# Influence of N, P and K Fertilizer Interactions on Growth of *Ilex crenata* Thunb. 'Helleri'[1]

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**Abstract**

*Ilex crenata* 'Helleri' was greenhouse-grown in sand culture for 8 weeks at 4 levels of N, P and K in a factorial arrangement. Nitrogen and K levels were maintained at 0, 25, 75, and 200 ppm and P at 0, 5, 15, and 40 ppm in the irrigation water. The lowest level of each nutrient required for optimal growth was 75 ppm N, 5-15 ppm P and 25 ppm K. When levels of P were maintained at 40 ppm, then 200 ppm K was required for maximum growth. The same trend occurred for N and P in that higher levels of N were required to promote maximum growth when P levels were at 40 rather than 15 ppm.

**Index words:** Nutrition, woody landscape plants, fertilization, holly



## Introduction

Container production of woody nursery plants can maximize growth if all essential nutrients are applied at the proper level and proportion to one another. Recently, single element experiments have demonstrated the levels of N (6) and P (13) which are required in the container media solution to promote maximum growth of *Ilex crenata* 'Helleri.' Little research has addressed the effects of nutrient interactions and balance on growth of woody nursery crops in containers. Flint and McGuire (2) investigated the influence of media N and K levels in a factorial experiment on growth of containerized *Forsythia* and *Viburnum,* but only media nutrient ranges of 10-30 ppm N and 8 to 60 ppm K were established. Other studies (1, 3, 8) on nutrient interactions addressed application rates and not the resultant nutrient levels in the container solution which ultimately determine plant growth. Therefore, the purpose of this research was to establish the minimum level of N, P and K in the container solution required to produce optimal growth of *Ilex crenata* 'Helleri.'

## Materials and Methods

Rooted cuttings of 'Helleri' holly were potted in 0.5 liter plastic containers with an 18 quartz sand medium. Ammonium nitrate was used to supply 0, 25, 75 and 200 ppm N in the irrigation water. Zero, 5, 15 and 40 ppm P was supplied by $H_3PO_4$ and 0, 25, 75 and 200 ppm K was supplied by $K_2SO_4$. The different levels of N, P and K were supplied in a factorial arrangement resulting in 64 treatments. Calcium at 45 ppm and Mg at 20 ppm were supplied from $CaSO_4$ and $MgSO_4$, respectively. Micronutrients were supplied as a Hoagland's micronutrient solution containing 5 ppm Fe (4). The nutrient solutions were prepared daily, adjusted to pH 5.5, and a 250 ml volume applied to each plant, except that every seventh day plants were leached with tap water and not fertilized. Treatments started on September 5, 1981 and continued for 8 weeks under natural photoperiod and day/night temperatures of approximately 21/26°C (70/80°F). A randomized complete block design with four replicates and two plants per treatment per replicate was used. At the termination of the experiment, dry shoot and root weights, and length of new shoots were determined. All data were submitted to regression analysis.

## Results and Discussion

The lowest levels of N, P and K combinations that maximized shoot growth were N-75, P-5 or 15, and K-25. (Fig. 1). Data for K-75 is omitted since it was similar to K-25. There was a significant interaction among the 3 nutrients in relation to dry weight. Dry weights at N-75 increased as P increased from 0 up to 5 or 15 ppm, but decreased at P-40 except at K-200. Dry weight was greatest at K-25 with P-5 or 15 but K-200 was required to obtain maximum growth at P-40. As with dry weight, shoot length (Table 1) was increased up to N-75, P-5 and K-25. These results are in line with previously published results for N (6), and P (13). Also a preliminary study with K indicated a level of about 25 ppm K was sufficient for maximum growth of 'Helleri' holly.

