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Fencing facility affects plant species and soil organic carbon in temperate steppes

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ABSTRACT

Fencing facility has been widely employed in steppes. However, the effects of fencing facility on plant species and soil organic carbon (SOC) have been rarely understood in steppes. Using soil sampling and plant quadrat clipping methods, in this study, we investigated the effects of fencing facility on the distributions of plant species and SOC in the temperate steppes of the Inner Mongolia. Plant biomass significantly increased with approaching fencing facility and was obviously higher in the leeward (south) than windward (north) sides. Perennial grasses accounted for approximately 68%–76% of the total aboveground biomass in both sides of fencing facility. SOC content also significantly increased with approaching fencing facility in the 0–10 soil layer but slightly increased in the 10–30 cm soil layer. Wind erosion and dust storm did markedly neither change the fractions of soil texture nor cause the difference in SOC content between the windward and leeward sides. Fencing facility increased SOC storage by 16.5% and 9.1% at 0.1 and 0.5 m locations relative to at 3 m location in the 0–10 cm soil layer, respectively. Edge effect is suggested as a potential mechanism driving the variations of plant species and SOC in both sides of fencing facility.

1. Introduction

Grasslands are widely distributed on the Earth's land surface, where artificial facilities are markedly constructed, such as fencing, access, sheepfold, and homestead. These distinctive facilities might greatly cause the uneven distribution of grasslands and enhance the heterogeneity of plants and soils. Fencing has been widely employed in grasslands worldwide for a series of purposes, such as restoring degraded grasslands (Deng et al., 2014b; Wang et al., 2016; Zhu et al., 2016), protecting wild animals from overhunting, and reducing human–wildlife conflict and human encroachment (Li et al., 2013; Durant et al., 2015; Koch et al., 2017). Fencing facility is usually constructed out of wood and/or iron/steel. However, tree and/or shrub can be selected to partly replace wood and/or iron/steel for fencing, particularly in woody grasslands, where tree and/or shrub are important for supporting biodiversity. For instance, shrubs such as *Artemisia ordosica* and *Caragana korshinskii* were selected for fencing in the steppes of northern China (Tang et al., 2001). For scattered prairie hedge system, the linear planting of tree and/or shrub has a fencing effect to redirect and reduce wind flow, and thereby change micro-meteorological factors, protect homes, grasses, livestock, and/or soils, and provide wildlife with favorable habitats (Tarnoczi and Berkes, 2010; Nair, 2012; Udawatta and Jose, 2012). Thus, fencing has globally gained popularity as an effective strategy for sustainable land management.

Approximately half of grasslands have been grazed worldwide (Asner et al., 2004; Giese et al., 2013), where grazing is associated with fencing. Besides micro-meteorological factors, fencing is well known in influencing plant biomass and species composition. Most of previous studies have focused on the effects of fencing and/or grazing on plants and soils in the various types of grasslands. For instance, moderate grazing was an appropriate management practice for conserving plant diversity (Olff and Ritchie, 1998). Grazing exclusion improved community coverage, plant height and diversity, and aboveground biomass but decreased belowground biomass in a desert steppe (Wang et al., 2016). In grasslands, short-term fencing improved biodiversity and productivity by effectively relieving grazing pressure (Hart, 2001;

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