ABSTRACT

CELL WALL BIOSYNTHESIS IN *ZEA MAYS*

By

Henricus EG van Erp

For my thesis research I studied dark-grown maize seedlings as a model system for cell wall biosynthesis. When maize seedlings are grown in complete darkness an organ develops called the mesocotyl, which serves to position the seedling towards the light. After exposure to light, the rapid elongation of the mesocotyl is reduced and concomitant with this, certain enzymatic activities related to cell wall biosynthesis are down-regulated, including a Golgi-localized glucan synthase. I attempted to identify the glucan synthase with biochemical methods and characterized the product it synthesizes. I established that it synthesizes (1,4)-β-glucan. Because pure (1,4)-β-glucan is not known to be synthesized in the Golgi, the glucan synthase might be involved in the synthesis of other polysaccharides, such as xyloglucan or mixed-linkage glucan (MLG). The glucan synthase was successfully solubilized with digitonin and it still synthesized (1,4)-β-glucan. However, after chromatography glucose-6-phosphate and glucose-1,6-diphosphate were synthesized instead of (1,4)-β-glucan.

I studied the correlation of the light-regulation of cell wall biosynthetic enzymatic activities to transcript levels of the maize *Cellulose Synthase Like (CSL)* gene family. The *CSL* gene family encodes the enzymes involved in the synthesis of the (1,4)-β-linked glycan backbones of hemicelluloses such as xyloglucan, MLG and (1,4)-β-mannan. As a first step, I annotated the maize *CSL* gene family. The rice and maize *CSL* gene families are similar, except for a few differences. The *CSLC* gene family is expanded

from five genes in *Arabidopsis* and six in rice to potentially twelve in maize. Also, an atypical *CSL* gene was found called *CSLX*. The CSLX protein is closely related to the CSLG proteins from poplar, which suggests that the CSLX protein belongs to the CSLG subfamily. Assays for enzymatic activities related to cell wall biosynthesis such as callose synthase, xylan synthase, glucan synthase, mannan synthase, UDP-galactose incorporating activity and latent inosine diphosphatase (IDPase) were performed. Mannan synthase and UDP-galactose incorporation were strongly reduced by light-treatment. Some of the *CSLA* genes encode for mannan synthases. The reduction in mannan synthase activity correlated with the reduction in *CSLA* transcript levels after light-treatment. This suggests that mannan biosynthesis is regulated at the level of transcription.