Nuclear factor Y subunit facilitates histone acetylation for salt tolerance in soybean

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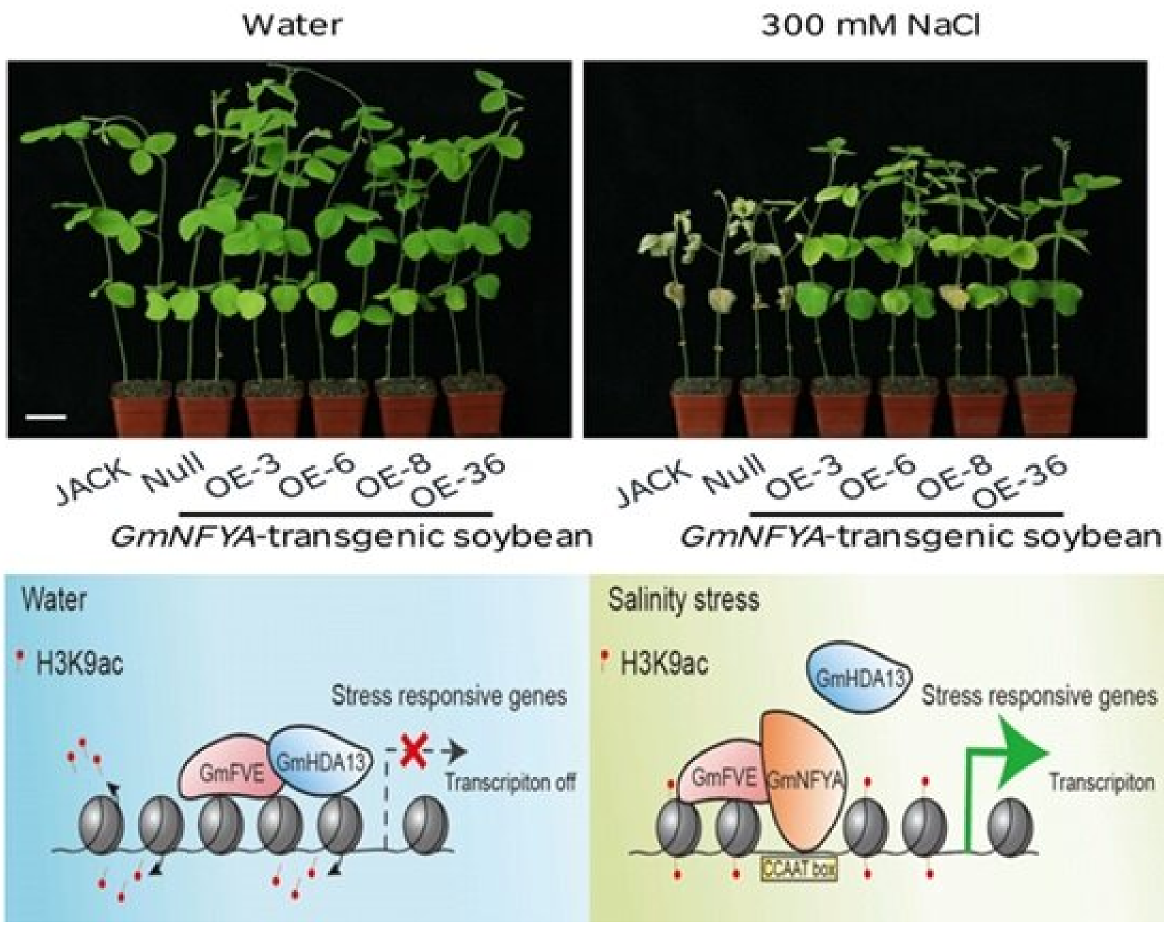

Fig 1. GmNFYA promotes salt tolerance in soybean. Upper panel: JACK is a cultivar used for transgenic analysis. Null is a transgene-negative line segregated from the original transgene-positive line, and used as a control. The OE-3, OE-6, OE-8 and OE-36 are stable homozygous transgenic soybean lines. Lower panel: a working model for GmNFYA functions. Under normal condition, GmHDA13 interacted with GmFVE for H3K9 deacetylation, and the salt responsive genes

are inhibited. Under salt stress, the GmNFYA is accumulated and competed with GmHDA13 for interaction with GmFVE. This action may push off the GmHDA13 and inhibited its function in deacetylation, thus maintaining the H3K9 acetylation levels for activation of salt responsive genes and further promotion of salt tolerance in soybean plants. Credit: IGDB

Salinity and drought stress are major environmental factors affecting agricultural production. These abiotic stresses impaired growth and development of crops, leading to plant death and yield loss. Soybean is an important crop for food and feed resources, and more than 80% of the national demands require imports from other countries. Promotion of the salt tolerance in soybean would make the crop more adaptive to the abiotic stresses and thus increase the potential yield especially in salty land area.

Recently, Prof Zhang Jinsong's team from the Institute of Genetics and Developmental Biology (IGDB) of the Chinese Academy of Sciences (CAS) discovered that a nuclear factor Y (NFY) subunit GmNFYA can modify histone acetylation and activate stress-responsive genes for salt tolerance in soybean.

Among different soybean accessions, the GmNFYA coding region exhibited no difference. However, under salt stress, the expression of GmNFYA is increased in both cultivars and wild soybeans, suggesting that the gene likely participates in salt responses. Overexpression of the gene improved the salt tolerance of the stable transgenic soybean plants (Fig 1).

The researchers revealed that, GmNFYA interacted with GmFVE, a component of histone deacetylase complex, and GmFVE also interacted with histone deacetylase HDA13. GmNFYA competes with HDA13 for interaction with FVE. Reduction of FVE and HDA13 gene expression improved salt tolerance of the soybean plants with RNAi-transgenic hairy roots, indicating that both genes play negative roles in salt tolerance. The levels of H3K9 acetylation were examined at salt responsive gene promoter regions.

They propose that, under normal condition, FVE/HDA13 complex acts at H3K9 for deacetylation, leading to low levels of gene expression. Under salt stress, GmNFYA accumulated and associated with FVE to release HDA13 for maintenance of more H3K9 acetylation, leading to activation of salt responsive genes and salt tolerance of soybean (Fig 1).

Additional study also identified an elite haplotype Hap I of GmNFYA promoter, which can be activated in a high level by the GmNFYA protein. This haplotype may be selected during future breeding efforts.

This study reveals a novel mechanism by which GmNFYA maintains H3K9 acetylation through interaction with FVE and pushing off the HDA13 for activation of salt tolerant genes, providing basis for the manipulation of soybean salt tolerance.

The study has been published online in the *Plant Biotechnology Journal* on July 15.

More information: Long Lu et al, Nuclear factor Y subunit GmNFYA competes with GmHDA13 for interaction with GmFVE to positively regulate salt tolerance in soybean, *Plant Biotechnology Journal* (2021). DOI: 10.1111/pbi.13668

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