EFFECTS OF VARYING LEVELS OF NITROGEN AND POTASSIUM ON THE GROWTH OF PRIMULA OBCONICA

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EFFECTS OF VARYING LEVELS OF NITROGEN AND POTASSIUM ON THE GROWTH OF PRIMULA OBCONICA

By

JOHN BERNARD GARTNER

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INTRODUCTION

A search of the literature reveals very little specific information on the nutrient requirements of *Primula obconica*. In fact a similar statement may be made about many of the common flowering plants. In previous work ([illegible]) it was found that a fairly definite nitrogen-potassium ratio was necessary for the best growth of *Cineraria stellata*. Experiments with *Begonia semperflorens* have shown that high quality plants can be produced only when nutrient levels in the soil are properly controlled (5). Likewise Geraniums (7) have been shown to require a properly balanced supply of soil nutrients.

Spurway (1[illegible]) has established certain optimum nutrient ranges for the various elements but his work did not include information on specific crops. Much work is necessary before specific information may be passed on to the grower about the nutrient need of individual flowering crops. In order to obtain the information with respect to *Primula obconica* the experimental work reported in this paper was undertaken.

REVIEW OF LITERATURE

Laurie and Kiplinger (9) have stated that insufficient potassium will cause yellow margins on the foliage of *Primula obconica*, but nutrient levels were not given.

Poesch (10) has discussed the culture of *Primula obconica* and described deficiency symptoms, but he mentioned nothing pertaining to the optimum nutrient levels.

Caldwell and MacGregor (2) found an interesting nitrogen-potassium relationship on corn, with an application of potassium, not only was the content of potassium in the plant increased, but also there was an increase in the content of nitrogen.

Carolus (3) found that when the supply of all other nutrients except potassium was sufficient for normal growth, a lack of an adequate supply of this substance resulted in an extremely low concentration of potassium and usually in a high concentration of soluble nitrogen, magnesium, and calcium in the stems or petioles of vegetable crops.

Shear, Crane and Myers (12) have stated that, "at any given level of nutritional intensity a multiplicity of ratios may exist between these elements.

maximum growth and yield occur only upon the coincidence of optimum intensity and balance." They have also stated that at any level of nutritional intensity there exists a nutritional balance at which optimum growth for that intensity level will result. This means that at any given level of nutritional intensity, provided all nutrient elements are in proper balance, it is possible to obtain plants that appear normal in every respect in which all metabolic processes are probably qualitatively normal. However, maximum growth and yield result only when the proper balance of nutrient elements occurs in combination with their optimum intensity."

Janssen and Bartholomew (6) found in tomato plants a high percentage of potassium was correlated with a low percentage of nitrogen and there is an inverse relationship between the potassium and nitrogen content of the plant when there is insufficient potassium for normal growth.

Rohde (11) states that leaves of plants are light green in color after heavy applications of potassium.

PROCEDURE

Plant Materials Used:

Primula obconica growing in three-inch pots in which the soil had relatively low nutrient levels were chosen for this experiment.

Soil Used:

The soil chosen for this experiment was a Hillsdale fine sandy loam which was obtained from the college farms and was known not to have been fertilized for the last twenty years.

Greenwood peat with a sedge composition having a pH of [illegible].5 was used in this experiment.

Soil Mixture:

The soil mixture consisted of three parts sandy loam field soil, two parts Greenwood peat and one part sand. Monocalcium phosphate was added to this mixture at the rate of a 2½" pot-full to a bushel of soil.

Method of Testing Soil:

The Spurway Test Method (15) was used in making all soil tests. These tests were made bi-weekly and the nutrient levels were than adjusted and re-tested three days after adjusting to determine if adjustment was adequate. These latter tests are shown by graphs.

Method of Testing Tissue:

The petioles of the leaves were tested using the Simplex Soils Testing Kit as devised for tissue testing by Cook (4). Leaves and petioles were obtained from representative plants of each plot and the petioles of these plants were tested for nitrogen and potassium at the end of the experiment.

Chemicals Added

Ammonium sulfate was used in a liquid form at the rate of one ounce to two gallons of water and at the rate of one ounce to one gallon of water depending on the amount of adjustment needed, for the nitrate levels. Potassium sulfate was used to adjust the potassium levels at the rate of one ounce to two gallons of water or one ounce to one gallon of water depending upon the adjustment needed. Phosphorous was added originally as monocalciumphosphate at the rate of 2½" pot full to one bushel of soil and the levels were kept around 5 p.p.m. on all plots. The pH was maintained between 6.5 and 7 on all plots by adjusting with Aluminum sulfate.

Soil Nutrients:

	Field Soil	Soil Mixture
Nitrates	0	Trace
Nitrites	0	Trace
Ammonia	Trace	Trace
Phosphorous	one-half ppm.	5 ppm.
Potassium	0	Trace
Calcium	80 ppm.	100 ppm.
Iron	5 ppm.	5 ppm.
Aluminum	0	0
Magnesium	10 ppm.	10 ppm.
Manganese	Trace	Trace
Sulfates	40 ppm.	40 ppm.
Chlorides	Trace	Trace
Sodium	0	0
pH	6.8	6

Cultural Methods:

On June 15th the plants were shifted from three inch pots to five inch pots using the soil mixture described. The plants were divided into the nine plots as shown in Table 1 using ten plants per plot. The plants were then placed in a greenhouse bench on top of five inch inverted pots to insure adequate aeration. A cheese cloth shade was constructed and placed over this bench to reduce the intensity of the sun during the hot summer months. This cheese cloth shade was removed in the fall when the days became cooler. During the spring and fall while the temperatures could be controlled, the night temperature was kept at 50°

and the day temperature around 60°F. The plants were spot-watered to keep them uniformly watered.

Three different levels of nitrogen and potassium were used and will be referred to as high, medium and low. The high level ran from 40 to 50 ppm., the medium level from 25 to 35 ppm., and the low level from 10 to 15 ppm.

Levels Maintained:

Nutrient levels of various plots are as indicated in Table 1.

Table 1

High N Series

Plot I	High Nitrogen and High Potassium
Plot II	High Nitrogen and Medium Potassium
Plot III	High Nitrogen and Low Potassium

