Biogeocenotechnology of restoration and increase of efficiency for degraded pasture ecosystems in Arid regions of central Asia and Russia

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Introduction The vegetation of natural pastures in Central Asia and Russia has a very important specific feature – ability to annually cycle and self-reproduce phytomass . Being an essential component of the biosphere it determines not only forage capacity of pastures , but also quality of the man's natural environment in arid territories and genetic diversity of flora and fauna . Here a great amount of carbon dioxide is fixed for long periods in the subsurface sphere of arid ecosystems (roots , organic matter of soil) . However , lack of necessary agricultural and ecological knowledge , poor management , destructive utilization of pastures , destruction of shrubs and semishrubs – all these negative factors are the causes of reduced biodiversity , decreased productivity , and degradation of pastures . For restoration of biodiversity and productivity of degraded pastures and saline lands , the best candidates appeared to be halophytes .

Materials and methods In the period from 1975 to 2000 mobilization and collection of genetic resources were conducted within a wide zone in arid regions of Turkmenistan , Uzbekistan , Kyrgyzia Republics of and also in southern regions of Russia (the Astrakhan , Volgograd , Saratov , Samara , Rostov Provinces , the Stavropol Territory , the Republic of Daghestan , and the Republic of Kalmykia) . In development of a technology of phytoreclamation of degraded pastures and saline soils the following species and varieties of halophytes selected in the course of introduction-selection efforts were used : *Haloxylon aphyllum* , *Salsola paletzkiana* , *S . richteri* , *Aellenia subaphylla* , *Eurotia* ceratoides , *Calligonum* spp . , *Ephedra strobilacea* , *Kochia prostrata* , *Salsola orientalis* , *Camphorosma lessingii* , *Artemisia turanica* , *Artemisia halophila* , *Poa bulbosa* , *Gamantus gamocarpus* (, *Climacoptera lanata* , *Halimocnemis villosa* and other pasture plants . Tests of the mentioned species were conducted in the Republic of Uzbekistan in piedmont semidesert (Nashanksy station) , in the sagebrush-ephemeral desert (Karnabsky station) and in the Southwestern Kyzylkums (Ayakagitinsky station) and in Russia (Solezaimischensky station) .

Results and discussions For selection of the most environmentally stable , highly productive species of forage halophytes 300 species of plants from the flora were tested . Integrated investigations conducted in the last 25 years made it possible to utilize resources- and energy-saving technologies for ecological restoration of biodiversity and productivity of degraded pasture ecosystems and secondary saline soils . The proposed technology of phytoreclamation of degraded lands is based on the following fundamental biogeocenotic principles (Shamsutdinov , 1996 ; Shamsutdinov & Ibragimov , 1983 ; Shamsutdinov & Shamsutdinov , 2002) : 1) compliance of an ecological-cenotic structure of created pasture ecosystems with the zonal type of natural biogeocenotic structures ; 2) utilization in design of adaptive ecosystems of various types of zonally typical dominant halophyte species belonging to the violent and patient types of a strategy ; 3) differentiation of ecological niches on the basis of seasonal , strata , succession , fluctuation and functional mutual supplementation of zonally typical dominant species in the course of formal of nodal communities . What ???These biogeocenotic principles make a theoretical basis for phytoreclamation of degraded lands . In the course of phytoreclamation it is possible to design various types of pastures with optimal productivity , structural and functional organization , and stability . Designs of such pasture ecosystems contain polydominant communities consisting of halophyte shrubs , semishrubs , xerohalophylic perennial and annual grasses (on the basis of a seed bank) .

Conclusions Germ populations of halophytes collected during expeditions provided a basis for the Central Asian genofund numbering 70 species and 5000 samples and the Caspian genofund in Russia including 50 species and 1200 samples . Environmentally oriented biogeotechnology of reclamation is realized by creation of spring-summer and autumn-winter perennial self-restoration pasture ecosystems in place of degraded lands .

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