Seed Rain and Viable Soil Seed Bank of 'Black Soil Land' Degraded Alpine Meadow in Qinghai-Tibetan Plateau

Zhanhuan Shang
Lanzhou University, China

Yushou Ma
Qinghai Academy of Animal and Veterinary Science, China

Ruijun Long
Lanzhou University, China

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Shang Zhanhuan[1], *Ma Yushou*[2], *Long Ruijun*[1*]
[1] *International Centre for Tibetan Plateau Ecosystem Management, College of Pastoral Agriculture Science and Technology, Lanzhou University, Lanzhou City, 730020, China* [2] *Institute of Grassland Science, Qinghai Academy of Animal and Veterinary Science, Xining City, 810003 China;* [*] *Corresponding author: Longrj@lzu.edu.cn*

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Introduction Seed rain and soil seed bank are important to restore degraded vegetation (Du et al, 2007). Black-soil-land resulting from extreme degraded alpine meadow accounts for about 30% of total alpine grassland in Qinghai-Tibetan Plateau. However, at present, there are no reports about seed rain and soil seed bank in black soil land degraded alpine meadow (Shang & Long, 2007). In order to understand the restoration function of seed rain and soil seed bank in black soil land, the goal of this study is to dertermine quantity and composite of seed rain and soil seed bank of black soil land.

Materials & methods The experimental site was located in the drainage basin of Yellow River with 34°27.856′N, 100°12.524′E and the altitude of 3745 m respectively. It is a typical black soil land on the Qinghai-Tibetan Plateau. The vegetation in the area was dominated by weeds and noxious plants.

Seed rain was measured by seed traps installed in plots (Drake, 1998; Urbanska & Fattorini, 2000). Soil seed bank was measured by soil core sampling and emergence experiments in greenhouse (Lunt, 1997; Jones & Esler, 2004). Quantity and composite of seed rain and soil seed bank were recorded. The index of Sørenson(Mueller-Dombois and Ellenberg, 1974) was used to compare comparability among seed rain, soil seed bank and the vegetation.

Results & discussion Seed rain density was 5944.44 seeds/m^2 and belonged to 23 species. Seed rain density of vegetation in Black soil land was higher than that in alpine land in Switzerland (Urbanska & Fattorini, 2000). The Density of the soil seed bank is 9772.80 seeds/m^2, which was lower than that in farmland weed seeds, but higher than that of Prairie high grassland and forest vegetation(Johnson & Anderson, 1986; Benvenuti *et al*, 2001). The comparability between soil seed bank and ground vegetation was not high. It was reported that the maximum Cs index is not more than 70% (Johnson & Anderson, 1986). Poisonous weeds bred by seed were the dominant vegetation of black soil land. Seed rain has close relations with the above-ground vegetation.

Table 1 *The basic data of seed rain and soil seed bank in tpyical black soil land grassland.*

Items/ Data	Density (seeds/m^2) Mean±SE	CV	Family	Genus	Species
Seed rain	5944.44±905.57	37.32%	15	22	23
Seed bank	9772.80±1790.99	40.98%	18	28	30

Table 2 *Similarity relationship between seed rain, seed bank and vegetation.*

Similarity index	*Cs*
Seed rain and seed bank	0.4151
Seed rain and vegetation	0.7925
Seed bank and vegetation	0.466

The comparability of species composition between soil seed bank and ground vegetation (0.4667) was lower than that between rain seed and ground vegetation (0.7925) in black soil land. Seeds breeding capability of poisonous weeds was strong, resulting in higher density of the soil seed banks and seed rain and weakening the spatial heterogeneity between alpine grass seed bank and the seed rain in Black soil land. Importing high density of seed rain and the large number of poisonous weed seeds in the black soil land strengthened the stability of secondary vegetation dominated by poison weeds.

Conclusion The vegetation succession in black soil land is towards more stable secondary vegetation dominated by poison weeds. Restoration of black soil land is difficult and lots work will be done in practices of artificial restoration.

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