Molecular genetic studies on spikelet development and tiller formation in rice

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Understanding of the molecular mechanisms that control morphological characteristics of plants is important for crop breeding and improving crop productivity. I have undertaken molecular genetic studies to elucidate regulatory mechanisms of spikelet development and tiller formation in rice (*Oryza sativa*), focusing on the function of the meristem, a tissue containing stem cells.

Discovery of genes required for panicle formation

Plant development depends on the meristem, in which the stem cells are self-maintained and provide cells to form lateral organs. Thus, the control of meristem maintenance and its fate is essential for proper development of lateral organs. Additionally, communication between the meristem and lateral organs is also important for plant development. However, little was known about genes involved in this communication. In this study, I revealed that *TONGARI-BOUSHI* (*TOB*) genes are involved in the communication from lateral organs to the meristem to ensure proper development of spikelet [1].

Elucidation of the genetic mechanisms underlying axillary meristem formation, the initial process of tillering

Shoot branching is a major event in plant body formation. In rice, shoot branch is called tiller. The tiller is an important agronomic trait, since tiller number determines panicle number, which directly affects grain production. The tiller is derived from the axillary meristem formed at the base of the leaf primordium. Thus, elucidation of the genetic mechanisms underlying axillary meristem formation will contribute not only to understanding of rice development, but also to improvement of rice yields. In this study, I revealed that stem cell maintenance in the early stage of axillary bud development is essential for the axillary meristem formation, and that *TILLERS ABSENT1* (*TAB1*) gene is required for the maintenance of the stem cells [2, 3]. I also found that *FLORAL ORGAN NUMBER2* gene acts as a negative regulator of stem cell fate by restricting *TAB1* expression [3]. In addition, I identified several other genes, which are related to *TAB1* function in the process. The genes identified in this study are expected to be useful genetic resources to alter tiller number of rice plants, potentially to improve rice yields in the future.

References

[1] Tanaka W. et al. (2012) The *YABBY* gene *TONGARI-BOUSHI1* is involved in lateral organ development and maintenance of meristem organization in the rice spikelet. *Plant Cell*, 24, 80-95.

[2] Tanaka W.et al. (2015) Axillary meristem formation in rice requires the *WUSCHEL* ortholog *TILLERS ABSENT1*. *Plant Cell*, 27, 1173-1184.

[3] Tanaka W. and Hirano H.-Y. (2020) Antagonistic action of *TILLERS ABSENT1* and *FLORAL ORGAN NUMBER2* regulates stem cell maintenance during axillary meristem development in rice. *New Phytologist*, 225, 974-984.