genetic plasma in breeding offset varieties of Lucerne of the type Rambler, drought-resistant varieties of Russian wildrye - Bozoysky improved.

Mobilization of the genetic resources of wild-growing plants is still quite topical area. Foreign scientists (botanists - florists, geneticists, breeders) showing increased

interest to the issue of collection of wild ecotypes, especially forage plants. The territory of Kazakhstan, in contrast to other countries, covers different areas, the subzone of the steppe, semi-desert terrain, as well as mountain ranges - Tarbagatay, Tien Shan, Altai, Mugadzharskaya and various soil - climatic conditions of its environmental pressures have contributed to the formation of a wide variety of ecotypes. On the other hand, the "industrial civilization": the development of large area for cultivation of agricultural crops, production of hydrocarbons, construction of various objects, geological research and exploration, as well as global climate change result in the disappearance of some species and limit their spread.

The problem of collecting wild species of forage grasses drew the attention of many researchers around the world. It should be noted that, in the context of the conservation interests of the world is increasing. The territory of Kazakhstan time (1969-1978 years) was swept by researchers Union (now All-Russia) Institute of Plant names N. Vavilov (VIR) for the collection of ecotypes of wild species of host plants. The global collection of VIR recharged 2446 Kazakhstan forage samples, including 209 samples of various types of alfalfa.

Formation, analysis, documentation and study of the gene pool of host plants by mobilizing the cultivars of the world collection and the collection of wild specimens, which are valuable sources for selection remains highly relevant direction.

2. Materials and Methods

Conduct field expeditions to places of greatest congestion of species diversity: mining systems and steppe regions of Kazakhstan, with appropriate sampling techniques from different ecotypes of forage plants.

To document and create an electronic database was used information retrieval system Cacdb_ICARDA (J. Konopka, M. Yessimbekova, S. Yerzhanova and et. all, (2004, 2006) [1], the software modified and improved by staff of Kazakh Scientific – Research Institute of Agriculture and Faming.

The study was based on the guidelines of VIR for the Study of the world collection of fodder crops (Lenigrad, 1981), field experiments on the selection of forage crops - according to the procedures of feed Institute (1981) and the State Commission of crops Republic of Kazakhstan (2002). The accuracy of the experiments is determined on the basis of analysis of variance on Dospehov B.N. (1985).

3. Results and their discussion

By employees of the Kazakh Scientific – Research Institute of Agriculture and Faming had carried an expedition on the territory of the Northern Kazakhstan with aim to survey the natural flora and collecting seeds of wild perennial forage grasses and legumes, as well as medicinal plants (E. Abdrashitova, *et al*, 1998). Their route of the expedition took place in the North-Kazakhstan low hills between the rivers Ishim - Selety. The flat area of this province in the past with a rich grasses, was assimilated by crops. The natural vegetation remained on marginal lands and not suitable arable lands: on scions, on Mezhsopochnoe hills and hollows, near scarifiying, in ravines, on saline lands, on floodplains.

In the process of collecting of seeds special attention was paid to those species of wild forage crops, which has breeding in the north of Kazakhstan. Seeds collected 125 samples belonging to 31 botanical species, including the 6 cereals. Collection of samples of wild wheat grass is a drought-resistant ecotypes of desert wheatgrass, wheatgrass widely wheatgrass, salt and wheat grass sun-resistant ecotypes.

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In this regard scientists of Kazakh Scientific – Research Institute of Agriculture and Faming K. Kozhakmetov, M. Yessimbekova and others carried out the great work, gathering valuable specimens of fodder and medicinal plants (2004, 2007, 2008).

In 2006, officers of the gene pool Kazakh Scientific – Research Institute of Agriculture and Faming expedition was conducted to collect herbarial and seed material types - congeners of forage crops of natural flora of Kazakhstan. Expeditional collection of material was held on the territory of Aktobe basins of the rivers Emba, Temir, Ilek, in the mountains Mugodzhary - Southern Ural) and Kostanai regions. Surveyed areas, according to data of previous surveys and present expedition is rich with genetic diversity of food crops. The region is a powerful hotbed of introgressive hybridization of species of alfalfa, wheat grass, is rich in a variety of populations of clover, sainfoin, astragalus, lomkokolosnik of sitnikov, wild rye, vetch, rank (wild species). 237 samples, 52 crops were collected, including 112 samples, 10 forage crops.

In 2007, the expedition was conducted to collect forage species relatives of the natural flora of the Almaty region. The route was worked out according to the herbarias of Institute of Botany and Phytointroduction of Republic of Kazakhstan. The length of the route was 3,100 km. and included 11 districts - Shelek, Alakol, Kerbulak, Raimbek, Sarkand, Zhalanash, Aksu, Zharkent, Taldykurgan, Ely, Sairam, Almaty and South - Kazakh regions which are rich in genetic diversity of wild and wild plants. 128 samples were collected, including 34 samples of feed crops 6 genera - *Agropyron Gaertn., Eremopyrum Jaub. et Spach., Melilotus officinalis, Medicago falcate L., Medicago sativa L., Phleum L.*.

