Self-fertility and Forage Yields of Alfalfa Selections and Their Progenies

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In the breeding of forage crops an evaluation of individual plant selections is highly important. Propagation of selections as clones and determination of seedling progeny performance are two of the methods widely used. The evaluation of open-pollination progenies probably is the most popular progeny test, and includes the use of seed harvested from a specifically designed polycross nursery (isolated), where male parentage is restricted to the lines represented in the nursery, or more simply, seed harvested from open-pollinated plant selections occurring in any general breeding nursery, variety plot, or field planting. Random pollination is desired, but whether actually achieved may depend on many factors, including dates of blooming, size and shape of plots, degree of randomization, isolation from other alfalfa, and possibly the differential attractiveness of certain genotypes to pollinating insects.

A recent review of progress in alfalfa improvement has been reported by White (31), emphasizing research on fertility relationships, insect pollination, and breeding procedures. The use of the polycross test for evaluating single plant selections has been adequately treated by Tysdal, et al. (30), and by Tysdal and Cran dall (28). Recent work with other forage crops, including crested wheatgrass and bromegrass, has indicated the usefulness of general open-pollination progenies, as reported by Knowles (18) and by Hawk (14).

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The ultimate criterion of combining ability lies in the actual behavior of selections in single crosses, multiple crosses and synthetic varieties. The relationship between performance of selected clones in single crosses and in open-pollination progenies has been discussed by Tysdal et al. (30), Tysdal and Cran dall (28), Bolton (4), and Wilsie and Skory (35). Inbred progenies also have been used for the evaluation of alfalfa selections. The time required to obtain selfed seed, however, and the fact that self-incompatibility limits the degree of inbreeding possible in many instances normally prevents the fullest use of selfed progenies.

Self-fertility and cross-fertility relationships are of importance in determining breeding behavior. Normally, under open field conditions, alfalfa is largely cross-fertilized. Self-fertility varies from nearly complete incompatibility to almost complete fertility, as has been demonstrated by Bolton and Fryer (5), Dean (11), Tysdal and Kiesselbach (29), and others. In general, according to Piper et al. (31), Hadfield and Calder (13), Tysdal (27), and Jones and Olson (15), cross-pollination results in three to four times as much seed as is produced by self-pollination.

Studies by Brink and Cooper (6, 7, 8) showed that lower seed setting upon selfing was due to several factors, including slower pollen-tube growth, a tendency for pollen tubes to pass directly by the micropyles, and differential endosperm development with subsequent ovule collapse. Stevenson and Bolton (25) demonstrated that cross-fertilization occurred in alfalfa if foreign pollen was applied to the stigma 1 hour or even longer after the flower had been tripped, where no emasculation had been practiced.

Earlier, Kirk (16) and Brink and Cooper (6) had pointed out the reproductive advantage of cross-fertilization, and had suggested that a considerable amount of self-fertilization probably would not prevent the maintenance of a high level of heterozygosity in alfalfa populations under natural conditions.

Although there appear to be many factors that would tend to minimize any undesirable effects resulting from considerable