

# The Effects of Nitrogen Fertilization and Deficit Irrigation Practices on Tomato Growth and Chlorophyll Concentration

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**Abstract**—Irrigation and fertilization are absolutely necessary in order to increase productivity in agricultural production. Water is the most important source of life on the earth. All living things need absolute water so that they can continue plants life. The fact that the nutrients present in the soil can complete the natural cycle is completely dependent on the water cycle. Irrigation is the amount and time required for the root zone of the plant in soil, which is needed by the plant and cannot enough by precipitation in agriculture.

This study was carried out in the farmer's greenhouse conditions between 2004-2005 years. Three different doses of nitrogen (N<sub>1</sub>:75 ppm N, N<sub>2</sub>:150 ppm N, N<sub>3</sub>:225 ppm N) were applied to the tomato plant grown in the greenhouse. S<sub>1</sub>:100% full irrigation, S<sub>2</sub>:50% irrigation according to pot capacity. The study was based on a trial randomized block design with 3 replications. At the end of 2 years, the results gave us; the best plant growth was measured with N<sub>3</sub>S<sub>1</sub> an average height by 128 cm. The worst plant height was obtained from N<sub>1</sub>S<sub>2</sub> an average height by 88 cm. Plant body diameter has been found between 0,82cm and 0,54cm. Irrigation practices were more effective to total chlorophyll content than the fertilization practices. As a result, the deficit irrigation has also developed as well as full irrigation. Deficit irrigation and nitrogen fertilizer increased crop yield in arid regions. It is suggested that irrigation water can be reduced and adequate fertilization can be increased crop production in arid regions.

**Keywords**— Nitrogen Fertilization, Deficit Irrigation, Tomato, Chlorophyll Concentration.

## I. INTRODUCTION

Plants need water to grown in agriculture production. The process of photosynthesis uses water to make the building blocks of life for plants. Agriculture is the growing of plants for humans and animals. In crop agriculture, water is an important climatic factor. It affects or determines plant growth and development. It is availability, or scarcity, can mean a successful harvest, or diminution in

yield, or total failure. Irrigation typically doubles farm yields and the number of crops grown in one year is increased from 1 to 2. Precipitation mainly rainfall, liquid water is made available to plants as surface water, soil moisture, or groundwater. One of the primary ways in which humans use water is by planting important crops in places where they can capture natural rainfall as rain-fed agriculture. Some forms of agriculture, such as intensive rice and corn production, can be practiced only in rainy climates. Such agricultural forms are much more productive than others, such as cattle and sheep herding, which are usually relegated to semiarid climates. One of the primary reasons rain-dependent forms of agriculture are more productive than dry-land forms is that they have sufficient water to allow plants to grow to their maximum potential. Therefore, the most agriculturally productive regions of the world are all regions where natural rainfall is sufficient to allow rain-fed agriculture. Because agricultural crops are so dependent on water, purposely adding water, beyond what naturally falls as rain is widely practiced to increase agricultural production. This critical practice is known as irrigation. In the twentieth century, the practice of irrigation was greatly increased to provide food for the world's growing population. The main purpose of the irrigation is to reduce the minimum need of the plant. Water shortage may not always result in low productivity (Turner 1990). If irrigation water increases in given to the plant increases the vegetative growth but cannot increase the generative yield (Alvarez-Reyna 1991).

In every irrigated region, water supplies are a limitation on further expansion of irrigated agriculture. In many regions, renewable supplies have already been exceeded, resulting in falling groundwater levels and greatly reduced river flow. In some regions, the depletion of water resources due to irrigation has reached crisis proportions. These are all examples of the depletion of regional water resources by irrigated agriculture. Irrigation is generally defined as the provision of water, which is necessary for plant development but cannot be met by

natural means, to the soil without causing environmental problems. The amount of water to be given; irrigation time and number, soil structure, climatic conditions, slope of land, plant variety and age. (Kanber,1997). Water scarcity affects plants by reducing chlorophyll formation. This effect is due to the reduced ability of the stomata to diffuse and to chloroplasts and other cell organelles it arises. Decrease in the amount of leaf water accelerates the decomposition of chlorophyll, such as slowing down the synthesis rate.

Most arid countries also Turkey has need deficit irrigation in agricultural production. In this study were applied 3 doses of nitrogen fertilizer and 2 doses irrigation tomato plants grown in the greenhouse. At the end of 2 years, deficit irrigation treatments also showed good growth and development. There is an indirect effect on photosynthesis of partial water shortage due to imbalance caused by soil and ecological conditions at any time during the development of plant-water relationships.

