



YIELD, NITROGEN UPTAKE AND NITROGEN USE EFFICIENCY BY TOMATO, PEPPER, CUCUMBER, MELON AND EGGPLANT AS AFFECTED BY NITROGEN RATES APPLIED WITH DRIP-IRRIGATION UNDER GREENHOUSE CONDITIONS

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Abstract

A number of experiments were conducted to investigate the influence of different N rates applied through drip irrigation on the growth and N uptake by tomato, pepper, cucumber, melon and eggplant under greenhouse conditions. It was found that, for tomato, the % NUE was significantly increased by applying the N fertilizer through fertigation (53.9 %) as compared to the soil application (34.0 %) at 100 mg N/L. In general, any further increase of N fertilizer did not have an improving effect on the tomato yield. With pepper, the % NUE was significantly increased by applying the N fertilizer in the irrigation water (49.2%) as compared to the soil application (33.9 %) at the same N level (140 mg N/L), being the optimum N rate under our greenhouse conditions. At a fertilization level of 100 mg N/L with fertigation, the % NUE was significantly increased as compared to the soil application. With respectively cucumber, melon and eggplant; the % NUE with fertigation was 63.4, 21.4 and 50.8 %, while with soil application it was 34.0 11.0 and 18.8 %.

1. INTRODUCTION

The maintenance of nutrients and water at optimum levels within the rhizosphere of plants is a primary factor for achieving higher yields, and increased fertilizer and water use efficiencies. Therefore, the application of water soluble fertilizers through the irrigation stream — fertigation — mainly with drip irrigation became a common practice in modern irrigated agriculture especially under greenhouse conditions [1,2,3,4,5].

Fertigation is widely practised for greenhouse vegetable production especially in the Antalya region of Turkey. However, further research is needed for a better understanding of this approach. Therefore, the objective of this study was to determine the effects of N fertilizer rates on yield, N uptake and nitrogen use efficiency of tomato, pepper, cucumber, melon and eggplant produced under greenhouse conditions using ¹⁵N labelled fertilizer and drip irrigation techniques.

2. MATERIAL AND METHODS

Eight experiments (3 with tomato, 2 with pepper, 1 with cucumber, melon and eggplant) were conducted on a Mediterranean Terrarosa soil (53% sand, 13% silt and 34% clay) in the greenhouse of the Antalya Horticultural Research Institute, at different times. The soil used in the experiments had a pH of 7.5 and contained 1.08% organic matter, 10 ppm of NaHCO₃-extractable phosphorus and 396 ppm of exchangeable potassium. The irrigation water used in the experiments had an EC value of 0.73 dS/m and contained (in meq/L): Ca=5.86, Mg=0.26, Na=0.37, HCO₃=0.58, SO₄=5.87 and Cl=0.85.

The experiment consisted of four randomized blocks; each divided into five plots (for tomato, pepper and cucumber) or six plots (for melon and eggplant). Each plot was 3.6 m wide and 3.63 m

long and contained four plant rows of which the two center rows were used for the harvest. Informative data about the experiments conducted are given in Table I.

The N application was done by drip irrigation. The drippers (one per plant) were spaced at 33 cm. The fertilizer N (ammonium sulphate) rate used was respectively 0, 50, 100, 150 mg N/L for spring and whole season tomato, spring 1996 cucumber, melon and eggplant, 0, 67, 134 and 201 mg N/L for spring 1994 tomato and pepper, and 0, 70, 140, 210 mg N/L for whole season pepper. In addition, soil applications of ammonium sulphate at a rate of 300 kg N/ha (1/3 before planting + 2/3 during the growth stages) and a slow release N fertilizer (of which, 300 kg N/ha was applied to the plots before planting) were carried out as treatments for tomato, pepper and cucumber and were applied in 3 equal portions at planting, initiation of flowering and fruit setting. They were also drip irrigated. Furthermore, for melon and eggplant slow release urea (400 kg N/ha) was also included as a treatment and it was mixed with the soil before planting. Phosphorus as H_3PO_4 and K as K_2SO_4 were applied through the irrigation system at rates of 60 and 180 mg/L, respectively.

^{15}N isotope sub-plots were established in each plot of each experiment. Therefore, the drippers of the three adjacent plants in the second row of each plot were blocked and respectively, 3.3% ^{15}N a.e. in the 1994 experiments and 2.0% ^{15}N a.e. in the 1995, 1996 and 1997 experiments were applied by using inverted bottles.

