Barley

BARLEY GENOTYPES GROWN WITH RIVER IRRIGATION WATER ON THE SAFFORD AGRICULTURAL CENTER (1)

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Summary

A 2-year experiment was conducted at the Safford Agricultural Center, Safford, Arizona, to study the response of 15 barley (Hordeum vulgare L.) genotypes to river irrigation water. Eleven of the barley genotypes were produced by subjecting the seeds of two barley cultivars, adapted to the southwestern environment, to thermal neutron irradiation.

The river irrigation water contained a lower concentration of total soluble salts and a lower sodium adsorption ratio (SAR) than did the well water from the well located on the Safford Agricultural Center. The electrical conductivity of the saturation extract, total salt content, and exchangeable sodium percentage were all much lower in soil irrigated with river water (non-saline environment) than in soil irrigated with well water (saline environment).

Most barley genotypes germinated uniformly, grew well, and produced relatively high yields of forage and grain when irrigated with river water. The combined data for two years gave positive correlations between grain yield and plant height, number of heads per unit area, and straw yield. Since there were significant differences between barley genotypes in a number of growth and yield characteristics in this non-saline environment, it should be possible, utilizing this genetic material, to develop improved barley cultivars for irrigation with river water on the Safford Agricultural Center and also, possibly, for similar semiarid environments throughout the world, using plant breeding techniques.

Introduction

Soils differ in their recognizable characteristics just as plants and animals differ. Soils acquire their individual properties from the forces that act upon them in their specific environment. For example, desert soils in the southwestern United States are usually alkaline in nature and contain large quantities of soluble salts, while the soils in the humid Northeast are acidic with low concentrations of soluble salts. In the Southwest and in similar semiarid regions throughout the world the concentrations of soluble salts in the soil and irrigation water are often so high that they interfere with the normal growth of most field crop plants.

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Materials and Methods

A two-year experiment was conducted at the Safford Agricultural Center, Safford, Arizona, to study the response of barley genotypes to a non-saline soil and irrigation environment. The research site was located at about 3,000 feet above sea level. The soil type was a Grabe Clay Loam, which is a member of the coarse-loamy, mixed thermic family of Cumulic Haplustolls. The soil was plowed, floated, disked, dragged, and bedded to produce a good seedbed. Elemental N at 150 lb/acre, in the form of ammonium nitrate, was applied prior to planting each year. The experiment was conducted in an area that had received only river irrigation water for the previous 10 years (non-saline environment).

The following 15 barley genotypes were grown each year: (1) 'Mesa 273', (2) 'Mesa 269', (3) 'Yuma 32', (4) 'Yuma 6', (5) 'Mesa 322', (6) 'Yuma 52', (7) 'Yuma 166', (8) 'Mesa 300', (9) 'Mesa 383', (10) 'Yuma 122', (11) 'Arimar', (12) 'Arivat', (13) 'Mesa 497', (14) 'Arizona 1970-1', and (15) 'California Mariout.' Arimar, Arivat, and California Mariout were commercial cultivars. Arizona 1970-1 was an early, short-strawed natural mutation from Arimar. All Mesa genotypes were thermal neutron induced mutants from Arivat and all Yuma genotypes were thermal neutron induced mutations from Arimar.

The experimental design was a Randomized Block Experiment with four replications. Each individual plot consisted of one hill that covered an area of 2.7 ft2 on a standard vegetable bed. Torrie (1962) reported that the hill method of planting was used successfully in evaluating strains (genotypes) of soybeans (Glycine max Merrill) when land was limited, the number of entries was large, or the seed supply was limited.

The barley was planted in November at the rate of 12 seeds per hill and the grain and straw were harvested with a hand sickle the following May each year. After planting, the barley was irrigated-up to saturate the soil to a depth of 3 feet and irrigated as needed throughout the growing season to ensure that the plants were never stressed for moisture. A total of 3 acre-feet of irrigation water were required to grow the barley genotypes to maturity.

The following data were recorded for each genotype each year: (1) plant height, (2) lodging, (3) number of heads per hill, (4) number of seeds per head, (5) seed weight, (6) grain yield, (7) straw yield, (8) grain-to-straw ratio, (9) days from planting to flowering, and (10) days from flowering to maturity. All data were analyzed using the standard analysis of variance. Means were compared using the Least Significant Difference (LSD) Test. Simple correlations were calculated between grain yield and the remaining nine characteristics observed for each genotype.

Results and Discussion

The growth of each of the 15 barley genotypes was evaluated in Grabe Clay Loam Soil that had received only river irrigation water for the previous 10 years (non-saline environment) and that was irrigated with river water during the experiment. Since the total soluble salts and the sodium adsorption ratio were much lower in river water than in well water, the electrical conductivity of the saturation extract, total salt content, and exchangeable sodium percentage were all much lower in soil irrigated with river water than in soil irrigated with well water. The foregoing soil and water chemical properties suggest that the non-saline environment, utilizing river water for irrigation, is much more conducive to optimum plant growth than is the saline environment in which well irrigation water is normally used.

The combined analysis of variance for the two-year period showed a significant difference between barley genotypes in plant height, lodging, number of heads per hill, number of seeds per head, seed weight, grain yield, straw yield, grain-to-straw ratio, days from planting to flowering, and days from flowering to maturity. The combined data for the 2-year period showed significant, positive correlations between grain yield and plant height, number of heads per hill, and straw yield.

Since there were significant differences between barley genotypes in a number of growth and yield characteristics when they were grown with river water (in a non-saline environment), it should be possible, utilizing this genetic material, to develop improved barley cultivars for irrigation with river water on the Safford Agricultural Center and also, possibly, for similar semiarid environments throughout the world, using plant breeding techniques.