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Registration of 'USU-Apogee' Wheat

'USU-Apogee' is a dwarf hard red spring wheat (*Triticum aestivum* L.) (Reg. no. CV-840, PI 592742) cultivar developed for high yields in controlled environments. USU-Apogee was developed by the Utah Agricultural Experiment Station in cooperation with the National Aeronautics and Space Administration (NASA) and released in April 1996 as an improved cultivar for bioregenerative life support systems in space.

USU-Apogee is a shorter, higher yielding alternative to 'Yecora Rojo' and Veery-10, the short field genotypes previously selected for use in controlled environments (1). USU-Apogee was tested under the designation CPL-20-1-41. USU-Apogee is 45 to 50 cm tall (depending on temperature), which is 10 to 15 cm shorter than Yecora Rojo and 2 to 5 cm shorter than Veery-10. USU-Apogee was selected also for resistance to the Ca-induced leaf tip necrosis that occurs in controlled environments.

USU-Apogee originated from the cross 'Parula'/'Super Dwarf', both of which were obtained from the CIMMYT germplasm collection in 1984. Parula has the pedigree FKN/3/2*FCR// 'KenyaAD'/'Gabo 54'/4/Bluebird/'Chanate', where FKN is the cross 'Frontana'/'Kenya58'//'Newthatch'. Parula was selected for its small leaf size. Super Dwarf has the CIMMYT germplasm number CMH79.481-1Y-8B-2Y-2B-0Y and the pedigree *T. sphaerococcum*/2*H-567.71/3/'Era'/'Sonora64'//2*Era, and was selected for its short stature (25 cm tall).

Single head selections were made in the F_2 to F_4 generations for short height, erect tillering habit, reduced tillering, and small leaves. These traits are desirable in high-yield conditions (2,3,4,5,7). Mass selections for short height and high yield were made in the F_5 to F_8 generations. All selections were made in a CO_2–enriched temperature-controlled greenhouse that had 350 $\mu mol\ m^{-2} s^{-1}$ of supplemental lighting from high-pressure sodium lamps. The photoperiod was 24 h (continuous light). The root-zone was a hydroponic soilless medium, watered twice daily with nutrient solution. Continuous cultivation made it possible to evaluate three to four generations per year. Yields in this environment (about 16 Mg ha^{-1}) are typically double the best irrigated field yields.

Yield evaluations, in the near-optimal conditions of the CO_2–enriched greenhouse, were conducted from the F_5 to F_8 generations. USU-Apogee had the least leaf tip necrosis, but had considerable variability for plant height, so 67 single heads selected from the F_9 generation were grown as head rows. Additional selections were made in the next six generations (F_{10} to F_{15}) for yield. In the F_{16} generation, 100 heads were selected and grown as head rows. After roguing off-type and nonuniform rows, the remaining 90 F_{16} lines were harvested and bulked as breeder seed.

USU-Apogee is resistant to the leaf tip chlorosis that occurs in wheat under rapid growth conditions, particularly in continuous light. This chlorosis can kill the top 30% of the flag leaf. The chlorosis is severe in Veery-10 and also occurs in Yecora Rojo. The segregating lines with the smallest leaves had the least chlorosis. Tissue analysis by inductively coupled plasma emission spectrophotometry indicated adequate Ca in the top 30% of small leaves (0.4% Ca), but inadequate amounts (0.05% Ca) in large leaves. USU-Apogee has smaller flag leaves (11 to 20 cm long, depending on temperature) than Yecora Rojo and Veery-10 (20 to 30 cm long). Calcium deficiencies, such as tip burn in lettuce (*Lactuca sativa* L.) and blossom end rot in tomato (*Lycopersicon esculentum* Mill.), are common in controlled-environment crop production, because Ca has low phloem mobility and is thus not sufficiently translocated to rapidly growing meristems. Foliar Ca applications and increased root-zone Ca are not effective, because they do not reach the meristematic leaf tissue (6).

USU-Apogee has rapid development. Heads emerge 23 d after seedling emergence in continuous light with a constant 25°C temperature. Heads of Yecora Rojo and Veery-10 emerge about 6 d later under these conditions. In field conditions, USU-Apogee heads about 3 d earlier than Yecora Rojo and 6 d earlier than Veery-10.

The yield advantage of USU-Apogee is greatest in conditions favorable to rapid development (warm temperatures, 23°C). Yields of Yecora Rojo and Veery-10 are similar, so most of our studies compared USU-Apogee with Veery-10. USU-Apogee outyielded Veery-10 by an average of 29 ± 2% in two studies at 23°C (60-d life cycle), but by an average of 13 ± 10% in three studies at 17°C (95-d life cycle). USU-Apogee outyielded Veery-10 by 8% in a replicated study in a growth chamber under high light (1200 $\mu mol\ m^{-2} s^{-1}$; 24-h photoperiod; 51.8 mol $m^{-2} d^{-1}$, equivalent to full sunlight at the summer solstice). USU-Apogee outyielded Veery-10 by 15 ± 3% in replicated field trials in 1994 and 1995, and outyielded Yecora Rojo by 14% in 1995. The yield of USU-Apogee was 160% of Super Dwarf and 100.1% of Fremont (an adapted semidwarf Utah wheat cultivar) in the 1995 field trial. Neither Veery-10 nor Yecora Rojo is specifically adapted to Utah field conditions. Heads per square meter and seeds per head are approximately 25% higher in USU-Apogee than in Veery-10, and mass per seed is about 25% less. The harvest index is 5 to 15% higher than that of Veery-10.

Bread-making quality was evaluated by the USDA-ARS Western Quality Wheat Laboratory at Pullman, WA. Milling and baking tests indicated that USU-Apogee has similar quality to Veery-10 and poorer quality than Yecora Rojo. Breeder seed of USU-Apogee will be maintained by the Plants, Soils, and Biometeorology Department at Utah State University, and small quantities are available for testing. USU-Apogee has not been submitted for U.S. plant variety protection.

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References and Notes

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