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Pearl millet [*Cenchrus americanus* (L.) Morrone] is a staple food for more than 90 million farmers in arid and semi-arid regions of sub-Saharan Africa, India and South Asia. We report the ~1.79 Gb draft whole genome sequence of reference genotype Tift 23D₂B₁-P1-P5, which contains an estimated 38,579 genes. We highlight the substantial enrichment for wax biosynthesis genes, which may contribute to heat and drought tolerance in this crop. We resequenced and analyzed 994 pearl millet lines, enabling insights into population structure, genetic diversity and domestication. We use these resequencing data to establish marker trait associations for genomic selection, to define heterotic pools, and to predict hybrid performance. We believe that these resources should empower researchers and breeders to improve this important staple crop.

Global temperatures are expected to increase from 1 to 6 °C by 2100, with serious consequences for agriculture¹. This means that climate-appropriate measures to ensure food security are a priority, especially as the human population is projected to reach 9.1 billion by 2050². Crops that are adapted to the predicted environmental changes have been proposed as one solution³. Even now, availability and further improvement of crops that can withstand climate change could reduce the hunger of the 805 million undernourished people living mainly in developing countries⁴.

Pearl millet (*Pennisetum glaucum* (L.) R. Br., syn. *Cenchrus americanus* (L.) Morrone), a C4 grass, is a highly cross-pollinated diploid ($2n = 2x = 14$) with excellent photosynthetic efficiency and biomass production potential. It is cultivated as a staple food grain and source of straw for fodder and fuel in arid and semi-arid regions of sub-Saharan Africa, India and South Asia. Climate-smart vegetative, reproductive, and physiological features of pearl millet make this crop well-suited to growth in harsh conditions including low soil fertility, high soil pH, high soil Al³⁺ saturation, low soil moisture, high temperature, high

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