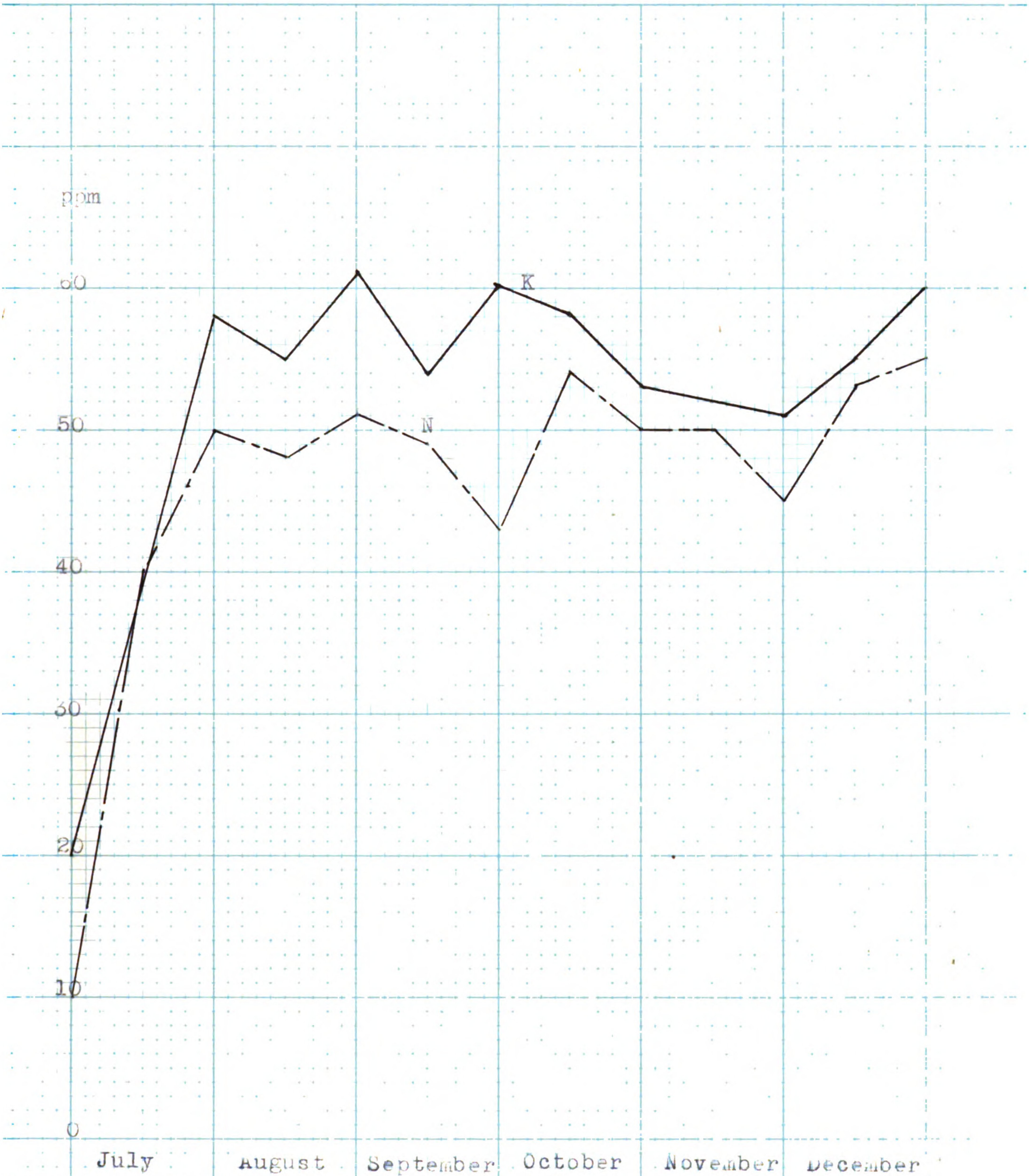
Medium N Series

Plot IV	Medium Nitrogen and High Potassium
Plot V	Medium Nitrogen and Medium Potassium
Plot VI	Medium Nitrogen and Low Potassium

Low N Series

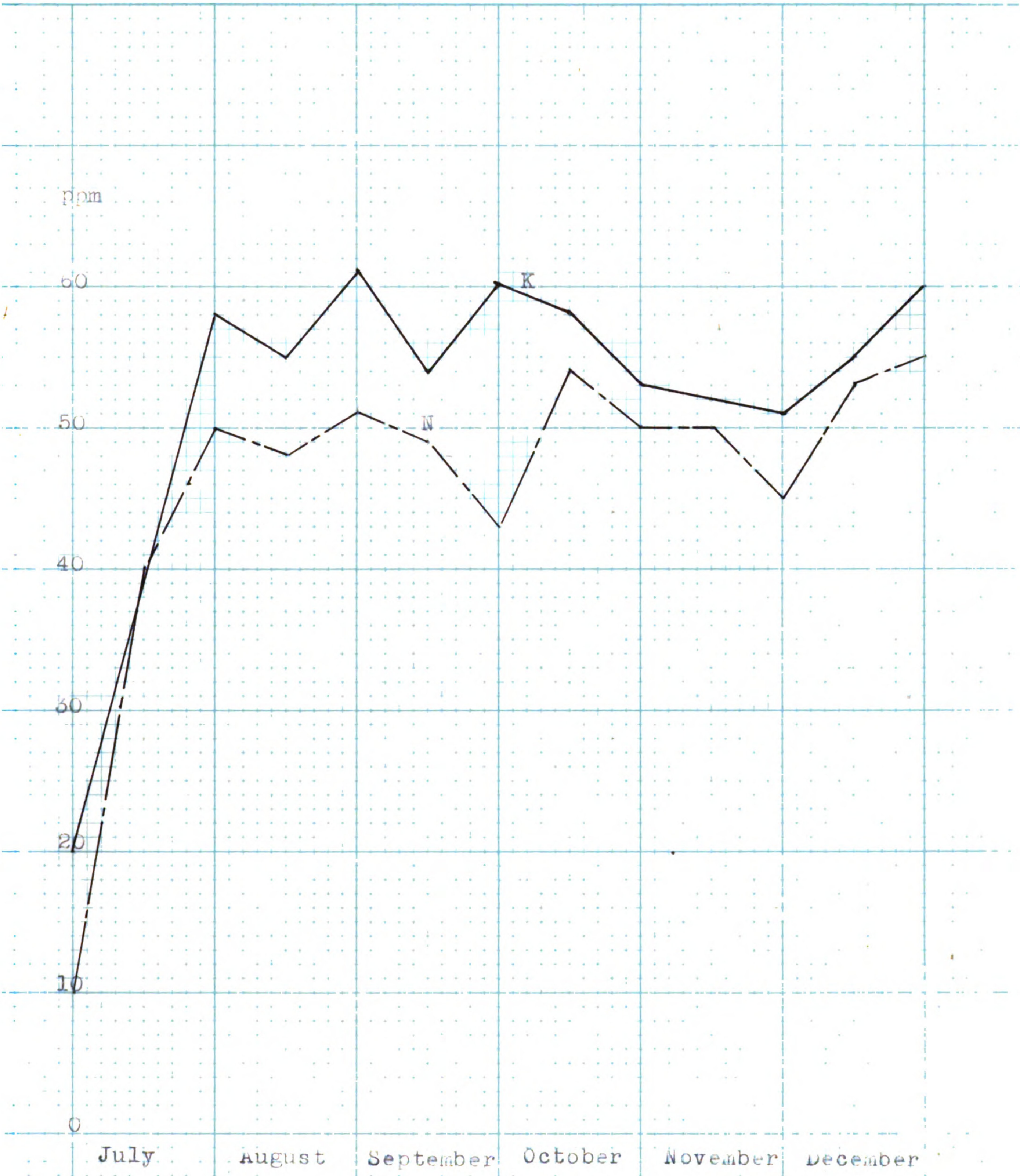
Plot VII	Low Nitrogen and High Potassium
Plot VIII	Low Nitrogen and Medium Potassium
Plot IX	Low Nitrogen and Low Potassium.

The following graphs show the levels maintained on the individual plots.



