REPEATABILITY OF REGRESSION STABILITY INDEXES FOR GRAIN YIELD OF OATS
(AVENA SATIVA L.)

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INDEX WORDS

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SUMMARY

Two lines of descent were established from an F3 bulk lot of oats (Avena sativa L.) initiated by mixing seeds from approximately 250 crosses. For one line of descent, seeds were radiated with thermal neutrons or X-rays from F3 through F6, followed by five generations of bulk propagation. The second was propagated for 10 generations. No artificial selection was practiced in either line of descent. Grain yield data from 20 random strains from each of four generations from the radiated (F7, F8, F9, and F11) and five from the nonradiated (F3, F5, F7, F8, and F12) line of descent and 20 check cultivars tested in 14 environments were used for estimating regression stability indexes of oat strains.

The 14 environments were assigned randomly to two sets of seven, and regression stability indexes were computed for the 180 experimental oat strains for both sets. Intrageneration correlations between regression stability indexes from the two sets of environments ranged from -0.35 to 0.64 (18 d.f.), and only one of nine was significant, indicating poor repeatability for estimates of this statistic computed from different sets of environments.

Correlations between regression stability indexes from two sets of environments, one in which the environments varied by soil nitrogen levels and a second in which they varied by soil phosphorus levels, ranged from -0.01 to 0.28, none of which was significant.

The relative magnitudes and ranking of the regression stability index values for the oat genotypes were nearly identical when environmental productivity indexes were assessed with any number of check cultivars from 2 to 20.

INTRODUCTION

A challenging problem in plant breeding is the development of a technique for predicting productivities of cultivars when grown over a range of environments. FINLAY & WILKINSON (1963) measured the adaptation reaction for yield of a cultivar across a series of environments by computing the regression of its yields upon the mean yields of all cultivars tested in the same environments. EBERHART & RUSSELL (1966) suggested that the sum of deviations for a cultivar from its regression line would measure its stability, whereas the magnitude of its linear regression indicated the type of environment to which the cultivar was best adapted.

We tested random lines of oats from several generations of two bulk populations

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in 14 environments in Iowa, USA. For purposes of testing the relationship between regression stability indexes estimated for a series of lines in two sets of environments, we divided the 14 environments randomly into two sets of seven. Further, regression stability indexes were computed for the oat lines for two sets of three environments each, in which soil nitrogen or phosphorus levels caused the differential productivities among environments within the sets. Correlations among the linear regressions estimated for two sets of environments were used to judge the repeatability of regression stability indexes.

MATERIALS AND METHODS

Materials and field evaluations. Our materials were oat (*Avena sativa* L.) strains from bulk populations initiated by compositing *F*₂ seeds from approximately 250 crosses. After one increase, the *F*₃ (A547) seed lot was subdivided into radiated (A548) and nonradiated (A557) lines of descent.

*F*₃ (A548) and *F*₄ (A610) seeds of the radiated line of descent were treated with thermal neutrons (TN) to total dosages of $1.39 \times 10^{13}$ and sown in alternate rows with A547, which served as the pollen donor for male-sterile florets on plants from radiated seeds. Seed of *F*₅ and *F*₆ was treated with 20 000 and 15 000 r of X-rays, respectively, and sown in alternate rows with the progeny of A610, which served as a pollen donor. The radiated line of descent was propagated without selection from *F*₇ through *F*₁₁. No treatment or selection was applied to the line of descent begun with A557. In each generation of the radiated (*F*₃–*F*₁₁) and nonradiated (*F*₃–*F*₁₂) lines of descent, approximately 100 000 seeds were sown. Seeding rate was one seed per cm of row. To obtain seed for propagation in each generation, the 65 kg of seed harvested in the previous generation of a line of descent were divided into six lots and equal size samples were taken from each to make a 3.0 kg composite for planting and 1.0 kg sample for cold storage.

In 1972, 20 random lines (each the progeny from a spaced plant) from each of four generations from the radiated (*F*₇, *F*₈, *F*₉, *F*₁₁) and five from the nonradiated (*F*₃, *F*₆, *F*₇, *F*₈, *F*₁₂) line of descent and 20 check cultivars were evaluated for grain yield in 14 environments. In each environment we sowed one replicate of the 180 experimental lines (i.e., 20 strains × nine populations) and two replicates of the check cultivars. Replicated check cultivars provided estimates of error mean squares within environments. A plot was a hill sown with 30 seeds, and plots were spaced 30.5 cm apart in perpendicular directions.

Several environmental variables known to affect grain yields of oats were represented in our set of environments (Table 1), and, to accomplish the goal of including all of them, we used environments at several sites in Iowa. Three dates of planting, reflecting a range of temperatures for the growing season, were sown on highly productive soil at Ames in Central Iowa. Soils at Castana, in west-central Iowa, are deep loess that respond to phosphorus fertilization. Soils at Sutherland in northwestern and at Kanawha in northcentral Iowa are responsive to nitrogen fertilization.

Grain yield was measured in g per plot. During all years of bulk propagation and evaluation, the oat plants were sprayed with a fungicide at weekly intervals to control foliar diseases.