635,64:631.811.1:581.145.2:581.192:631.547.6:631.559

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SEASONAL CHANGES IN THE PHYSICAL AND CHEMICAL COMPOSITION OF TOMATO FRUITS AS AFFECTED BY NITROGEN LEVELS

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A great number of studies have been reported concerning the effect of different levels of nitrogen on growth and yield of tomato plants. However, much less attention has been given to the effect of nitrogen levels on growth and development of tomato fruits. The present investigation was designed to study the effect of different levels of nitrogen on the physical and chemical changes in 'Moneymaker' tomato fruits during growth and development.

Materials and Methods

This work, conducted in 1966 in the greenhouse of the Plant Physiological Research Laboratory, Agricultural University, Wageningen, Netherlands, utilized the gravel culture method. Three differenf levels of nitrate nitrogen (15.8, 12.9 and 1.0 milli-equivalents) were used as recommended by Steiner (3). The composition of these nutrient solutions is shown in Table 1.

Seeds of the tomato variety 'Moneymaker' were sown on ths 25th of April and transplanted on the 13th of May, 1966. The N level 12.9 mEq (considered as a normal nutrient solution) was used starting from transplanting until flower initiation. Then the three N levels were applied to 15 plants each starting June 6, 1966 and were renewed every week. Flowers were labelled for anthesis at two days intervals. Samples of 20 fruits each were first picked on August 10th, then after 25, 35, 45, 60 and 65 days. Soon after harvest the following determinations were made: Fruit weight, fruit size, percentage of dry matter, total sugars (5), crude proteins (2), and carotene and lycopene (6).

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Table 1. Composition of nutrient solutions.

mEq NO_3^-	15.8	12.9	1.0
Salts in mg/litre			
KH_2PO_4	63	63	63
$Ca(NO_3)_2 \cdot 4\,H_2O$	809	809	112
$MgSO_4 \cdot 7\,H_2O$	148	148	148
$Mg(NO_3)_2 \cdot 6\,H_2O$	233	233	–
KNO_3	408	108	–
KCl	–	221	301
$MgCl_2 \cdot H_2O$	–	–	185
$CaCl_2 \cdot 2\,H_2O$	–	–	434
Acids in ml/litre			
HNO_3 1 N	3.1	3.1	–
HCl 1 N	–	–	3.1

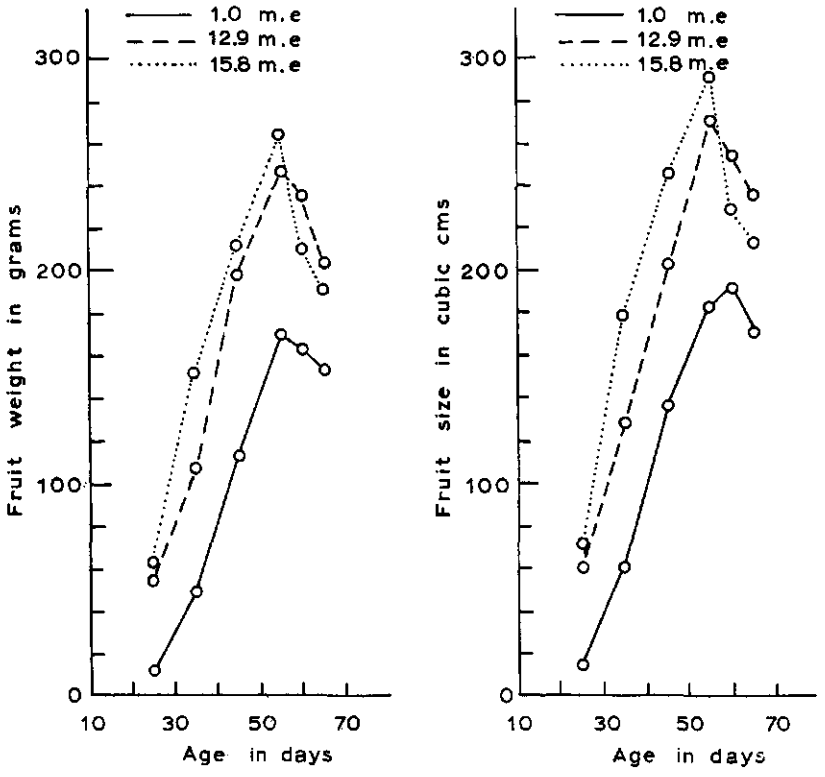

Fig. 1: Seasonal changes in weight and size of tomato fruits as affected by different levels of nitrogen.