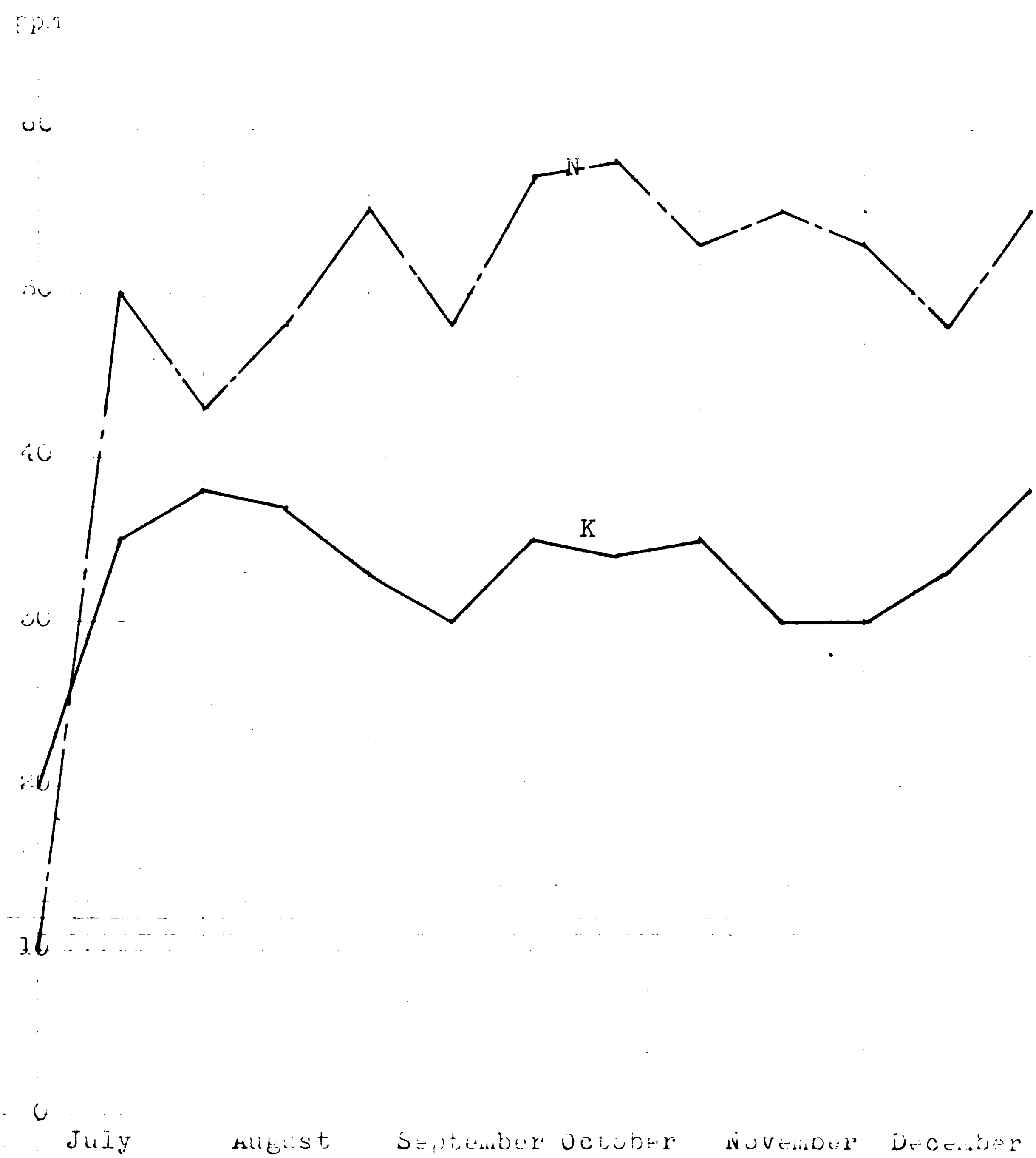
Nitrogen and Potassium levels of Plot I

Fig. 1



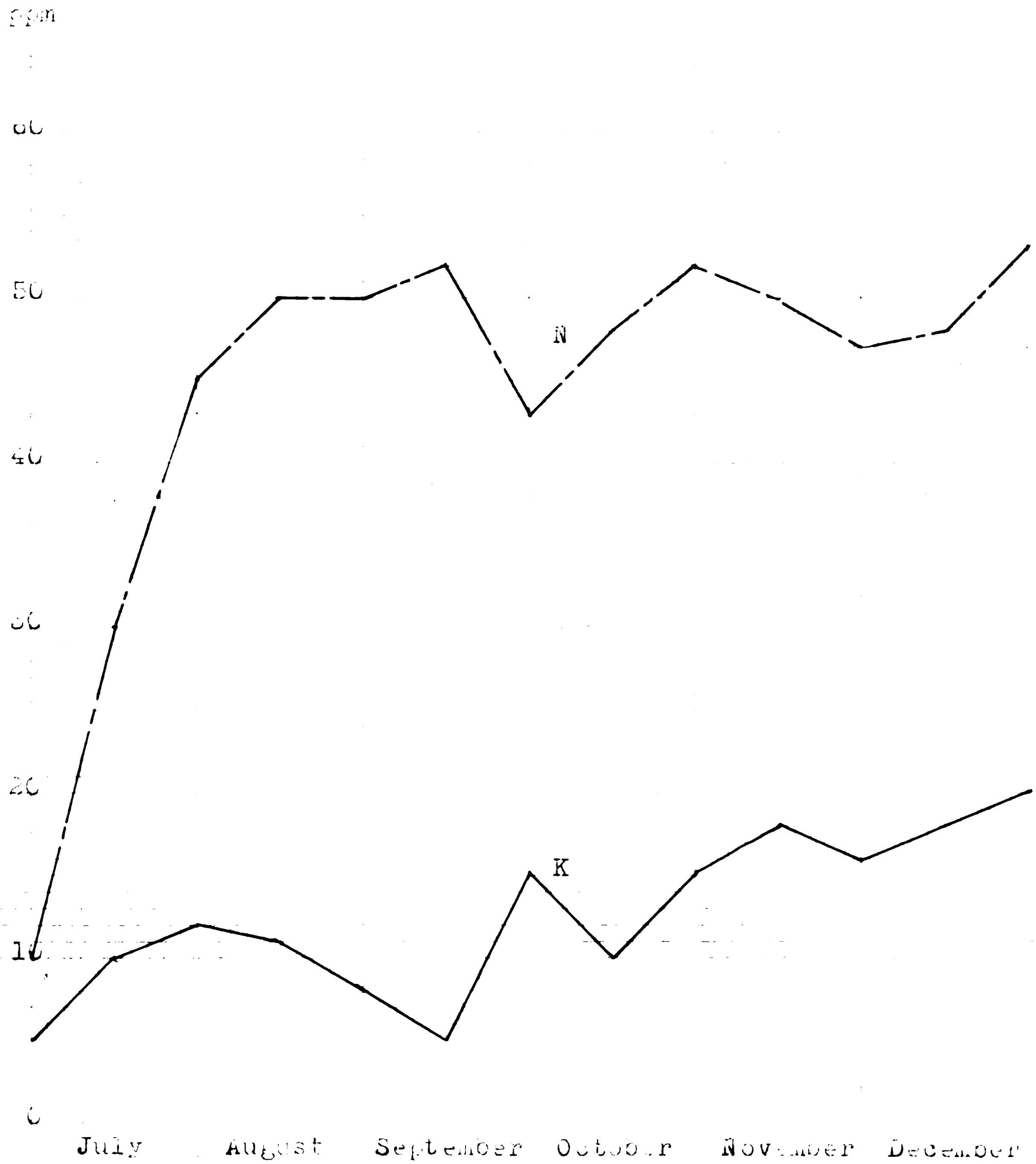
Nitrogen and Potassium levels of Plot I

Fig. 1



