WATER UTILIZATION OF VEGETABLES GROWN UNDER PLASTIC GREENHOUSE CONDITIONS IN ANKARA USING NEUTRON PROBE TECHNIQUE

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ABSTRACT

In order to find suitable varieties of tomato, pepper and cucumber for plastic greenhouse conditions in Ankara and ensure both higher yields and lower NO_3 leaching greenhouse experiments were conducted for three years. In the first year (2001) of the experiment four different varieties from each vegetable, namely, Tomato (Ecem F_1, 9920 F_1, 2116 F_1 and Yazgı F_1), Cucumber (Hızır F_1, Rapido, Hana, and Luna) and Pepper (1245 F_1, 730 F_1, Serademre 8 and 710 F_1) had been grown in the plastic greenhouse using drip irrigation-fertigation system. Yazgı F_1 variety for tomato, Hızır F_1 variety for cucumber and Serademre 8 variety for pepper were chosen to be the suitable varieties to grow in the plastic greenhouse conditions in Ankara.

One access tube in each N_3 and N_0 treatment plots of tomato, cucumber and pepper in 2002 and 2003 experiments were installed for the soil moisture determinations at 30, 60 and 90 cm depths. Readings with the neutron probe were taken before planting and after harvest for the water consumption calculations using the water balance approach and the WUE was calculated on the basis of the ratio of dry matter weight to the amount of water consumed.

Tensiometer and suction cups were installed at 15, 30, 45 and 60 cm depths only to N_1, N_2 and N_3 treatments plots of each vegetable in 2002 and 2003. Tensiometer readings were taken just before irrigation. Also, soil solution samples from suction cups were taken at final harvest and NO_3 determinations were done with RQFLEX nitrate test strips.

Significantly higher yields and WUE values were obtained when the same amount of N fertilizer is applied through fertigation compared to the treatment where N fertilizer applied to the soil then drip irrigated. The nitrate concentrations of the soil solution increased as the N rates increased and no NO_3 had been found in the soil solution taken from 75 cm soil depth, indicating that no leaching of N fertilizer occurred beyond 75 cm soil depth.

INTRODUCTION

The plants can use nitrogen easily and more efficiently if they can exist at optimum levels in the effective root zone of the plants. Drip irrigation-fertigation is the system that can provide both nitrogen and water at desired levels and conditions in the root zone. Both yields, nitrogen and water use efficiencies can be increased by drip irrigation-fertigation [1,2,3]. This system was applied as a sensible method of supplying water and nitrogen inside the greenhouse [2,3]. Plastic greenhouses without heating systems had been widely used in the Mediterranean and Agean Sea Regions of Turkey successfully during the last decade for drip irrigated–fertigated vegetable production [3]. However, plastic greenhouses are recently had being used for vegetable production at temperate locations of Central Anatolia, like Ankara, without the need of any additional heating in cool weather (early April – late October). In general, open field vegetables are produced and sent to market in mid-July in Ankara. To grow vegetables earlier then July in Ankara climatic conditions will be an extra income to the farmers due to selling their vegetables for higher prices.

In this report water use efficiencies of tomato, cucumber and pepper under conventional N fertilizer application and N fertigation was compared.

MATERIAL AND METHODS

The detailed ''material and methods'' of this research is given in [4]. Additional specifications are as follows: a) Including fertigation and no fertigation irrigation treatments,

totally, 1700, 1020 and 1460 mm of water in year 2002 and 1600, 1180 and 1340 mm of water in year 2003 was applied during the growth period for tomato, cucumber and pepper, respectively. b) Soil samples from 0-90 cm depth, with 30 cm increments were taken after final harvest and % N, % ^{15}Ndff (nitrogen derived from fertilizer) determinations carried out. c) Tensiometer and suction cups were installed at 15, 30, 45 and 60 cm depths only to N_1, N_2 and N_3 treatments plots of each vegetable in 2002 and 2003. Tensiometer readings were taken just before irrigation. Also, soil solution samples from suction cups were taken at final harvest and NO_3 determinations were done with RQFLEX nitrate test strips. d) One access tube in each N_3 and N_0 treatment plots of tomato, cucumber and pepper in 2002 and 2003 experiments were installed for the soil moisture determinations at 30, 60 and 90 cm depths. Readings with the neutron probe were taken before planting and after harvest for the water consumption calculations using the water balance approach and the WUE was calculated on the basis of the ratio of dry matter weight to the amount of water consumed.

