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**Breeding and genetics of perennial wheat and kernza**

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**Abstract**

We are developing a new perennial grain that we have named “kernza” by domesticating the perennial grass *Thinopyrum intermedium* (intermediate wheatgrass). In 1983, intermediate wheatgrass was selected for domestication by the Rodale Research Center (Kutztown, Penn., USA). Nearly 100 species of perennial grasses were evaluated for perenniality, ease of threshing, shatter resistance, lodging resistance, synchronous maturity, seed mass, seed flavor, and other traits before choosing intermediate wheatgrass to domesticate. The Rodale Research Center performed two cycles of selection, beginning in 1988. Using selections made by Rodale, breeding work began at The Land Institute (Salina, Kan., USA) in 2002. Selection has been for yield per head, increased seed mass, free threshing ability, reduced height, and early maturity. Two cycles of selection at The Land Institute have increased seed yield by about 75% and seed mass by about 25%, when grown in a solid stand. Since 2001 we have also been working to develop perennial wheat by crossing wheat (*Triticum* spp.) with perennial *Thinopyrum* species. We have obtained a few stable lines with one set (12-14) *Thinopyrum* chromosomes and 42 wheat chromosomes. These have better agronomic performance in Kansas than other materials, but lack perenniality. Crosses between winter durum wheat and *Thinopyrum intermedium* have been recently developed, and they are promising in terms of perenniality, seed weight, winter hardiness, and vigor. To study the impact of annual/perennial genome dosage on perenniality and agronomic performance, we have crossed diploid and tetraploid wheat lines with tetraploid and hexaploid *Thinopyrum* species. All F<sub>1</sub> plants are perennial, and have been doubled with colchicine. Wheat chromosome-specific markers have been used to characterize 94 plants that were perennial in the field. Plants with more wheat chromosomes eliminated tended to be more perennial, but specific chromosomes were not associated with perenniality or annuality.