The amount of water to be applied for each experiment was calculated according to Class A Pan using the procedures described by [6].

Harvested plants were separated into stem + leaves and fruit for tomato, pepper, cucumber, into stem, leaf, fruit skin, fruit and seed for melon, leave, stem and fruit for the eggplant. They were dried at 70⁰ C and ground. Total N determinations were done on these samples using the micro Kjeldahl method and the ^{15}N analyses were done using a Jasco-150 emission spectrometer according to [7].

3. RESULTS AND DISCUSSION

Dry matter (t/ha), total N uptake (kg N/ha), Ndff (%) and Ndff (kg N/ha) for the different parts of each crop as influenced by the applied N rates are given in the a, b, c and d section of every table, respectively. In the e section of each table the averaged total marketable yield (t/ha), NUE (%) and WUE (kg/ha-cm) as influenced by the applied N rates are given in addition to the averaged total yield, N uptake and Ndff data. They also include the results of the statistical analyses made.

3.1. Tomato

The results of the spring 1994, spring 1995 and whole season tomato experiments are given in Tables II, III and IV, respectively. The whole season grown tomato gave a higher total dry matter contents, higher % Ndff and % NUE values and lower WUE values as compared to spring tomato. The lowest marketable and dry matter yields and the lowest total N uptakes were obtained with the control treatments (0 mg N/L), while the highest values were obtained with 100 mg N/L).

The fertilizer N uptake and % NUE by the tomato plant were significantly increased when the N fertilizer was applied in the irrigation water (fertigation) as compared to the soil N application at the same level.

3.2. Pepper

The results of the spring 1994 and whole season pepper experiments are given in Tables V and VI, respectively. The whole season grown crop gave lower marketable yields and WUE values, but higher total dry matter, % Ndff, and % NUE values as compared to the spring grown crop. The lowest marketable yields, dry matter yields and total N uptakes were obtained from the control treatments (0 mg N/L). Total dry matter and total N uptake by pepper were not significantly

influenced by the N rates. However, the fertilizer N uptake and % NUE were significantly increased with fertigation as compared to the soil application at the same level.

3.3. Cucumber

The results of the experiment conducted with cucumber are given in Table VII. The lowest marketable and dry matter yields for cucumber were obtained with the control treatment (0 mg N/L), while significantly higher yields were obtained at the optimum N rate, 140 mg N/L, applied to the soil rather than through fertigation. However, the soil application treatment gave significantly lower % Ndff, % NUE and % WUE values as compared to the other N treatments.

3.4. Melon

The results of the experiment conducted with melon are given in Table VII. The lowest marketable and total dry matter yields were obtained with the control treatment (0 mg N/L), while the highest yields were found with the 150 mg N/L fertigation treatment. Lower yields were obtained when the N fertilizer was applied to the soil rather than into the irrigation water (fertigation). The amount of N uptake increased as the N rate increased. The N uptake values obtained from the soil applications were found to be lower than the fertigation treatments. The highest total N uptake occurred at the highest N rate (150 mg N/L). Although the same amount of N fertilizer was applied with the soil application treatment, lower fertilizer N uptake values were obtained with the soil application treatment as compared to the N₂ (100 mg N/L) fertigation treatment.

The fertilizer N uptake and % NUE were significantly increased with fertigation compared to the soil application of N and the application of slow release N fertilizer at the same level of fertilization. The % NUE changed according to the N rate and N application method. In general, as the N rate increased the % NUE values decreased as expected.

3.5. Eggplant

The results of the experiment conducted with eggplant are given in Table VII. The lowest marketable and dry matter yields were obtained with the control treatment (0 mg N/L), while the highest marketable yield was found with 150 mg N/L. The highest dry matter yield was obtained with 100 mg N/L when the slow release N fertilizer was applied.

The fertilizer N uptake and % NUE were significantly increased with fertigation as compared to the soil application treatment at the same level of fertilization.

4. CONCLUSIONS

From the three experiments, it can be concluded that, for tomato, the % NUE was significantly increased by applying the N fertilizer through fertigation (53.9 %) as compared to the soil application (34.0 %) at 100 mg N/L. In general, any further increase of N fertilizer did not have an improving effect on the tomato yield.

