Emir. J. Agric. Sci. (1992), 4: 1-13

# The Effect of Frequency of Nitrogen Application on Growth Yield and Quality of Tomato Grown under Plastic-houses.

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## ABSTRACT :

An experiment was carried out during 1984 growing season to study the effect of the frequency of nitrogen fertilizer application on growth yield and quality of tomatoes grown under plastic houses in the Jordan Valley.

Application of nitrogen fertilizer at two week intervals produced significantly higher total and marketable yields and vegetative growth when compared to 1 and 4 week, intervals, treatment. The total amount of nitrogen fertilizer was 120 kg/ha for each treatment in all cases.

No significant differences was observed due to the frequency of nitrogen application on pH, titratable acidity, total soluble solids, as well as nitrogen and phosphorous content of the leaves and stems.

For tomatoes grown under conditions similar to those of this study, it is recommended to fertilize by nitrogen four times during the season at a rate of 30 kg/ha at two weeks intervals.

Key words : Nitrogen, yield, quality, tomato, plastic house, and fruit.

## INTRODUCTION

Tomato (Lycopersicon esculentum Mill.) is the most important vegetable crop in Jordan. So in order to get high

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and good quality yields, the crop needs controlled supply of water and fertilizers, especially, nitrogen through-out the growing period. Nitrogen is a major plant nutrient and is usually added during the growth season.

Fisher et al., (1971), reported that the fruit yield of tomato plants grown in a glass-house increased in response to high rates of nitrogen applied before initiation of the first truss. According to Fawusi (1977), the best timing of nitrogen fertilizer application of tomato plants was : first application at two weeks after transplanting, and second application at fruit set. Miller et al., (1981), found that the fruit yield was not significantly different between treatments which received a total of 90 kg N/ha whether applied once or split into 2 or 4 application, they also found that split application of nitrogen through drip irrigation did not improve the efficiency of nitrogen uptake when compared to a single application.

Increasing nitrogen concentration in the liquid had significantly increased the titratable acidity, but total solids and sugar content were less affected with increasing nitrogen in liquid feed (Bar-Yosef, et al., 1980). Tomatoes contain usually from 4.0 to 6.0 % of total soluble solids (Gould, 1974). The greatest concentration of nitrogen in the plant tissue occured in the treatment where N fertilizer rate was split into four application as compared to that where all the N was applied in one two applications (Miller et. al., 1981).

The objectives of this study were to determine the effects of frequency of nitrogen fertilizer application on growth, yield and quality of tomato grown under drip irrigation in plastic-houses in the Jordan Valley.

## MATERIALS AND METHODS

A study was carried out at the University of Jordan Agricultural Research Station in the Jordan Valley during the season of February to July, 1984. The experiment was conducted in plastic-house (9 x 49 m). Three frequencies of nitrogen application, were studied in a randomized complete block design, they were :

F1 = Once every 4 weeks at a rate of 60 kg N/ha.
F2 = Once every 2 weeks at a rate of 30 kg N/ha.
F3 = Once every week at a rate of 15 kg N/ha.

All of the above treatments received a total of 130 kg N/ha. The plastic house was divided into three blocks, each block representing one replicate was further subdivided into three plots of 3.2 x 4.0 m for each treatment.

Land preparation was done by rotary plowing and seed-bed was prepared by shallow rotating and levelling. Tomato seeds cv. "Claudia Raff" were then planted directly on December 5, 1983. Distances between rows were 80 cm and between hills were 40 cm. Each row had its own drip line, one dripper was located near each plant.

Triple superphosphate, at a rate of 100 kg. $P_2O_5$/ha was side-dressed 10-15 cm deep at planting time. Protection against blights was achieved by spraying with Zineb and Diathane M 45 at a rate of 2.5 g/l (commercial product) of water weekly.

Urea fertilizer was dissolved in 20 liters of water for each plot, then 0.5 liter of this solution was added to each plant. The first application was added to all treatments at the same time during last half hour of irrigation. Later nitrogen fertilizer was added at fixed time intervals according to the experimental design regardless of irrigation time.

