Effect of stocking rates on plant morphology in the inner Mongolia steppe of China

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Introduction During the long period of co-evolution with herbivores, range plants have adapted and developed resistant mechanisms in response to grazing (Briske, 1991). The objective of this experiment was to determine the morphological response of a number of the dominant plant species in the Inner Mongolia steppe of China to stocking rate.

Materials and methods There were four stocking rates (no-grazing, 1.33, 4.00 and 6.67 sheep/ha) on plots that had been subjected to these grazing pressures for six years. Of *Stipa krylovii*, *Cleistogenes squarrosa* and *Artemisia frigida,* 20 bunches were chosen per treatment, while of *Leymus chinensis* (rhizomatous plant), 20 plots (30 cm x 30 cm) were selected per treatment. Plant height (H, cm), biomass (g DM per shoot or bunchgrass) (B), number of the shoots on the two adjacent reproductive nodes or tillers in a bunchgrass (S) (P and V were the reproductive and vegetative shoots for *Stipa krylovii*, respectively), length between two nodes along rhizome or stolon (D, cm) and maximum diameter of the *Cleistogenes squarros* canopy (R) were measured.

Results Heavy grazing decreased H and B of individual range plants (Table 1). The distance between nodes along rhizome or stolon was reduced by grazing for *L. chinensis* and *A. frigida*. Light grazing increased shoot density for *L. chinensis* and reproductive tillers for *S. krylovii*. Heavy grazing decreased the range of canopy for *C. squarrosa.*

Table 1 Morphologies of individual range plants under different stocking rates

Plant species	Item	Stocking rate (sheep/ha)				Plant species	Item	Stocking rate (sheep/ha)			
		0	1.3	4.0	6.7			0	1.3	4.0	6.7
Leymus chinensis	H	18.1a	16.8a	9.7b	8.6b	*Cleistogenes squarrosa*	H	11.8a	8.9bc	6.5c	3.5d
	B	3.3a	4.9a	0.8b	0.5b		B	31.9a	6.1b	5.9b	3.9c
	S	1.8b	2.6a	1.3c	1.4bc		R	14.5a	9.9b	8.2b	7.3d
	D	2.6a	2.1b	2.0bc	1.6c		S	64.2a	67.4a	35.3b	44.3b
Stipa krylovii	H	51.6a	42.9b	41.2b	33.8d	*Artemisia frigida*	H	8.2a	9.7a	4.9b	2.7b
	B	33.6a	40.1a	15.5b	5.0c		B	8.8a	/	2.4b	1.6b
	P	3.2b	5.7a	2.7c	1.2d		S	4.9a	/	4.0a	5.8a
	V	29.3a	26.5a	20.9b	12.4c		D	3.0a	/	2.0ab	1.2b

Conclusions Plants with rhizomes or stolons may have adapted to grazing by increasing the reproductive node density. Fragmentation of bunchgrasses may be their strategy under heavy grazing. Therefore, 1.3 sheep/ha seems to be optimum in terms of plant height and biomass of individual plant.

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Reference

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