On average of the two experiments with pepper, the % NUE was significantly increased by applying the N fertilizer in the irrigation water — fertigation — (49.2 %) as compared to the soil application (33.9 %) at the same N level (140 mg N/L), being the optimum N rate under our greenhouse conditions.

At a fertilization level of 100 mg N/L, the % NUE was significantly increased as compared to the soil application. With respectively cucumber, melon and eggplant; the % NUE with fertigation was 63.4, 21.4 and 50.8 %, while with soil application it was 34.0 11.0 and 18.8 %. ^{xx} Total amounts of N applied were 200, 400 and 600 kg N/ha, for 50, 100 and 150 mgN/L treatments, respectively.

TABLE I. TIME TABLE AND CHARACTERISTICS OF THE CONDUCTED EXPERIMENTS

Plant type (mm)	Variety Used	Planting date	First fruit picking	Harvesting date	Water applied
Spring 1994 Tomato Lycopersicon esculentum Mill	Sander	25 Feb. 1994	12 May 1994	4 July 1994	392
Spring 1995 Tomato Lycopersicon esculentum Mill	Sander	31 Jan. 1995	8 May 1995	3 July 1995	345
Whole season Tomato Lycopersicon	Fantastic F144	10 Oct. 1994	16 Feb. 1995	25 May 1995	1427
Spring Pepper Capsicum annum	Dora	25 Feb. 1994	12 May 1994	4 July 1994	392
Whole season Pepper Capsicum annum	Dora	10 Sep. 1994	2 Nov. 1994	20 April 1995	260
Whole season Cucumber Cucumia salivus	Yerli	15 Oct. 1995	13 Nov. 1995	25 April 1996	325
Melon Melopeon L.	Polidor F1	28 Feb. 1997		30 July 1997	200
Eggplant Solanum melongena	Faselis F1	3 Sep. 1997	1 Dec. 1997	15 June 1998	435

TABLE IIa. DRY MATTER YIELD OF SPRING 1994 TOMATO (t/ha)

	Nitrogen rate (mg N/L)				Soil application
	0	67	134	201	134
Stem + Leaves	5.2	5.5	4.8	5.0	5.7
Fruit	4.0	6.1	6.5	5.7	6.1

TABLE IIb. TOTAL N UPTAKE BY TOMATO (kgN/ha)

	Nitrogen rate (mg N/L)				Soil application
	0	67	134	201	134
Stem + Leaves	59.8	91.9	93.8	103.2	88.7
Fruit	74.9	134.5	139.4	114.2	121.4

TABLE IIc. % Ndff BY TOMATO

	Nitrogen rate (mg N/L)				Soil application
	67	134	201	134	134
Stem +Leaves	51.0	57.6	57.4	50.7	50.7
Fruit	58.3	56.3	62.0	32.2	32.2

TABLE IIId. FERTILIZER N UPTAKE BY TOMATO (kg N/ha)

	Nitrogen rate (mg N/L)			Soil application
	67	134	201	134
Stem + Leaves	46.9	54.2	59.6	45.4
Fruit	78.3	77.4	71.0	39.1

TABLE IIe. AVERAGED TOTAL MARKETABLE AND DRY MATTER YIELDS, TOTAL N, Ndff, %NUE, AND WUE OF SPRING TOMATO (1994)

Tomato	Nitrogen rate ^{xx} (mg N/L)				Soil appl.
	0	67	134	201	134
Marketable yield (t/ha)	75.5c ^x	97.8a	96.3a	87.0b	95.6ab
Total D.M. (t/ha)	9.2b	11.7a	11.3a	10.5ab	11.9a
Tot. N (kg N/ha)	135.9c	226.3a	233.2a	217.3ab	210.1b
% Ndff	-	54.7a	57.0a	59.7a	41.4b
Total Fert. Uptake (kg N/ha)	-	123.9a	132.9a	129.7a	87.0b
% NUE	-	62.0a	33.2b	21.6c	21.8c
WUE (kg/ha-cm)	235.1d	245.8dc	297.4a	276.3b	253.7c

^x Values in rows followed by the same letter are not significantly different at the 0.05 probability level.

^{xx} Total amounts of N applied were 200, 400 and 600 kg N/ha for 67, 134 and 201 mg N/L treatments, respectively.