Red ripe fruits were harvested from the middle 16 plants of each treatment at two-day intervals starting March 29, 1984. Data on yield and fruit number were recorded through out the harvest season.

Representative fruit samples at the peak of the harvest season were collected and analyzed for pH using a precision pH-meter "E 510" with glass and calomel electrodes. Titratable acidity (TA) as percent citric acid was determined by titration to pH 8.3 with 0.1 N NaoH solution. Total soluble solids (TSS) were determined by using Belling Hamm Stanley refractometer.

At the end of the harvest season, dry matter content of leaves and stems of the plant were determined after drying in

a forced-draft oven at 65-70°C, then samples were taken and ground to pass a 40-mest screen. Samples were wet digested, total nitrogen was then determined by Micro-Kjeldhal method (Bremner, 1965) and phosphorous was determined by Olsen method.

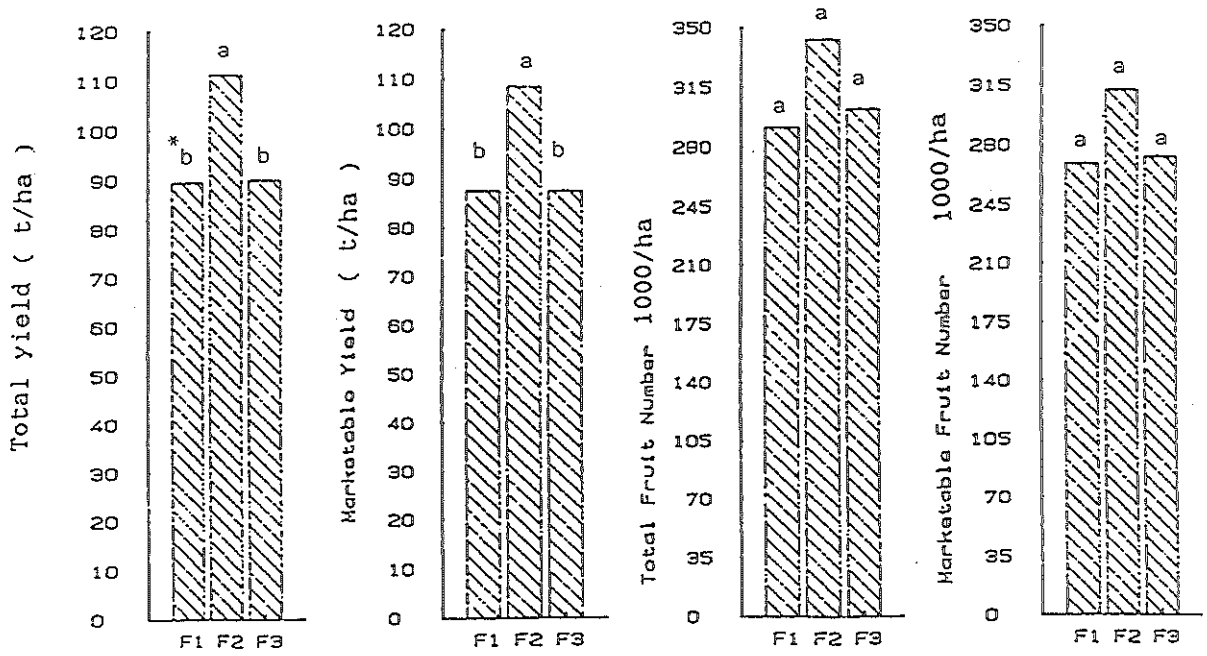
## RESULTS AND DISCUSSION

The effect of the fertilizer treatments on total and marketable fruit yield are presented in Figure 1. Fertilizer treatment $F_2$ was significantly higher for total yield (111.1 t/ha) and marketable yield (108.5 t/ha) as compared to that of $F_1$ and $F_3$ treatments. The total and marketable yields were 89.4 and 87.5 t/ha, respectively for $F_1$, and 89.9 and 87.5 t/ha, respectively for $F_3$ treatments. No significant differences between fertilizer treatments were detected in the number of total or marketable fruits over the season. $F_2$ treatment gave highest total fruit number ($856.8 \times 10^3$) and marketable fruit number ($780.3 \times 10^3$) per hectare. No significant difference was found with respect to weekly yield, except for the second week in which $F_3$ gave the highest yield (Fig.2).

