Soil Nitrate Levels for Roses

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The best production and stem length of roses occurs when the soil is kept moist and maintained at a nitrate level between 25 and 100 ppm all year. This can be done commercially by allowing the soil nitrate level to drop to 25 ppm, then adding sufficient nitrogen fertilizer to raise the nitrate level to 100 ppm, and again allowing it to drop to 25 ppm before the next application.

It is not necessary, or desirable, to change the nitrate level in the soil from summer to winter. Less fertilizer need be applied in winter to maintain the desired level because of slower growth and less loss in leaching. Less fertilizer is required in the first year to maintain the desired level than in subsequent years because of the liberation of nitrate from the decay of soil organic matter and the lower utilization of nitrate by the plant during the first year than in subsequent years.

Arrangement of benches with crocks for catching the drip to be returned to the plot. This arrangement was necessary for maintaining a uniform nutrient supply.

Many rose growers are using the results of soil tests to determine the time and amount of application of nitrogen fertilizers. It therefore is desirable to know the nitrate levels to be maintained for high production and quality.

Roses have been grown in a series of experiments since 1940 with definite concentrations of nitrogen in the soil. Budded plants were grown in a silt loam composted with 25% by volume of manure. There were nine plants in each plot with four replicate plots in each treatment. The soil was tested twice a month by extracting according to the Spurway method and determining nitrates by the phenoldisulphonic acid method. The results of the analyses are expressed as parts per million (ppm) of nitrate (NO_3) in the soil extract.

To maintain fairly constant concentrations of nitrogen in the soil, small amounts of nitrogen fertilizers (ammonium sulphate, calcium nitrate, and ammonium nitrate) were applied in solution every three to five days. The plots were water tight and all of the water that leached from the soil drained into a crock; this solution was re-applied to the soil, so no fertilizer was lost. Other fertilizers were applied to maintain the phosphorus between 3 and 10 ppm, potassium between 18 and 50 ppm, and the pH from 5.3 to 6.7 with practically no difference in the various plots.

Early Experiments

In the first experiment (Florists' Exchange, April 3, 1943; Florists' Review, February 18, 1943) roses were grown in soil with nitrate levels of approximately 2 to 50 ppm and the highest production (30-33 flowers per square foot from September 3 to April 15 with an average stem length of 17 inches) was obtained with 20-25 and 45-60 ppm of nitrate in the soil. With less than 15 ppm the rose production was significantly less.

*This project was started by Dr. E. V. Staker of the Agronomy Department in 1940. It was conducted by the author during 1941 to 1943, by Dr. Joseph E. Howland 1944 and 1945 and by the author since 1945. Soil tests were by Iva E. Piper. F. F. Horton has cared for the plants and taken the records. The project has been under the supervision of Dr. Kenneth Post.

In the second experiment (Florists' Exchange, Oct. 28, 1944; Florists' Review June 13, 1946) roses were grown with soil nitrate levels of approximately 10 to 125 ppm. Production was good with all treatments but increased with each increase in nitrate content of the soil (Table 1), the greatest production was obtained with 95 to 145 ppm. The rose production was significantly decreased from the maximum when the nitrate level dropped to 15 to 35 ppm or lower during two seasons and below 15 ppm during a third season. The average stem length was approximately the same (18 to 20 inches) with all nitrate concentrations.

50 to 500 ppm

In these two experiments the nitrate concentration was not high enough to cause plant injury and a decrease in flower production. Therefore, Briarcliff roses were grown with soil nitrate levels of 50 to 500 ppm (Table 2) during the 1945-47 seasons. In both seasons the highest production and quality were obtained when the nitrate was 50 to 100 ppm in the soil.

There was no visible injury to the plant, except slightly less growth and production, with nitrate levels of 90 to 155 and 165 to 265 ppm. The size and color of the leaves and flowers were normal. With 300 and 400 ppm of nitrate the roots of the plants were injured and a definite iron chlorosis appeared. This was followed by the development of dead areas in the leaves.

Table 1.

Effect of Soil Nitrate Concentration on Production of Better Times Roses

Nitrate Test (ppm)	Salable Flowers per Square Foot 1942-43 (10 months)	1943-44 (12 months)	1944-45 ($10\frac{1}{2}$ months)
7-15	23.7	34.3	29.5
15-35	24.4	36.4	32.8
40-65	25.4	36.9	34.3
65-95	26.1	37.4	35.8
95-145	27.1	39.1	36.8

It is not necessary to have different nitrogen concentrations in the soil at different seasons of the year. This is shown by the flower production by seasons in the first two experiments.

In the 1941-42 experiment, the production, as given in Table 3, increased with each increase of the soil nitrogen concentration in the winter as well as in the spring and fall. Plants grown with 20-60 ppm of nitrate produced more flowers than plants with less than 14 ppm.

Table 2.

Effect of Soil Nitrate Concentration on Production of Briarcliff Roses.

Nitrate Test (ppm)	Salable Flowers/Sq.Ft. 11/1/45 - 4/30/46 (6 months)	7/1/46 - 4/30/47 (10 months)	Average Stem Length (Inches) 1945-46	1946-47
50-100	10.3	29.5	22.7	21.6
90-155	8.8	25.1	23.1	18.1
165-265	8.4	25.1	21.5	17.1
270-420	6.9	23.0	18.8	16.1
375-520	5.1	17.5	18.3	13.0

*No production records from 5/1/46 - 6/30/46 because of fumigation injury.

