YIELD, GROWTH, LEAF NUTRIENT CONTENT OF GUAVA (*PSIDUM GUAJAVA. L*) AS AFFECTED BY DIFFERENT RATES OF NITROGEN FERTILIZATION

BY

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ABSTRACT

Five nitrogen rates, namely 0.0, 300, 600, 900 and 1200 g N per tree per year in the form of urea, were applied to nine-year-old guava (*Psidum guajava. L*) trees grown under orchard conditions at El Rahad Agricultural Scheme in 1988 to study their effects on growth, leaf nutrient content and yield. The amount of urea was split into two equal doses, half in April and half in August of 1988. The results showed that all rates of nitrogen led to significant increase in tree height and trunk circumference than the control, throughout the experimental period. Each increase in the rate of nitrogen showed an increase in height and in trunk circumference. Significantly higher leaf-N content was detected in trees receiving different rates of nitrogen than the control. Each increase in the rate of nitrogen resulted in an increase in the leaf-N content. All rates of nitrogen had virtually no effect on leaf-P, K, Ca, Mg, Fe, Mn, Zn and Cu contents, regardless of the sampling date. As the season advanced, leaf-N and Fe contents increased and leaf-P, K, Ca, Mg, Zn, Mn and Cu content tended to remain, more or less, constant. Trees treated with different rates of nitrogen had significantly higher total yield than the control. Application of 900 or 1200g N per tree per year resulted in significantly higher yield than the rest of the rates. Each increase in the nitrogen rate produced an increase in the total yield.

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ملخص:

أضيفت خمسة معدلات من النيتروجين هي 0.0,300,600,900,1200 جرام نيتروجين في شكل يوريا لأشجار جوافه بعمر 9 سنوات وذلك بمشروع الرهد الزراعي لدراسة تأثير معدلات النيتروجين علي النمو والمحتوي الورقي للعناصر والإنتاجية. أضيفت كميات اليوريا علي جرعتين متساويتين في شهري أبريل وأغسطس من عامي 1988 و 1989.

أظهرت النتائج أن كل معدلات النيتروجين أدت إلي زيادة معنوية في طول الشجرة وقطر الجذع مقارنة بالشاهد خلال فترة التجربة، وكانت هناك زيادة معنويه في طول الشجر وقطر الجذع بازدياد معدل النتروجين. كما أظهرت النتائج أن إضافة السماد قد ادت إلي زيادة معنوية في المحتوي الورقي للنيتروجين بغض النظر عن وقت أخذ العينة، وأن كل زيادة في معدل النيتروجين نتجت عنها زيادة في المحتوي الورقي من النيتروجين ولم يكن لمعدلات النيتروجين المختلفة أي تأثير علي المحتوي الورقي من الفسفور والبوتاسيوم والكالسيوم والزنك والحديد والمنجنيز والنحاس بغض النظر عن وقت أخذ العينة. وبتقدم الموسم، حدثت زيادة في المحتوى الورقي من النيتروجين والحديد بينما ظل محتوى الأوراق من الفسفور والبوتاسيوم والكالسيوم والماغنسيوم والزنك والمنجنيز والنحاس ثابتاً. كما أوضحت النتائج أن الأشجار التي تم تسميدها أعطت إنتاجية أعلي من إنتاجية الشاهد وأن إضافة 900 أو 1200جرام نيتروجين للشجرة في العام أدت إلي إنتاجية أعلي معنوياً من المعدلات الأخرى وأن كل زيادة في معدل النيتروجين أدت إلي زيادة في الإنتاجية الكلية.

INTROCUCTION:

Guava (*Psidium guajava L*) is one of the most important fruit crops of the tropical world. It is greatly relished for its exotic flavors, delicious taste and high nutritive value (rich in vitamin C). It occupies a premier position among the tropical and subtropical fruit trees, which give more than one crop during the year.

