DELLA regulates arbuscular mycorrhiza formation by interacting with the central symbiosis transcription factor CYCLOPS

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Arbuscular mycorrhiza (AM) symbiosis with glomeromycotan fungi is a widespread strategy of plants to acquire mineral nutrients from soil. Root colonization by AM fungi culminates in the formation of highly branched structures called arbuscules that release the mineral nutrients to the plant. Arbuscule formation requires DELLA proteins and is accordingly inhibited by gibberellin. However, it remained unknown how DELLA promotes arbuscule formation mechanistically. During colonization perception of fungal signals triggers nuclear calcium spiking, which is decoded by a nuclear localized calcium and calmodulin dependent kinase (CCaMK). CCaMK interacts with and phosphorylates the transcription factor CYCLOPS that activates downstream AM signaling. We found that DELLA physically interacts with CYCLOPS to regulate target genes specifically involved in arbuscule formation such as *RAM1*, which is required for arbuscule branching. CYCLOPS directly binds to a *cis*-element in the *RAM1* promoter and likely recruits DELLA to the DNA. Ectopic expression of degradation resistant DELLA-delta17 induces *RAM1* and other genes involved in arbuscule formation in the absence of the fungus. Furthermore, ectopic *RAM1* expression supports arbuscule formation in a *cyclops* mutant and in presence of GA placing *RAM1* downstream of the CYCLOPS-DELLA complex. We reveal a transcription factor complex, which integrates symbiosis and GA signaling possibly to adjust symbiosis development with the plant physiological state.