

Characteristics of sprouts occurrence by cutting to lower the stump height after harvesting the oak forest on the slope

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Background and Objective

- ◇ In sprout regeneration, the initial afforestation cost is reduced and growth is fast. As the sprout regeneration sites are mainly distributed in steep slopes (National Institute of Forest Science, 2017), the lower part of the stump is relatively high if the stump cutting is not carried out horizontally based on the upper slope.
- ◇ In the existing sprout regeneration work, the stump is cut as low as possible to induce the sprout to generate underground or near the surface, and the cut surface is smoothed and slightly inclined to prevent water from pooling.
- ◇ Since the height standard of the stump cutting on the slope is ambiguous, it is necessary to improve it by reflecting the locational characteristics of the sprout regeneration site. The purpose of this study is to propose an improved stump cutting method considering the locational environment that can induce the generation of superior root sprouts.

Materials and Methods

- ◇ In order to understand the location and growth characteristics of the sprout regeneration sites, ten central and southern regions (Cheongju, Gongju, Jecheon, Eumseong, Yeongam, Boseong, etc.) are investigated.
- ◇ In order to investigate the characteristics of the sprout occurrence according to the stump cutting, places with the similar locational environment and stump diameter distribution (Table 1) were selected, and characteristics of the sprout occurrence between stumps arranged low to the upper slope and parallel to the ground (control area, left of Figure 1) and stumps arranged parallel to the slope and close to the ground (treated area, right of Figure 1) were investigated and analyzed.

Table 1. Locational environment and a stump status of the study site

Classification	Elevation(m)	Slope position	Slope cardinal directions(°)	Gradient of slope(°)	Mean stump diameter(cm)	Investigation number of stumps
Control area	250	Hillside upper	240	34	22.1 ± 4.3	40
Treated area	225	Hillside upper	260	33	22.3 ± 3.9	40



Figure 1. stump cutting method (left: control area, right: treated area)

Results and Discussion

1. Location and growth characteristics of the sprout regeneration site

- The sprout regeneration is conducted at oak species such as *Quercus mongolica*, *Q. variabilis*, *Q. acutissima*.
- They are mainly distributed at gradient of 25 to 38 degrees (31 degrees on average), and in most cases, the stump on the lower slope direction is higher, cut low based on the upper slope (Table 2).
- A stump height Difference of 18 cm(upper: 12 cm, lower 30 cm) occurs on average between the upper and the lower slope.
- The average number of sprouts generated per stump is twelve, and the ratio of a lateral sprout (64 %) is higher than that of a root sprout (36 %).



Fig 2. Current stump cutting method

Table 2. Overview of sprout regeneration sites

Study site	Dominant tree species	Gradient (°)	Mean stump diameter(cm)	Mean stump height(cm)		Average number of sprouts / stumps	Number of the sprout occurrence by parts(%)	
				lower	upper		lateral	root
1	<i>Q. mongolica</i>	25	27.3	30.0	13.2	13	68.2	31.8
2	<i>Q. mongolica</i>	30	23.7	26.9	11.1	12	60.3	39.7
3	<i>Q. variabilis</i>	27	16.5	22.4	12.4	12	67.5	32.5
4	<i>Q. acutissima</i>	31	28.4	28.8	9.6	13	58.4	41.6
5	<i>Q. acutissima</i>	28	21.7	36.1	13.8	12	62.3	37.7
6	<i>Q. variabilis</i>	29	24.2	22.9	7.3	11	68.1	31.9
7	<i>Q. variabilis</i>	35	26.3	35.4	14.7	12	64.7	35.3
8	<i>Q. variabilis</i>	37	26.0	34.5	10.4	13	68.0	32.0
9	<i>Q. mongolica</i>	33	14.5	15.6	8.8	12	57.8	42.2
10	<i>Q. variabilis</i>	38	19.0	29.8	11.9	12	68.1	31.9

2. Characteristics of the sprout occurrence according to the stump cutting

- The average number of sprouts generated per stump was eleven, and there was no difference between control and treatment (Table 3).
- The amount of stump lateral sprouting decreased by 38 % in the treatment area (4.3/stump) compared to the control area (6.9/stump).

Table 3. Number of the sprout occurrence according to the stump cutting

Classification	Average number of sprouts/stumps		Total(Number/Stump)
	Lateral sprout(Ratio, %)	Root sprout(Ratio, %)	
Control area	6.9(64.0%)	3.8(37.0%)	10.7
	4.0 - 12.0	1.0 - 5.0	
Treatment area	4.3(39.8%)	6.5(60.2%)	10.8
	2.0 - 8.0	2.0 - 7.0	

- The amount of root sprouts (control area: 3.8/stump, treatment area: 6.5/stump) increased by 171 % (Figure 3).
- 79.5 % of the lateral sprouts of the control area occurred on the lower slope direction (Figure 4).