In 2008, the collection of plant genetic resources held in 6 regions of the South - Kazakhstan - Saryagash, Tolebi, Tyulkubas, Sairam, Jambul, Kazygurt. Collected 44 wild and crazy - increasing the sample (seeds, herbarium) 4 groups of crops - corn, fodder, technical, medical. On forage crops - 6 samples of 3 genera of forage crops - rank, alfalfa, sweet clover.

In general, during the three years (2006 - 2008) was collected 413 samples, including the 152 feed sample [2].

Was conducted a survey of the Aksu - Zhabagaly State Nature Reserve, which is located in the north - western end of Talas Alatau mountain range in the western Tien - Shan on the territories of Tolebi and Tyulkubas areas of the South - Kazakhstan region and district Zhualy of Zhambyl region. Flora of the reserve are 1704 species of plants, including 1279 higher (M. Yessimbekova, R. Kushanova, 2006, 2007).

An extensive analysis was carried out to form the gene pool of forage crops in Kazakhstan and further study for selection. Analysis of the structure of the gene pool of the collected shows that the genetic resources provide a unique and valuable materials for further study. Feature of the study is a new integrated approach: documenting, organizing and creating an electronic database of forage crops.

By researchers has assembled the gene pool of forage crops

about 9500 specimens, of which 59.44% of the collection of alfalfa and 32.36% - wheatgrass (Fig. 1) [3].

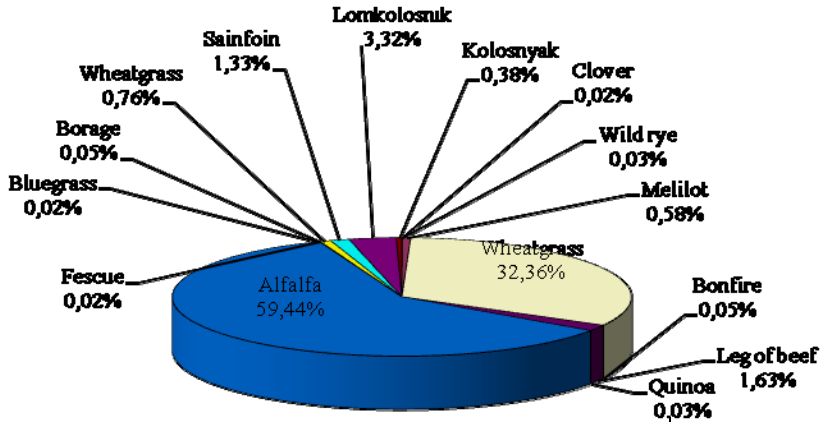

Fig 1: Structure of NBD in the context of forage crops

Documenting the collection and forwarding of the material included observations of interest to users of germplasm and was conducted in accordance with international methodology on a specially designed form. Were fixed data of the location of the sample associated with the place of vegetation, a description of the status, characteristics of the plant and its local use, conducted by the management (M. Yessimbekova, S. Yerzhanova., et all, 2004, 2006, 2007) [4].

Data presented in a table with the following columns:

- The national registration number in the database - *NC*; - taxon - *Agropyron cristatum subsp.pectinatum (Bieb) Tzvel. etc.* - the name of the class - *ID*; - type of development - *S* - spring, *W* - winter, *F* - Elective - type of population - *CV*- grade, *WI* - wild, *RM* - Research material, *LA* - sort of national selection , status - *PL* - pure line, *PO* - population, *SE* - mass selection or screening - the donor - *Donor*, scientific - research institutions (*SRI*) - the donor country - *CTY*; - the originator - *ORI*; - pedigree - *Pedigree*; - storage - Ins_cons. - *NRU*, which houses the collection - a gathering place of the sample - *a country, region, district, etc*., - the date of the sample collection expedition - *nn. mm. ff.* - Day, month, year - location code sample collection - *COD*.

Created an electronic database of host plants, including alfalfa and wheat grass with a retrieval system Cacdb_ICARDA.

Study collection of alfalfa Kazakh Scientific – Research Institute of Agriculture and Faming conducted in the department of feed, oilseeds and legumes (G. Meyrman, K. Baytarakova, 2006, 2007, 2008) [5], consisting of 500 accessions: Institute of Plant and 34 countries around the world. The collection was mainly represented by accessions of two species: *Medicago sativa* L. and *Medicago varia Mart*, monitoring was performed for 3 years, during this period had a 10 cuttings: in the 2006 year was sowing - 2 mowing, in 2007 - 2008 was 4 mowing.

