Barley is an important crop in many of the irrigated areas of the Western States. The soils in a number of these areas are saline or subject to salinization, and it is generally recognized that the salt tolerance of barley permits it to be grown on soils where other crops would fail. There are many reports of the high salt tolerance of barley (3, 4, 5), but there are few quantitative data on the response of different varieties to prescribed levels of salinization maintained under standardized conditions. The following studies were initiated to obtain such information.

EXPERIMENTAL DESIGN

The first experiments with barley were carried out on 14 X 14 feet field plots set up by a special procedure (1, 9). The seeds were planted in nonsaline soil that was not salinized until the plants had an average of four to five leaves. The irrigation water applied thereafter contained 3,000, 6,000 and 9,000 ppm of added salts for three of the treatments with the fourth being the unsalinized control. At the end of the growing season, there was little difference in the yield of grain within each of eight varieties as a result of using these saline irrigation waters.

Because of the nature of the first year's results, concentrations of the saline irrigation waters applied to plots in a second study were increased to 8,000, 12,000 and 16,000 ppm of added salts. Sixteen varieties were tested, and it was observed that increased salinization significantly decreased height of straw but did not decrease yield of grain appreciably. It thus appeared desirable to use water of even higher salinity, to vary the time in the growth cycle of the plant when salinization was effected, and to compare simultaneously the responses of wheat and barley varieties.

Four varieties of barley and two varieties of wheat were planted in 14 X 14 feet field plots on the Laboratory grounds during December 1949. Two seeds were placed in each planting space. These spaces were 3 inches apart in rows at 6-inch intervals. A Latin square design was used in the plot so that there were 36 subplots, each four rows wide and eight planting spaces long, each variety being replicated six times. It was possible, therefore, to determine the standard errors for each variety mean within each plot as well as the pooled standard error for each treatment mean. Since treatments per se were not replicated on different plots, comparisons between any two treatments were measured by use of the two respective standard errors. Significant differences between plots could be attributed to either (a) treatment differences or (b) soil heterogeneity. Pretreatment of the experimental area by commingling the soil with a bulldozer largely eliminated soil heterogeneity. Also, several thousand soil samples were taken from the plots during the course of the experiment in order to obtain a detailed picture of the status of the soil in each plot brought about by treatment. On the basis of the foregoing, as well as evidence obtained from previous replicated experiments, the authors are confident that a significant difference observed between two given plots is attributable to treatment.

Salt Tolerance of Barley and Wheat in Soil Plots Receiving Several Salinization Regimes

A. D. Ayers, J. W. Brown, and C. H. Wadleigh

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- Hank
- Chevron
- Atlas
- California Mariout
- Lemhi (wheat)
- Ramona 44 (wheat)

Salt salinity levels were established and maintained by flooding the plots with specifically salinized irrigation waters. Equal weights of NaCl and CaCl2 were added to the normal irrigation water (containing 400 ppm total dissolved solids) so that it contained 5,000, 10,000 and 20,000 ppm of added salt. All irrigation waters were fortified with 32 ppm of K and 25 ppm of N added as potassium and calcium nitrate. The soil was fertilized with 18% superphosphate at the rate of 1,000 pounds per acre just before planting.

The growth cycle was divided into three stages: early, intermediate, and late. The first period embraced the time from seed planting until there were four leaves on the majority of the plants. The second period was from the 4-leaf to the early boot stage, and third or late period was from early boot stage to maturity.

The concentrations of the irrigation waters applied to the plots during each of the three growth periods are given in Table 1. Throughout the first stage of growth, the soil moisture was kept near field capacity by frequent irrigations. During the later periods, irrigations were less frequent and all plots were usually irrigated with 5 inches of water when the soil moisture tension at the 8-inch depth in the control plot reached about one atmosphere.

On harvesting each variety within a subplot at maturity, stems were cut one inch above the ground, and the heads counted and weighed separately from the straw. Average height of straw in each subplot was also obtained. On threshing, all the heads of one variety in each plot were composited.

OBSERVATIONS ON THE EFFECT OF SALINITY ON GERMINATION AND SEEDLING STAGE

Inasmuch as the plots were irrigated within a few hours after the seed was planted, and were kept at a low soil moisture tension by additional irrigations, any effect on germination was attributable to salinity rather than to soil moisture tension. When the irrigation water contained 5,000 ppm of added salts, emergence of the seedlings was delayed as much as 2 to 3 days. When 10,000 ppm salts were added to the water, there was an additional delay of 1 to 2 days. The increased salinity of the irrigation water had little effect on stand of plants, since the stand exceeded 98% in all plots.

A measure of the total soil moisture stress (osmotic pressure of soil solution plus moisture tension) occurring in the soil during this germination period was obtained.