The effect of the various fertilizer treatments on vegetative growth are shown in (Figure 3). Fertilizer treatment $F_2$ had the highest production of leaves, stems, and total vegetative growth, compared to the other two treatments.

High correlation was found between vegetative growth and total yield ($r = 0.90$), indicating that vegetative growth supported higher yield (Fig. 4).

Differences between fertilizer treatments may be due to different nitrogen uptake by plant under different treatments. However, in $F_2$ treatment nitrogen was applied at the time of irrigation or few days prior to irrigation, this resulted in possibly less volatilization of nitrogen when compared to $F_1$ and $F_3$ treatments. This result agrees with Fenn and Escarzaca, 1976, who found that urea resulted in greater nitrogen absorption by plants when applied to the surface of a soil wetted to saturation. Bar Yosef and Shilkoslami, 1979, showed that the maintenance of nutrients




* Means followed by the same letter in each treatment don't differ significantly at the 5% level according to DMRT.

Figure 1- Total and marketable yield, and total and marketable fruit number, under three nitrogen fertilizer treatments ($F_1$=4 weeks, $F_2$=2 weeks, and $F_3$=1 week) for tomato grown inside plastic house, in the Jordan Valley.

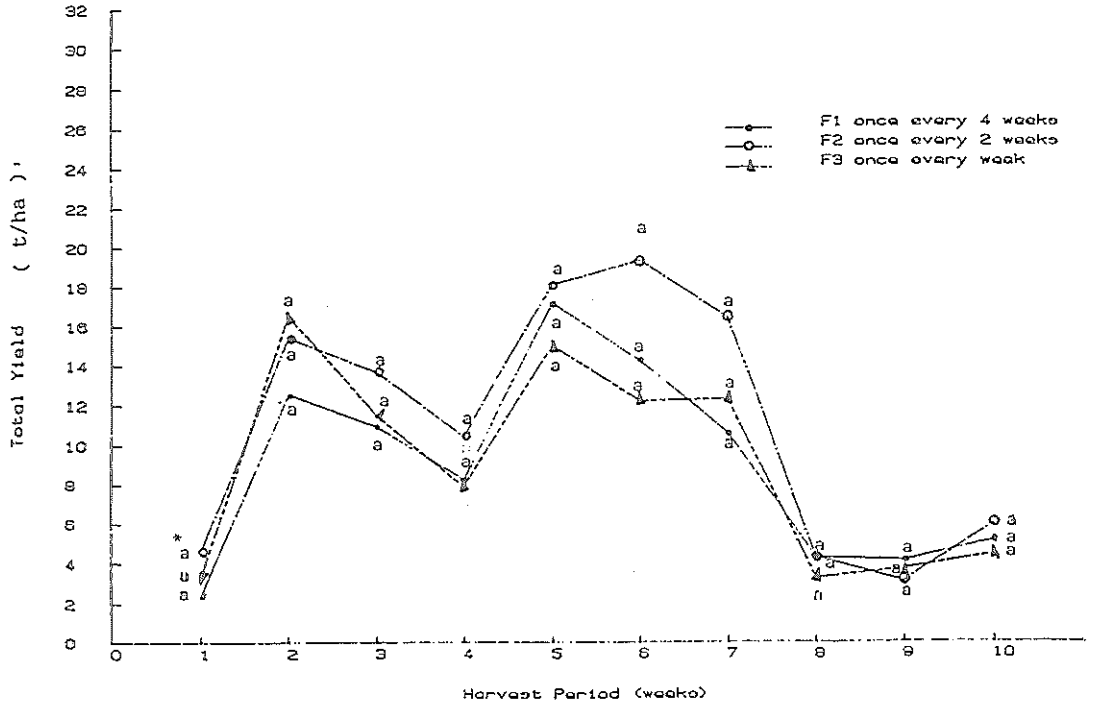



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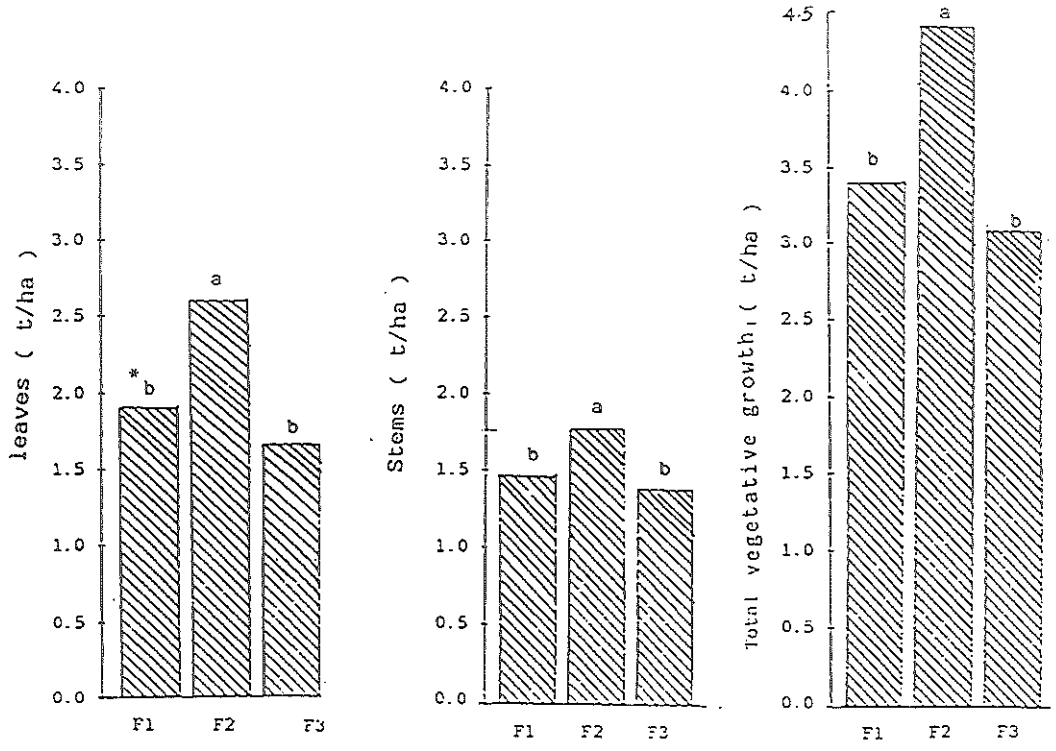
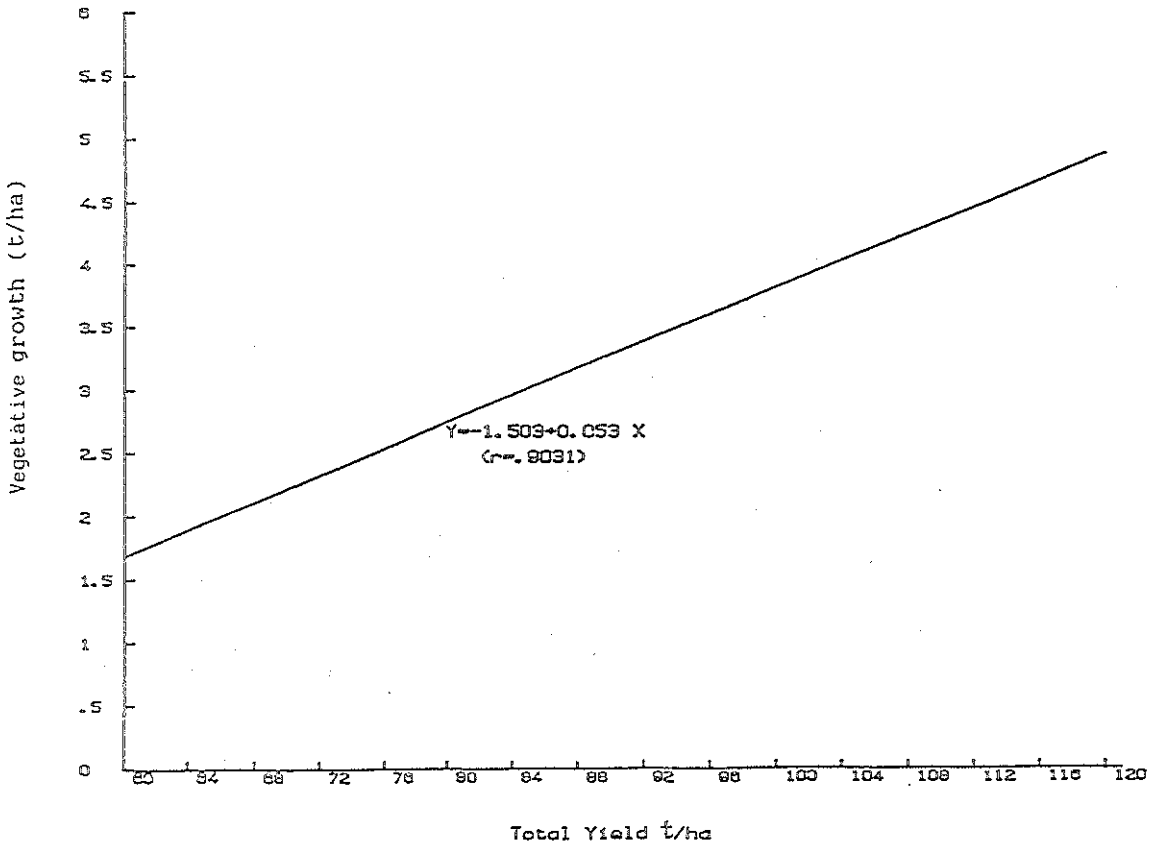
Figure 2- Total yield distribution under three nitrogen fertilizer treatments ($F_1$=4 weeks, $F_2$=2 weeks, and $F_3$=1 week) for tomato grown inside plastic house, in the Jordan Valley.