Phenological observations have revealed that all of the studied accessions of spring growth begins almost simultaneously. The difference between the accessions by date of flowering, which had in the first cut, stored and later cut system. According to data for two years (2007 and 2008) were early maturing accessions in which the formation of the first cut (spring growth-beginning of flowering) occurred after 58-60 days. To determine the breeding value accessions evaluated their efficiency on the green mass and structural indicators that make up the harvest, such as plant height, plant stand density, the yield of dry matter, leaf-bearing, resistance to major diseases: brown patch and askohitoz.

Analysis of the yield of green mass during the three years accessions have studied compared to the standard cultivar showed the following results. Of the 500 accessions of the collection at the average yield exceeded the standard of 247 accessions and 253 accessions were given crop is lower than the standard. The most high-yield were 41 accessions, which gave the yield of green mass of more than the standard for 20-35.2%. Yield level in 63 accessions was larger than the standard 10-20%, and 153 accessions to 10%.

The average height of the plants in accessions varied in the range 68.6 - 77.2 cm with a standard height - 72.8 cm. Density stem from accessions to an average of 224 -321 stems/m^2, a value of 236 standard, 4 stems/m^2. Average leafy standard was 48%, while the accessions it has changed within the 46.2 - 53.8%.

Worldwide collection of alfalfa on completed test cycle allocated 31 high-accessions for forage crops. Its collection of eight wild species of alfalfa and hybrids derived from crosses with wild seed alfalfa.

Longevity of crested wheat grass swards due to its high drought tolerance, winter hardiness, good vegetative renewal and restoration of grass seed.

The study was conducted in the collection of wheatgrass Aral Stations PGR (M. Takaeva). Collection for a comprehensive study consisted of 70 wild specimens, 10 varieties of wheat grass. Tillering determined earing: we counted the number of generative and vegetative shoots with the accounting area at the individual standing plants. Seed productivity installed after threshing and drying, by weighting the treated seeds. The assessment determined the hardiness of plants by a single person, by counting the number of live and dead in a plot in the autumn and in the spring at the beginning of the growing season. Percentage of winter hardiness established by dividing the number of live plants, preserved in the spring, on the number of plants last fall and multiplying the result by 100. Assessment of the response of plants to drought produced in points: 1 - very weak (some slight yellowing of basal leaves),

3 - weak (yellowing of basal leaves), 5 - average (yellowing of the basal and lower stem leaves), 7 - strong (yellowing of the basal and lower stem leaves and loss of turgor green leaves), 9 - very strong (yellowing of the leaves, their loss of turgor and hypoplasia of the generative organs, the inflorescence does not come out of the vagina of the top sheet).
On biology root development wheatgrass dedicated work and other Kazakh scientists, in particular: Ametova A.A., Nurbayeva O.N., Ismailov B., Ramazanov K.R, Esimbetov A.E. investigated the specificity of the root system in different periods of development and differences were found between species. It was found that in the early stages of growth and development in the rapidly developing germ wheat grass roots, and further side. In the phase 3 leaves (22 days after sowing) the proportion of plants with two embryonic roots in wide kolosly forms was 32%, in narrow kolosly was - 23%.

The problem of creation and selection of drought-resistant varieties of wheat grass is quite sharp, as many of the areas where this crop is grown is different arid climate. Successful breeding for drought resistance in wheat grass is only possible if enough complete information about the reaction of the starting material for the lack of moisture and high temperatures.
Work on the creation of drought-resistant varieties adapted to local conditions are constrained by insufficient knowledge of the gene pool of wheat grass on the ground, the lack of objective and productive methods for the evaluation and selection of drought-resistant forms.

A study of collection material samples along the length of the growing season divided into 3 groups: early maturing (90-96 days), medium (97-103 days) and late (104-109 days). Found that highly productive on the green mass of wild specimens are wheatgrass group of middle-and-wild samples with low productivity tend to belong to a group of early-ripening. The study of varieties showed that some varieties originating from Kazakhstan (Karabalyk - 202, the Kazakhstan-60, Batyr) from Russia grade Basovsk meadow, Canada Parkway reached grade-level standard, and other varieties that stand out in the areas of zoning, were unable to give a stable yield of green mass data: the collector's assessment under strict conditions, in terms of productivity lost much of standard varieties of wheatgrass Aktobe narrow ear of local. The study of the dynamics of the water regime in the drought gave an idea of the degree of stability samples of wheatgrass on the Northern Aral Sea. For samples of Siberian wheatgrass Atyrau region (k - 37766) and Taukum hybrid (k - 38045) have high adaptive capacity, since they are more efficient to use a protective-adaptive mechanisms as increased drought and acute shortage of water had the best performance on the ability to resist dehydration (Takaeva M., Yerzhanova S., 2009) [6].

As a result of the collection of prospective studies identified patterns that sent for further breeding research institutions of the country.
Thus the collection of wild ecotypes of forage grasses and their study in the culture with the release of domestic sources - valuable attributes and properties have a significant impact on the development of selection - genetic science with the expected effect on the breeding of new varieties. By variety, in turn, will have an environmental and social effects of food security.

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