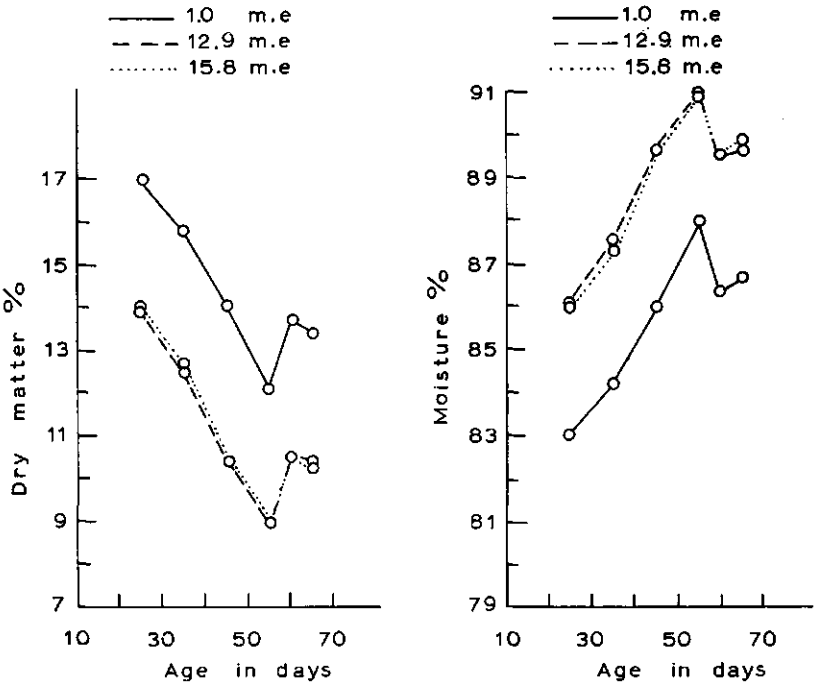

Fig. 2: Seasonal changes in dry matter and moisture percentages of tomato fruits as affected by different levels of nitrogen.

Results and Discussion

Fruit weight and size.

In all treatments fruits increased in weight and size up to 55 days of age which coincided with the turning stage. Fruits harvested after 60 and 65 days showed a relative decrease in weight and size. However, this may be due to smaller fruits harvested in the last two samples. Fruit growth in general increased with the increase in nitrogen level (Figure 1). The difference in effect between the lowest and the other two levels of N was much greater than between the medium and high N level. The effect of nitrogen on fruit growth could be correlated with its effect on plant growth in general.

Dry matter and moisture contents of fruits.

Seasonal changes in the dry matter percentage and moisture content of fruits followed an inverse pattern. Fruits from plants under the low N level were always higher in dry matter percentage than those from either medium or high N level, which did not differ much in this respect (Figure 2). This could be related to the fact that fruits from the low N level were always smaller and contained less juice than fruits from plants of the other two N levels.

Total sugars and crude proteins.

Total sugars as shown in figure 3 were significantly affected by N levels. They were always higher under the low N level compared with the other two levels. Furthermore, while under the medium and high N levels total sugars showed a. sudden decrease after 45 days of age, this did not occur under the low N level In this case, total sugars generally increased until the end of the experiment. The reason of the decrease occurring at 45 days of age for fruits under medium and high N levels could be attributed to the climacteric rise (increased respiratory activity) which took place in these fruits at this stage. These observations are supported by the findings of NEUBERT (1) who reported that high N application was associated with a decrease in monosaccarides. TAKAHASHI et al. (4) also found that deficiency of N, particularly in sand culture, reduced plant vigor and yield but increased the sugar content of fruits.

Fruits from plants treated with medium or high N levels were always much higher in their crude proteins content than those from plants under the low N level (Figure 3).

