

Alfalfa Genetic Gain for Forage Yield Using Single-Cross Hybrid Progeny Testing

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Average alfalfa yields reported in the literature have made very little gain over the last few decades. As a result alfalfa genetic gain for forage yield is perceived as not making progress over the same time period, putting the crop at risk of stalling in productivity and multi-environment adaptability, especially in the context of a changing climate. The objective of this study was to measure genetic gain for forage yield in a commercial alfalfa breeding program in a key North American dairy region.

In the DLF USA, Inc., alfalfa breeding program, a reciprocal recurrent selection breeding scheme has been conducted for the last 13 years between a male sterile population and six other genetically unique breeding pools. Newly selected plants from each pool are clonally propagated and test-crossed against two male sterile testers to create two single-cross hybrids which are progeny tested in replicated forage yield trials at three Midwestern locations for three years. Likewise, newly selected male sterile clones are test-crossed against two male fertile testers to create two single-cross hybrids which are progeny tested similarly. Each clone's yield performance in the single-cross hybrid is compared head-to-head against a common check clone's yield performance test-crossed against the same tester. When the forage yield advantage of each clone relative to the check clone is regressed against the year the clone was identified, genetic gain can be calculated at the clonal level.

Clones that were selected based on progeny testing forage yield performance have then been used in various ways over the last 9 years to develop populations in breeder seed cages as potential commercial varieties. These new varieties were forage yield tested at four Midwestern locations for three years. Over this 9-year period, varietal genetic gain was calculated by measuring the average yield performance of the top 10% of the new varieties in each breeding year compared against a common set of 3, 4, 5, or 6 commercial check varieties across years.

On a clonal basis, genetic gain for forage yield in the male sterile pool over a period of 14 years ranged from 0.15% to 1.07%/year, depending on the check clone used, but was 0.54%/year with the most robust dataset. In the six other genetic pools, genetic gain for forage yield ranged from 0.26% to 1.06%/year using the most robust dataset and averaged 0.66%/year. It appears as the number of replications increases that our overall clonal genetic gain across sterile and fertile pools falls between 0.54% and 0.66%/year.

On a varietal basis, over a period of 11 years, seven regressions were calculated against different check sets. Varietal genetic gain averaged 0.86%/year, and ranged from 0.49%/year to 1.42%/year. This is in line with other major crops like corn and soybeans.

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