Onion Fertility Evaluation Under Different Levels of Salt Stress, Safford Agricultural Center 1986

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SUMMARY

Yield data were taken with a long-day onion variety, using different levels of nitrogen, phosphorous and potassium and at two different levels of soluble salts in the soil. Yields of the plots with additional fertilizer applied did not vary statistically from the check plot, which had 79 lbs/ac of nitrogen and 66 lbs/ac of P_2O_5. A correlation was found, however, between the electrical conductivity of a saturated paste extract from the soil and the yield of onions. A loss of 205 sacks (50 lbs/sack) of onions per acre are lost for each unit increase in soil conductivity.

INTRODUCTION

Onions were commercially grown in Graham county in 1986, and it was deemed important to gather data on the fertility needs of the crop under different levels of salt stress.

MATERIALS AND METHODS

Inca, a long-day onion, which was grown by the local farmers as a spring planted onion, was selected for this study. The plots were 10 feet long with 4 lines of onions being planted on each 40 inch bed. Different soil amending materials were used to prevent crusting to establish a stand; after emergence, the stand was thinned to approximately 2 inches between plants. It was assumed that the amending materials, which were applied to the surface of the beds and not incorporated, did not affect yields.

Two areas were selected for the study: 1) watered with well water for the past 6 years; and 2) watered with city water over the same period of time. The first set of plots were watered with well water throughout this study. The second set of plots were watered with river water when it was available and with well water when river water was not available. The soil test data and other pertinent data concerning the experiment are reported below:

SOIL TYPE: Pima sandy clay loam

PREVIOUS CROP: Grapes

TILLAGE: Disced, double ripped, disced, rototilled, land-planed, bedded, rolled, mulched, and shaped

EXPERIMENTAL DESIGN: Randomized complete block design with 6 replications

PLANTED: 21 March 1986, watered up

HERBICIDE: None

SOIL TEST:

	Fresh water	Well water
pH	8.3	8.4
Electrical conductivity	3.2	4.6
Sodium (meq/l)	26.9	34.8
Calcium + Magnesium (meq/l)	5.5	6.0
Sodium Adsorption Ratio	16.2	20.1
Exchangeable Sodium Percent	18.5	22.1
Nitrate nitrogen (ppm)	5.0	24.0
Phosphorous (ppm)	3.0	3.0
Potassium (ppm)	412	541
% Organic matter	1.27	1.10

FERTILIZER: Applied uniformly to all plots: 100 lbs/ac urea and 330 lbs/ac 10-20-0, preplant; other fertilizer treatments were applied in the furrow and watered into the beds on May 30th; urea, 11-53-0 and KCl were the sources of nutrients

IRRIGATION: Approximately weekly for 2 April to 22 August

INSECTICIDES: None

HARVEST: 2 September

SORTED AND GRADED: 12 September

RESULTS AND DISCUSSION

Table 1. Yield (50 pound sacks per acre) and Percent Size Fractions by Fertility Treatment on "Fresh water" plots.

Treatment	% Jumbo	% Large	% Medium	% Small	Total Yield	% of Check
$N\text{-}P_2O_5\text{-}K_2O$						
50-0-0	3.3 a*	76.4 a	18.4 b	1.9 a	1062 a	108
10-50-0	6.5 a	76.4 a	15.3 b	1.9 a	1008 a	103
60-50-75	5.6 a	78.1 a	14.8 b	1.4 a	998 a	102
0-0-75	4.4 a	76.1 a	17.7 b	1.7 a	990 a	101
Check	0.9 a	66.8 a	29.1 a	3.3 a	981 a	100
100-0-0	4.2 a	79.0 a	14.8 b	1.9 a	969 a	99
110-50-150	7.8 a	76.7 a	14.1 b	1.3 a	964 a	98
0-0-150	4.9 a	74.0 a	18.6 b	2.4 a	951 a	97

** Values with the same letter, within columns, are not significantly different at the 5% level using the Student-Newman- Keul's method.*

The yields in Table 1 are very good for all treatments and no significant differences were seen between treatments. When higher amounts of nutrients (>100 lbs/ac) were added, the yields seemed to decrease slightly. This indicates that the adverse affect of increasing the salt content of the soil was probably greater than the beneficial effect of the added nutrients.

Table 2. Yield (50 pound sacks per acre) and Percent Size Fractions by Fertility Treatment on "Well Water" Plots.

Treatment	% Jumbo	% Large	% Medium	% Small	Total Yield	% of Check
$N\text{-}P_2O_5\text{-}K_2O$						
0-0-75	3.7 a*	62.3 a	29.7 b	4.4 a	771 a	120
110-50-150	0.0 a	44.0 b	48.5 a	7.5 a	704 ab	109
100-0-0	2.0 a	54.4 ab	36.2 ab	3.8 a	669 ab	104
Check	2.0 a	51.4 ab	40.2 ab	6.4 a	644 ab	100
10-50-0	2.8 a	53.4 ab	39.8 ab	7.5 a	614 b	95
0-0-150	1.3 a	51.3 ab	42.4 ab	5.0 a	612 b	95
60-50-75	0.1 a	45.5 b	47.7 a	6.7 a	588 b	91
50-0-0	0.0 a	54.4 ab	39.2 ab	6.4 a	569 b	88

