4- RESULTS AND DISCUSSION

4-1- First Experiment: Effect of surface drip irrigation regime on growth, yield and quality of tomato.

4-1-1-Vegetative growth characteristics:

Data presented in Table (8) show the effect of drip irrigation regime on vegetative growth parameters of tomato plants grown under sandy soil conditions during 2001-2002 and 2002-2003 seasons.

Such data reveal that irrigation tomato plants at a constant rate of 12, 14, 16 or 18-m^3 water / feddan daily i.e. with water amounts 1800, 2100, 2400 and 2700 m^3 water/fed. through the growth season (150 days) significantly affected all the studied vegetative growth parameters expressed as plant height, number of branches /plant, fresh and dry weight of plant during both seasons of study. In this respect, the highest values in all measured growth characters were recorded as a result of irrigation the plants at diplation of 44.1 % of available water, with a constant rate of water (16 m^3 /fed. daily) all over the growing seasons compared with other tested irrigation rates (12, 14 and 18 m^3 water /fed. daily) On the other hand, irrigation the plants at diplation of 39 % of available water with 18 m^3 water /fed. daily as a constant rate throughout the different growing stages led to a significant decrease in all studied growth traits compared with using 14 and 16 m^3 water /fed. daily. However, the same data in Table (8) indicate also that changing the irrigation regime through increasing the used rates of irrigation, i.e., 12, 14 and 16 m^3 water /fed. daily by 4 or 8 m^3 water /fed

Table (8) Effect of drip irrigation rate on vegetative growth characteristics of tomato plants.

Seasons	2001-2002				2002-2003			
Irrigation treatments m^3/fed.	Stem length (cm)	Number of branches /plant	Fresh weight/ plant (g.)	Dry matter/Plant (g.)	Stem length (cm)	Number of branches /plant	Fresh weight/ plant (g.)	Dry matter/Plant (g.)
1800	62.5	8.0	1020.3	223.2	56.2	7.7	937.3	207.5
2100	76.0	13.1	1392.5	265.0	75.2	13.2	1503.2	288.5
2400	84.5	14.7	1573.4	278.6	86.0	14.4	1611.9	285.9
2700	63.0	11.1	1205.1	267.7	60.7	10.5	1095.7	245.8
2640	71.5	11.0	1327.8	264.2	69.0	10.0	1331.1	266.7
3480	76.7	12.0	1405.1	260.9	75.7	12.0	1495.6	282.6
2940	79.0	13.2	1467.2	267.1	77.7	14.0	1505.0	280.2
3780	82.5	15.0	1602.1	282.4	85.0	15.5	1677.2	312.6
3240	93.7	15.7	2152.7	368.2	86.7	15.7	2002.7	342.1
4080	89.2	13.6	1756.5	302.3	89.5	13.5	1635.1	275.7
L. S.D at 0.05	4.9	1.4	198.8	33.0	4.2	1.2	145.8	27.5

daily during the second month after transplanting and 8 or 16 m^3 water /fed. daily during the last three months of growing season, positively increased all the vegetative growth parameters, (plant height, number of branches, fresh and dry weight / plant) compared with using 12, 14 ,16 or 18 m^3 water /fed. daily as a constant rate all over the growing season of plant . In this regard, following the irrigation rate in which the plants received 16, 20 and 24 m^3 water /fed. daily during the first, second and the last three months of growing seasons, respectively reflected the highest values in all the studied morphological characters of plant during both seasons of study. On the other hand, using the highest level of irrigation (4080 m^3/fed.) in which the plant irrigated by 16, 24 and 32 m^3 water /fed. daily during the first , second and the last three months, respectively of the growing season, tended to decrease all the measured growth aspects . It could be refer that using the lowest level i.e., 12m^3 water /fed .daily along the growing season (1800 m^3 water /fed) decreased the vegetative growth of plant that is may be due to the insufficient water to satisfy the irrigation water requirement of plant. On the other hand, using the highest level of irrigation water, i.e., 18 m^3 water / fed daily along the growth season (2700 m^3 /fed) and or 16 m^3/fed daily increased to 24 and 32 m^3 water per day during the second month and the last three months, respectively with a summation of 4080 m^3 water /fed. during the whole growing season, decreased the vegetative growth of plant. Such adverse effect of higher levels of water may be due to its unfavorable effect of higher rate of water to plant growth especially during the first months after transplanting which in turne affect adversely on vegetative growth rate of plant .Similar

results were reported by. El- Beltagy *et al.* (1984), Giardini *et al.* (1988), Fattahalla. (1992-a), Merghaney (1997), Navarretet and Jeannequin (2000), on tomato Sawan *et al.* (2001) on common bean and El- Kassas *et al.* (2002) on pepper.

