# Effect of different rates of nitrogen fertilizer on growth, fruit quality and yield of Guava under New Halfa conditions

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## Abstract

The present study was conducted during 1988-89, 1989-90 and 1990-91 seasons on 12 years old Guava trees grown at New Halfa sugar factory orchard to study the effect of Nitrogen fertilizer rate on the growth, fruit quality, and yield of Guava trees under New Halfa conditions. N-fertilizer in from of urea was applied in to tow equal doses the first applied in October and the second applied in June next year. The results showed that all rates of Nitrogen led to significant increase in [tree height and trunk circumference, fruit weight, fruit size, fruit circumference, total soluble solids and leaf –N content] when compared with the control through out the experimental period. The result revealed that, the economic rate of Nitrogen fertilizer for Guava trees under New Halfa condition, is 600 g urea to be applied in two doses per tree per year.

## Introduction

Guava (*Psidium guajava* L*)* is one of the most popular fruit in the Sudan and grown in a wide range of soil types. It is greatly relished for it's flavor, delicious taste and high nutritive value and give more than one crop during the year. In Sudan most of guava growers don't fertilize their trees, in spite of the importance of fertilizers for guava trees because the fruits are borne on new wood, 9-11 months old and any treatment that encourage new growth influence the fruiting directly. Guava have two vegetative growth cycles under New Halfa conditions one in Autumn and the other in Winter, i.e. guava trees have also two root growth cycles which start within 2-3 weeks before the vegetative cycle. For this reason the most suitable time for fertilizer application under New Halfa conditions are two doses one on the first week of October and the other on a first week of June next year.

Several investigators reported that an increase in N rate is associated with an increase in yield of different species of fruit trees Calver (1970) Jones *et al. (*1970), Shawky *et al* (1973), koo *et al* (1974). Sinha *et al*. (1961),working on guava trees, reported that as the level of nitrogen increases the fruit weight, fruit size, ascorbic acid,T.S.S., yield and leaf N tended to increase. Also, Singh and Singh (1969) working on the effect of different N and micronutrients levels on growth and flowering of guava shoot, reported a positive correlation with the growth rate, Increasing the length and number of leaves and flowering shoot. Rajput and Singh (1973) found that the growth characters of guava trees are significantly improved by all concentrations of urea spray (2%, 4% and 6%) and flowering, yield and size of the fruits increased with increasing concentration of nitrogen. The highest yield was recorded at 4% urea spray.

Therefore this study focuses on the effect of nitrogen fertilizer rate on the growth, fruit quality, and yield of guava trees under New Halfa conditions.

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## Material and methods

This research was carried out for 3 consecutive seasons (1988-89, 1989-90 and 1990-91), at New Halfa sugar factory orchard, Kassala state. Twelve years old Guava trees (white fruit type) of nearly uniform size, growth, vigor and bearing habits were selected. The soil is alkaline deep cracking clay with pH 8.5 (Appendix !). All the trees received similar cultural practices that are commonly used in Sudan. Irrigation was done by flooding the basins around the tree at regular intervals of about one month, except during the rainy seasons.

Five rates of N namely, 0.0, 200, 400, 600, 800 and 1000 g per tree per year were applied. These rates were splitted in to two equal halves and applied in October and June of the three successive seasons. The nitrogen in the form of urea (46 % N) was broadcasted 30 cm from the trunk and out to the edge of canopy of the tree. A randomized complete block design with four replications was used in this experiment, with 4 trees per plot. Tree height and trunk circumference were measured in at monthly interval. Fruit size and other quality parameters were determined using a 10-fruit sample from each tree by standard laboratory procedures, from random samples of 40 fruits from each plot.

Yield was expressed as the total number and weight of fruits produced per tree in each cropping season harvested in August and December.

Fifty leaves of uniform size from the third pair from shoots of current season's growth located at height of 1.8–2 m from the ground, were collected to form a composite sample for determinations of nutrient elements composition. Tissue analysis procedures were done as reported by Chapman (1961).

Total N was determined by the Macro-Kjeldahl procedure, P by Molbo dovanada phosphoric acid procedure, K by flame photometry, and Ca, Mg, Mn, Zn, Fe and Cu by atomic absorption Spectrophotometer.

Data were analyzed statistically and mean separation was done by using Duncan's Multiple Range Tests.