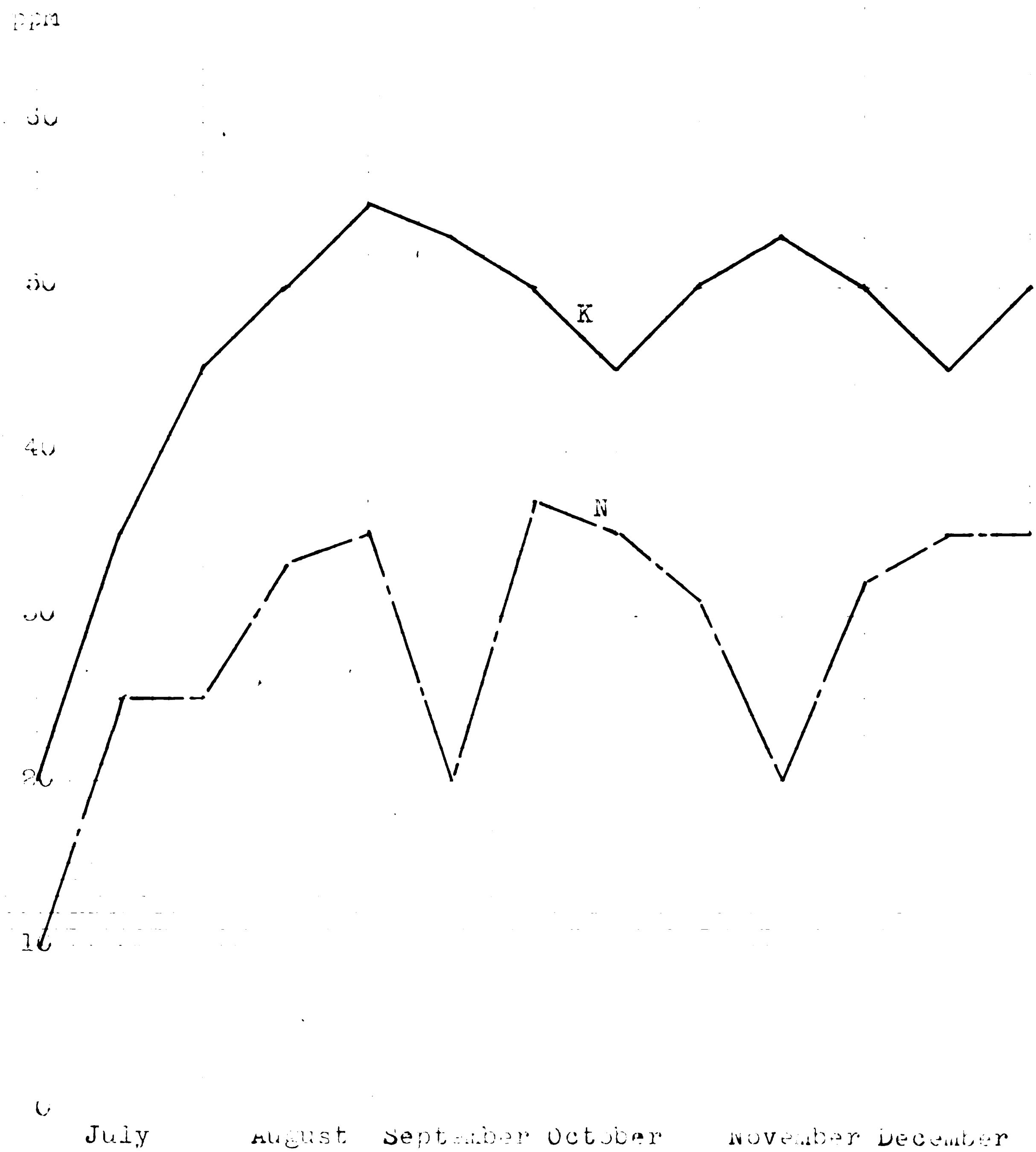
Nitrogen and Potassium levels of Plot II

Fig. 2



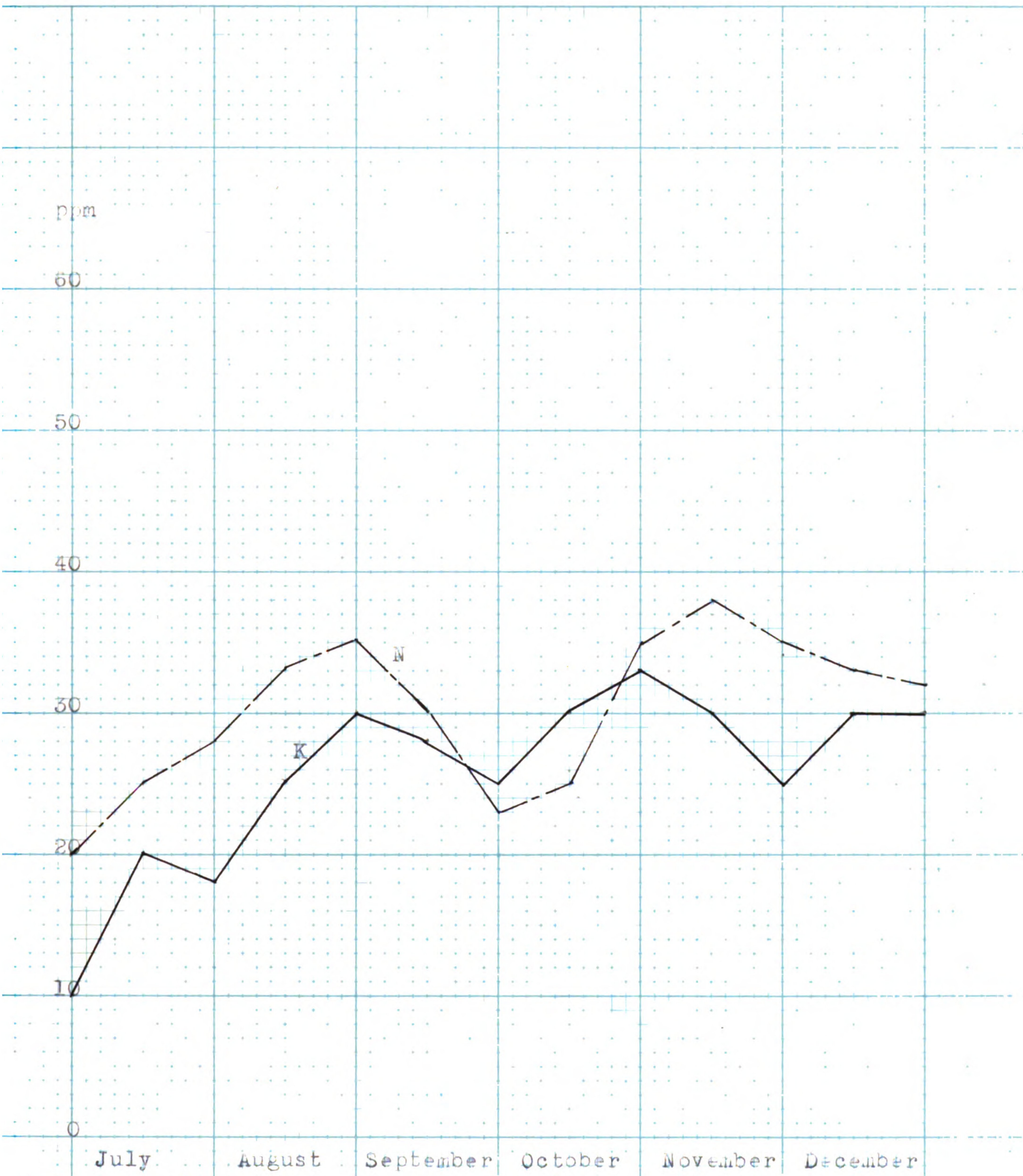
Nitrogen and Potassium levels of Plot III.