The need for fertilizing guava trees to bear large crops has been emphasized, because the fruit is borne on the new growth and any treatment, which brings about vigorous vegetative growth, also

encourages fruiting. Nitrogen is one of the primary factors governing growth and production. 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. Several investigators reported that an increase in the nitrogen rate is associated with an increase in yield of different species of fruit trees (Calvert, 1970; Jones *et al.* 1970; Shawky *et al.* 1973; Koo *et al.* 1974; Dawoud 1991; Dawoud 1993). Sinha *et al.* (1961). Working with guava trees, reported that as the levels of nitrogen increased, leaf-N and-K contents tended to increase; leaf-P showed a significant downward trend, and leaf-Ca did not seem to be affected. The effect of different nitrogen, and micronutrients levels,on growth and flowering shoot of guava trees were studied by Singh and Singh (1969). They found that high levels of nitrogen had accelerated growth by increasing the length and number of leaves of the flowering shoot.

A survey of the literature indicates that research efforts on guava in the Sudan are needed, especially in the area of fertilization since the main factor contributing to the low yield and bad quality of guava fruits is the little use of fertilizers. Therefore, the purpose of this work was to study the effect of different rates of nitrogen on growth, leaf nutrient composition and yield of guava.

MATERIALS AND METHODS:

Nine-year-old guava trees of nearly uniform size, growth, vigour and bearing habits were selected for this investigation in 1988. The trees were growing in the orchard of El Rahad Agricultural Scheme (heavy alkaline soil, pH 8.0-8.5), and did not receive fertilizers for a number of years. The tree spacing was 7x7m, five rates of nitrogen, namely 0.0, 300, 600, 900 and 1200 g N per tree per year were applied. These rates were split into two equal doses and applied in April and in August of 1988. The nitrogen, in the form of urea (46% N), was broadcasted 30cm from the trunk and out to the drip-line (edge of canopy) of the tree. All experimental trees received almost similar cultural practices (irrigation,

cultivation, etc.) during the course of this investigation. A randomized complete block design with four replications was used in this study, and means of treatments were separated using the Duncan's Multiple Range Test at 5% level. The experiment was conducted for the two seasons of 1988 and 1989.

Tree height and trunk circumference were measured in various months. Forty leaves of uniform size, from the third pair from shoots of current season's growth located at a height of 1.5-2.0m from the ground, were collected to form a composite sample for determination of nutrient elements composition. Leaf samples were collected in June, September and November of 1988. For determination of nitrogen leaf contents. Leaf samples were dried in a forced-draft oven at 70° C for 48 hrs. After complete drying, the samples were ground in a Retsh Mill to pass through a 40-mesh screen. The samples were thoroughly mixed before taking representative sub samples for chemical analysis. Total N was determined by the macro-Kjeldahl procedure; P by molbdo vanada-phosphoric acid procedure; K by flame photometry; and Ca, Mg, Mn, Zn, Fe and Cu by Atomic Absorption Spectrophotometer (SP 191). Yield was expressed as the total number and weight of fruits produced per tree in each cropping season in July and November (time of the commercial harvesting of the orchard).

RESULTS AND DISCUSSION:

The results revealed that the application of different rates of nitrogen led to significant increase in tree height throughout the experimental period, compared to the control (Table 1). Increasing the rate of nitrogen resulted in a significant increase in the tree height. It is evident from the data that tree height measured in December, 1988, did not differ significantly between the rates of 900 and 1200 g N per tree per year. In general agreement with this finding are those reported by other investigators working with orange and grapefruit (Sharples and Hilgeman 1969; Calvert 1970; Smith *at al.* 1968 Dawould 1991; Dawoud 1993). Likewise, significant increase was noticed in trunk circumference than the two lowest doses (300 and 600 g N per tree per year). These results are in agreement with those reported by Singh and Singh (1969) working

with guava and Williams and Billingsbey (1974) working with apple. On the other hand, the data did not confirm the observations of Dawoud (1991) who indicated that application of the lowest nitrogen rate (400 g N per tree per year) to 'Foster' grapefruit trees resulted in bigger trunk circumference. This indicates that fruit tree species tend to respond differently to the rate of nitrogen.

