

Effect of grazing gradients on soil microbe variation in Inner Mongolia steppe

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Introduction Soil microbes are very important parts in grassland ecosystem . It forms a powerful dynamical resources store and plays a key role in plant residues decomposition , humus formation and nutrients transition and cycle . Numerous studies have suggested that grazing by livestock will influence soil physical and chemical qualities on grassland while soil microbe will promote nutrients transition under reasonable grazing density . we detected the variation of soil microbes .

Material and methods The site is located in Chifeng Dalinor National Natural Reserve of Inner Mongolia(116°38'~116°41' N , 43°25'~43°27' E) . Annual average temperature is 1~2 °C ,annual accumulate temperature over 10°C is 1300~1700°C . Vegetation type is *Leymus chinensis*+*Stipa grandis*+*Cleistogenes squarrosa* and dark chestnut soil . Four grazing gradients arranged from heavy grazing (HG) , moderate grazing (MG) , light grazing (LG) and no grazing (CK) . Soil samples for microbe analysis were collected to a depth of 20 cm by an auger of 8cm diameter and divided into three sections (0-5cm , 5-10 cm , 10-20 cm) . Three replicates in each grazing gradients and five points mixed . Soil microbe data in the study is the total number of three sections . Soil samples collecting for soil moisture , PH and bulk density is also divided in three sections just like the method of soil microbe . Statistical analysis was done by SPSS 15.0 .

Results The trend of Bacillus was HG>MG>LG>CK and there were no significant differences among grazing gradients(Table 1) .

Table 1 Soil microbe variation (cfu / g dry soil) .

Grazing gradients	Bacteria ($\times 10^6$)	Bacillus ($\times 10^6$)	Mold ($\times 10^4$)	Actinomyces ($\times 10^6$)	Bacterium of nitrogen fixation($\times 10^6$)
HG	4.70±2.04ba	2.22±1.18a	0.83±0.32a	3.55±1.23a	0.87±0.36ba
MG	4.23±0.70ba	1.63±0.64a	0.66±0.06a	3.13±0.43a	0.86±0.28ba
LG	7.63±3.81a	1.56±1.01a	1.13±0.44a	5.16±0.71a	1.22±0.27a
CK	2.23±0.32b	0.64±0.61a	0.96±0.28a	4.77±1.81a	0.64±0.08b

The same or different letters mean no significance or significant between different grazing gradients ($P < 0.05$)

Bacteria , bacillus , bacterium of nitrogen fixation are negatively correlated with soil moisture . Mold and Actinomyces are positively correlated with soil moisture . Mold and Actinomyces are positively correlated with soil pH(Table 2) .

Table 2 Correlations between soil indicators and different microbial groups .

Soil indicators	Bacterial	Bacillus	Mold	Actinomyces	Bacterium of nitrogen fixation
Soil moisture	-0.352	-0.498	0.583*	0.366	-0.438
PH	0.179	0.044	0.545	0.467	-0.243
Bulk density	-0.081	-0.297	0.188	0.051	0.604*

Significant correlation on 0.05 level .

Conclusions Grassland utilization will affect soil microbes . The variance of soil microbes in different grazing gradients is obviously . Soil microbe will decrease when grazing density increased . Soil microbial groups in LG are higher than that of other three gradients except Bacillus group . This result suggests that reasonable grazing density will increase microbial quantity . Soil environmental factors are positively or negatively affect soil microbial quantity . All the five microbial groups will affect by soil moisture . Mold and Bacillus are mainly affected by soil pH . Bacterium of nitrogen fixation has a close relation to soil bulk density .

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