Figure 3. Root sprout occurrence in treatment area

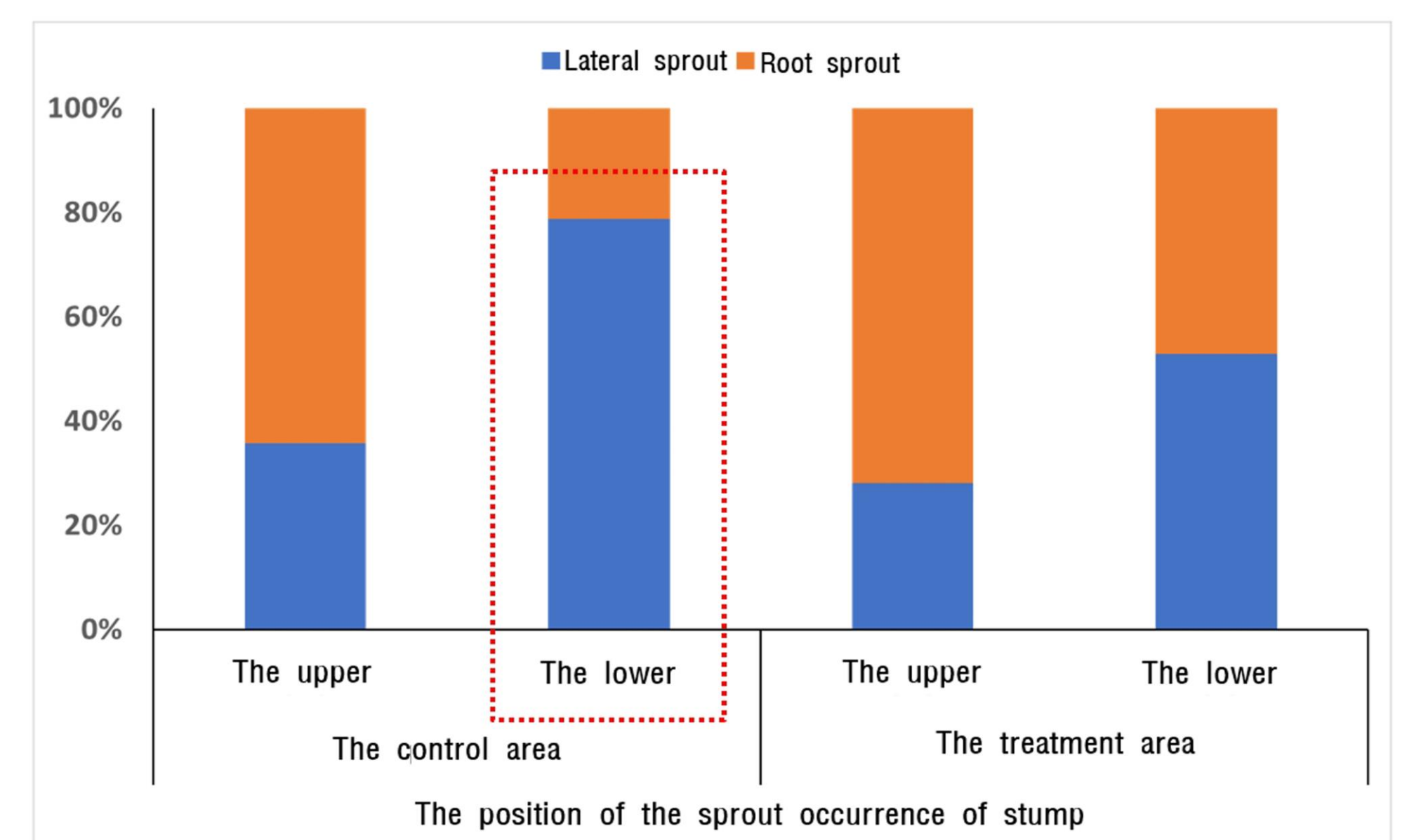


Figure 4. Ratio of the stump occurrence in control and treatment area

- In stumps in treatment area, the growth of root sprouts on upper slope was good and there was no difference in growth on the lower slope (Figure 5).