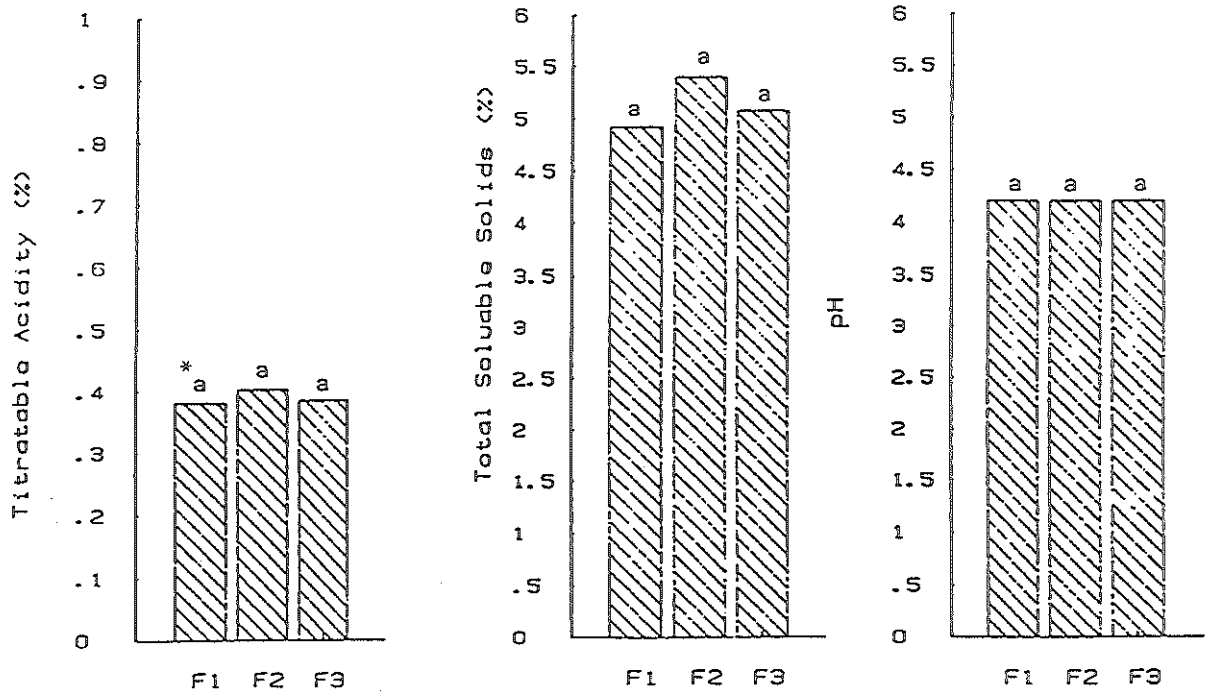



* Means followed by the same letter in each treatment dont differ significantly at the 5% level according to DMRT.

Figure 3- Dry weight of leaves, stems, and vegetative growth under three nitrogen fertilizer treatments ($F_1$=4 