## II. MATERIALS AND METHODS

This study has taken place in the province of ŞanlıurfaHarran Region, latitude 37 ° 07 '30" North, longitude 39 ° 15' 00" East and 530 meters above sea level and is located in the Harran Plain in Turkey. The average rainfall is being carried out the study received a total of 322 mm in the study area (Anonim, 2006). This shows that, for the deficit irrigation research is needed in this area. This study has been carried out in the farmer's greenhouse. This research was set up to randomized block design with 3replication. Domestic tomato seeds are used. Each of 5-liter pots 1:1ratios were filled with soil material and sand. 1 plant per pot was grown well developed. Irrigation was determined as 100% and 50% according to field capacity. The fertilization was determined 75 ppm N, 150 ppm N, and 225 ppm N. Ammonium sulfate (21%N) was used as the nitrogen source. Irrigation water is determined according to the pot capacity. The pots were weighed every three days and the reduced water was completed according to the pot capacity. After 10 weeks from sowing, all measurements were made and the plants were harvested. These measurements continued for two years.

Plant height was measured. Chlorophyll determination has been made. It was calculated by these formulas. Chlorophyll a:  $11.64x (A663) - 2.16x (A645)$ ,

Chlorophyll b:  $20.97x (A645) - 3.94x (A663)$  (Strain and Svec).

Tarist statistical program was used. It is grouped according to LSD test (Açıközve ark. 1994).

## III. RESULTS AND DISCUSSION

In this study carried out as a pot experiment, the tomato plant was applied deficit irrigation and different doses nitrogen fertilizer. As a result of this study, it was concluded nitrogen fertilization can be done together with the deficit irrigation. Such agricultural production can be applied in arid and semi-arid regions. We were applied % 100 irrigation and 225 ppm N fertilizer was the best plant height was average 118 cm from N<sub>3</sub>S<sub>1</sub>. The minimum height was determined average 88cm with deficit irrigation and 75 ppm N application (Table 1).

Table.1: Average Plant Height (cm) under Different Treatments

Fertilizer	Irrigation I (%100)	Irrigation II (%50)
N <sub>1</sub> (75 ppm N)	104	88
N <sub>2</sub> (150 ppm N)	110	103
N <sub>3</sub> (225 ppm N)	118	108

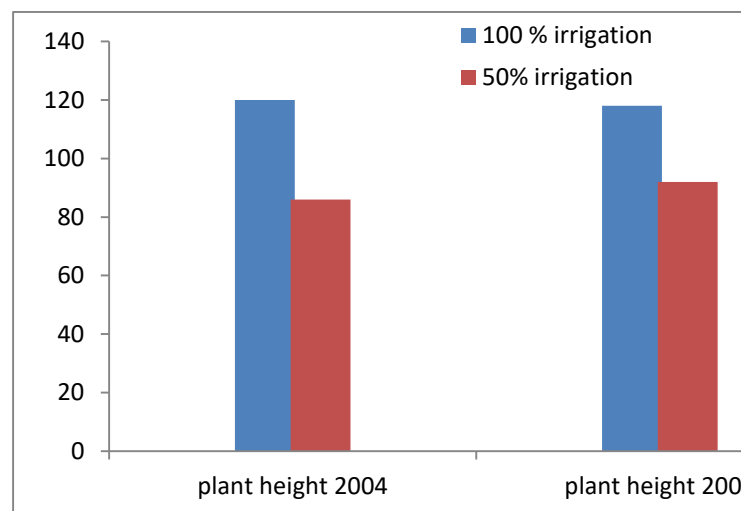


Fig.1: Irrigation - Plant Height Relation

Plant height was determined mean 120cm by 100% irrigation, while 86cm by 50% irrigation in 2004. Irrigation supported plant development. Plant height increased with irrigation water.

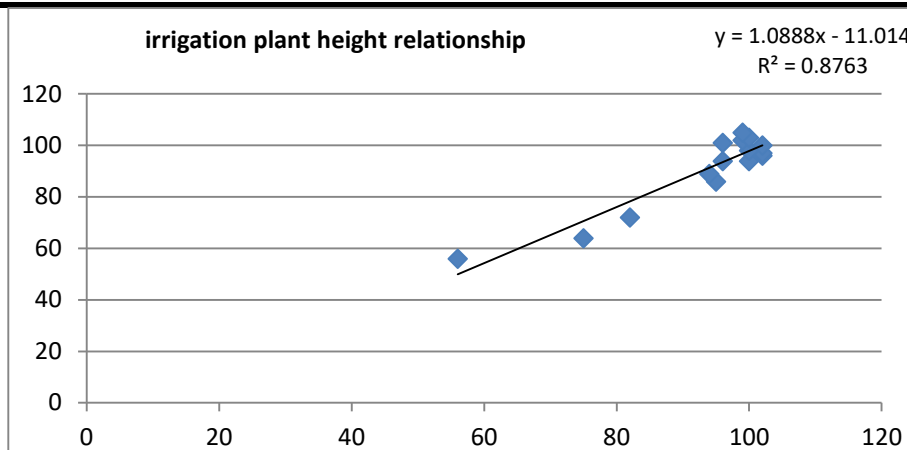


Fig.2: Irrigation and Plant Height Relation

The effects of doses of N2 and N3 on plant height were similar (Fig 3). Intermediate dose N in the study supported the growth and development of the plant. This result reveals that the plant will reach a sufficient level, even if the fertilizer is not used in excess.

