Pearl millet genomes reveal a CARLACTONIC ACID METHYL TRANSFERASE as key determinant of strigolactone pattern and Striga susceptibility

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Abstract

Carotenoids are vital isoprenoid photosynthetic pigments with diverse roles in photosynthesis and photoprotection. In plants, they play an important role as precursors of hormones and signaling molecules, such as Abscisic acid (ABA), strigolactones (SLs), zaxinone, anchorene and β-cyclocitral.

Strigolactones (SLs) are a recently discovered hormone that inhibits shoot branching and is released by plant roots into the rhizosphere to attract symbiotic mycorrhizal fungi (AM), particularly under phosphate (Pi) starvation. SLs control secondary stem growth, plant height, and leaf shape. Additionally, SLs mediate physiological processes that include senescence, stomatal closure, and biotic/abiotic stress responses and determine root architecture. However, SLs also act as germination stimulants for root-parasitic weeds, such as *Orobanche* and *Striga*, posing severe agricultural problems worldwide.

Pearl millet is the sixth most important cereal crop after rice, wheat, maize, barley and sorghum. The yield of pearl millet, primarily cultivated in subtropical regions, including Sub-Saharan Africa and India, is significantly affected by *Striga hermonthica*, considered one of the seven major threats to global food security. The wild pearl millet line 29Aw (Aw) from Niger exhibits resistance to *Striga* through both pre- and post-attachment mechanisms. In contrast, SOSAT-C88 P10 (P10) is a susceptible millet line derived from the SOSAT variety, which originates from a cross between the landraces Sauna and Sanio and has high yields in West Africa. To investigate the underlying resistance mechanisms, we first verified the contrasting phenotypes of the two lines under greenhouse conditions. Root exudates from P10 induced higher Striga germination than those from Aw, suggesting that P10 susceptibility may be related to released SLs.

Here, we identified four SLs present in the Striga-susceptible P10, but absent in the resistant line Aw. The Aw genome lacks a 0.7Mbp section containing two putative CARLACTONIC ACID METHYLTRANFERASE1 (CLAMT1) genes. Upon transient expression, P10CLAMT1b formed methyl carlactonoate (MeCLA), an intermediate in SL biosynthesis. Feeding Aw with MeCLA resulted in the production of two P10-specific SLs. Screening a diverse pearl millet panel confirmed the pivotal role of the CLAMT1 section for SL diversity and *Striga* susceptibility. Our results uncover a new SL and the cause for Striga-susceptibility in pearl millet.

Keywords: Carotenoids, Strigolactones, Pearl millet, Striga.

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