Fig. 3



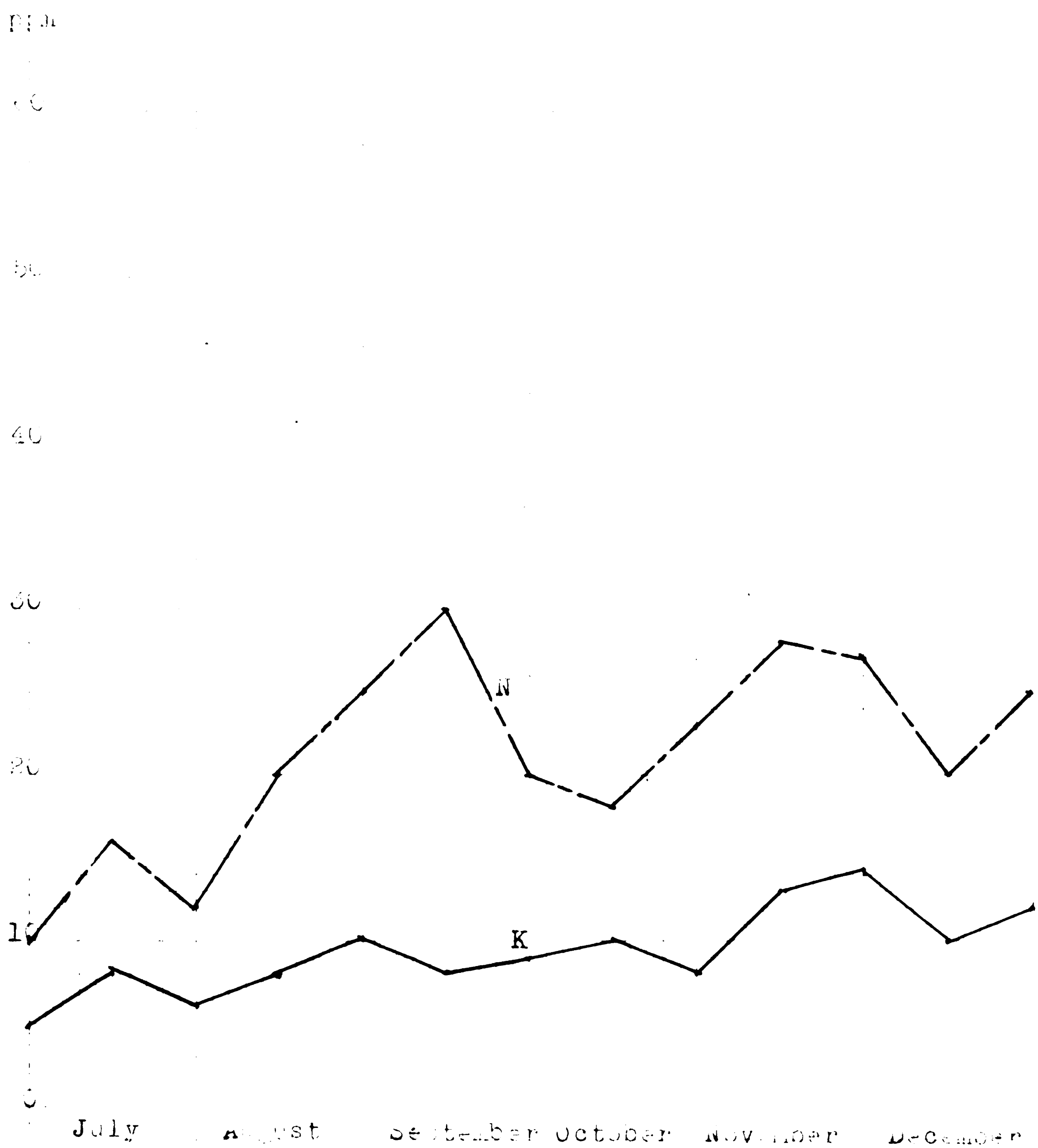
Nitrogen and Potassium levels of Plot IV.