In the 1942-45 experiment, the flower production figures (Table 4) show that in 8 of the 11 seasons the production with 40 to 145 ppm of nitrate in the soil was higher than with 7 to 15 or 15 to 35 ppm. In the falls of '42 and 43 and winters of '42 and 43 and '43 and 44, two out of the three high nitrogen (above 40 ppm) treatments were as high as or higher than the low nitrogen (below 35 ppm) treatments in flower production.

It therefore is recommended that the optimum range of 25 to 100 ppm should be maintained in all seasons. The amount of fertilizer required will, however, vary with the seasons. Less fertilizer is required to maintain the optimum levels during the winter months when the plants, because of poorer light conditions, grow less than in the other seasons.

Table 3.

Effect of Soil Nitrate Levels on Seasonal Rose Production

1941-42 Experiment

Soil Nitrate Tests (ppm)	Number of Salable Flowers Per Square Foot Sept. Oct. Nov.	Dec. Jan. Feb.	March to April 15
1-3	6.5	5.6	3.5
4-6	11.1	7.6	6.9
8-14	13.0	7.9	8.1
20-25	13.3	8.2	8.5
45-60	14.7	10.0	8.3

Amount of Nitrate Used

The quantities of nitrogen that were applied to the soil in some of the treatments are presented in Table 5. The amounts of nitrogen applied per 100 sq. ft. to maintain 15 to 35 ppm during the second and third seasons of the 1942 to 45 experiment were 1.37 and 1.24 ounces per month from No- 1 to March 1 and 1.93 ounces from March 1 to November 1. To maintain higher levels, more nitrogen fertilizer had to be applied.

Davidson (Roses Inc. Bulletin 123, February 1948) found that mature rose plants in nutrient solution culture absorbed 1.23 ounces of nitrogen per 100 square feet per month during the period from November 1 to March 1, and 2.25 ounces per month from March 1 to November 1. These data show a close correlation between the nitrogen applications in the soil experiments with the nitrogen absorption by roses grown in nutrient solution.

The amount of fertilizer necessary to supply these amounts of nitrogen can be calculated from knowing that ½ pound of nitrate of soda contains about 1.3 ounces of nitrogen and ½ pound of ammonium sulphate supplies about 1.6 ounces of nitrogen.

The amount of nitrogen fertilizer re quired during the first season was much less than during the second and third seasons. This is probably due largely to liberation of nitrogen upon breakdown of the organic matter in the new soil. In addition, the plants were smaller, (during the first season) thus requiring less nitrogen. During the winter months considerably less nitrogen was applied than during the other seasons. In the 1945-47 experiment the same general relationship existed but the nitrogen applications were less than in the previous experiment.

These data show that the amount of nitrogen fertilizer that need be applied to a new soil containing considerable organic matter during the first season is less than during subsequent seasons and that less fertilizer need be applied in winter months than in the other months to maintain the optimum soil nitrogen concentration of 25-100 ppm.

Summary

1. For optimum growth and production of roses, maintain 25-100 ppm of nitrate in the soil all year.

2. Less nitrogen fertilizer is required to maintain the optimum nitrate levels during winter as compared to other months.

2. With a newly prepared soil, less fertilizer need be applied during the first sesson than in subsequent seasons.

Table 4.

Effect of Soil Nitrate Levels on Seasonal Rose Production

Soil Nitrate Tests (ppm)	NUMBER OF SALABLE FLOWERS PER SQUARE FOOT											
	1942-43			1943-44				1944-45				
	Sept. Oct. Nov.	Dec. Jan. Feb.	Mar. Apr. May	June July Aug.	Sept. Oct. Nov.	Dec. Jan. Feb.	Mar. Apr. May	June July Aug.	Sept. Oct. Nov.	Dec. Jan. Feb.	Mar. Apr. May
7 - 15	8.2	4.9	7.2	13.4	7.6	4.6	6.3	16.2	8.2	4.9	6.2
15 - 35	8.3	4.7	7.2	14.3	8.6	4.6	7.0	17.8	9.6	4.8	6.8
40 - 65	8.4	4.8	7.3	15.4	8.6	4.6	7.2	18.1	9.7	5.3	7.4
65 - 95	8.0	5.2	7.9	15.0	9.1	4.2	7.8	18.5	10.0	5.9	7.8
95 - 145	8.5	4.5	8.7	15.6	9.5	4.8	7.8	19.8	10.6	5.3	7.9

Table 5.

Amount of Nitrogen Applied to Maintain
Definite Soil Nitrogen Concentrations

Date of Experiment	Soil Nitrate Test (ppm.)	Ounces of Nitrogen Applied / 100 sq. ft. / Month				
		First Season		Second Season		Third Season
		Nov. 1- Mar. 1	Mar. 1- Nov. 1	Nov. 1- Mar. 1	Mar. 1- Nov. 1	Nov. 1- Mar. 1
	15-35	0.12	1.08	1.37	1.93	1.24
1942-45	40-65	0.46	1.50	1.86	2.74	1.47
	95-145	1.12	2.20	2.63	3.18	2.28
1945-47	50-100	0.18	0.97	0.53	----	----

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Your editor, Kenneth Post