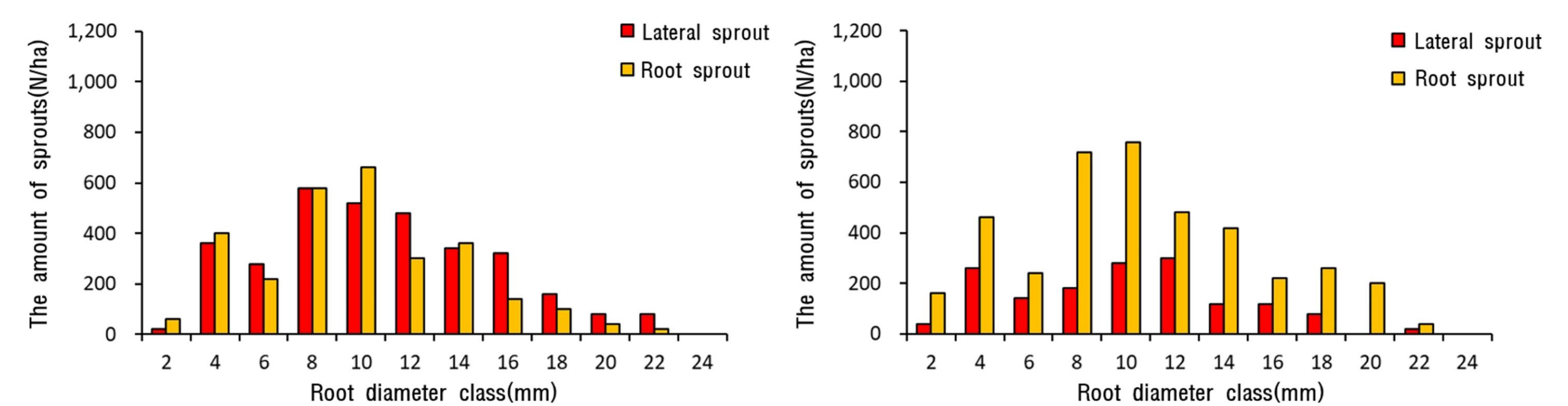


Figure 5. The root diameters distribution of lateral and root sprouts by slope direction (lower: left, upper: right) of the stump in treatment area

- In stumps in control area, the growth of lateral sprouts on lower slope is more dominant than that of root sprouts (Figure 6).
- As the height of stump increases, the amount of lateral sprouts increases, implying that the possibility of remained lateral sprouts are higher than that of root sprouts after the arrangement.

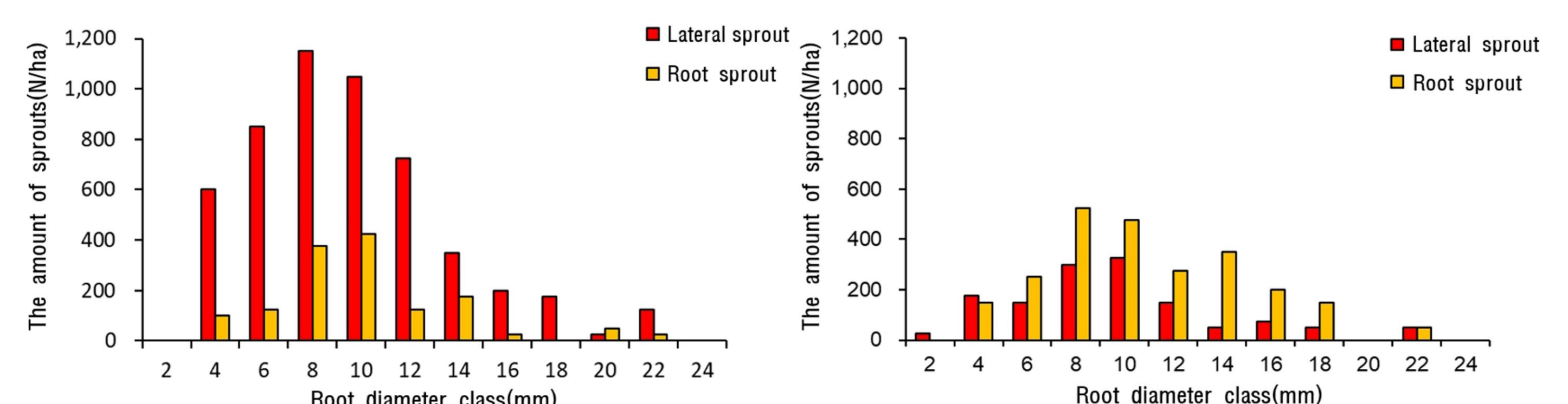


Figure 6. The root diameters distribution of lateral and root sprouts by slope direction (lower: left, upper: right) of the stump in control area

- It is analyzed that the overall lowering of the stump height acted as a factor in reducing the occurrence of lateral sprouts. And it is interpreted that improved stump cutting (*parallel to the slope and close to the ground*) will be advantageous to promote the development of superior root sprouts after harvesting.