'Master regulator' protein controls flowering, disease resistance in plants

February 5 2014, by Natalie Van Hoose

(Phys.org) —The next time you stop and smell the roses, thank MED18. The protein MED18 controls many important plant processes, including when a plant blossoms, how it resists key fungal diseases, and how it responds to environmental stress factors, a Purdue University study shows.

"MED18 is like a master regulator," said Tesfaye Mengiste, professor of botany and plant pathology and the study's lead researcher. "The versatility of its functions is surprising."

Understanding and manipulating MED18 could lead to improved resistance to necrotrophic fungal diseases in plants, Mengiste said.

Necrotrophs are fungi that infect and kill plant cells to take their nutrients, causing diseases that are difficult and costly to manage. Examples include northern leaf blight, ear rot and gray mold, which is estimated to cause a greater economic loss of ornamental plants and vegetables than any other disease.

When necrotrophs attack, they stimulate an increase in the expression of two plant genes that render a plant more susceptible to infection. But MED18 works with other proteins to "turn off" those target genes, contributing to disease resistance in an indirect yet important way. MED18 also helps activate a gene that bolsters a plant's defense against wounding and infection by necrotrophs.

Mengiste and his fellow researchers found that the presence of MED18 limited disease symptoms and fungal growth in Arabidopsis plants infected with gray mold fungus.

"This provides a new hope for resisting fungal infections because MED18 functions differently than more classical defense tactics," Mengiste said.

Using MED18 to toughen up plants' defense against fungal diseases would not necessarily require generating transgenic plants, said Mengiste. Natural variants with desirable characteristics could also be used to cultivate more disease-resistant specimens in plant populations.

The study showed that MED18 plays a vital role in other plant functions as well, including flowering time and how a plant responds to abscisic acid, a hormone that regulates how plants cope with environment stresses such as drought.

The protein is also involved in starting, guiding and terminating transcription, impacting multiple steps of gene expression. Mengiste compares MED18's role in transcription with that of an orchestra conductor who begins the music, signals the entrance of certain instruments and draws the piece to a close.

The variability of the protein's functions makes it a prime target for genetic improvement of plants, he said.

"Now that we know what it does, we can use MED18 to improve crop growth, fruit production, flowering time and disease resistance."

More information: "MED18 interaction with distinct transcription factors regulates multiple plant functions." Zhibing Lai, Craig M. Schluttenhofer, Ketaki Bhide, Jacob Shreve, Jyothi Thimmapuram, Sang

Yeol Lee, Dae-Jin Yun,Tesfaye Mengiste. *Nature Communications* 5, Article number: 3064 DOI: 10.1038/ncomms4064
Received 13 August 2013 Accepted 04 December 2013 Published 23 January 2014

Abstract
Mediator is an evolutionarily conserved transcriptional regulatory complex. Mechanisms of Mediator function are poorly understood. Here we show that Arabidopsis MED18 is a multifunctional protein regulating plant immunity, flowering time and responses to hormones through interactions with distinct transcriptional factors. MED18 interacts with YIN YANG1 to suppress disease susceptibility genes glutaredoxins GRX480, GRXS13 and thioredoxin TRX-h5. Consequently, yy1 and med18 mutants exhibit deregulated expression of these genes and enhanced susceptibility to fungal infection. In addition, MED18 interacts with ABA INSENSITIVE 4 and SUPPRESSOR OF FRIGIDA4 to regulate abscisic acid (ABA) responses and flowering time, respectively. MED18 associates with the promoter, coding and terminator regions of target genes suggesting its function in transcription initiation, elongation and termination. Notably, RNA polymerase II occupancy and histone H3 lysine tri-methylation of target genes are affected in the med18 mutant, reinforcing MED18 function in different mechanisms of transcriptional control. Overall, MED18 conveys distinct cues to engender transcription underpinning plant responses.