SYNOPSIS. Forage yield and other agronomic data were obtained on 96 clones, randomly selected from Ranger alfalfa, and their polycross progenies. About one-third of the total genetic variance for forage yield in Ranger was of the additive sort. Heritability for forage yield was about .25. Reciprocal recurrent selection was proposed as the most rapid means of increasing yield.

EARLY studies of inheritance in alfalfa were limited chiefly to traits governed by qualitative factors. These studies as summarized by Atwood and Grün (1) indicated that diploid inheritance prevailed but that tetraploid inheritance also could have been used as a basis of explanation for observed results in a few instances. More recently the studies of Stanford (8), Twamley (9), Oldemeyer (7), and Dudley and Wilsie (4) showed that tetraploid inheritance was common. A complex situation of tetra-disomic inheritance was suggested by Hanson (5), Twamley (9), and Dudley and Wilsie (4) for some traits. The inheritance of combining ability for forage and seed yield was demonstrated by several workers who concluded that these characters were quantitative in nature. The literature on combining ability studies was recently reviewed by Kehr and Graumann (6). Information on the nature of gene action involved in forage yield is necessary to the development of more efficient breeding methods and the utilization of superior germ plasm in the form of synthetics and hybrids.

Each seed available for alfalfa improvement may be viewed as a potential clone. Current emphasis in alfalfa breeding is on obtaining clones having a suitable combination of desired traits such as resistance to economically important diseases and insects, abundant yield of high quality forage, and inherent seed-producing ability. The most prevalent basis for selection of clones is the use of the polycross test which provides an estimate of general combining ability. Clones high in general combining ability are utilized in the formulation of synthetic varieties. While selected clones provide an immediate basis for experimental synthetics which may ultimately be commercial varieties, there is a critical need for studies to determine the nature of the gene action controlling quantitatively inherited traits, so that the most efficient breeding system may be devised.

Comstock (3) outlined the information of a statistical nature that seemed pertinent to alfalfa breeding as follows: estimates of (1) genotype-environmental interaction variances, (2) genotypic covariances among the economically important characters, and (3) the extent of additivity in gene action. He pointed out that information on items (1) and (2) is important in breeding work, while item (3) is of practical importance to the breeder. An understanding of the quantitative nature of many of the economically important characters was also mentioned.

The purpose of this study was to determine the extent of the genetic variability in forage yield of Ranger alfalfa, to estimate heritability of forage yield, and to discuss the relative to systems of alfalfa breeding.

MATERIALS AND METHODS

Ranger alfalfa, a winter-hardy, bacterial wilt-resistant variety developed cooperatively by the Nebraska Agricultural Experiment Station and the United States Department of Agriculture, was chosen for this study because of its wide adaptation and its broad gene base. It is a multiple synthetics from selections obtained from Cossack and Ladak. Its area of adaptation is roughly the northern United States and it is being utilized to some extent in other countries. Clones obtained from Ranger alfalfa promise for use in new hybrids and synthetics.

One-hundred and twenty randomly selected plants of certified seed of Ranger were initiated. Cuttings from them in the greenhouse and were transplanted to a seed production nursery in April 1953. A modified lattice design with 3 replications was used with 5 cuttings of each clone planted in a row in each replication. Cutts were 1½ feet apart in rows 3 feet apart. Seed from all given clone was bulked. The natural population of the agent of pollination.

The clones were vegetatively propagated again in the fall and winter of 1953-54 to provide part establishing yield trials in the spring of 1954. An adequate polycross seed of some clones and differentiation of others reduced the number of clones in trials to 96. This was considered a reasonably adequate population.

Replicated tests of the 96 clones and their progenies were established at 2 locations on the Agriculture Experiment Station in late April and early May 1954. The soil, a Sharpsburg silty clay loam, was supplemented with irrigation. At location I, I received only normal rainfall whereas at location II, rainfall was supplemented with irrigation.

Almost perfect stands, which persisted throughout the season, were obtained at location I; but unfavorable weather at location II resulted in poor stands in several of the replicates. Consequently, the test at location II was re-established in 1955.

A randomized complete block design with 4 replications was used for each location of this experiment. The 96 clones were subdivided at random into 6 groups of 16 clones each. Clones were kept together in a block in each replication and corresponding polycross progenies also were grouped as their parental clones, but different randomizations were used. Since polycross seed was drilled and transplanted by hand, all 96 polycross progenies were not used in each replication, and all 96 clones were not used in replication.