

# シモフリゴケの有性生殖を制限する繁殖パラメーター

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## A study of the restricting parameters on sexual reproduction in the moss *Racomitrium lanuginosum*

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Population of flowering plants located at the margins of species' distribution often display reduced sexual reproduction and an increased reliance on asexual reproduction. This trend has been confirmed also in the bryophyte (e.g., Eckert 2002; Pigott 1981). To clarify which reproductive parameters limit sexual reproduction in population in the moss *Racomitrium lanuginosum* (Hedw.) Brid., the following three studies were conducted:

1. An analysis of the reproductive parameters of sexual reproduction of *R. lanuginosum* along an altitudinal gradient;
2. A clarification of the effects of environmental factors on phenological factors associated with the sexual reproduction of *R. lanuginosum*; and
3. Comparative study of morphological parameters of male and female individuals of *R. lanuginosum*.

In the first study, changes in sexual reproductive parameters along an altitudinal gradient in the alpine zone of Mt. Fuji were investigated. Production of sporophyte occurred only below 3000 m alt. and aborted sporophytes at the EOI stage were found mainly at 3000 m alt. The number of antheridia per shoot and per inflorescence decreased with increasing altitude, while the number of archegonia per shoot and per inflorescence were almost the same at all altitudes, and most of the gametangia of each sex matured. Possible reasons for the limited sporophyte production are the limitation of fertilization by the absence of sex expression, the lack of male gametangia, low temperatures, and/or the shortened growth period for sporophyte development.

In the second study, a comparative study was conducted to determine the effect of the snow cover as length of growth period on the reproduction process of *R. lanuginosum*. In this study, we compared the phenology of gametangia and sporophytes between two distinct habitats; a seasonally snow-covered site (ca. 2200 m alt. on Mt. Fuji, called Okuniwa) and a snow-free site (ca. 645 m alt. on Mt. Mihara). At both sites, antheridia took longer to mature than archegonia, and antheridia and sporophytes developed during winter. At Okuniwa, although the development of antheridia and sporophytes stopped under the snow cover for 4.5 months, maturation of male and female gametangia and dispersal of spore occurred synchronously in June. These results showed that the responses of phenology to the growth environment differed between males and females. Some notable phenological patterns, the dispersal of sperm from antheridia occurred before archegonia maturation, and the spore were dispersed during winter, were observed only at Mt. Mihara.

To explore the reasons for the different responses on sexual reproduction between male and female to the growth environment, the morphological parameters related to sexual reproduction of *R. lanuginosum* were investigated. The branching pattern was monopodial and inflorescence formation was cladocarpous. Compared with females, males had significantly higher numbers of second and subsequent branches per shoot, and significantly more gametangia per shoot and per inflorescence. The different responses of some morphological parameters such as the number of gametangia per shoot, between male and female were found in each site.

These results supported that the main cause of the limitation of sexual reproduction was suggested to be the decrease of frequency of antheridia with increasing altitude, along with the low temperatures and shortened growth period. In the marginal area of the sexual reproduction, males and females showed some critically different responses to the environment in several reproductive parameters.

### References

- Eckert C. G., Loss of sex in clonal plants, *Evol. Ecol.*, 15, 501-520, 2002.
- Pigott C. D., Nature of seed sterility and natural regeneration of *Tilia cordata* near its northern limit in Finland, *Ann. Bot. Fennici*, 18(4), 255-263, 1981.