RESULTS AND DISCUSSION

Two year average values of total dry matter yields and water use efficiency (WUE, kg dry matter/ha. mm) values for tomato variety Yazgı F_1, cucumber variety Hızır F_1 and pepper variety Serademre 8 at different N rates are given in Table 1.

Significantly higher total dry matter yields and WUE values were obtained from N_3 treatments for tomato and cucumber, but from N_2 treatment for pepper. For all three vegetables the lowest total dry matter yields and WUE values were obtained when no N fertilizer applied (N_0 treatment). Also, significantly total dry matter yields and WUE values were obtained when same amount of N fertilizer (N_2 treatment) is applied through fertigation compared to the treatment where N fertilizer applied to the soil then drip irrigated (N_{soil} treatment).

Table 1. Two years average total dry matter yields and WUE values of vegetables grown at different N treatments under plastic greenhouse conditions.

	N Rates				
	N_0	N_1	N_2	N_3	N_{soil}
TOMATO (Yazgı F_1)					
Total Dry Matter Yields (kg/ha)	10003 c	11681 b	11692 b	12383 a	11402 b
WUE (kg dry matter/ha . mm)	6.06 c	7.07 b	7.08 b	7.68 a	6.91 b
CUCUMBER (Hızır F_1)					
Total Dry Matter Yields (kg/ha)	7937 d	9797 c	10301 b	10535 a	10130 b
WUE (kg dry matter/ha. mm)	7.21 c	8.90 b	9.36 a	9.57 a	9.20 ab
PEPPER (Serademre 8)					
Total Dry Matter Yields (kg/da)	8155 d	10736 c	13175 a	12478 b	10860 c
WUE (kg dry matter/ha . mm)	5.82 c	7.66 b	9.41 a	8.91 a	7.75 b

* Values followed by the same letter within a row are not significantly different at 0.05 levels according to LSD analysis.

Higher average soils % Ndff (nitrogen derived from fertilizer) values were obtained under different vegetables as the N rate increased. Generally, lower % Ndff values are obtained as the soil depth increased and no labeled N was detected in the soil samples taken from 60-80 cm depth. The % Ndff values obtained for the conventional N-fertilizer application treatment (N_{soil}) were higher than the same amount of N-fertilizer applied through fertigation (N_2), which showed that with fertigation treatment less N fertilizer was leached.

When average nitrate concentrations (ppm NO_3) in soil solutions taken at different depths, N rates and times for different vegetables grown are evaluated it was observed the nitrate concentrations increased as the N rates increased and no NO_3 had been found in the soil solution taken from 75 cm soil depth.

Tensiometer and neutron probe readings for each vegetable were taken at different soil depths just before each irrigation in 2002 and 2003 experiments; the suction, in mbar, that water held by the soil and soil moisture content, in mm, were calculated. Highest tensiometer readings were obtained for 15 cm soil depth for tomato and pepper, except in early August for which the highest was obtained for 30 cm soil depth. Tensiometer readings taken from 45-60 cm soil depth did differ very little, which can be seen from the figures, indicated that almost no water movement had occurred below 60 cm depth.

For tomato soil moisture content at different depths and rates (N_0 and N_3 fertilizer treatments) showed very little differences monthly, although the total moisture content in the 0-90 cm soil profile showed considerable differences. However, for cucumber and pepper soil moisture contents at different depths and rates (N_0 and N_3 fertilizer treatments) showed considerable differences monthly beside the total moisture content in the 0-90 cm soil profile.

CONCLUSION

Significantly higher yields and WUE values were obtained when the same amount of N fertilizer is applied through fertigation compared to the treatment where N fertilizer applied to the soil then drip irrigated. The nitrate concentrations of the soil solution increased as the N rates increased and no NO_3 had been found in the soil solution taken from 75 cm soil depth, indicating that no leaching of N fertilizer occurred beyond 75 cm soil depth.

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NITROGEN UTILIZATION OF VEGETABLES GROWN UNDER PLASTIC GREENHOUSE IN ANKARA CONDITIONS USING ^{15}N TECHNIQUE

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ABSTRACT

In order to find suitable varieties of tomato, pepper and cucumber for plastic greenhouse conditions in Ankara and eventually to identify the best N fertilizer rate greenhouse experiments were conducted for two years. Yazgı F_1 variety for tomato, Hızır F_1 variety for cucumber and Serademre 8 variety for pepper were chosen to be the suitable varieties to grow in the plastic greenhouse conditions in Ankara.