Row spacing effects on biomass components and accumulated energy in *Elymus sibiricus* L.

Jinping Liu [A] *and Minghong You* [B]

[A] School of Life Science, China West Normal University, 637009, Nanchong, Sichuan, People's Republic of China
[B] Sichuan Academy of Grassland Science, 611731, Chengdu, Sichuan, People's Republic of China
Contact email: jpgg2000@163.com

Keywords: *Elymus sibiricus* L., row spacing, plant parts, biomass structure, energy.

Introduction

Elymus sibiricus L. is widely distributed in the eastern Tibetan Plateau of China. Current research on *E. sibiricus* mainly focuses on resource assessment, breeding, cultivation and dynamics of forage yield. Little is known about the effects of row spacing on the biomass components and accumulated energy of *E. sibiricus*. We conducted a study to determine the effects of row spacing on biomass components and accumulated energy in *E. sibiricus.* These data are important to optimize forage and seed production of *E. sibiricus*, and can assist in developing animal husbandry, structurally adjusting the agricultural industry and protecting the environment.

Material and methods

E. sibiricus L. (cv. Chuancao No. 2) was planted in a randomized block design with five row spacings (30, 45, 60, 75 and 90 cm). At the flowering stage of the third year, the biomass and accumulated energy of the roots, stems, leaves and inflorescences was determined.

Results and discussion

Row spacing had a significant effect on fresh grass yield of *E. sibiricus* in the third year (P<0.01) (Table 1). Although fresh grass yield varied from 11,448 to 19,226 kg/ha, the coefficient of variation was only 0.7 %. Row spacing had a significant effect on total biomass (P <0.01), but row spacing had a more significant effect on aboveground biomass than underground biomass with a narrower spacing resulting in greater biomass. Biomass of leaves, stems and inflorescences was significantly affected by row spacing (P<0.01) and the ranking was stem > leaves > inflorescence. Because of self-sowing of *E. sibiricus*, biomass of leaves and stems, and total aboveground biomass with a 90-cm row spacing were considerably higher with a 90-cm spacing compared to a 75-cm spacing. Row spacing had a significant effect on the root system (P<0.01). A narrower row spacing resulted in a greater root biomass, whereas row spacing had no effect on the plant crown (P>0.05). Although plant density is low with a large row spacing, greater nutrient and water availability may result in more vigorous tillers compared to tillers in a narrow row spacing.

Row spacing had a significant effect on the accumulated energy in various plant parts of *E. sibiricus* with the ranking of leaf > stem > inflorescence > root. With a 30-cm spacing, fresh grass yield and cumulative energy reached a maximum of 19,226 kg/ha and 115,631 KJ/ha, respectively (Table 2), with the greatest proportion of the energy contained in the leaves (28%).

Table 1. Multiple comparisons of biomass components of *E. sibiricus* with various row spacing.

Row spacing (cm)	Fresh grass yield (kg/ha)	Aboveground biomass (kg/ha)				Underground biomass (kg/ha)		
		Total	Leaf	Stem	Inflorescence	Total	Crown	Root
30	19226 a	6673 a	1922 a	3810 a	941a	208 a	62 a	144 a
45	16734 b	5626 b	1409 b	3287 b	930 a	194 ab	52 a	141 a
60	14712 c	5048 c	1146 c	3065 c	837 ab	178 bc	46 a	131 ab
75	11448 d	3905 e	968 c	2334 e	603 c	162 cd	46 a	116 b
90	14653 c	4830 d	1362 b	2794 d	673 bc	145 d	51 a	94 c
C.V. (%)	0.7	2	7.8	3.5	13.4	6	20.7	8.5
F	2186	277	34	80	6	16	1	11
P	<0.0001	<0.0001	<0.0001	<0.0001	0.0092	0.0002	0.3555	0.001

Note: Values within a column with different letters are significantly different.

Table 2. Effect of row spacing on cumulative total energy of *E. sibiricus*.

Row spacing (cm)	Unit energy value of biomass（J/g）				Accumulation of energy（KJ/ha）				Cumulative total energy（KJ/m^2）
	Leaf	Stem	Root	Inflorescence	Leaf	Stem	Root	Inflorescence	
30	16888 b	16723 a	17225 a	16925 a	32469 a	64758 a	2482 a	15922 a	115631a
45	17545 a	16563 a	17719 a	16720 a	24723 b	55309 b	2505 a	15554 a	98092 b
60	17503 a	16562 a	17397 a	16697 a	20055 d	51515 c	2280 a	13975 b	87826 c
75	17415 ab	16527 a	17625 a	16804 a	16861 e	39330 e	2050 ab	10132 d	68374 e
90	17058 ab	1635 4a	17532 a	16892 a	2323 1c	46534 d	1650 b	11374 c	82790 d
CV (%)	1.9	1.9	1.8	1.9	1.3	0.6	15	2.4	0.4
F	2.5	0.5	1.1	0.3	1009.4	2656	3.7	191	9112
P	0.1100	0.7325	0.4063	0.8723	<0.0001	<0.0001	0.0429	<0.0001	<0.0001

Table 3. Effect of row spacing on energy distribution within various plant parts of *E. sibiricus*.

Row spacing (cm)	Ratio of energy components（%）			
	Leaf	Stem	Root	Inflorescence
30	28.1 a	56.0 c	2.2 bc	13.8 c
45	25.2 b	56.4 c	2.6 ab	15.9 a
60	22.8 c	58.7 a	2.6 ab	15.9 a
75	24.7 b	57.5 b	3.0 a	14.8 b
90	28.1 a	56.2 c	2.0 c	13.7 c
CV（%）	1.2	0.6	13.0	2.2
F	151.8	36.6	4.6	33.2
P	<0.0001	<0.0001	0.0224	<0.0001

Thus, a 30-cm row spacing was the optimal for forage production. However, with a 60-cm row spacing, accumulated energy values of the inflorescences and stems were 59 % and 16 %, respectively (Table 3). With a 60-cm row spacing, the number of inflorescences per tiller were significantly higher than those with other row spacings. Therefore, a 60-cm spacing was optimal for seed production.

Conclusion

A row spacing of 30 cm was optimal for forage production, whereas a 60-cm row spacing was optimal for seed production.