Fig. 4



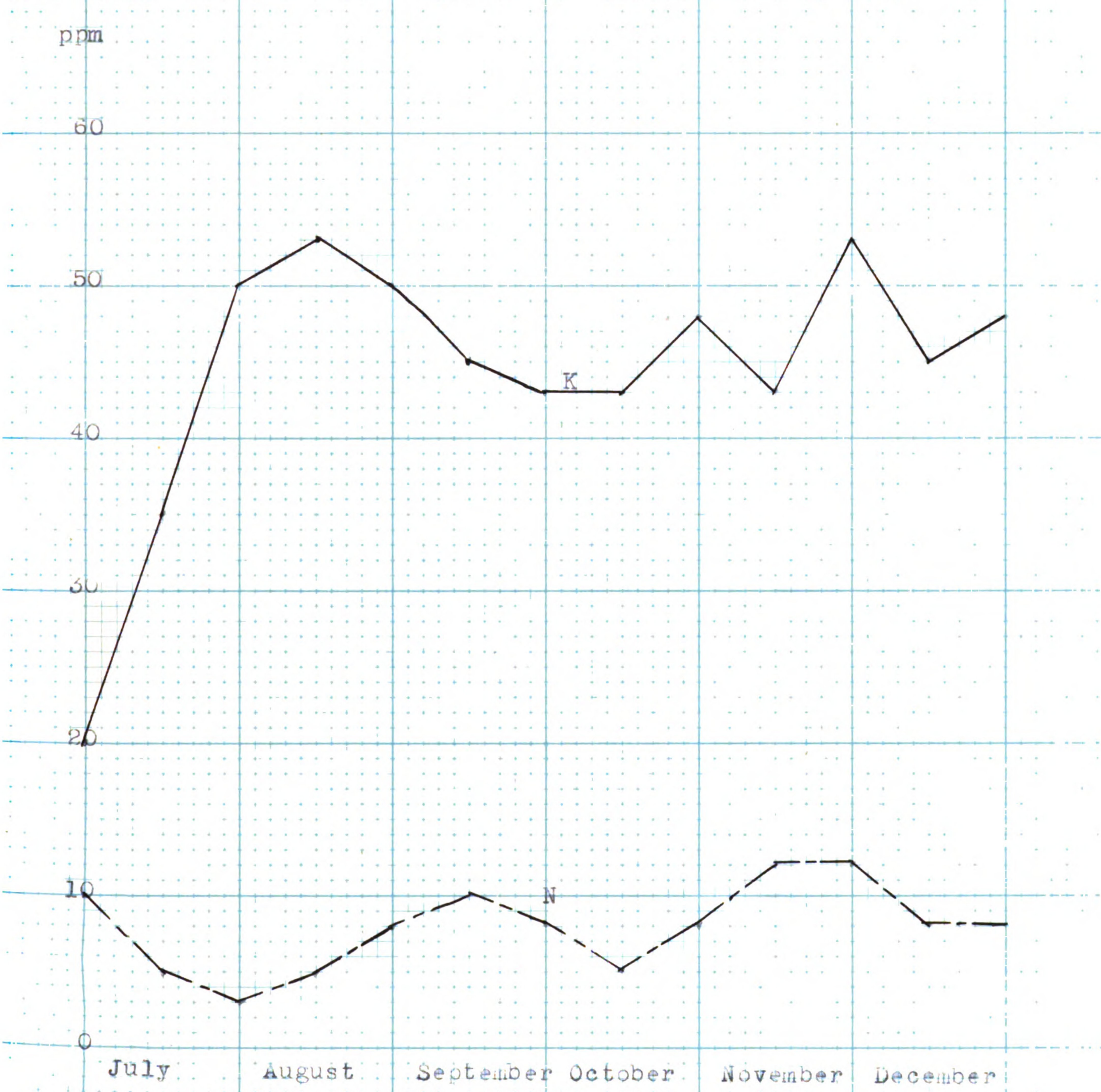
Nitrogen and Potassium levels of Plot V.

Fig. 5



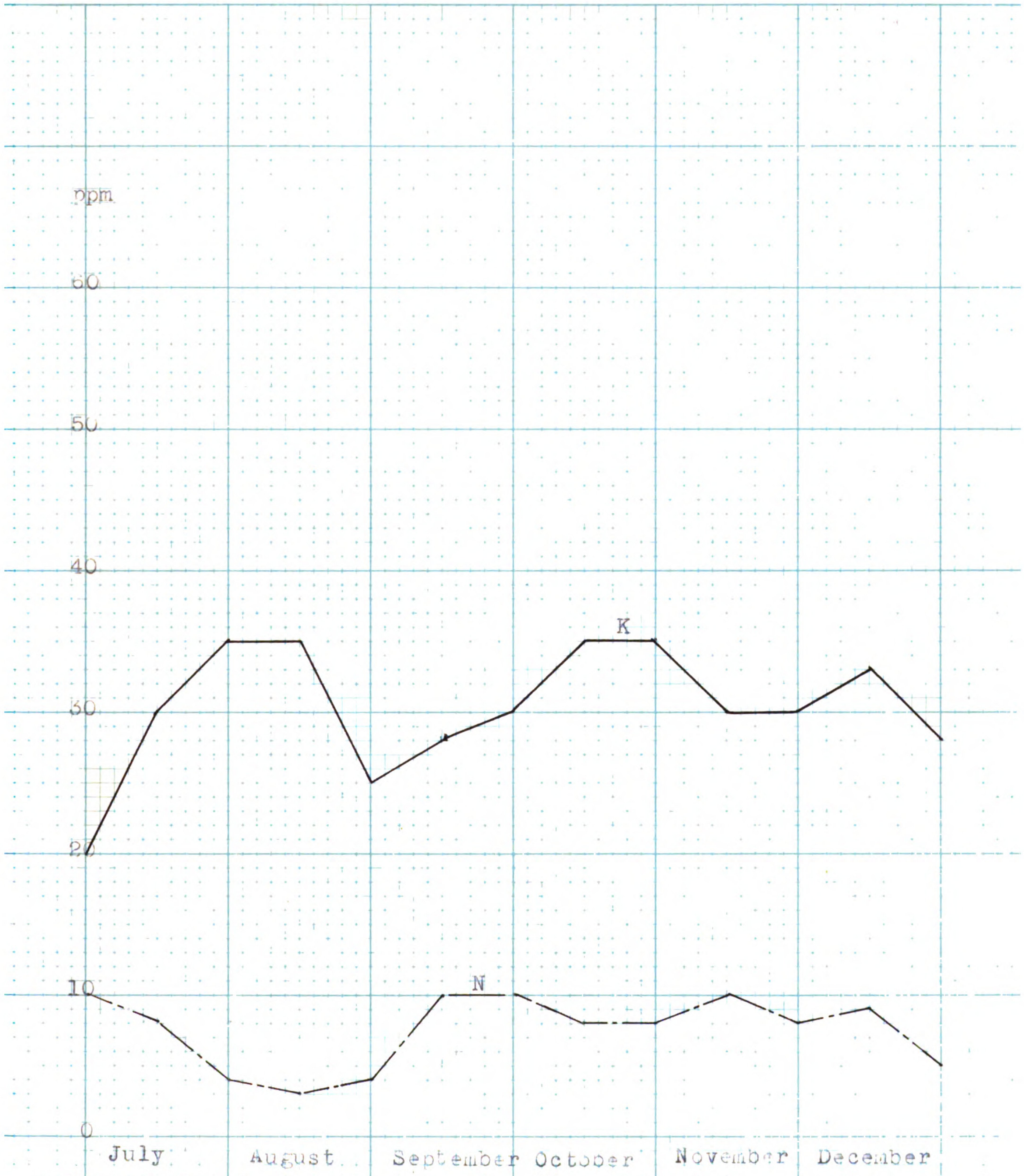
Nitrogen and Potassium levels of Plot VI.

