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Biological soil crust under shrubs and its topsoil properties in the process of dune vegetation restoration in the Horqin Sandy Grassland , Inner Mongolia

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Key words : biological soil crust development , desertification , the Horqin Sandy Grassland , shrub , succession

Introduction Biological soil crust (BSC) is a major structural feature of surface soils and sediments , especially in the arid and semiarid regions , which commonly result from the development of communities of micro-organisms on the surface of physical soil crusts . BSCs are well developed under different shrubs along the vegetation restoration gradient of dunes in the Horqin Sandy Grassland , Inner Mongolia , northern China .

Material and methods The Horqin Sandy Grassland is located in the agro-pastoral transition zone between the Inner Mongolian Plateau and the Northeast Plains of China , and is one of the most severely desertified regions of China . We conducted a field investigation wherein , BSC and topsoil (0-2 .5 cm and 2 .5-5 cm under BSC) samples were taken under different shrubs in different habitats , and their physicochemical properties , including particle size distribution , bulk density , organic matter , nitrogen , phosphorus , electrical conductivity (EC) , pH , and CaCO₃ content .

Results and discussion Here in the Horqin Sandy Grassland , due to ecological effects of dune shrubs and their habitats , as the dunes transitioned from semi-mobile dune to semi-fixed dune , fixed dune and interdunal lowland , a succession of physical , algae , lichen and moss crusts developed under dominant shrubs .

Table 1 Site description of BSC samples in the Horqin Sandy Grassland .

Sites	Shrub types	Crown diameter (cm×cm)	Crust types	Crust color	Crust Cover
Mobile dune	—	—	—	—	—
Semi-mobile dune	Artemisia halodendron	45×60-70×90	Physical crust	gray and offwhite	30%
Semi-fixed dune	Caragana microphylla	95×110-145×205	Physical crust	gray	50%
			Algae crust	dark gray	60%
Fixed dune	Artemisia frigida	28×30-35×40	Lichen crust	yellow green	80%
			Moss crust	light brown	85%
Interdunal lowland	Salix microstachya	55×70-84×120	Lichen crust	light green	90%
			Moss crust	black green	90%

Simultaneously the value of plant community characteristics increased overall , including cover , richness , aboveground biomass , litter and species diversity . The thickness , water content , fine fraction , and nutrients of BSCs were gradually increased along this successional trajectory . Topsoil nutrients , <0 .05 mm particle content in 0-2 .5 cm and 2 .5-5 cm layers under BSCs increased gradually with the BSC developed from physical to moss crust , and they were higher than that in mobile dune . Moreover , fine fraction , total and available nutrients of topsoil under BSC were decreased gradually from upper to inner layer within 0-5 cm . At a soil depth of 0-120 cm soil layer , water content in mobile dune was much higher than that under BSCs at each layer , owing to shrub establishment and BSC formation which decrease the infiltration of rainfall to the soil .

Conclusions BSC formation and topsoil amelioration can firstly be ascribed to the distinct protection role of shrub establishment , contributing to against wind erosion . No matter what kind of crust was formed , all crusts contained comparatively large amount of fine particles . The more stable the habitat was , the longer the BSC was formed , and the more the finer particle content was contained , as well as the higher values in chemical properties in the BSC .