TABLE IIIa. DRY MATTER YIELD OF SPRING 1995 TOMATO (t/ha)

	Nitrogen rate (mg N/L)				Soil application
	0	50	100	150	100
Stem + Leaves	5.7	5.0	4.9	4.9	5.3
Fruit	3.5	5.0	6.5	6.0	6.0

TABLE IIIb. TOTAL N UPTAKE BY TOMATO (kg N/ha)

	Nitrogen rate (mg N/L)				Soil application
	0	50	100	150	100
Stem + Leaves	55.9	83.3	89.8	97.6	93.7
Fruit	58.4	97.1	160.1	128.4	130.2

TABLE IIIc. % NDFB BY TOMATO

	Nitrogen rate (mg N/L)			Soil application
	50	100	150	100
Stem + Leaves	56.8	73.6	75.4	51.9
Fruit	62.0	81.8	87.7	61.3

TABLE IIIId. FERTILIZER N UPTAKE BY TOMATO (kg N/ha)

	Nitrogen rate (mg N/L)			Soil application
	50	100	150	100
Stem + leaves	47.6	66.0	73.0	47.4
Fruit	59.5	130.6	112.3	74.8

TABLE IIIe. AVERAGE TOTAL MARKETABLE AND DRY MATTER YIELD, TOTAL N, Ndff, %NUE AND WUE OF SPRING TOMATO (1995)

Tomato	Nitrogen rate ^{xx} (mg N/L)				Soil appl.
	0	50	100	150	100
Marketable yield (t/ha)	66.0c ^x	92.3b	112.3a	94.3b	97.1b
Total D.M. (t/ha)	9.2c	9.9b	11.4a	11.0a	11.3a
Tot. N (kg N/ha)	114.2c	180.3b	249.9a	226.0a	223.9a
% Ndff	-	59.4b	77.7a	81.5a	56.9b
Total Fert.Uptake(kg N/ha)	-	107.1c	194.2a	184.2a	127.4b
% NUE	-	53.6a	48.6a	30.7b	31.9b
WUE (kg/ha-cm)	274.9c	298.9c	337.1a	306.4b	307.1b

^xValues in rows followed by the same letter are not significantly different at the 0.05 probability level.

^{xx} Total amounts of N applied were 160, 320 and 480 kg N/ha, for 50, 100 and 150 mg N/L treatments, respectively.

TABLE IVa. DRY MATTER YIELD OF WHOLE SEASON TOMATO (t/ha)

	Nitrogen rate (mg N/L)				Soil application
	0	50	100	150	100
Stem + Leaves	4.5	4.3	4.3	4.6	4.6
Fruit	4.5	5.3	6.4	6.6	5.5

TABLE IVb. TOTAL N UPTAKE BY TOMATO (kg N/ha)

	Nitrogen rate (mg N/L)				Soil application.
	0	50	100	150	100
Stem + Leaves	77.9	100.8	113.6	125.4	101.3
Fruit	79.4	107.2	134.9	124.1	112.9

TABLE IVc. % Ndff BY TOMATO

	Nitrogen rate (mg N/L)			Soil application
	50	100	150	100
Stem + Leaves	67.8	73.8	82.0	63.2
Fruit	66.4	72.9	84.5	66.3

TABLE IVd. FERTILIZER N UPTAKE BY TOMATO (kg N/ha)

	Nitrogen rate (mg N/L)			Soil application
	50	100	150	100
Stem + Leaves	67.8	83.7	102.5	63.9
Fruit	71.3	98.2	105.1	74.6

TABLE IVe. AVERAGE TOTAL MARKETABLE AND DRY MATTER YIELD, TOTAL N, Ndff, %NUE AND WUE OF WHOLE SEASON TOMATO (1995)

Tomato	Nitrogen rate ^{xx} (mg N/L)				Soil appl.
	0	50	100	150	100
Marketable Yield (t/ha)	108.1c ^x	123.2b	136.6a	135.2a	118.3b
Total D.M. (t /ha)	9.0d	9.6c	10.7ab	11.1a	10.1bc
Tot. N (kg N/ha)	157.3c	208.0b	248.4a	249.4a	214.2b
% Ndff	-	67.1b	73.3ab	83.3a	64.7b
Total Fert.Uptake (gN/ha)	-	139.4b	182.1a	207.3a	138.2b
% NUE	-	69.7a	45.5b	34.5c	34.6c
WUE (kg/ha-cm)	206.7c	225.3ab	250.5a	252.8a	233.5ab

^x Values in rows followed by the same letter are not significantly different at the 0.05 probability level.

