Changing light promotes isoflavone biosynthesis in soybean pods and enhances their resistance to mildew infection

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Abstract

Mildew severely reduces soybean yield and quality, and pods are the first line of defense against pathogens. Maize-soybean intercropping (MSI) reduces mildew incidence on soybean pods; however, the reason remains unclear. Previous studies confirmed the key function of soy isoflavone in soybean mildew resistance, while changing light (CL) from maize shading is the most important environmental feature in MSI. CL also regulates isoflavone biosynthesis in soybean seeds. We hypothesized that CL affects isoflavone accumulation in soybean pods, impacting their disease resistance. In the present study, shading treatments were applied during different developmental stages of soybean plants according to various CL environments under MSI. Chlorophyll fluorescence imaging (CFI) and classical evaluation methods confirmed that CL, especially vegetative stage shading (VS), enhances pod resistance to mildew. Further metabolomic analyses and exogenous inhibitor experiments revealed the important relationship between jasmonic acid (JA) and isoflavone biosynthesis, which has a synergistic effect on the enhanced resistance of CL-treated pods to mildew. VS promoted the biosynthesis and accumulation of constitutive isoflavones upstream of the isoflavone pathway, such as aglycones and glycosides, in soybean pods. When mildew infects pods, endogenous JA signaling stimulates the biosynthesis of downstream inducible malonylated isoflavones and glyceolin to improve pod resistance.

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