Table 1. Increases in height and trunk circumference of guava trees (Measured in various months) as affected by different rates of nitrogen fertilization

Nitrogen rate (g. N/tree)	Increases in tree height (cm)		Increase in trunk circumference (cm)		
	October	December	August	October	December
	1988	1988	1989	1989	1989
0	10.0 e	10.0 d	1.8 b	1.8 c	1.9 c
300	30.0 d	70.0 c	15.0 a	7.0 b	9.0 b
600	40.0 c	80.0 b	5.0 a	8.6 b	10.9 b
900	50.0 b	93.0 a	5.8 a	10.0 a	14.0 a
1200	60.0 a	95.0 a	6.9 a	14.0 a	16.0 a

Means in a column followed by the same letter (s) are not significantly different at p=0.05, according to Duncan's Multiple Range Test.

Table 2: Seasonal changes in leaf-nitrogen content of guava trees as Affected by different rates of N fertilization

Nitrogen g. N/tree	Sampling Dates					
	1988			1989		
	June	September	November	June	September	November
	Leaf-N content (%)					
0	1.20 c	1.01 d	1.05 c	1.30 c	1.20 c	1.20 b
300	1.30 b	1.34 c	1.75 b	1.64 b	1.73 b	1.83 a
600	1.32 b	1.43 b	1.79 b	1.83 a	1.90 a	1.90 a
900	1.34 b	1.51 b	1.86 a	1.90 a	1.91 a	1.93 a
1200	1.42 a	1.78 a	1.90 a	1.92 a	1.97 a	2.00a

Means a column followed by the same letter (s) are not significantly different at p=0.05, according to Duncan's Multiple Range Test.

Table 2 shows the influence of nitrogen rates on leaf-N content. All nitrogen rates resulted in significantly higher leaf-N content than the control, regardless of the sampling date. There was a corresponding increase in the leaf-N content as the rate of nitrogen was increased. In accord with this finding are those reported by other investigators working with orange, guava and grapefruit trees (Reuther and Smith 1950; Sinh *et al* 1961; Rodriguez and Moreira 1969; Smith 1969; Rajput and Singh 1973; Reese and Koo 1975; Dawoud 1991). The differences in leaf-N among trees in the successive rates of nitrogen tended to be rather small, especially in the last sampling date. However, leaf-N was higher in the second year than in the first year, and this might be due to the repeated applications of nitrogen.

Generally, these results are in agreement with those reported by smith (1967) working with 'Valencia' orange trees. Part of these findings, however, disagreed with those reported by other investigators (Reuther and Smith 1950; Rodriguez and Moreira 1969 Reese and Koo 1975; Dawoud; 1991) who found that increasing nitrogen rate increased leaf-Ca and decreased leaf-N, P and K contents. A definite trend in leaf-N tended to increase, and this is in agreement with the findings of Sinha *et al.* (1961) and Dawoud (1991).

Significantly higher yields were found in the treated trees than in the control trees (Table 3). The marked effect of nitrogen on yield might be due to the cumulative stimulating effect of nitrogen on the vegetative growth characters, which formed the base for flowering and fruiting. Application of 900 or 1200 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 tree species (Calvert 1970, Jones *et al.* 1970; Koo *et al.* 1974; Biely *et al.* 969; Dawoud 1991; Dawoud 1993). Overall yields were progressively increased by increase in the nitrogen rate. This is in conformity with the observations of Rajput and Singh (1973) working with guava trees, and with other investigators working with lime and orange (Jones *et al.* 1970; Shawky *et al.* 1973).

Table 3: Effect of application of different rates of nitrogen on guava Tree yield. (1988)

Nitrogen rate(g N/tree)	Yield (Fruits/tree) 1988			Yield kg/tree 1988		
	June	November	Total	June	November	Total
0	266 c	199 bc	456 c	216 c	211 c	427 d
300	471 b	260 bc	731 b	379 ab	306 b	685 c
600	797 a	190 c	977 a	491 a	415 ab	828 b
900	361 b	300 b	661 b	263 b	565 a	908 a
1200	352 b	412 a	764 b	297 b	611 a	908 a

Means in a column followed by the same letter (s) are not significantly different at P=0.05, according to Duncan's Multiple Range Test

Overall, the present results indicate that there is no difference in tree height, trunk circumference and yield between trees in the two highest rates of nitrogen (900 and 1200 g N per tree per year). Therefore it could be concluded that the 900 g rate of nitrogen is sufficient or optimal for guava trees under the conditions of this experiment.

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