^{xx} Total amounts of N applied were 200, 400 and 600 kg N/ha, for 50, 100 and 150 mg N/L treatments, respectively

TABLE Va. DRY MATTER YIELD OF SPRING PEPPER (t/ha)

	Nitrogen rate (mg N/L)				Soil application
	0	67	134	201	134
Stem + Leaves	4.9	5.6	5.3	5.3	6.0
Fruit	1.4	2.3	2.4	2.6	2.3

TABLE Vb. TOTAL N UPTAKE BY PEPPER (kg N/ha)

	Nitrogen rate (mg N/L)				Soil application
	0	67	134	201	134
Stem + Leaves	118.9	182.0	178.8	193.9	163.3
Fruit	46.1	73.0	79.5	84.2	67.5

TABLE Vc. %Ndff BY PEPPER

	Nitrogen rate (mg N/L)			Soil application
	67	134	201	134
Stem + Leaves	57.9	51.0	40.1	32.8
Fruit	46.6	64.2	40.1	45.4

TABLE Vd. FERTILIZER N UPTAKE BY PEPPER

	Nitrogen rate (mg N/L)			Soil application
	67	134	201	134
Stem + Leaves	104.6	92.0	77.9	52.6
Fruit	33.8	50.9	34.2	30.5

TABLE Ve. AVERAGE TOTAL MARKETABLE AND DRY MATTER YIELD, TOTAL N, Ndff, %NUE and WUE OF SPRING PEPPER (1994)

Pepper	Nitrogen rate ^{xx} (mg N/L)				Soil appl.
	0	67	134	201	134
Marketable yield (t/ha)	30.4c ^x	43.7ab	45.1a	42.8b	43.2ab
Total D.M. (t /ha)	6.4b	7.9a	7.7a	7.8a	8.3a
Tot. N (kg N/ha)	165.0d	255.0b	258.3b	278.0a	230.7c
Total Fert. Uptake (kg N/ha)	-	133.4ab	148.8a	112.3b	90.2c
% NUE	-	66.7a	37.2b	18.7c	22.6c
WUE (kg/ha-cm)	296.1c	353.5ab	361.7a	342.4b	331.8ab

^x Values in rows followed by the same letter are not significantly different at the 0.05 probability level.

^{xx} Total amounts of N applied were 200, 400 and 600 kg N/ha, for 67, 134 and 201 mg N/L treatments.

TABLE VIa. DRY MATTER YIELD OF WHOLE SEASON PEPPER (t/ha)

	Nitrogen rate (mg N/L)				Soil application
	0	70	140	210	140
Stem + Leaves	5.8	6.1	5.8	6.0	6.2
Fruit	1.6	2.3	2.8	2.6	2.3

TABLE VIb. TOTAL N UPTAKE BY PEPPER (kg N/ha)

	Nitrogen rate (mg N/L)				Soil application
	0	70	140	210	140
Stem + Leaves	132.4	202.3	215.8	239.3	198.1
Fruit	38.4	65.1	82.2	88.2	64.2

TABLE Vic. %Ndff BY PEPPER

	Nitrogen rate (mg N/L)			Soil application
	70	140	210	140
Stem + Leaves	63.1	82.4	81.9	62.2
Fruit	69.4	88.8	90.8	68.9

TABLE Vid. FERTILIZER N UPTAKE BY PEPPER (kg N/ha)

	Nitrogen rate (mg N/L)			Soil application
	70	140	210	140
Stem + Leaves	126.0	178.0	196.0	137.0
Fruit	44.7	67.7	80.9	44.1

TABLE Vie. AVERAGE TOTAL MARKETABLE AND DRY MATTER YIELD, TOTAL N, Ndff, %NUE AND WUE OF WHOLE SEASON PEPPER (1995)

Pepper	Nitrogen rate ^{xx} (mg N/L)				Soil appl.
	0	70	140	210	140
Marketable yield (t/ha)	20.3d ^x	25.2c	31.3a	29.7ab	27.5b
Total D.M. (t / ha)	7.4b	8.4a	8.6a	8.6a	8.5a
Tot. N (kg N/ha)	170.9c	267.4b	297.9ab	327.6a	262.3b
% Ndff	-	66.2b	82.1a	86.3a	69.0b
Total Fert. Uptake (kg N/ha)	-	177.0d	244.6b	282.7a	181.0c
% NUE	-	88.5a	61.2b	47.1c	45.3c
WUE (kg/ha-cm)	273.8b	330.2a	338.4a	335.7a	327.8a

^x Values in rows followed by the same letter are not significantly different at the 0.05 probability level.

