Plants and their Pathogens

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Histochemical methods for localization carbohydrate storage tissue in wheat stem

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Wheat and other grasses are capable of storing excess carbohydrates within the stems. These carbohydrates are essential to maintain yields when photosynthetic capacity is reduced, i.e. during periods of environmental and biotic stresses [1]. Wheat stems store carbohydrates in the form of glucose, fructose, sucrose, starch, and fructans [2], though the localization of these carbohydrates within tissues and cells of the stem had not previously been studied. Here we present our initial findings on the histological location of carbohydrates in wheat stem tissues.

In this study we applied histochemical methods to show the distribution and localization of different types of carbohydrates in wheat stems. Wheat stems of breeding line ZP-D 14/I were sampled from the field in the phases of early grain-filling (9-10 d after anthesis) and late dough (35 d after anthesis). Samples were sectioned manually using razor blades, stained and observed under a LEICA 2000 light microscope, equipped with a LEICA DC 300 camera and IM1000 software. The following histochemical tests were performed: Fehling test for monosaccharides [3], Molisch's test (thymol sulphuric acid) for saccharose and fructans [4], Lugol's test for starch [5], and Periodic acid-Schiff test (PAS) for water insoluble polysaccharides [5, 6].

During the early grain-filling phase, the main tissue responsible for non-structural carbohydrates was the chlorenchyma located at the periphery of the wheat. Histochemical staining detected reducing sugars (glucose and/or fructose) (Figure 1), oligosacharides and starch in this tissue. By the phase of maturing grains of wheat (35 d after anthesis), there were no detectable amounts of mmonosaccharides, oligosaccharides or starch in the non photosynthetically-active parenchyma cells in the wheat stem. This evidence provides a new opportunity for targeting future crop improvement, as breeding new genotypes with large amounts of chlorenchyma in the stem are likely to offer a greater possibility for plants to increase productivity, especially in stress conditions.

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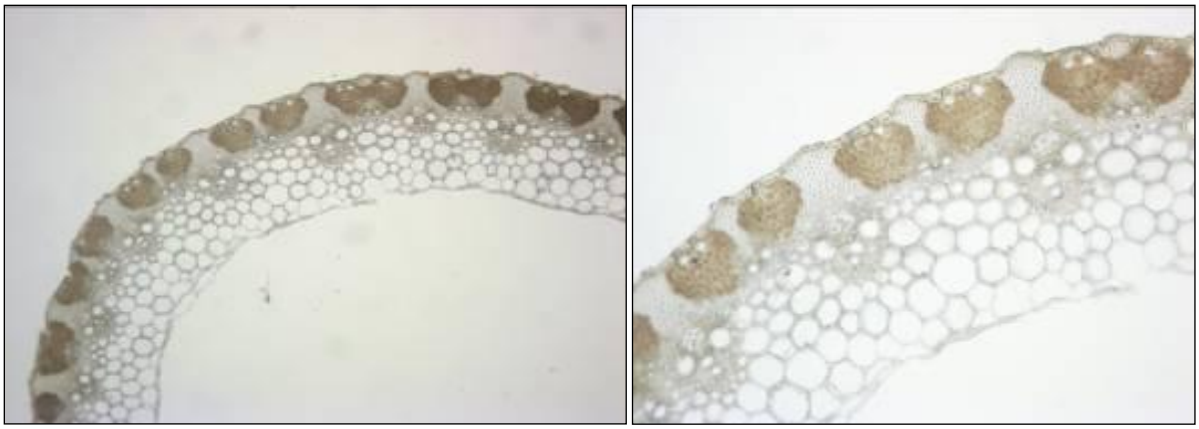

Figure 1. Unstained freehand section of wheat stem in early reproductive growth phase.

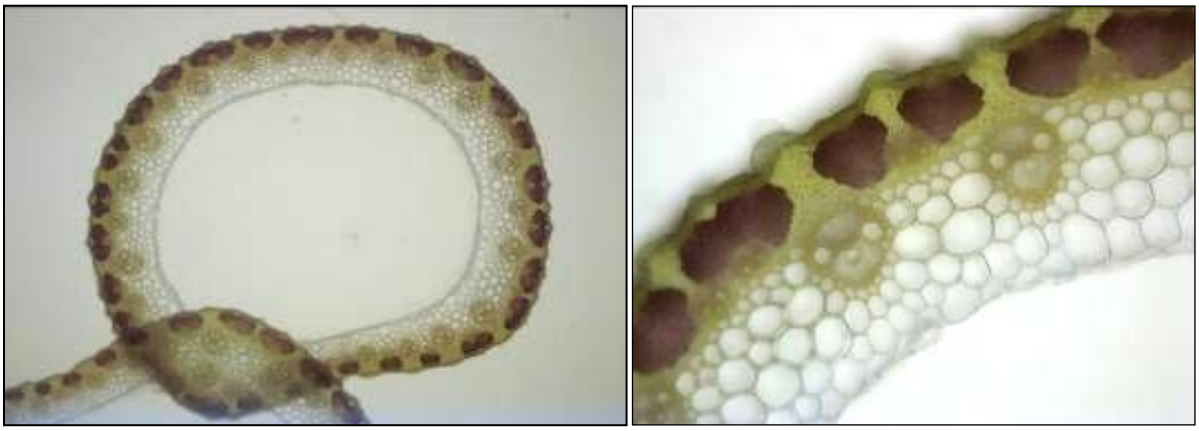

Figure 2. Fehling test applied on section of wheat stem in early reproductive growth phase. The appearance of reddish brown stain in the samples indicating presence of reducing sugars (monosacharides) in the chlorenchyma tissue