Identification and overexpression of *gibberellin 2-oxidase* (*GA2ox*) in switchgrass (*Panicum virgatum* L.) for improved plant architecture and reduced biomass recalcitrance

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Gibberellin 2-oxidases (GA2oxs) are a group of 2-oxoglutarate-dependent dioxygenases that catalyse the deactivation of bioactive GA or its precursors through 2β-hydroxylation reaction. The level of bioactive GA has been shown to be negatively correlate with plant tillering and adventitious root development especially among cereal grains. Additionally, reduced levels of bioactive GA has been implicated with reduced lignin deposition in eudicots. To date, there are no reports on how lignification in monocots is affected by GA. In this study, putatively novel switchgrass C_{20} *GA2ox* genes were identified with the aim of genetically engineering switchgrass for improved architecture and reduced biomass recalcitrance for biofuel. Three C_{20} *GA2ox* genes showed differential regulation patterns among tissues including roots, seedlings and reproductive parts. Using a transgenic approach, we showed that overexpression of two C20 *GA2ox* genes, that is *PvGA2ox5* and *PvGA2ox9*, resulted in characteristic GA-deficient phenotypes with dark-green leaves and modified plant architecture. The changes in plant morphology appeared to be associated with *GA2ox* transcript abundance. Exogenous application of GA rescued the GA-deficient phenotypes in transgenic lines. Transgenic semi-dwarf lines displayed increased tillering and reduced lignin content, and the syringyl/guaiacyl lignin monomer ratio accompanied by the reduced expression of lignin biosynthetic genes compared to nontransgenic plants. A moderate increase in the level of glucose release in these transgenic lines might be attributed to reduced biomass recalcitrance as a result of reduced lignin content and lignin composition. Our results suggest that overexpression of *GA2ox* genes in switchgrass is a feasible strategy to improve plant architecture and reduce biomass recalcitrance for biofuel.