Fig. 6



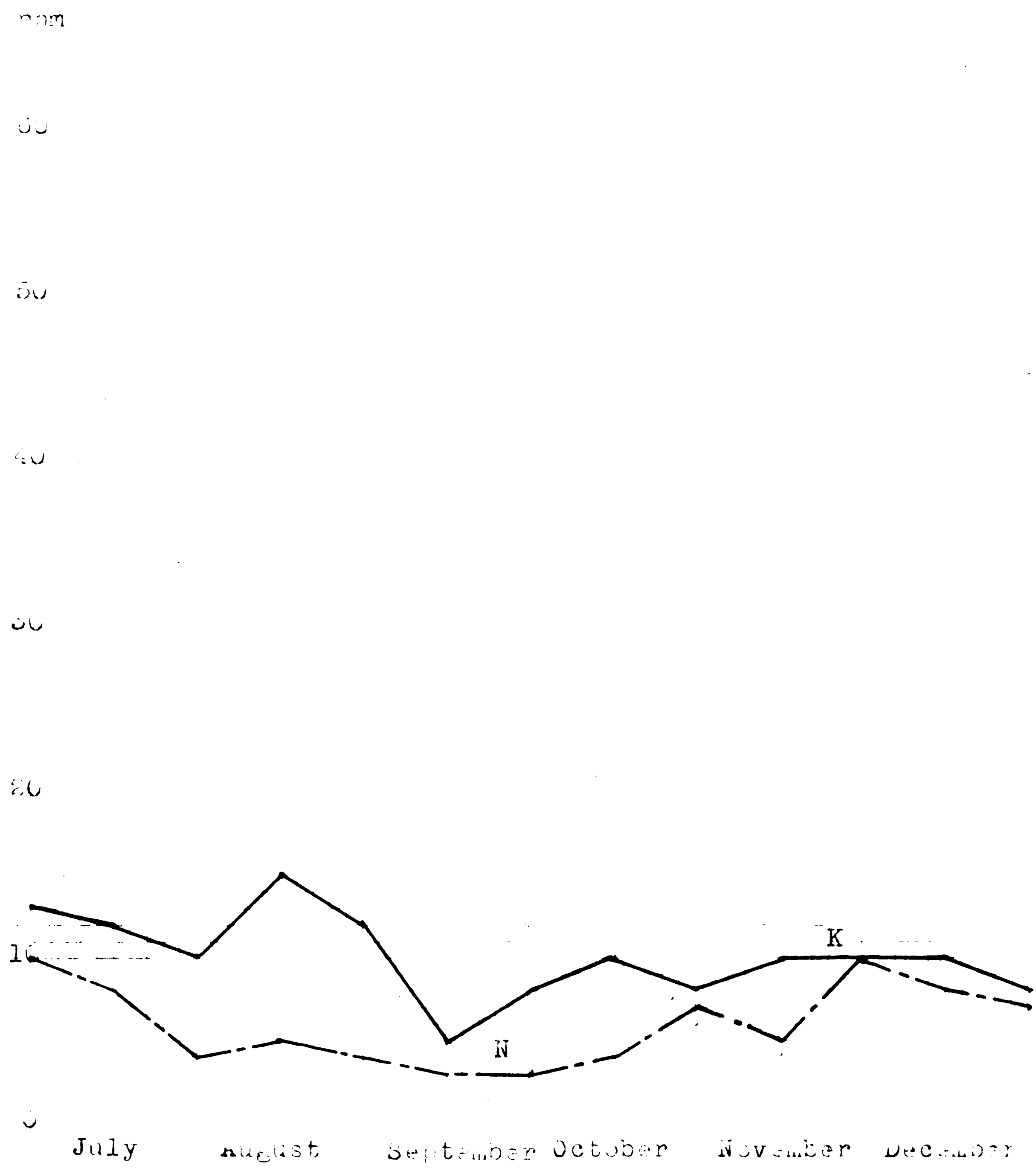
Nitrogen and Potassium levels of Plot VII.

Fig. 7



Nitrogen and Potassium levels of Plot VIII.

Fig. 8



Nitrogen and Potassium levels of Plot IX

Fig. 9

Results

High N Series

Plot I

High-N, high-K group resulted in stunted and chlorotic plants which were light yellow in color. Plants in this plot were the poorest observed in any of the plots.

Plot II

High-N, medium-K also resulted in stunted and chlorotic plants, but the stunting was not as severe as found in plants in Plot I.

Plot III

High-N, low-K resulted in the best plants of the high N series, although these plants still were not the best plants in the experiment. They were light green in color and were of average size.

This high-N series, plot I, II, and III are shown in Plate I.

HIGH NITROGEN SERIES

PLATE I

Medium N Series

Plot IV

The medium-N, high-K plants were average in size but were light green in appearance, and were not as desirable as the plants in the other two plots in this series.

Plot V

The medium-N, medium-K produced the best plants in the experiment. These plants were of a desirable color and size.

Plot VI

The medium-N, low-K plots were the second best group of the experiment. These plants were smaller than the ones in Plot V but they were still very desirable plants. (Plate II).

MEDIUM NITROGEN SERIES

PLATE II

Low N Series

Plot VII

The low-N, high-K treatment resulted in small plants, which were light green in color and were the poorest of the Low N series.

Plot VIII

The low-N, medium-K plot were fair plants but were not quite as desirable as the low N low K group.

Plot IX

The low-N, low-K group were the best plants of the low N series, resulting in good plants but not quite as desirable as the medium N medium K group.

However, the low-N, low-K plants were more desirable plants in size and shape than the low-N,medium-K. The low-N, medium-K group had the best color of any of the plants in this series showing a nice green color, where the low-N, low-K, and low-N, high-K plants were slightly chlorotic. (Plate III).

LOW NITROGEN SERIES

PLATE III

Comparing these plants on another basis and having the potassium at the same level and varying the nitrogen, the following results were obtained.

High K Series

The high-K, medium-N, treatment resulted in the best plants in this series. The high-N, high-K plants were the poorest of this series. The high-K, low-N plants were not too desirable as they were yellow in color and small. (Plate IV).

Medium K Series

The medium-N, medium-K produced the best plants in the experiment, and the high-N, medium-K resulted in one of the poorest plots which were chlorotic and stunted. However, these plants were not as chlorotic and stunted as the high-N, high-K plants. The medium-K, low-N plants were good plants but not quite as desirable as the medium-N and medium-K. (Plate V).

Low K Series

The medium-N, low-K were the best plants of this series and also were one of the best groups of the experiment. The low-N, low-K resulted in a fair plant with the high-N, low-K producing the poorest plants of this series. (Plate VI).

HIGH POTASSIUM SERIES

PLATE IV

MEDIUM POTASSIUM SERIES

PLATE V

LOW POTASSIUM SERIES

PLATE VI

The ratio of nitrogen to potassium influenced the growth of the plant but the root growth varied more with the nitrate variation than with the potassium variation. The high nitrate series resulted in very poor root growth, the medium nitrate series produced a fair root growth, and the low nitrate series showed the best root growth, although not much superior to the medium nitrate series, especially during the last part of the experiment. This was more noticeable in the early stages of the experiment. This is indicated in plate VIl.

HIGH N　　MEDIUM N　　LOW N

ROOT GROWTH OF PRIMULA OBCONICA

The Results on The Tissue Tests:

		Nitrogen	Potassium
Plot I	High-N, High-K	VH	VVH
Plot II	High-N, Med.-K	VVH	VH
Plot III	High-N, Low- K	VVH	M
Plot IV	Med.-N, High-K	M	VH
Plot V	Med.-N, Med.-K	H	H
Plot VI	Med.-N, Low -K	M	M
Plot VII	Low -N, High-K	L	VH
Plot VIII	Low -N, Med.-K	M	H
Plot IX	Low -N, Low -K	L	L

V - Very
H - High
M - Medium
L - Low

DISCUSSION

During the summer months the differences between treatments were much greater than towards the end of the experiment in early winter. Although at this time there were still marked differences in the various plots as shown by the photographs. This is due to the fact that Primroses like cool weather and during these adverse conditions results of this experiment were very much intensified. When cool weather set in, the plants became more active and started into a vigorous growth. This was more noticeable with the treatments that produced good plants.

