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Introduction

Onion seed production in the United States on 2,793 and 2,892 acres for the years 1970 and 1971, respectively, produced about 1,112,000 and 1,033,000 pounds per year (1). About 40 percent of this seed is grown in southwestern Idaho.

Because climate, soil variations and available nutrients differ greatly among soils, areas and states, nutritional studies in onion seed production in southwestern Idaho are needed. Growers need information to predict and use the correct kind and rate of plant nutrients for efficient onion seed production and for improved quality.

The objectives of this study were to determine the kind and rate of fertilizers needed to produce onion seed and to obtain soil and plant analysis data for use in predicting need of nutrients in onion seed production.

Literature Review

Some research in southwestern Idaho has shown no beneficial effects from application of nitrogen, phosphorus and potassium in commercial onion bulb production (2). Research from other areas indicated that the onion root system is comparatively limited, the feeding zone is rather restricted and nitrogen-phosphorus fertilizers are needed for commercial bulb production (4, 5 and 6). Some evidence has shown an increase in the number of plants producing seed stalks after applying phosphorus fertilizer in commercial bulb production fields (5). For maximum yield of transplanted bulbs, micronutrients are probably not needed (6). One investigator stated that onion growers believed that excessive nitrogen resulted in bulbs with poor storage quality by preventing proper ripening. These growers, therefore, have refrained from heavy nitrogen applications on onion bulbs grown for seed production (3).

Procedure

Experiments on nutritional needs of onions for seed production were conducted during 1971 and 1972 at the University of Idaho Research and Extension Center at Parma in Canyon County, Idaho.

The plots were on a Greenleaf silt loam soil having a laminated layer of silt at the 14 to 18 inch soil depth which restricts root penetration but allows slow water penetration. The preceding crop was barley in the crop rotation.

Soil was bedded before fertilization and rebedded after fertilization and before seeding.

Fertilizer treatments consisted of four nitrogen rates — 0, 80, 160 and 320 pounds per acre with and without 160 pounds of P_2O_5 and K_2O per acre. Micronutrients were zinc, manganese, iron, copper and boron. Some of these were applied alone and in various combinations.

This study involved a 2-year period where onions were seeded in 1971 for seed production in 1972. All fertilizer treatments were applied the year before seeding and in the spring of the second year to one-half of the plots. This would compare nutrient effects of 1 year against a 2-year or annual application. Rows were 18-inches wide on beds and 24-inches between beds. Crookham's Seed Company onion inbred M611C variety was used.

All fertilizer was banded 4 to 5 inches deep and 4 inches to the side of each row of four row plots 20 to 40 feet in length.

Nitrogen was applied as ammonium sulfate; P_2O_5 as treble super phosphate; K_2O as potassium chloride; zinc, manganese and copper as sulfate salts; iron as a chelate (Sequestrine 138); and boron as solubor.

Each year soil samples were taken before fertilization and again after onion harvest. The soil samples were analyzed for nutrients by the following extraction methods:

Nitrate-nitrogen saturated calcium sulfate extractant

Phosphorus and potassium — sodium bicarbonate, 1 to 20 extractant

Micronutrients — zinc, iron, manganese and copper, DTPA extractant

Boron, hot water extractant

The most recently matured leaves were collected —usually the third leaf from center of plant. Onion leaves were collected at two periods, late September 1971 and early bloom 1972.

Methods for analysis were:

Nitrate-nitrogen and phosphate-phosphorus, soluble in a 2 percent acetic acid solution; and for total nitrogen, phosphorus, potassium, zinc, manganese, iron, copper and boron.

Seed heads were collected from 10 feet of the two center rows, dried in green house and threshed for total yield and germination measurements. Germination tests were made by Crookham's Seed Co., Caldwell, Idaho.

Results and Discussion

Observation showed no great contrast in top growth or color as affected by treatments.

Bee activity on the onion seed umbels appeared very good and was not affected by fertilizer treatments.

Root growth of onions extended down to the 18 inch restrictive soil layer and indicated very little pink root or other diseases.

The application of nitrogen, phosphorus, zinc, manganese, iron, copper and boron fertilizers showed no beneficial effect on onion seed production. The nutrient levels already in the soil aside from the treatments were sufficient to produce top yields of over 700 pounds seed per acre with percentage germination of 82 to 85 percent.

Nitrate-nitrogen in the top 2 feet of soil before fertilization was very high — 42 ppm. Levels of other nutrients in the 0 to 8 inches of soil were: phosphorus 13.3 ppm, potassium 257 ppm, zinc 2.77 ppm, manganese 18.73 ppm, 8.33 ppm, copper 1.63 ppm and boron 0.37 ppm.

Nitrate-nitrogen in soil in the spring of the second year, before 1972 nitrogen fertilization and after harvest of seed from both the 1971 and the 1971 and 1972 fertilized plots, was very high where nitrogen fertilizer had been applied (Table 1.) Since soil samples were taken from the center of beds where nitrate-nitrogen would accumulate from banded fertilizer and furrow irrigation, the concentrations do not measure the total amount present on a pound per acre basis.

This finding is illustrated in Fig. 1, which shows nitrate-nitrogen in the soil down to the 3-foot soil depth in samples taken from the edges and center of 42 inch beds. These results show high nitrate accumulations from applied nitrogen fertilizer and indicate points of concentrations as affected by banding and irrigation. Concentrations of nitrate-nitrogen were higher at all depths in samples taken from the center of beds as compared to samples taken from the edges of beds. Occurrence of these concentrations illustrate the problem of obtaining a representative soil sample for analysis.