^{xx} Total amounts of N applied were 175, 350 and 525 kg N/ha, for 70, 140 and 210 mg N/L treatments, respectively.

TABLE VIIa. DRY MATTER YIELD OF CUCUMBER (t/ha)

	Nitrogen rate (mg N/L)				Soil application
	0	70	140	210	140
Stem + Leaves	6.7	10.3	7.4	10.5	11.0
Fruit	2.6	4.4	3.0	4.5	4.8

TABLE VIIb. TOTAL N UPTAKE BY CUCUMBER (kg N/ha)

	Nitrogen rate (mg N/L)				Soil application
	0	70	140	210	140
Stem + Leaves	112.2	196.7	160.6	233.1	144.1
Fruit	86.6	153.1	136.8	195.8	192.0

TABLE VIIc. %Ndff BY CUCUMBER

	Nitrogen rate (mg N/L)			Soil application
	70	140	210	140
Stem + Leaves	43.3	64.5	65.1	42.4
Fruit	42.1	63.4	62.2	28.9

TABLE VIIId. FERTILIZER N UPTAKE BY CUCUMBER (kg N/ha)

	Nitrogen rate (mg N/L)			Soil application
	70	140	210	140
Stem + Leaves	85.2	103.6	151.7	61.1
Fruit	64.5	86.7	121.8	55.5

TABLE VIIe. AVERAGE TOTAL MARKETABLE AND DRY MATTER YIELD, TOTAL N, Ndff, %NUE AND WUE OF SPRING CUCUMBER (1995)

Cucumber	Nitrogen rate ^{xx} (mg N/L)				Soil appl.
	0	70	140	210	140
Marketable yield (t/ha)	86.6d ^x	146.6b	106.0c	150.5b	162.8a
Total D.M. (t/ha)	9.3b	14.7a	10.4b	15.0a	15.8a
Tot. N (kg N/ha)	197.8d	249.8c	297.4b	328.9a	286.1b
% Ndff	-	42.7b	64.0a	63.7a	35.6b
Total Fert. Uptake (kg N/ha)	-	106.7b	190.3a	209.5a	101.9b
% NUE	-	71.1a	63.4b	46.5c	34.0d
WUE (kg/ha-cm)	298.6c	354.2a	340.3ab	334.9b	310.5c

^x Values in rows followed by the same letter are not significantly different at the 0.05 probability level.

^{xx} Total amounts of N applied were 175, 350 and 525 kg N/ha, for 70, 140 and 210 mg N/L treatments, respectively.

TABLE VIIIa DRY MATTER YIELD OF MELON (t/ha)

	Nitrogen rate (mg N/L)				Soil application	Slow release
	0	50	100	150	100	100
Stem	0.5	0.9	1.0	0.8	0.8	0.8
Leaf	1.5	1.8	2.4	1.9	1.8	1.8
Fruit skin	0.5	0.5	0.7	0.6	0.5	0.5
Fruit	0.7	0.9	1.0	1.0	0.9	1.0
Seed	0.4	0.5	0.4	0.5	0.3	0.4

TABLE VIIIb TOTAL N UPTAKE BY MELON (kg N/ha)

	Nitrogen rate (mg N/L)				Soil application	Slow release
	0	50	100	150	100	100
Stem	4.8	9.7	11.4	10.2	7.8	7.0
Leaf	23.6	30.5	41.4	39.9	33.8	32.0
Fruit skin	7.6	8.6	10.9	11.1	8.3	9.6
Fruit	11.6	18.3	20.1	26.9	15.9	19.6
Seed	13.3	12.6	11.0	13.5	6.0	10.3

TABLE VIIIc. %Ndff BY MELON

	Nitrogen rate (kg N/L)			Soil application
	50	100	150	100
Stem	31.0	50.9	64.0	52.7
Leaf	31.2	40.0	86.0	40.7
Fruit skin	47.6	66.3	76.8	56.0
Fruit	35.5	42.5	67.5	44.9
Seed	38.6	43.3	68.8	54.1

