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The Role of Epigenetics and Environmental Stimuli in the Inheritance of Freezing Tolerance in Wheat

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The field of epigenetics has discovered that the genome is affected by environment, and it is possible to use the idea of epigenetics in plant breeding by exposing plants to various environmental cues such as frost, drought, or hot temperatures. The progeny that result from these epigenetic changes often have slightly higher frost, drought, or heat tolerance. These principles were first discovered by the eminent Russian biologist Trofim Lysenko in the 1940's, but the underlying mechanism for such observations was not previously known. At this current time, this phenomenon has not been extensively studied and the potential role of DNA methylation in plant breeding has not been thoroughly explored. In this

research, 43 wheat varieties were subjected to freezing temperatures in a randomized complete block design during four site years. The subsequent generation of wheat after the freezing treatment was ~15% more tolerant of freezing temperatures than the previous generation, indicating significant epigenetic changes were caused by the freezing treatment in the previous generation. We conclude that environmental stimuli can shape the phenotype of wheat, and that these epigenetic changes can be heritable in subsequent generations. This potentially could have an enormous impact on the breeding of varieties that can withstand abiotic stresses.