Genomics Enabled Purging Selection to Develop 200 Alfalfa Inbred Lines Toward High Yield Hybrid Production

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The USDA Crop Production Historical Track Records indicate that alfalfa yield trends remained stagnant at 2.1 tons per acre until 1955, followed by a steady increase over three decades. However, over the past 40 years, yield gains have plateaued at 3.3 tons per acre. The primary method for variety development, the synthetic breeding scheme, has contributed to this stagnation. Alfalfa, an outcrossing species with an average self-pollination rate of 30%, experiences significant inbreeding depression. Interestingly, autoploid alfalfa exhibits inbreeding depression comparable to that of diploid maize, though the reasons remain unclear. Synthetics serve as the foundation for developing varieties to mask deleterious alleles, yet they are susceptible to inbreeding depression, and hybrid performance is constrained by insufficient heterosis. To address these challenges, the USDA Alfalfa Forage Research Program initiated a project in 2018 (project #: 2018-70005-28792) aimed at developing 200 alfalfa inbred lines to reduce deleterious alleles and enhance purity. This project conducted the largest self-pollination experiment in history, involving over 5,000 plants. More than 200 inbred lines have been maintained through five generations of self-pollination. These inbred lines are invaluable for exploring heterosis among inbreds and facilitating the development of synthetics from inbred with reduced deleterious alleles.