Characterization of a Cotton Fiber Gene Promoter

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Cotton fibers are unicellular trichomes derived from outer integument cells of the ovule. Our previously study showed that cotton R2R3 MYB transcript factor GaMYB2 could complement the Arabidopsis trichome mutant of glabra1 (tgl), suggesting that cotton fiber initiation and Arabidopsis leaf trichome share similar molecular mechanisms of regulation. We then isolated the GaMYB2 promoter and analyzed its activity in cotton (Gossypium hirsutum), tobacco (Nicotiana tabacum) and Arabidopsis plants. A 2062 bp upstream fragment of GaMYB2 was fused to the glucuronidase (GUS) reporter gene. Histochemical staining revealed that in transgenic cotton plants, GaMYB2 promoter exhibited activities predominantly in the ovule of 0 DPA and in the developing fiber cells (such as those of 9 DPA), and to a lesser extent in trichomes of other aerial organs, including leaf, stem, and bract. Similar to cotton RDL1 promoter reported previously, the GaMYB2 promoter was specific to trichomes in transgenic Arabidopsis plants. Different from Arabidopsis which has unicellular non-glandular trichomes, tobacco has both glandular and non glandular multicellular trichomes. Interestingly, in tobacco GaMYB2 promoter directed GUS gene expression exclusively in head cells of the multicellular glandular trichome. This promoter provides a tool not only for engineering of glandular trichome-based metabolism but also for dissecting regulatory mechanisms of glandular trichome development. To localize the regulatory regions important for trichome expression of the GaMYB2 promoter, successive 5-deletions were performed. We found that a 360 bp fragment upstream to the translation initiation codon was sufficient for driving gene expression in Arabidopsis trichomes and tobacco glandular trichomes. A putative cis element, T/G box, located at 233 to 214, was identified. Yeast one hybrid assay showed that Arabidopsis bHLH protein GL3, also a trichome regulator, had a binding activity to the T/G box motif. Over expression of GL3 enhanced the GaMYB2 promoter activity. These results suggest that the cotton bHLH protein(s) homologous to GL3 may play a role in transactivating GaMYB2 expression in cotton trichomes, particularly in cotton fibers.

Key words: promoter; cotton fiber; trichome; glandular trichomes; MYB