Response of Fertile Tiller Characters and Seed Yield of *Elymus sibiricus* L. to Row Space Alteration

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Introduction

Elymus sibiricus L. cv chuancao NO.2 is widely planted in the eastern Tibetan Plateau of China. At present, the study about *E. sibiricus* L. seed yield has focused on the influence of fertilizing and harvest time on seed yield and its components. The response of fertile tiller characters and seed yield of *E. sibiricus* L. to different row space still has not been reported. This experiment analyzed the response of fertile tiller characters and seed yield to different row spaces, and presents the optimal spacing to increase seed yield and quality in the Northwest Plateau of Sichuan. The objective was to provide a scientific basis for large-scale seed production.

Materials and Methods

E. sibiricus L. cv chuancao NO.2 was planted according to a randomized block design, with five row spaces (30cm, 45cm, 60cm, 75cm, 90cm), 3 repeats. Plot size was 3m×5m=15m^2 with 1m alleys between neighboring plots. Each plot was sown at 100-grain seed per 1-meter-length. At milk stage of the third year, number of tillers and fertile tillers in a 50 cm-long transect in the middle of each plot was measured, and the number of tillers and fertile tillers per unit area was calculated. From each plot 50 fertile tillers were selected randomly, and individual vertical height, length of ear stalk and cob was measured, diameter of fertile tiller 10 cm from the ground was measured with a vernier caliper, and the number of spikelets, florets and seeds were counted. At dough stage, three 2 square metre areas in the middle of each plot was randomly selected to harvest seed by hand for calculating seed yield. All data were analyzed by using SAS 9.1.

Results and Discussion

The number of tillers per unit area significantly decreased with the increasing of row space (Table 1). When row space was more than 60cm, the difference of tillers per unit area was no longer significant. The ratio of fertile tillers in the row space of 60cm was significantly higher than that of other treatments.

It was also found that row space had a significant influence on the height of fertile tiller (P<0.01) (Table 2). Height of fertile tillers in the row space of 30cm and 45cm was significantly lower than that of other treatments. When row space was more than 60cm, height of fertile tillers no longer increased. Meanwhile, row space had high significant impact on diameter of fertile tiller (P<0.01), with diameter of fertile tiller becoming bigger with increasing row space.

Row space significantly affected numbers of spikelet, seed and floret per fertile tiller (P<0.05). When the value of row space was 60 cm, number of spikelets was maximum, with the minimum value present in the row space of 30cm.

The number of spikelets per fertile tiller didn't increase with the increasing row space over 45cm, only the number of florets per spikelet increased with the increasing row space. Therefore, number of florets per fertile tiller didn't become large with increasing row space. In the larger row

Table 1. Multiple Comparison about Tillers and Ratio of Fertile Tiller in Different Row space. Values in a same column with different letters indicate significant difference.

Item	Vegetative shoots/m^2	Reproductive shoots/ m^2	Tillers/ m^2	Ratio of fertile tiller %
30 cm	1476 ± 112.5a	1152 ± 185.5 a	2628 ± 280.5a	43.66 ± 2.28 c
45 cm	901 ± 33 b	854 ± 39.5 bc	1754 ± 59.5 b	48.66 ± 1.07 d
60 cm	453 ± 39.5 d	883 ± 24 b	1337 ± 49 c	66.12 ± 2 a
75 cm	638 ± 57.5 c	697 ± 21.5 c	1334 ± 84 c	52.28 ± 1.78 c
90 cm	501 ± 34 d	709 ± 15c	1210 ± 32 c	58.65 ± 1.75 b
F	108.32	11.33	42.95	62.18
P	<.0001	0.001	<.0001	<.0001

Table 2. Multiple Comparison on Fertile Tillers and Inflorescence Characters in Different Row space. Values in a same column with different letters indicate significant difference.

Item	Height of fertile tiller (cm)	Diameter of fertile tiller (mm)	Length of ear stalk (cm)	Diameter of ear stalk (mm)	Length of cob (cm)	Ears/fertile tiller	Florets/fertile tiller	seeds/fertile tiller
30 cm	95.27±1 b	35.38±2.34 d	30.37±2.05 c	13.61±0.86 b	15.8±0.08 b	36.52±1.03 c	95.59±13.2 b	39.43±0.11 c
45 cm	95.6±1.55 b	40.26±1.53 c	36.19±1.62 b	14.84±1.38 b	16.98±0.1 a	43.98±0.92 b	113.27±6.2 ab	47.84±3.4 c
60 cm	105.27±2.7 a	47.34±1.63 b	44.19±1.33 a	16.33±0.2 a	17.78±0.4 a	48.38±0.88 a	137±20.1 a	74.58±10.01 a
75 cm	105.1±4.55 a	50.42±0.61 a	45.24±0.09 a	16.5±0.09 a	17.88±1 a	48.08±0.2 ab	129±132.3 a	73.71±1.14 a
90 cm	105.6±2.4 a	52.45±0.8 a	45.39±0.2 a	16.77±0.24 a	17.78±0.4 a	45.94±24 b	127±12.2 a	65.08±2.04 b
F	11.68	60.72	74.03	9.90	7.78	13.14	4.14	24.75
P	0.009	<.0001	<.0001	0.0017	0.0041	0.0005	0.0311	<.0001

Table 3. Multiple Comparison on Characters of Seed Yield in Different Row space. Values in a same column with different letters indicate significant difference.

Treatments	Setting percent %	1000-seed weight (g)	Potential seed yield (kg/ha)	Presentation seed yield (kg/ha)	Harvested seed yield (kg/ha)
30cm	41.88±6.03 b	3.07±0.01 b	3401.96±948.45 ab	1390.23±220.77 b	1176.33±28.15 c
45cm	42.42±5.29 b	3.21±0.18 ab	3104.01±281.57 ab	1607.54±96.77 b	1426.55±103.8 b
60cm	54.44±5.07 a	3.22±0.15 ab	3873.56±320.95 a	2107.75±151.79 a	1764.85±119.63 a
75cm	49.51±5.04 ab	3.23±0.05 ab	2919.83±330.32 b	1835.01±53.30 b	1588.05±134.1 ab
90cm	51.51±5.14 a	3.32±0.06 a	2985.03±182.59 ab	1531.08±57.12 b	1508.2±117.08 b
F	3.75	2.09	1.75	15.23	10.48
P	0.0409	0.01576	0.02146	0.0003	0.0013

space, florets significantly impacted the number of seeds per fertile tiller. Yet in the lower row space, significance decreased. Number of tiller per square metre in the row space of 90cm was smaller, coupled with the emergence of seed shattering by wind at the milky stage, thus number of seed per fertile tiller was significantly lower than that of 60cm to 75cm.

Row space significantly influenced seed setting percent ($P<0.05$) (Table 3). The bigger the row space, the higher the setting percent. The difference of 1000-grain weight was not significant for different row spaces up to 75cm ($P>0.05$). Row space significantly impacted presentation seed yield. When the row space was 60 cm, presentation seed yield was highest, with the value of 2107.75 ± 151.79 kg/ha, which was significantly higher than that of other treatments. Because of inconsistent seed maturity and strong seed shattering, harvested seed yield was far below presentation seed yield. When the row space was 60cm, harvested seed yield reached the highest, with the value of 1764.85 ± 119.63 kg/ha, which was significantly higher than that of others. Potential seed yield per square meter was stable. A row spacing of 60cm provided maximum harvested seed yield.

Conclusions

The row space of 60cm, because of facilitating field management and mechanization operation, obtained the highest seed yield, and is worthy of promoting in practice.