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Heat and drought stress responses alter grain characteristics by impeding starch precursors of wheat

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In semi-tropical regions, particularly in the Punjab (India), drought and high temperature stress are serious constraints for wheat production. Understanding the key metabolic steps may help the breeders and biotechnologist to develop heat and drought tolerant genotypes. Six wheat cultivars, namely PBW 343, PBW 550, PBW 621, PBW 175, C 306 and HD 2967 were extensively characterized for transformation of sugars to starch under heat and drought stress conditions. Significant reduction in enzyme activities of ADP-Glucose pyrophosphorylase (AGPase), alkaline inorganic pyrophosphatase and phosphofructokinase (PFK) in conjunction with reduced starch content under heat and drought stress conditions was apparent. However, contents of reducing sugars and fructans were increased while amylose and amylopectin content decreased. Correlation analysis revealed positive correlation of amylose with alkaline inorganic pyrophosphatase and starch with AGPase and PFK. Role of PFK was evident from correlation between AGPase and PFK indicating its predominant role in providing substrate for AGPase activity. Significant effects of stress treatments (T), genotype (G) and genotype-by-treatment (G×T) interaction were observed for AGPase, alkaline inorganic pyrophosphatase and PFK, amylose, amylopectin, starch, total sugars, fructans, 1000 grain weight and plant height. Thousand grain weights decreased more under heat stress as compared to drought stress indicating higher severity of the former stress.

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