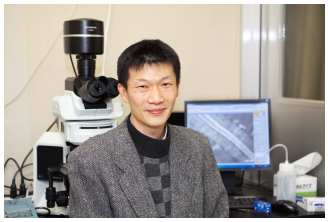
Faculty of Science, Yamagata University

Mechanisms that allow plants to avoid environmental stresses



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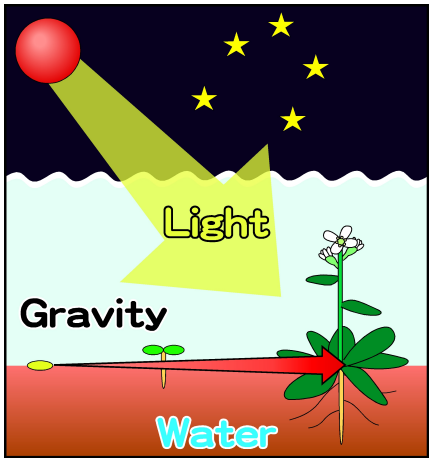
Research impact at a glance

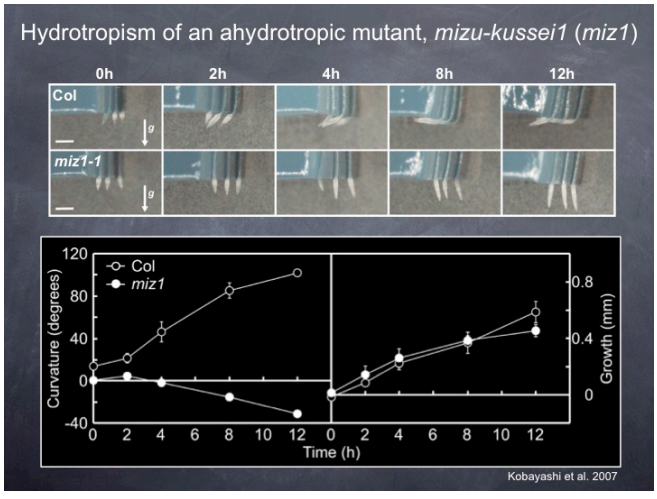


Unlike mobile organisms, land plants are sessile in nature and must complete their life cycles where they germinate. Accordingly, land plants have evolved various mechanisms for responding to environmental signals, allowing them to tolerate or avoid environmental stresses such as water scarcity. To improve plant survival under water-deficit conditions, it is necessary to understand the molecular mechanisms underlying drought avoidance. Root of plant is the primary organ for water absorption. Root can sense a moisture gradient and grow toward the wet area, a process termed positive hydrotropism. Using molecular genetic analyses, we succeeded to identify of genes essential for hydrotropism. Furthermore, our physiological and molecular biological analyses revealed molecular framework of root hydrotropism.

Detailed description of the research

Background:

With the current global climate changes, plant production is now threatened. To improve plant survival under water-deficit conditions, it is necessary to understand and utilize drought avoidance mechanism. Indeed, land plants have evolved unique mechanisms to avoid drought. Among them, root hydrotropism is a response to water potential gradients. However, the molecular mechanism underlying root hydrotropism is less understood.



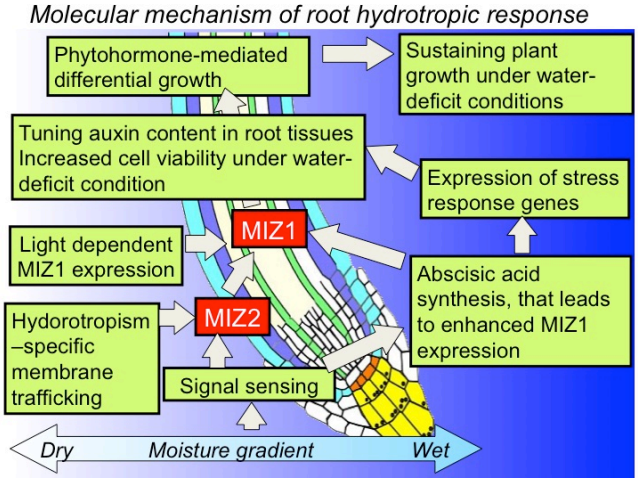
On-going research:

1. Understanding the molecular function of proteins necessary for root hydrotropism.

Recently, we have identified two ahydrotropic mutants of *Arabidopsis*, *muzu-kussei1* (*miz1*) and *miz2*, and these are the only ahydrotropic mutants in which the responsible genes have been identified. We will understand the molecular functions of MIZ1 and MIZ2 in root hydrotropism. In addition, we will identify new molecules that have essential role in root hydrotropism, utilizing molecular biological and physiological approaches. And finally, we will manipulate root hydrotropism using the molecules that will be identified in this study, and develop plants with enhanced root hydrotropism.

2. Identification of sensory molecules for environmental signals.

Molecular mechanism of root hydrotropic response



As described above, plants are capable to respond to environmental signals, such as light, gravity and moisture gradients. However, only photoreceptors are identified to date. Identifying sensory molecules for other environmental signals are necessary for full understanding the molecular mechanisms of adaptive response of plants to the surroundings. Using molecular biological and genetic strategies, we are currently searching potential molecules that are responsible for sensing environmental signals. Once we understand such molecules, they may be manipulated to develop plants with enhanced survival capabilities under stressed conditions, improvements that will be beneficial for overcoming current climate changes.

Selected publications

Original papers:

1. Dietrich et al. *Nature Plants*, DOI: 10.138/nplants.2017.57, 2017
2. Morohashi et al. *New Phytologist*, DOI: 10.1111/nph/14689, 2017
3, Iwata et al. *Annals of Botany*, 112: 103-114, 2013
4, Moriwaki et al. *Plant, Cell and Environment*, 35: 1359-1368, 2012
5, Miyazawa et al. *Plant and Cell Physiology*, 53: 1926-1933
6, Miyazawa et al. *Plant Physiology*, 149: 835-840, 2009
7, Kobayashi et al. *PNAS*, 104: 4724-4729, 2007

Reviews, etc.:

1. Moriwaki et al. *American Journal of Botany*, 100: 25-34, 2013
2. Miyazawa et al. *Advances in Botanical Research*, 57: 349-375, 2011