Comparative Performance of Diallel Crosses and Related Second Generation Synthetics of Alfalfa. II. Winterhardiness and Persistence

J. C. Theurer and L. J. Elling

In northern latitudes winterhardiness and stand persistence are important traits governing the economical production of alfalfa. Therefore, the breeder must seriously consider these two factors in searching for superior germ plasm and determining the best clonal combinations for use in varieties for commercial production. Intensified effort has been exerted recently to evaluate clones in diallel combinations. In addition a few studies have been made to determine if synthetic variety performance can be predicted accurately from the average behavior of the corresponding crosses. However, limited work has been reported on the performance of the diallel crosses and all possible synthetics derived from a given set of clones.

This paper presents data on the winterhardiness and persistence of diallel crosses among five alfalfa clones and their 26 possible Syn-2 generation synthetics.

LITERATURE REVIEW

Many methods have been used to measure the winterhardiness of alfalfa. Among these are cold-chamber tests, germination under osmotic pressure, correlation with fall-growth habit, electrical conductance, the number of stomata, and estimated percent stand, or actual percent winter survival.

Heinrichs (3) found that fall recovery and the soluble carbohydrates in roots were the most reliable of several rapid methods for determining winterhardiness. Correlations of these two characters and winterhardiness were -.76 and .78 respectively. Johnson (4) obtained correlations of similar magnitude for winterhardiness and fall dormancy relationships for 11 clones and their diallel crosses.

Elling et al. (1) reported a highly significant correlation (r = .49) between winterkilling and fall growth of diallel combinations of 14 alfalfa clones of diverse origin. However, the progenies of one clone, C318, made substantial fall growth and suffered little winterkilling, suggesting that progress could be made in selection for increased fall growth without sacrificing winterhardiness. These workers found that the variance component for general combining ability was six times that for specific combining ability for winterhardiness, although both combining ability variances were highly significant.

Perrson and Elling (6) studied the winterhardiness and persistence, among other characters, for one 3-clone and two 4-clone synthetics, and for 15 clonal crosses. They found no significant differences between synthetic performance and the average performance of corresponding single crosses. Specific combining ability effects were significant for winterhardiness, and general combining ability effects were significant for persistence.

Ronningen and Hess (8) obtained significant correlations (r = .74 to .90) for stand and yield at the end of three years of harvest. They suggested that several auxiliary tests located in farmers' fields would provide a good basis for drawing conclusions concerning persistence.

According to Tysdal et al. (10) disease resistance, especially bacterial wilt, and cold resistance are of paramount importance for maintaining good stands in northern latitudes. The bacterial wilt resistance of the single crosses and of the synthetics included in the present study was reported previously (9).

MATERIAL AND METHODS

The five clones selected for this study were relatively self-sterile and of diverse origin. They consisted of clone 3 (Minn. 259), clone 4 (Minn. 247), clone 5 (Minn. 255), clone 6 (Minn. 265) and clone 7 (Minn. 271).

Diallel crosses and Syn-2 generation seed for the 26 possible synthetics of the 5 clones were obtained by hand pollination in the greenhouse without emasculation. A more complete description of the clones and crossing procedures has been given (9).

The field planting consisted of 10 single crosses, ten 2-clone synthetics, ten 3-clione synthetics, five 4-clone synthetics, one 5-clone synthetic, and the 3 check varieties, Vernal, Ranger, and Du Puits. These 39 entries were seeded at Rosemount, Minn., in a split-split-plot experiment with main plots being drilled and spaced plantings. Each of these units was split so that the six classes of progenies constituted subplots. The sub-subplots, consisting of entries within classes of progenies, were randomized in the respective subplots. An individual sub-subplot in the drilled unit consisted of 3 adjacent rows 1 foot apart and 20 feet long. In the spaced unit, each sub-subplot consisted of 2 adjacent rows 20 feet long with individual plants on 18 inch centers.

Two of 4 replications were seeded June 19, 1958, and the others July 20, 1958, as a precautionary measure against complete seedling failure. The study was maintained under clean cultivation during the year of seeding to reduce weed competition and assure good establishment. In early September of the seeding year, the entire nursery was clipped to remove excess foliage and allow time for adequate regrowth and hardening before winter. Harmful insects were