weeks, $F_2$=2 weeks, and $F_3$=1 week) for tomato grown inside plastic house, in the Jordan Valley.

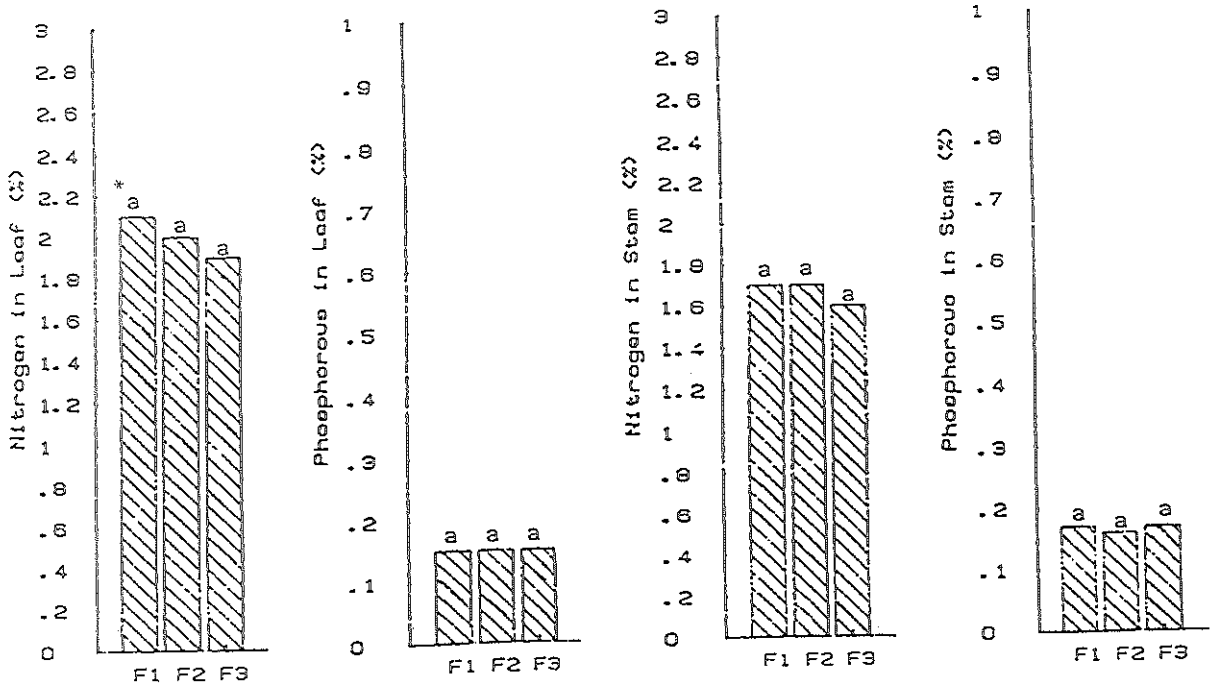



Figrue 4- Relationship between total yield and vegetative growth of tomatoes grown inside plastic house, in the Jordan Valley.