Nitrogen fertilizer increased total percent nitrogen in seed onion leaves taken Sept. 22, 1971 — the first year of growth. The control was 3.58. From 320 pounds nitrogen per acre it was 3.83 percent. Manganese concentration in leaves was increased from 33.8 ppm on the control to 81.8 ppm from 320 pounds nitrogen per acre. The concentration of other nutrients — phosphate-phosphorus, percent total potassium and total ppm of zinc, iron, copper and boron —

were not significantly affected by nitrogen fertilizer rates.

Results from analysis of onion leaves taken June 15, 1972, the second year of growth when seed umbels were at early flowering, were quite similar to those shown in 1971. Total percent nitrogen increased slightly with increased nitrogen rates. Manganese increased from 43 ppm on the control up to 204 ppm from the first year 320 pound nitrogen rate and up to 231 ppm where 320 pounds nitrogen per acre had been applied both years. Zinc increased from 29.0 on control up to 35.6 ppm on the high nitrogen rate plot.

Concentrations of phosphate-phosphorus and total percent potassium in onion leaves at both sampling dates were increased with application of phosphorus and potassium fertilizers. Application of zinc, manganese, iron, copper and boron fertilizers had no great effect on concentrations in plant when composed with the control. The high levels shown on the control plots may account for this situation.

Since no fertilizer applied showed any benefit in onion seed production, the levels of nutrients shown in plant leaves of the control plots should be sufficient to produce onion seed yields over 700 pounds per acre. This is top yield obtained at this location.

Table 2 shows adequate levels of plant nutrients in onion leaves needed, at the two sampling dates, to produce onion seed under conditions of these experiments.

Table 1. Nitrate-nitrogen in the soil after fertilization in the onion seed experiment.

Time of sampling and treatments	Soil depth in inches (ppm, Nitrate-Nitrogen) 0-12	12-24	24-36
April 10, 72[1]			
lb. N. per acre			
0	10.3	13.6	12.5
80	10.3	14.4	21.1
160	27.8	51.5	21.1
320	72.7	83.2	30.9
Aug. 15, 72[2]			
lb. N. per acre			
0	3.6	0.0	0.0
80	7.6	1.3	9.6
160	14.0	3.8	59.3
320	36.4	23.4	46.6
Aug. 15, 72[3]			
lb. N. per acre			
0	13.6	0.6	4.0
80	51.5	41.6	26.6
160	118.6	15.2	49.8
320	247.1	128.5	56.8

[1] Soil samples taken before second year application of fertilizer.
[2] Soil samples taken after seed harvest from 1971 fertilization.
[3] Soil samples taken after seed harvest from 1971 and 1972 fertilization.
All samples taken from center of onion beds.

Table 2. Concentration of nutrients in seed onion leaves shown on control plots at two sampling dates.

Nutrients	Sampling Dates Sept. 22, 71	June 15, 72
Nitrogen, percent	3.58	2.30
Phosphate-Phosphorus, ppm	2042	1500
Potassium, percent	4.14	4.32
Zinc, ppm	20.30	30.00
Manganese, ppm	33.80	43.20
Iron, ppm	138.50	170.30
Copper, ppm	7.80	2.80
Boron, ppm	23.00	43.00

Summary

Application of nitrogen, phosphorus, potassium, zinc, manganese, iron, copper and boron fertilizers did not improve seed yields. Combinations of zinc and iron, in fact, may have reduced seed yield.

High amounts of nitrate-nitrogen were found in the top 2 to 3 feet of soil before fertilization and after harvest of onion seed. On this soil, the nitrate-nitrogen below the 24-inch soil depth would not be available for future crop use. A compact layer of silt at the 14 to 18 inch soil depth will restrict penetration of plant roots.

Concentrations of nitrogen, phosphorus and potassium in onion leaves were increased by the application of fertilizers containing these nutrients.

Manganese and zinc concentrations in onion leaves were increased with increased nitrogen rates.

The levels of nutrients shown in the soil and plant leaves were sufficient to maintain good yield and quality of onion seed without the addition of fertilizer.

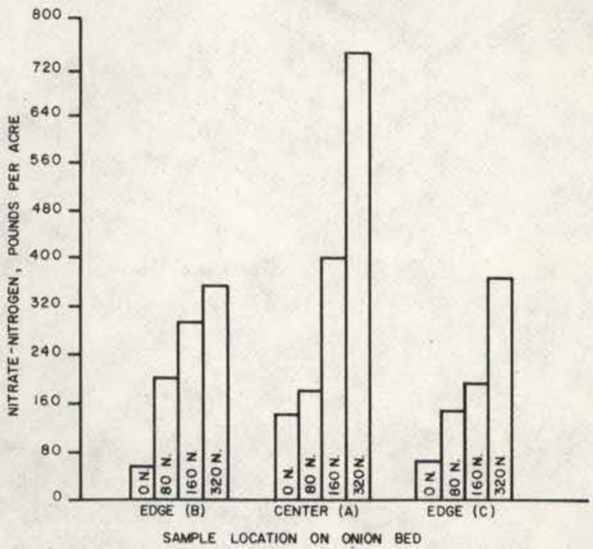

Fig. 1. Nitrate-nitrogen in 3 foot soil profile taken in spring before second year application of fertilizer, showing effects from nitrogen rates and sample location.

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