Regardless of P and K levels, root dry weight (Table 1) increased up to N-25 with a decrease at N-200. Increasing P levels caused incremental decreases in root growth and K increased root growth to the maximum at K-25. Past research has shown weekly applications of 50 ppmN in the irrigation water to promote greater root growth in comparison to shoot growth (11). This tendency for N to preferentially support root growth over the shoots was reversed at 300 ppm N. The response to P in this study confirms an earlier report (13), and indicates that relatively low levels of P are required to support root growth. The belief that high P levels are required for rapid root development in container production is unwarranted. During early spring when liners are planted into mineral soil, P is fixed and plant uptake limited due to slow diffusion rates from the soil particle in the cool soil environment. Under these conditions additional P applied to the root zone could increase uptake and growth. However, with container production the

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nutrients are applied to maintain the optimal nutrient levels in the medium solution around the roots.

The reason for reduced growth at P-40 with either K-0 or K-25 could be explained on the basis of elevated inorganic P (Pi) in the plant which has been shown to cause reduced plant growth (7, 9, 10). This condition develops when applied P levels are greater than required for optimal growth (5). This condition is aggravated under low K conditions (9, 10) since K promotes the conversion of Pi to nucleic acids and phosphoproteins (9). Thus growth reduction in this study at K-0 or K-25 at P-40 could be attributed to a reduction in the synthesis of organic compounds critical for growth.

Data on interactive effects of N, P and K on the growth parameters in Table 1 are not given since interactions were primarily due to responses between 0 nutrient levels and higher ones. For example at N-0, there typically would be no growth response due to additions of P or K, whereas at N-25 there would be a response to applied P or K. Therefore, the main effects shown in Table 1 were not influenced to a great extent by the interactive effects.

### Significance to the Nursery Industry

Maximum growth of holly occurred at N-75, P-15 and K-25 or a ratio of N-P-K in the container solution of 5-1-3. In terms of an $N-P_2O_5-K_2O$ ratio, this would be 5-2.3-3.6 or about 15-7-11. There are commercial fertilizers with this approximate analysis available to the nursery industry, but ones with higher ratios of P should be used with caution, since more K and N are required to offset growth reductions due to high P. For example, with container plants, P levels in the soil solution when preplant additions of superphosphate have been made followed by applications of fertilizers with a complete analysis, have been shown to be in excess of 40 ppm (12).

These data indicate that both nutrient levels and the ratio of one nutrient to the other is important when

**Table 1. Influence of N, P and K fertility rates (main effects) on shoot length and root weight of 'Helleri' holly.**

| Treatment (ppm) | | Shoot length (cm) | Root weight (mg) |
|---|---|---|---|
| N | 0 | — | 78 |
| | 25 | 1.7 | 144 |
| | 75 | 2.0 | 147 |
| | 200 | 2.0 | 130 |
| Significance[z] Linear Fit | | .01 | .01 |
| P | 0 | 0.6 | 149 |
| | 5 | 1.7 | 130 |
| | 15 | 1.7 | 118 |
| | 40 | 1.7 | 101 |
| Significance[z] Linear Fit | | .01 | .01 |
| K | 0 | 1.2 | 117 |
| | 25 | 1.4 | 130 |
| | 75 | 1.5 | 124 |
| | 200 | 1.5 | 128 |
| Significance[z] Linear Fit | | .01 | .02 |

[z]Values less than .05 indicate that data are highly significant.