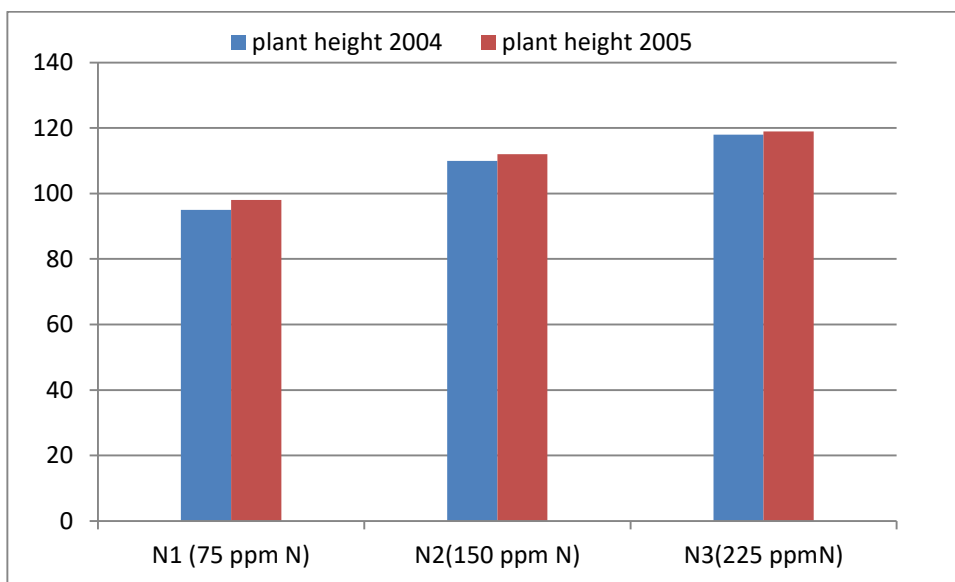


Fig.3: Fertilization Plant Height Relation

Plant body diameters were determined along two research year. Fertilization was found to be more effective on plant stem diameter growth (Table2).

Table.2: Average Plant Body Diameter (cm)

Fertilizer	Irrigation I (% 100)	Irrigation II (% 50)
N <sub>1</sub> (75 ppm N)	0,56c	0,54c
N <sub>2</sub> (150 ppm N)	0,65b	0,67b
N <sub>3</sub> (225 ppm N)	0,82a	0,78a
LSD(% 5):0.912		

\*There was no difference between the averages in the same letter group

The highest amount of chlorophyll was found in 25 mMNaCl and it was found that this value decreased with increasing amount of salt (Acaret al.2011). Iron deficiency reduces the amount of chlorophyll a and b. Most researchers have reported plant-feeding chlorophyll association (KacarveKatkat, 2009).Leaf chlorophyll-a,

chlorophyll-b and total chlorophyll levels were reduced by restriction of the water given to the plants (Kaynaş and Eriş 1998).the values of leaf chlorophyll content were found higher in plants irrigated at frequent intervals, and the decrease in leaf chlorophyll content decreased as the irrigation intervals increased.

Table.3: Mean Total Chlorophyll Content of Leaf (mg/ml)

Fertilizer	Irrigation I (%100)	Irrigation II (%50)
N <sub>1</sub> (75 ppm N)	2.12c	1.14d
N <sub>2</sub> (150 ppm N)	3.64b	1.63d
N <sub>3</sub> (225 ppmN)	4.12a	2.37c
LSD(%5):1.05		

\*There was no difference between the averages in the same letter group

Some researchers have reported that fertilization practices increase chlorophyll concentration in plants (Abdalla and Abdelwahab 1995), (Sangakkara et al. 1996), (Güneş and Aktaş 2004). Iron is not involved in the chlorophyll structure, but there is a close relationship between the iron nutrition of the plant and chlorophyll content. There is a close relationship between adequate and inadequate iron feeding and chlorophyll coverage (Aktaş, 1994).

#### IV. CONCLUSIONS

N fertilization applied to tomato plants at different doses, results in full irrigation and partial irrigation applications higher plant height, best plant body diameter and highest chlorophyll formation has determined from 225ppmN and full irrigation treatments. As the amount of irrigation decreased, the plant height decreased. As plant development slowed, the trunk diameter decreased. As the amount of water given decreases, the formation of chlorophyll decreases. In areas with water scarcity and semi-arid, irrigation can be carried out to support the development of the plant and the chlorophyll formation with N fertilization as needed.

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