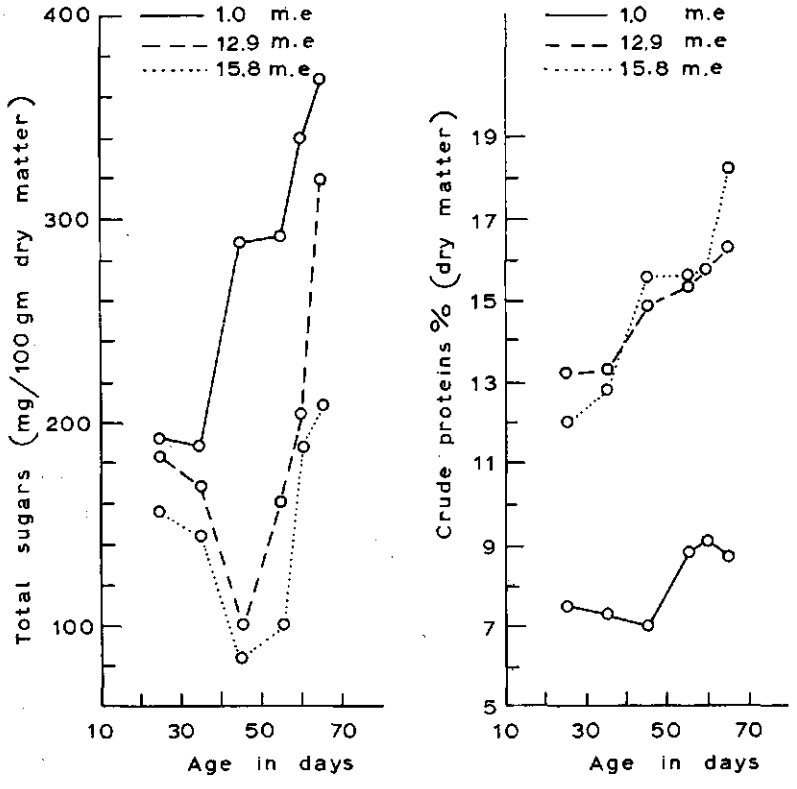

Fig. 3: Seasonal changes in total sugars and crude proteins of tomato fruits as affected by different levels of nitrogen.

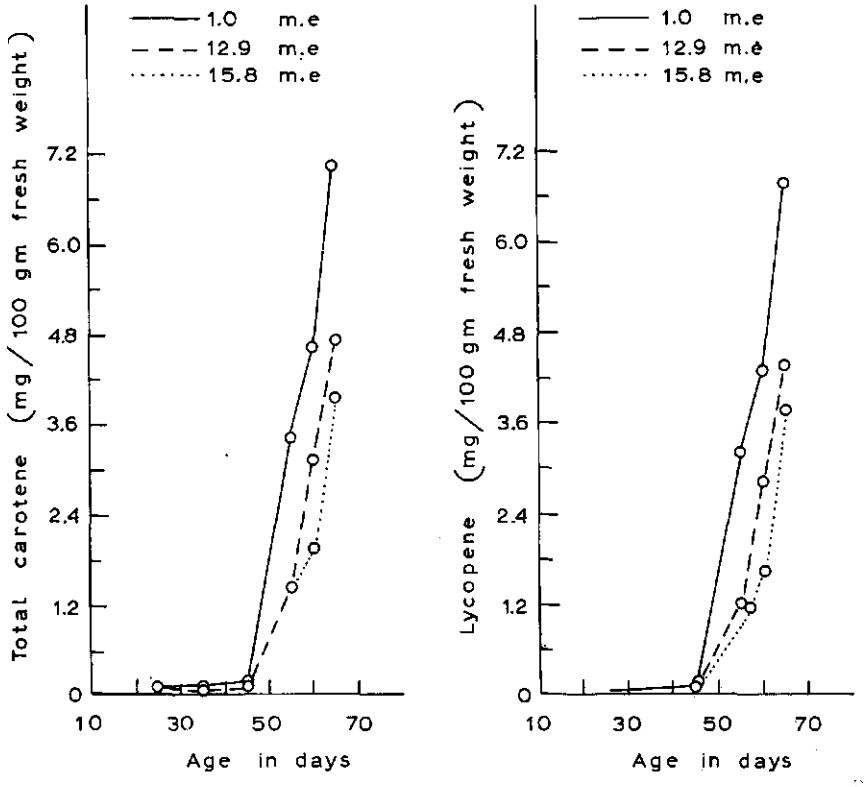

Fig. 4: Seasonal changes in total carotenes and lycopene of tomato fruits as affected by different levels of nitrogen.

The percent of crude proteins, in general, showed a gradual increase until the end of the experiment, which was clearer under both medium and high N levels. NEUBERT (1) found that high N applications caused an increase in total nitrogen. The increase in crude proteins is directly proportional to total N increase.

Carotene and lycopene percentage.

Fruits from plants under the low N level were faster and earlier in gaining both carotene and lycopene. They were higher also in their carotene and lycopene contents at the end of the experiment than those under the medium or the high N levels. In general as the N level increased the carotene and lycopene contents of the fruits decreased (Figure 4). TAKAHASHI and NAKAYAMA (4) reported similar results. They observed that N-deficient fruits were high in carotene and lycopene.

Summary

The present investigation was designed to study the effect of different levels of nitrogen on the physical and chemical changes in 'Moneymaker' tomato fruits during growth and development. It was noticed that fruit growth increased with the increase in nitrogen level and the difference in effect between the low and the other two levels of N was much greater than between the medium and the high N level. The fruits from plants under the low N level were always higher in their dry matter than those from either medium or high N levels and these last two N-levels did not differ much in this respect. Total sugars were always higher under low N level as compared with the other two levels. In general, total sugars increased till the end of the experiment and as the N level increased, total sugars decreased. Crude proteins content of fruits under either medium or high N levels were always much higher than those from the low N level. Fruits under the low N level were earlier and higher in gaining both carotene and lycopene than those under the medium or the high N levels. As the N level increased, the carotene and lycopene contents of the fruits decreased. It may be concluded that for good color in tomato fruits, the supply of N should be as low as possible without reducing fruit yield.

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