* Means followed by the same letter in each treatment don't differ significantly at the 5% level according to DMRT.

Figure 5 - Chemical properties of tomato fruits grown under three nitrogen fertilizer treatments ($F_1$=4 weeks, $F_2$=2 weeks, and $F_3$=1 week) for tomato grown inside plastic house, in the Jordan Valley.




* Means followed by the same letter in each treatment don't differ significantly at the 5% level according to DMRT.

Figure 6 – Nitrogen and phosphorus content in leaves and stems of tomato plants under three nitrogen fertilizer treatments ($F_1$=4 weeks , $F_2$=2 weeks, and $F_3$=1 week) for tomato grown inside plastic house, in the Jordan Valley.

within the sphere of plant roots with drip irrigation could be accomplished if proper rates and water application frequencies were used. In $F_1$ nitrogen fertilizer treatment, nitrogen was applied at two times, once every 4 weeks. This treatment may have resulted in higher nitrogen loss by volatilization, Later and Avnimelech, 1980, reported that drying and wetting cycle, induced a flush of microbial activity and thus inhanced denitrification. El-Khattari, 1983, also found that, the volatile nitrogen loss increased with time proportional to the application rate. Fenn and Kissel, (1974), and Chao and Kroontje, (1964), reported that total ammonia nitrogen losses increased when $NH_4$-N application rate was increased. In $F_3$ nitrogen fertilizer treatment, half of the total amount applied with irrigation water, and the other half was applied to the surface in water solution. However, possible volatilization $NH_4$-N losses from the second surface application may have occured.

Data on measured quality factors of tomatoes are presented in (Figure 5). There were no significant effects between nitrogen fertilizer treatments but the percent titratable acidity, and the percent soluble solids tended to increase under $F_2$ treatment.

In general, these results agree with findings of several workers, for example : Weight et al., (1962) whom reported that % TA was 0.44 - 0.47; % TSS was 5.75 - 5.58; and pH was 4.21 - 4.27.

Nitrogen and phosphorus percentage in leaves and stems did not show any significant difference between the three nitrogen fertilizer treatments (Fig.6).

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# أثر تعدد إضافات السماد النيتروجيني على إنتاج ونوعية البندورة المزروعة تحت بيوت بلاستيكية

ملخص :

أجريت هذه التجربة خلال موسم ١٩٨٤ لمعرفة تأثير مواعيد إضافة الأسمدة النيتروجينية على إنتاج ونوعية الثمار لمحصول البندورة تحت ظروف الزراعة المحمية في وادي الإردن .

دلت النتائج على أن معاملة إضافة السماد مره واحده كل إسبوعين قد تفوقت وبدلالة إحصائية من حيث الإنتاج الكلي والمسوق والنمو الخضري لدى مقارنتها بالتسميد مرة كل إسبوع ومر ة كل أربع أسابيع . هذا وقد بلغت الكمية الكلية من سماد النيتروجين ١٢٠كغم / هكتار لكل من المعاملات الثلاث .

كما دلت النتائج على عدم وجود فروقات ذات دلاله إحصائية بين معاملات إضافة الأسمدة النيتروجينية على درجة الحموضة المعايرة والمواد الصلبة الذائبة وكذلك محتوى الأوراق والسيقان من النيتروجين والفسفور .

بناء على ما تقدم ينصح بتسميد البندورة تحت ظروف مشابهه بالسماد النيتروجيني مره كل إسبوعين وبمقدار ٣٠ كغم نيتروجين للهكتار .