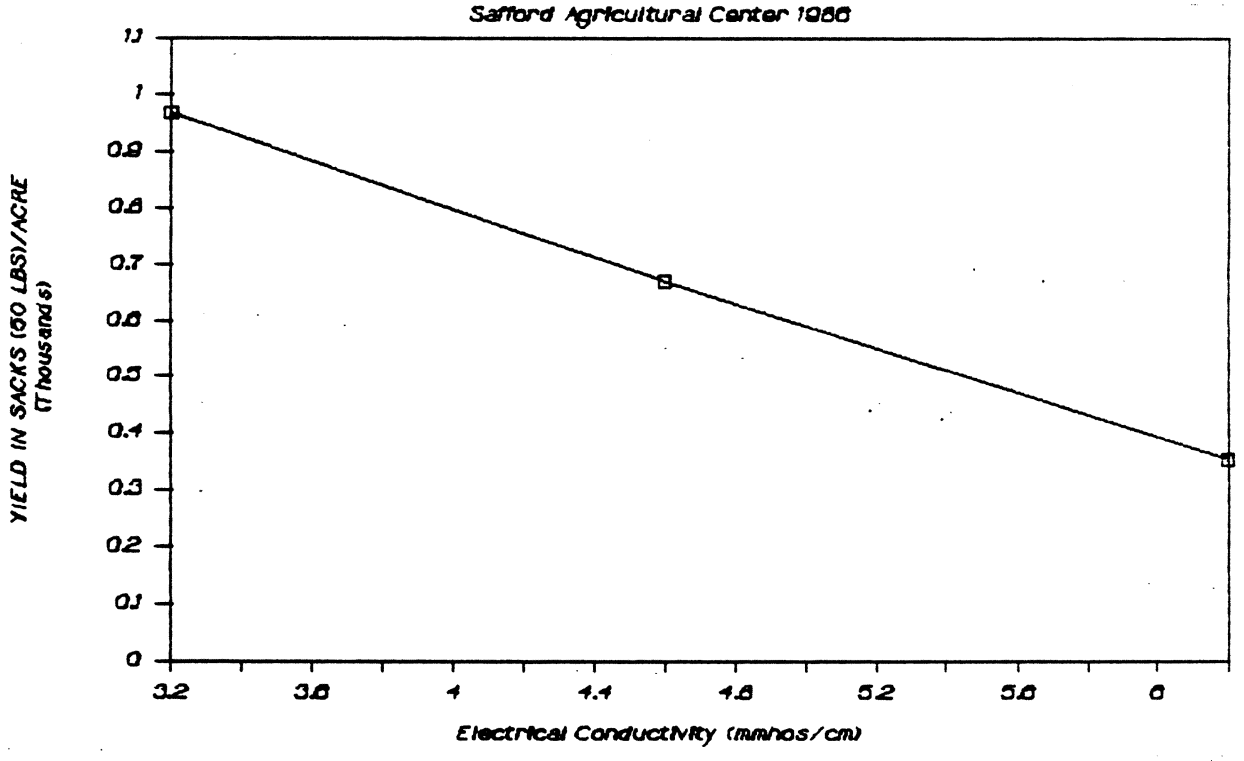
** Values with the same letter, within columns, are not significantly different at the 5% level using the Student-Newman- Keul's method.*

Onion yields in the well-watered plots (first series) were substantially lower than those in the fresh water plots (second series). Some statistically significant differences were seen, even though none of the treatments produced yields significantly different from the check plot. Onion yields are suppressed by the soluble salts in the soil profile as indicated by Maas (1) and in the Western Fertilizer Handbook (2), so one would suspect that lower fertility would be needed to produce the maximum achievable yield. On the contrary, the higher quantities of nutrients out-yielded the lower quantities (excepting potassium).

To confound the issue even more, the well water plots contained more nitrate nitrogen (24ppm nitrate is equivalent to about 11 pounds of nitrogen per acre furrow slice) than the fresh water plots and a small amount of nitrogen (about 16 pounds of nitrogen per acre over the irrigating season) was contained in the well water. These additional sources of nitrogen should have suppressed the need for higher quantities of nitrogen, but did not. These results might suggest that salt-stressed plants require more nutrients to achieve their potential. Or, at least, that salt stress and fertility requirements for onions are not independent variables.

To look further at the effect of soluble salts in the soil on onion yields, total yields of the 100-0-0 treatment were plotted against electrical conductivity for onions grown in both fresh and well water plots and an adjacent plot which had an electrical conductivity of 6.2 mmhos/cm. This information is shown in Figure 1.

Figure 1. Onion Yields in sacks (50lb) per acre as a Function of Electrical Conductivity of a Saturated Paste Extract.



The relationship shown here corresponds with that reported by Maas (1), namely, that a straight line relationship exists between yield and soil salinity. Under conditions in the Safford area, with this variety of onions, it means a loss of 205 sacks of onions per acre for each unit increase in electrical conductivity.

From Table 2-5 in the Western Fertilizer Handbook (2), no reduction in yield of onions should be seen below an electrical conductivity of 1.2 and that reductions of 10%, 25%, 50% and 100% would be observed at conductivities of 1.8, 2.8, 4.3 and 7.5 respectively. Determining what the electrical conductivity of a soil is before the crop is planted cannot be overemphasized.

REFERENCES

1. E.V. Maas. 1986. Salt Tolerance of Plants. Applied Agricultural Research 1:1 pp12-26.

2. Western Fertilizer Handbook, Sixth Edition. 1980. The Interstate Printers & Publishers, Inc.