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Determining the Mechanism of Yield Stability in Alfalfa

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Abstract
Year-to-year stability of crop yields is important for farmers, and hence is an important goal of plant breeding programs. Especially in perennial crops like alfalfa farmers need to know that they can count on consistent yields over a period of three or more years. Alfalfa varieties are composed of a population of many genetically distinct plants (or genotypes), unlike corn hybrids or soybean lines, which are genetically uniform. Our goal is to determine whether the entire population of plants or single plants within a population determine yield stability of alfalfa. If varietal stability is due to the stability of individual plants in the population, then breeders can select individual plants with stable performance under many environmental conditions to use in the development of stable varieties. Conversely, if yield stability of a variety results from the interaction of many different genotypes, each of which performs better under some conditions than others, then alternative methods for developing stable cultivars must be investigated.

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Introduction

Year-to-year stability of crop yields is important for farmers, and hence is an important goal of plant breeding programs. Especially in perennial crops like alfalfa farmers need to know that they can count on consistent yields over a period of three or more years. Alfalfa varieties are composed of a population of many genetically distinct plants (or genotypes), unlike corn hybrids or soybean lines, which are genetically uniform.

Our goal is to determine whether the entire population of plants or single plants within a population determine yield stability of alfalfa. If varietal stability is due to the stability of individual plants in the population, then breeders can select individual plants with stable performance under many environmental conditions to use in the development of stable varieties. Conversely, if yield stability of a variety results from the interaction of many different genotypes, each of which performs better under some conditions than others, then alternative methods for developing stable cultivars must be investigated.

Previous research has suggested that increased genetic diversity can lead to increased stability; therefore, we will evaluate alfalfa varieties developed from different numbers of parental genotypes. If diversity leads to stability, those varieties derived from larger numbers of parent plants should perform more reliably. The results of this research will help breeders determine the number of parents and their genetic diversity when developing new, stable varieties.

Materials and Methods

We selected ten individual genotypes from each of ten varieties (5454, Affinity, DK140, Enhancer, Innovator +Z, Jade, Stampede, Wetland, WL324, and Vernal) for this study. The number of parental clones from which these varieties were developed ranged from eight to 99. Stem cuttings of each genotype were made in the greenhouse to allow for replication of individual plants. The cuttings were planted in five environments in Iowa, including Nashua, in August 2000. The plot design was a lattice with two replications, with three cuttings per genotype in each replication. Yield will be measured on these plots by hand harvesting three times a year for three years, and yield stability over years and locations will be calculated.

Results and Discussion

Beginning in 2001, we plan to compare the average yield of each entire population with the yields of its component single genotypes. We will also attempt to find a correlation between the yield stability of the populations and their parental clone numbers.

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