Bigger slant for a better plant: Decoding leaf angle genetics for better crop yields

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Plants have been the primary source of our food for ages. With the human population growing rapidly, there is a continual increase in the demand for food produce. Since agricultural land is limited, fulfilling

this increasing demand requires finding ways to improve the food crop productivity from existing cultivations. "Crop architecture," or the design of the crop plant, can have a major influence on its produce. Identifying crop architecture patterns and underlying biology could, therefore, help improve agricultural productivity.

In a new study published in *The Crop Journal*, a team of researchers from China has now delved deeper into the genetic basis of crop architecture using rice as a model plant system. Leaves are the primary site for photosynthesis, the process by which plants convert light energy into chemical energy in the form of food. Furthermore, the "leaf inclination" or the angle at which the leaf emerges from the stem, determines its exposure to sunlight and, in turn, its photosynthetic capacity. In their study, the researchers identified genetic factors that control leaf inclination in rice, Oryza sativa. Giving further insight into the implications of their work, Professor Hongwei Xue, who led the study, explains, "The leaf inclination is an important trait determining the shape of the light-receiving part of the rice leaf. Identifying genetic variants with a leaf angle that favors ideal plant architecture can help in breeding rice varieties with higher productivity, improving the yield."

Several plant hormones, particularly "auxin" and "brassinosteroids" (BRs), are known to regulate leaf inclination. Interestingly, mutants that are deficient in BRs show erect leaf architecture with decreased inclination while rice plants with decreased auxin levels exhibit increased leaf inclination. Auxin mutants with changed leaf angle have been shown to present altered BR responses. However, the precise mechanisms governing these effects remain unknown.

To understand the auxin-BR cross-talk, the researchers began by screening a rice T-DNA insertion population and identified an auxin insensitive mutant arr1. The mutation was confirmed through genomic analysis. Functionally, on treatment with an auxin stimulant, the mutant

plants showed significantly lower levels of auxin signaling factors such as OsIAA1, OsIAA9, OsIAA19 and OsIAA24 compared to wild type plants.

Next, they went on to compare the leaf inclination and the lamina joint (region connecting the leaf blade and sheath/stalk) of wild type plants and arr1. Notably, arr1 mutant had enlarged leaf angles compared to the wild type. Furthermore, the adaxial cells (cells closer to the stalk) at the leaf joint of the mutant were twice as long as those of wild type plants, contributing to an enlarged inclination.

Genetic analysis revealed that the arr1 mutant showed an increased expression of the OsIAA6 gene, which resulted in increased leaf inclination due to gain-of-function of the protein. A distinctly high expression pattern of OsIAA6 in the lamina joints also suggested its role in determining the leaf angle.

On investigating the interacting partners of OsIAA6, the researchers found that OsIAA6 regulated leaf inclination by suppressing the auxin response factor, OsARF1. Moreover, they found that OsBZR1, the key transcription factor in the BR signaling pathway, binds to the promoter of OsIAA6 and regulates its expression, suggesting the role of OsIAA6 in the auxin-BR pathway crosstalk.

These findings suggest that OsIAA6 acts as the link between the auxin and BR signaling pathways in mediating leaf inclination, an insight that could open up new avenues for development of rice crop varieties with higher photosynthetic efficiency.

"Better plants can lead to a better life. The results in our study could contribute to a better understanding of plant growth and help design the ideal crops," comments Prof. Xue.

It is certainly a step forward in increasing the production of rice, the staple food for majority of the human population.

More information: Meiqing Xing et al, Rice OsIAA6 interacts with OsARF1 and regulates leaf inclination, *The Crop Journal* (2022). DOI: 10.1016/j.cj.2022.02.010

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