TABLE VIII d. FERTILIZER N UPTAKE BY MELON (kg N/ha)

	Nitrogen rate (mg N/L)			Soil application
	50	100	150	100
Stem	3.0	5.8	6.5	4.1
Leaf	9.5	16.6	34.3	13.7
Fruit skin	4.1	7.2	8.5	4.6
Fruit	6.5	8.5	18.1	7.2
Seed	4.9	4.8	9.3	3.3

TABLE VIII e. AVERAGE TOTAL MARKETABLE AND DRY MATTER YIELD, TOTAL N, % Ndff, % NUE AND WUE OF MELON (1997)

Melon	Nitrogen rate ^{xx} (mg N/L)				Soil appl.	Slow rel.
	0	50	100	150	100	100
Marketable yield (t/ha)	28.4c ^x	35.3b	44.3a	42.1a	36.9b	37.4b
Total D.M. (t/ha)	3.6c	4.7b	5.4a	4.7b	4.3bc	4.5bc
Tot. N (kg N/ha)	60.9c	79.8b	94.9ab	101.6a	71.8b	78.4b
% Ndff	-	35.1c	48.6b	72.6a	49.7b	-
Total Fert. Uptake (kg N/ha)	-	28.0c	42.9b	76.8a	32.9c	-
% NUE	-	28.0	21.4	25.6	11.0	-
WUE (kg/ha-cm)	142.1d	176.5c	221.6a	210.7b	123.0e	124.8 ^e

^x Values in rows followed by the same letter are not significantly different at the 0.05 probability level.

^{xx} Total amounts of N applied were 150, 300 and 450 kg N/ha, for 50, 100 and 150 mg N/L treatments, respectively.

TABLE IX a. DRY MATTER YIELD OF EGGPLANT (t/ha)

	Nitrogen rate (mg N/L)				Soil application	Slow release
	0	50	100	150	100	100
Leaves	0.4	0.6	0.5	0.5	0.5	0.6
Stem	1.4	1.91	1.9	2.0	1.8	2.1
Fruit	0.2	0.3	0.2	0.2	0.2	0.2

TABLE IX b. TOTAL N UPTAKE BY EGGPLANT (kg N/ha)

	Nitrogen rate (mg N/L)				Soil application	Slow release
	0	50	100	150	100	100
Leaves	16.4	26.8	23.9	21.4	21.5	22.7
Stem	11.2	21.9	27.3	31.8	23.1	19.0
Fruit	4.8	8.5	5.8	6.8	7.2	5.3

TABLE IX c. %Ndff

	Nitrogen rate (mg N/L)			Soil application
	50	100	150	100
Leaves	17.7	37.6	48.3	17.2
Stem	23.4	33.9	41.2	12.9
Fruit	23.2	36.0	53.1	11.5

TABLE IXd. FERTILIZER N UPTAKE BY EGGPLANT (kg N/ha)

	Nitrogen rate (mg N/L)			Soil application
	50	100	150	100
Leaves	4.74	8.99	10.33	3.7
Stem	5.12	9.25	13.10	2.98
Fruit	1.97	2.09	3.61	0.83

TABLE IXe. AVERAGE TOTAL MARKETABLE AND DRY MATTER YIELD, TOTAL N, % Ndff, % NUE AND WUE BY EGGPLANT (1997-1998)

Eggplant	Nitrogen rate ^{xx} (mg N/L)				Soil appl.	Slow rel.
	0	50	100	150	100	100
Marketable Yield (t/ha)	62.4d ^x	91.7ab	93.8a	87.1b	81.9bc	76.1c
Total D.M. (t /ha)	1.99b	2.77a	2.66a	2.65a	2.63a	2.85a
Tot. N (kg N/ha)	32.4c	57.2ab	57.0ab	60.0a	51.8b	47.0b
% Ndff	-	20.7c	35.7b	45.1a	14.5d	-
Total Fert. Uptake (kg N/ha)	-	11.8c	20.3b	27.1a	7.5d	-
% NUE	-	59.0a	50.8ab	45.2b	18.8c	-
WUE (kg/ha-cm)	143.5c	210.9a	215.7a	200.3ab	186.3b	175.0b

* Values in rows followed by the same letter are not significantly different at the 0.05 probability level.

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