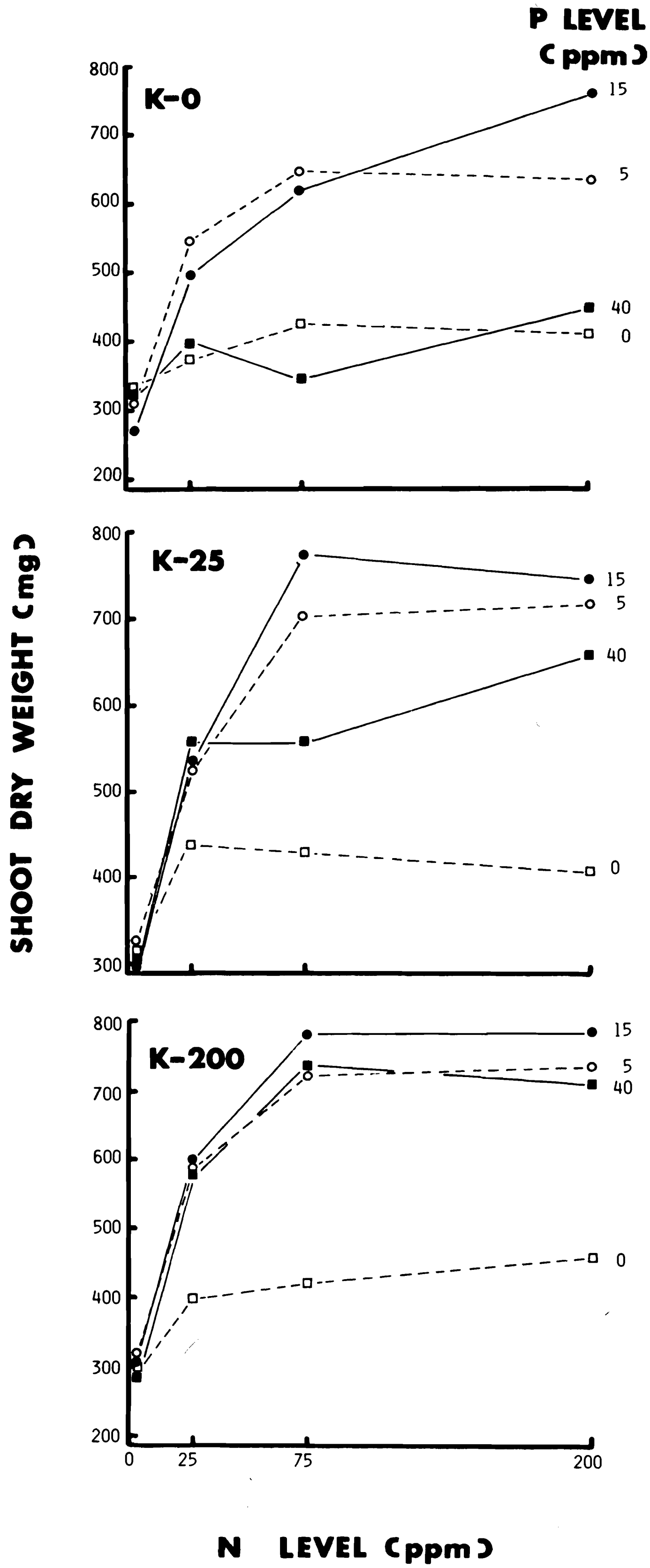


**Fig. 1. Influence of N, P and K rates on dry weight of 'Helleri holly.**

establishing a nutritional program for container production.

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# Rooting of Semi-Hardwood Peach Cuttings as Affected by Basal Fungicide, Mist, and Anti-Transpirant Treatments[1]


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## Abstract

Dipping semi-hardwood *Prunus persica* 'Harmony' and 'Cresthaven' cuttings in a Captan-Benomyl mixture following an IBA quick dip treatment increased rooting compared to cuttings not receiving the fungicide treatment. Fungicide treated cuttings rooted as well or better in moist sand with daily watering as they did under intermittent mist. An anti-transpirant dip did not improve rooting and was deleterious to rooting in some treatments.



**Index words:** *Prunus persica* L., Captan, benomyl, Vapor Gard


### Introduction

Increasing interest has been shown in recent years by growers to propagate their own peach trees by rooting cuttings. Rooted cuttings are of particular interest to those growers planting high density systems such as the orchard meadow (2) or Tatura trellis (1). In these cases, grower propagated trees represent a significant savings in establishment cost of the orchard. For growers with more conventional plantings, the potential savings, though less, could still be significant.

The method of propagation most often used is rooting of semi-hardwood cuttings taken after terminal bud set. In Virginia this usually occurs in early August. Terminal cuttings of approximately 20 cm (8 in) are taken and all but the upper 3 to 4 leaves removed. Basal wounds are made on each side of the cuttings after which they are dipped for 5 seconds in 2500 ppm IBA, inserted into the rooting medium and placed under intermittent mist (2).

In previous unpublished work, variable results were observed in our experiments with this method, due to fungal rot of the cuttings. Overcash *et al.* (3) used a fungicidal dip following the IBA treatment but Couvil-


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