## Results and discussion

Data shown in Table 1 indicate significant treatment differences in the three seasons of study. The application of different N-rate led to significant increase in trunk circumference throughout the experimental period compared to the control. The same trend was observed for the number of twigs per shoots and the length of the shoot per year. It is evident from the data that the increase in the trunk and number of twigs per shoot for the three years of the experiment did not differ significantly between N-rates of 600 and 1000 g per tree per year. In general the results are in agreement with the findings reported by other investigators working with orange and grape fruit (Smith *et al.* 1968; Hilgeman and Sharples, 1969; Dawoud, 1991; Dawoud, 1993).

Table 2 shows the influence of nitrogen rates on the yield of guava tree expressed as a number of fruit per tree. The marked effect of nitrogen on yield might be due to the cumulative stimulating effect of nitrogen on the vegetative growth characters which form the base for flowering and fruiting. Application of 600 or 1000 g N per tree per year resulted in significantly higher total yields than the other nitrogen rates. In agreement with this finding are those reported by other investigators working with different fruit trees species (Jones et al., 1970; Koo, 1974; Dawoud, 1991 and Calvert, 1970).

The data in Tables 3, 4,5 show the effect of different nitrogen levels on the fruit quality parameters. Fruit size, fruit diameter, fruit weight, TSS and ascorbic acid increased with increasing N-level up to 600 g per tree. Higher rate of nitrogen application resulted in reduction of the fruit size, diameter, weight and total soluble solids per fruits. These findings are in line with those reported by other researchers working with orange, grape fruit, and date palm (Reuther and Smith, 1950; Dawoud and Salih, 1995; Dawoud, 1991 and Smith, 1969).

Table 6 show the effect of N-rate on leaf nutrients content. All nitrogen levels resulted in significantly higher leaf Nitrogen content than the control.

Leaf P and leaf Ca show a negative relation with N-rate, i.e. they had inverse relation with Nitrogen, in contrast to leaf K and leaf Mg, which show positive relation with N-rate. Also there seemed to be a positive relation between leaf Zn and leaf Fe with Nitrogen rate, in contrast to leaf Cu and leaf Mn.

## Recommendation

Based on the results of this study, it is recommended to apply 600-1000 g N per year, as urea, split into two equal doses, one in the first week of October and the other in first week of June next year.

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## Appendix 1. The characteristics of New Halfa sugar factory orchard

| Sample No. | pH | EC Mmhos/ cm paste | N ppm | Available nutrient content in mg/kg soil | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | P | K | Na | Fe | Mn | Zn | Cu | free CaCo3 % |
| 1 | 8.4 | 0.45 | 308 | 5 | 402 | 450 | 58.3 | 84.1 | 0.58 | 1.03 | 4 |
| 2 | 8.2 | 0.53 | 406 | 5 | 350 | 430 | 57.3 | 79.9 | 0.50 | 1.06 | 3.8 |
| 3 | 8.5 | 0.46 | 309 | 6 | 310 | 430 | 58.2 | 74.9 | 0.51 | 1.03 | 4 |
| 4 | 8.6 | 0.43 | 306 | 6 | 352 | 550 | 52.2 | 76.0 | 0.52 | 0.84 | 4 |
| 5 | 8.5 | 0.56 | 308 | 5 | 350 | 530 | 49.3 | 86.0 | 0.59 | 1.11 | 3.9 |
| 6 | 8.8 | 0.57 | 308 | 5 | 353 | 496 | 35.1 | 78.9 | 0.50 | 1.02 | 3.7 |

## Table 1. Effect of different nitrogen levels on growth rate of Guava.

| Treat. | Increases in trunk circumference% | | | Length of shoots/branch\year(cm) | | | No. of twigs/branch | | |
|---|---|---|---|---|---|---|---|---|---|
| Years | 1988 | 1989 | 1990 | 1988 | 1989 | 1990 | 1988 | 1989 | 1990 |
| control | 8 | 8 | 10 | 56 | 55 | 56 | 4.06 | 4.2 | 4.2 |
| 200g | 11 | 11 | 12 | 61 | 74 | 72 | 5.0 | 5.2 | 5.1 |
| 400g | 13 | 14 | 14 | 70 | 81 | 78 | 6.03 | 6.3 | 6.1 |
| 600g | 14 | 17 | 18 | 83 | 86 | 87 | 7.3 | 7.35 | 7.4 |
| 800g | 17 | 18 | 19 | 98 | 98 | 97 | 7.5 | 7.74 | 7.6 |
| 1000g | 16 | 18 | 18 | 97 | 101 | 107 | 7.5 | 7.7 | 7.6 |
| Cv | 2.7% | 4.5% | 5.0% | 1.1% | 0.7% | 1.1% | 0.3% | 1.1% | 2.1% |
| S.E± | 0.21 | .26 | 0.31 | 0.36 | 0.24 | 0.36 | 0.0073 | .029 | 0.05 |