It was first decided to select very small plants and wash the soil off the roots and repot in a soil mixture comparable to that used commercially, but lacking in nitrogen and potassium, and then build up the nitrogen and potassium to the desired proportions. After working the soil and repotting, these Primroses seemed to stand still failing to root or put on growth. It is known that Primroses have a very delicate root system and are sensitive to adverse treatment. Several workers in the field of Floriculture have reported this fact.

Since the above method proved unsatisfactory, Primroses in three-inch pots which were growing in soil relatively low in nutrients were shifted into larger pots containing the mixture described in the "Procedure."

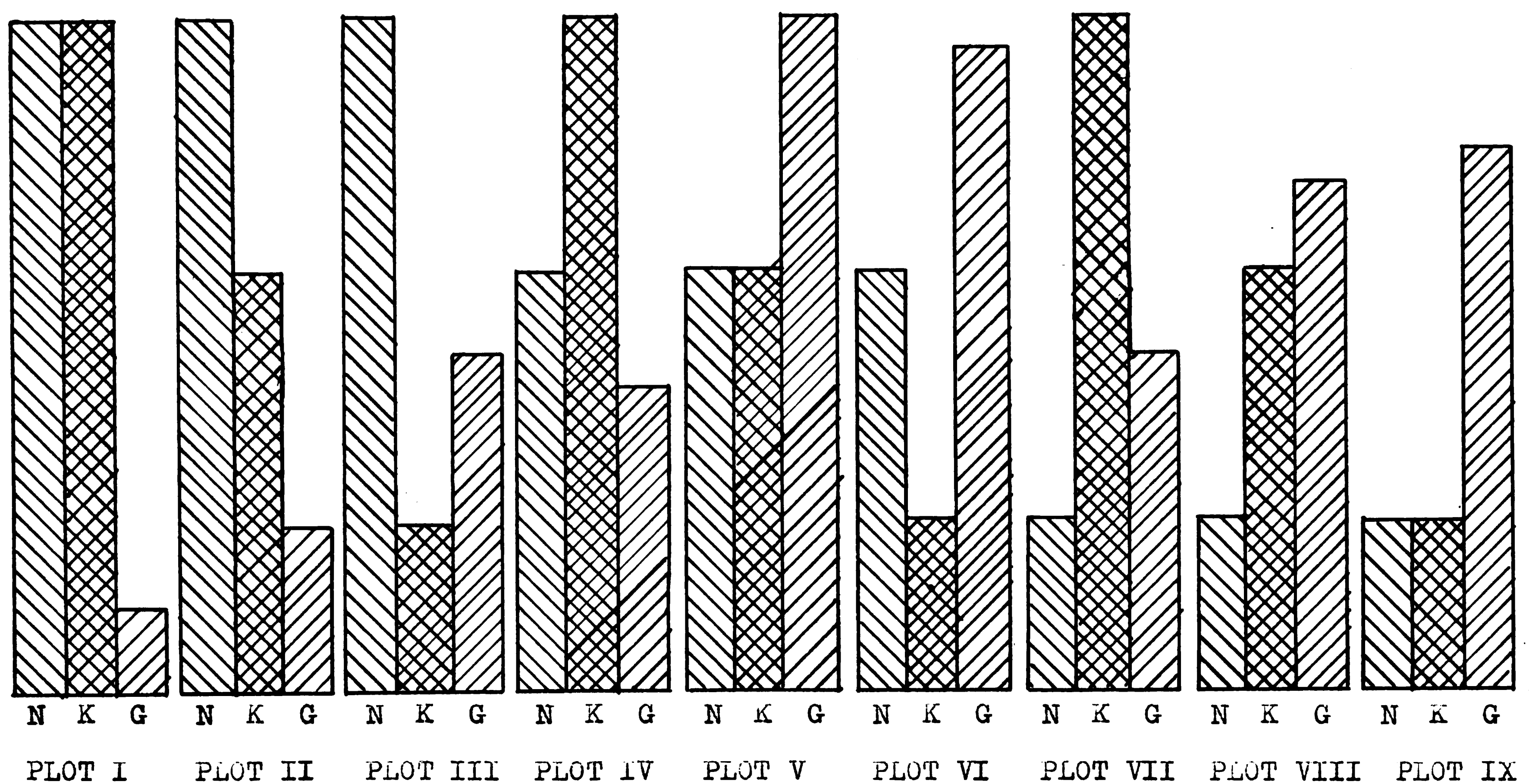
The cause of the chlorotic and stunted conditions of the high-N, high-K and high-N, medium-K groups is evidently due to a combination of high amounts of nitrogen and potassium, since in Plot III the plants with high-N and low-K were not extremely chlorotic or stunted and the same was true in Plots IV and VII with high-K and medium and low-N. Whether or not this ties up some other element causing the chlorosis and stunting or causing a toxic effect itself, it is not known.

Noble (11) states that leaves of plants are light green in color after heavy applications of pot ash. This was well portrayed in the high N series. It was interesting to note that the higher the potassium the more chlorotic the plant, as shown in Plate I.

The medium N series produced two of the best plots of the experiment. The medium-N, medium-K and the medium-N, low-K, resulted in very desirable plants both in size and color. In all three of the high, medium and low nitrogen series, the lower the potassium the better the plant except in Plot V of the medium-N series, the medium-K plot gave the most desirable plants of the experiment. This also showed that it possibly is the potassium that is the antagonistic element.

The ratio of Nitrogen to potassium for Primroses should be 35 ppm. nitrogen and 25 ppm. potassium. It may be stated that Primroses act unfavorably to high amounts of potassium and favorably to lower amounts of potassium. This is shown by the growth chart in comparison to the nutrient levels. (Figure 10).

It is not known whether the potassium at higher rates is antagonistic resulting in a tie up of other elements or whether the potassium itself is toxic to Primroses. High nitrogen although not being beneficial did not cause as much stunting and chlorosis on Primroses as the potassium. It was found while working on Cinerarias that the high amounts of nitrogen was not harmful when the potassium was low. The same conclusion may be drawn here that high nitrogen was not harmful when the potassium was low. It still shows that it is more or less a combination of high potassium along with high nitrogen since high potassium with medium and low nitrogen resulted in poor plants but not nearly as poor as the plants with high nitrogen and high potassium. This chlorotic and stunted condition which exists with high N and high K might possibly be caused by excessive soluble salts, but this is not probable. The total amounts of soluble salts in the high-N, high-K group were not over 400 ppm.



GROWTH OBSERVATIONS IN COMPARISON WITH NUTRIENT LEVELS

Fig. 10

CONCLUSION

High amounts of nitrogen together with high amounts of potassium caused severe stunting and chlorosis of *Primula obconica*. The higher the potassium content the more chlorotic and stunted the plant. Stunting and chlorosis was more prevalent when the nitrogen content was also high. When the potassium levels were low and the nitrogen levels high, stunting and chlorosis was not prevalent, and when the potassium was high and the nitrogen low fair plant growth was obtained.

The best results were obtained when the nitrogen was 35 ppm. and the potassium 20 ppm.

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