Interrelations of Moisture, Plant Population, and Fertility on the Production of Red Triumph Potatoes in Western Nebraska

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It is well known that the yields of irrigated crops may be influenced markedly by the level of soil fertility, by the irrigation practices followed, by the plant population per unit area, and by a number of other factors. Furthermore, it appears evident that there is no single optimum for any one factor that will hold regardless of the status of the other factors. However, much of the information available on the effect of the factors of crop production has been obtained by a study of the individual factors. When such information has been used for recommending a practice such as the use of commercial fertilizers, it has frequently been necessary to make some estimate of the interaction of some other factors with soil fertility level even though those interactions had not been evaluated quantitatively.

Werner (7) has summarized the results obtained in Nebraska on the factors affecting the production of potatoes. Results obtained on the rotation plots at the Scotts Bluff Field Station in western Nebraska emphasize the value of alfalfa in the rotation for the production of potatoes (2, 3). Field experiments have been conducted in western Nebraska to determine the value of commercial fertilizers for potato production (5, 6). It seems evident from the latter experiments that the results have been influenced by the irrigation practice followed and by the plant population as well as by the fertility level of the soil, although the interactions of those factors were not evaluated. Therefore, it seems desirable to obtain information on the interactions of moisture level, plant population, and soil fertility level on the production of irrigated potatoes in western Nebraska. Such interactions have been studied effectively with other crops in a factorial-design experiment (1, 4).

An experiment was initiated at the Scotts Bluff Field Station, Mitchell, Neb., in 1946 on Tripp very fine sandy loam to study the interactions of moisture level, plant population, and fertility level upon the yield and quality of potatoes. The experiment was conducted on land that had grown potatoes in 1945 and had grown alfalfa for 3 years prior to 1945. In this initial experiment, the main objective was to obtain information regarding satisfactory moisture levels and plant populations to be used later in more comprehensive experiments. The results obtained indicated that both moisture level and plant population have a marked influence upon the yield of potatoes on Tripp very fine sandy loam. However, it was apparent that the high-moisture level used was inadequate for obtaining maximum yields.

In 1947 a more comprehensive experiment was conducted. It is the purpose of this paper to present the results obtained in 1947.

EXPERIMENTAL PLAN AND PROCEDURE

It is common practice in western Nebraska to plant potatoes about June 15 to 20 following either alfalfa or sweet clover. In the 1947 experiment potatoes followed a heavy crop of alfalfa which was plowed under just prior to planting on June 17 and 18. The experiment consisted of three moisture levels, three plant populations, and five fertility levels replicated four times. The treatments were as follows:

1. Moisture level. All plots were given an initial irrigation when the plants were about 6 inches high. Following this irrigation schedule was:
   - **M<sub>i</sub>** Irrigated to keep the soil wet. This was done for the first 2 weeks by irrigating when the tension at a 6-inch depth in the row reached 100 mm Hg, then when the tension reached 200 mm Hg. All high-moisture level plots were irrigated 16 times.
   - **M<sub>s</sub>** Irrigated to represent common farm practice. Irrigated when the soil moisture tension reached 150 mm Hg at a 6-inch depth in the row. All medium-moisture level plots were irrigated seven times.
   - **M<sub>a</sub>** Irrigated when the resistance shown by grain was 100,000 ohms, at a depth of 6 inches in the row. The low moisture level plots were irrigated 14 times.

2. Plant population. There was a constant spacing of 12 inches within the row. The row spacings were as follows:
   - **S<sub>i</sub>** 36 inches, 14,520 plants per acre.
   - **S<sub>a</sub>** 30 inches, 17,424 plants per acre.
   - **S<sub>s</sub>** 24 inches, 21,780 plants per acre.

3. Fertility level. A high level of fertility could be expected following the plowing of a heavy crop of alfalfa. Fertilizer and manure treatments were made as follows:
   - **F<sub>i</sub>** None.
   - **F<sub>a</sub>** Manure, 15 tons per acre applied before planting.
   - **F<sub>s</sub>** 60 pounds N per acre applied as ammonium nitrate at planting time.
   - **F<sub>a</sub>** 120 pounds N per acre applied as ammonium nitrate at planting time.
   - **F<sub>s</sub>** 120 pounds N plus 200 pounds P<sub>2</sub>O<sub>5</sub> per acre as ammonium nitrate and triple superphosphate (28% P<sub>2</sub>O<sub>5</sub>) at planting time.

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