Fall Growth, Winterhardiness, Recovery After Cutting and Wilt Resistance in F₂ Progenies of Vernal x DuPuits Alfalfa Crosses

Thad. H. Busbice and C. P. Wilsie

'Vernal' and 'DuPuits' varieties of alfalfa (Medicago sativa L.) each have certain agronomic characters that tend to complement the other. Table 1 shows a comparison of these characters. Vernal was developed by combining 6 selections from 'Cossack' with 5 second-generation plants from hybrids between a diploid Medicago falcata and the cultivated varieties 'Kansas Common' and 'Ladak' (9). It is well adapted to conditions of the midwestern section of the United States. DuPuits was developed from a cross of two slightly inbred clones of the Örnelong strain and is adapted to the milder climatic conditions of Europe.

It would be advantageous to combine into a single variety the desirable characteristics of both Vernal and DuPuits. It was the purpose of this study to determine the degree of association of these characters in F₂ populations of Vernal x DuPuits crosses. Special attention was given to the association of fall growth with winterhardiness, recovery after cutting and seasonal distribution of yield.

Kohel (12) has pointed out that some yield is sacrificed in winterhardy alfalfa because of the less vigorous recovery and the habit of fall dormancy.

An association of fall growth habit with winterhardiness has been observed and reported by many workers. Brand (1) in 1910 suggested that the ability of alfalfa to become dormant, in spite of temperatures high enough to force continued growth, was important in winterhardiness. Other authors, Young (4), Mark (14), Smith (15, 16), and Larson and Smith (13), have reported that varieties that produce tall upright fall growth are more likely to be winterkilled. Within the Vernal variety, Smith (16) found that progenies from crosses of tall x tall were nonwinterhardy, intermediate x intermediate were intermediate in winterhardiness, and short x short were very winterhardy. Heinrichs et al. (11) concluded that plants in F₂ populations from hardy x nonhardy crosses might be classified on the basis of fall growth and hexosan content, the classification to be used in predicting hardiness. Theurer (18) found that, in general, varieties which showed rapid spring growth were those that made the most rapid regrowth after cutting and were the least winterhardy and the least persistent.

While most of the literature has indicated that winter survival in cold climates is dependent upon early fall dormancy, some reports have suggested that these characters may not necessarily be genetically linked. In a winterhardiness study Elling, Hanson, and Graumann (9) reported that one entry (Pa. 53-13) made substantial fall growth, but suffered little winter killing. Theurer and Larson found an entry (synthetic 35) that had good regrowth, fair winterhardiness, and a better end of the second growing season than any other.

In Australia, Daday and Greenham (5) indicated that recombination of cold hardiness at growth had occurred and that selection for cold hardiness was effective. They suggested that the north-south difference in cold hardness and and winter dormancy types of M. sativa might be coincidental as to selection, or that it might be due to pleotropic genes. Later, Daday (4) proposed that the difference between cold injury and winter growth of alfalfa varieties was due not to genetic linkage nor to independent ecotypic selection.

MATERIALS AND METHODS

Fourteen F₂ progenies, produced by selfing 12 entry parents, and 10 entries from different parents of Vernal and DuPuits, were space planted two feet apart in rows 40 inches apart in the field at Ames, Iowa, in the spring of 1962. The space planting allowed for individual plant measurements and also fully exposed the plants to the detrimental effects of the following winter. The field was kept weed free, and the surface of the soil level was covered by a 1 1/2-inch woolley. Each entry was represented by 140 plants in rows 40 inches apart, with the mid-September clipping having the most harmful effect.

On September 12, 1962, the plants were clipped to a uniform height of 1 1/2 inches. Woolley and Wilkie (20) had found that time of fall clipping significantly influenced hardiness, with the mid-September clipping having the most harmful effect. Theurer (18) found that, in general, varieties which showed rapid spring growth were those that made the most rapid regrowth after cutting and were the least winterhardy and the least persistent.

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Entry means for the several characters were obtained by a complete analysis of variance. Simple correlations were computed using the formula:

\[ r = \frac{SS_{xy}}{\sqrt{SS_{xx} \cdot SS_{yy}}} \]

where SS_{xy} is the covariance of x and y, SS_{xx} is the variance of x, and SS_{yy} is the variance of y.

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