## Table 2. Effect of different nitrogen levels on fruit yield) of guava (kg/tree).

| Treat. | No. of fruit | | | | Yield (kg) | | | |
|---|---|---|---|---|---|---|---|---|
| Years | 1988 | 1989 | 1990 | combined | 1988 | 1989 | 1990 | combined |
| control | 476 | 506 | 507 | 525.6 | 209 | 223 | 223 | 231 |
| 200g | 777 | 802 | 804 | 788.9 | 404 | 419 | 409 | 410 |
| 400g | 1065 | 1099 | 1097 | 1083 | 618 | 637 | 614 | 628 |
| 600g | 1405 | 1440 | 1430 | 1422 | 913 | 936 | 901 | 924 |
| 800g | 1417 | 1459 | 1457 | 1441 | 822 | 846 | 830 | 836 |
| 1000g | 1092 | 1114 | 1111 | 1103 | 568 | 579 | 544 | 573 |
| C.V. | 0.18 | 0.54 | 0.38 | 5.9 | o.64 | 0.4 | 0.7 | 0.4 |
| S.E± | 0.76 | 2.37 | 1.15 | 11.9 | o.59 | 0.90 | 0.15 | 7.3 |

## Table 3. Effect of different nitrogen levels on physical characters of Guava fruit.

| Treatment | Fruit size ($cm^3$) | | | Fruit wt.(g) | | |
|---|---|---|---|---|---|---|
| | 1988 | 1989 | 1990 | 1988 | 1989 | 1990 |
| Control | 44 | 45 | 43 | 44 | 44 | 44 |
| 200g | 54 | 53 | 46 | 50 | 51 | 51 |
| 400g | 57 | 56 | 49 | 56 | 58 | 58 |
| 600g | 62 | 61 | 63 | 62 | 65 | 63 |
| 800g | 58 | 57 | 48 | 58 | 58 | 57 |
| 1000g | 57 | 56 | 49 | 51 | 52 | 49 |
| c.v | 6.4 | 0.95 | 3.2 | 2.02 | 1.9 | 2.4 |
| S.E± | 1.46 | 0.3 | 0.6 | 0.44 | 0.42 | 0.44 |

**Table 4. Effect of different nitrogen levels on chemical characters of Guava fruits.**

| **Treatment** kg/tree | **T.S.S%** | | | **Ascorbic acid/mg/100gfruit juice** | | |
|---|---|---|---|---|---|---|
| **Years** | **1988** | **1989** | **1990** | **1988** | **1989** | **1990** |
| Control | 12 | 12 | 12 | 70 | 70 | 70.7 |
| 200g | 14 | 14 | 14 | 72 | 72 | 72 |
| 400g | 16 | 16 | 16 | 75 | 75 | 75 |
| 600g | 18 | 18 | 18 | 80 | 80 | 80 |
| 800g | 16 | 16 | 16 | 78 | 78 | 78 |
| 1000g | 16 | 16 | 15 | 76 | 75 | 76 |
| CV% | 0.45 | 0.59 | 0.5 | 1.09 | 1.12 | 1.13 |
| S.E± | 0.29 | 0.52 | 0.31 | 0.33 | 034 | 0.49 |

**Table 5. Effect of different nitrogen levels on nutrient levels in Guava leaves.**

| | **N** | **P** | **K** | **M g** | **Ca** | **Cu** | **Mn** | **Zn** | **Fe** |
|---|---|---|---|---|---|---|---|---|---|
| | | | **%** | | | **Ppm** | | | |
| Control | 1.13 | 0.09 | 1.2 | 0.32 | 2.53 | 20 | 144 | 182 | 130 |
| 200g | 1.5 | 0.08 | 1.3 | 0.4 | 2.54 | 20 | 143 | 184 | 131 |
| 400g | 1.6 | .06 | 1.54 | 0.5 | 2.31 | 19. | 134 | 240 | 143 |
| 600g | 1.8 | 0.05 | 1.54 | 0.54 | 2.32 | 19.4 | 132 | 241 | 144 |
| 800g | 1.8 | 0.04 | 1.71 | 0.71 | 2.23 | 18.3 | 121 | 222 | 151 |
| 1000g | 2 | 0.04 | 1.74 | 0.73 | 2.24 | 18.4 | 120 | 224 | 154 |
| CV% | 0.17 | 0.07 | 0.01 | 0.2 | 0.1 | 0.5 | 0.4 | 0.9 | 0.2 |
| SE± | 0.04 | 0.009 | 0.04 | 0.3 | 0.9 | 0.1 | 0.5 | 0.2 | 0.4 |