4-1-2- Chemical composition of plant foliage:

Data illustrated in Table (9) show the effect of drip irrigation regime on total nitrogen, phosphorus and potassium concentration of plant foliage. It is evident from the recorded data that increasing the irrigation level either in case of irrigation with constant rate (12, 14, 16 or 18 m^3 water /fed. daily) thought the growing seasons or following a changing rate by increasing the rate of application (12, 14 or 16 m^3/fed.) 4 or 8 m^3 water /fed. per daily. during the second months and 8 or 16 m^3 water /fed. per day during the next last three month along the growing season, decreased the total nitrogen , phosphorus and potassium concentration of the plant foliage during the two seasons of study. In this respect, the highest concentration for all assayed macro-nutrients was obtained as a results of irrigation at 52.8 of field capacity by using 12 m^3 water /fed., per day along the growing season. The reduction of NPK concentration in plant foliage as a result of increasing the irrigation rate may be due to the increasing of absorbed and translocated water to the foliage plant parts which in turne diluted such concertino of macro–nutrients in foliage cells of plant. Also such decreased may be due to the distribution of absorbed amounts N, P and K nutrients on large vegetative weight of plant as indicated in Table (9) and consequently decreased it concentrations in this parts of plant.

Table (9) Effect of drip irrigation rate on N, P and K concentration (mg /100 g. D.W) of plant foliage.

Seasons	2001-2002			2002-2003		
Irrigation treatments m^3/fed.	N	P	K	N	P	K
1800	4595	511	4863	4614	516	4828
2100	4435	472	4717	4428	467	4720
2400	4306	471	4643	4312	474	4661
2700	4267	408	4454	4311	414	4432
2640	4366	484	4786	4397	486	4779
3480	4329	462	4638	4315	450	4686
2940	4290	467	4620	4205	458	4642
3780	4289	442	4523	4197	443	4533
3240	4265	436	4360	4211	431	4372
4080	4178	431	4213	4136	428	4221
L. S.D at 0.05	32	15	78	31	15	40

Obtained results are in agreement with those reported by. Gamayun (1980), Locascio *et al.* (1986), Fattahallah (1992-a), Locascio and Smajstria (1996), on tomato and El-Nemr (1997), De-Pascale *et al.* (2000) and El-Kassas (2002) on pepper.

4-1- 3- Fruits Yield and its components .

Data in Table (10) show the effect of drip irrigation regime on fruit set percentage and total fruit yield as well as its components during 2001 –2002 and 2002 –2003 seasons.

Such data show that fruit set percentage, total fruit yield and its components expressed as number and weight of fruits/ plant, early and total produced yield /fed. were significantly affected by the different studied irrigation rates either as a constant rates along the growing season or changed at the second and the last three months of growth stage. In this regard, irrigation at rate of 14 m^3/fed. per day during the first month increased to 22 m^3 water /fed. during the second month and 30 m^3 water /fed. daily during the last three months of growth (irrigation at 54.9, 64.3 and 69.8 % of field capacity, respectively) with a total amount of water (3780 m^3 water /fed.) reflected the highest values of fruit set percentage, number and weight of fruits/plant as well as early and total yield /fed followed by treatment in which the plant irrigated with 2940 m^3 water /fed during the growing season applied as 14 ,18 and 22 m^3 water fed. daily during the first, second and the last three months per fed. respectively, of growing season (5 months) and treatment in which the plant received 2400 m^3 water /fed. during the growing season applied as a constant rate 16 m^3 water /fed.

Table (10) Effect of drip irrigation rate on fruits set percentage, total fruit yield and its components.

Seasons	2001-2002						2002-2003					
Irrigation treatments m^3/fed.	Fruit set (%)	Number of fruits /plant	Early yield (ton/fed).	Yield / Plant (kg)	Total yield (ton / fed)	Water use efficiency m^3/kg fruit	Fruit set (%)	Number of fruits /plant	Early yield (ton/fed).	Yield / plant (kg)	Total yield (ton / fed)	Water use efficiency m^3/kg fruit
1800	60.5	81.1	7.100	6.2	27.708	0.065	61.1	76.3	8.013	6.1	27.326	0.066
2100	75.3	87.2	10.106	8.5	34.412	0.061	76.7	79.2	13.702	8.3	34.666	0.061
2400	85.6	77.1	13.466	9.6	36.487	0.066	85.2	77.6	15.461	9.7	36.093	0.066
2700	78.5	62.4	7.177	5.4	26.040	1.037	80.3	72.6	9.502	6.1	26.775	0.101
2640	59.1	84.9	8.557	7.4	31.817	0.083	58.8	77.1	13.045	6.9	32.628	0.081
3480	66.2	74.3	10.289	8.4	34.389	0.101	68.8	70.9	13.308	8.1	34.361	0.101
2940	86.5	76.1	11.550	9.8	37.335	0.079	87.1	79.5	13.938	10.1	36.802	0.080
3780	90.3	74.6	14.227	10.5	38.614	0.098	93.4	76.3	16.170	10.5	37.747	0.100
3240	81.9	77.9	12.232	9.1	35.227	0.092	81.4	76.7	13.282	8.9	35.568	0.091
4080	77.3	76.9	10.526	8.0	35.043	0.116	74.0	77.5	11.996	7.9	35.201	0.116
L.S.D at 0.05	7.5	8.9	2.295	0.7	10.34		6.0	13.9	2.560	0.9	2.024	

per day along the growing season. In addition, such aforementioned treatments did not significantly different from each other. However, the highest value of water use efficiency was obtained in case of irrigation at a rate of 14 m^3 water daily as a constant level during the growing season. In this respect, the relative increase in yield due to the use of 16 m^3 water daily and the increasing effect in fruit set percentage and total fruit yield and its components as a result of irrigation with 3780, 2940 and 2400 m^3 water /fed .during the growing seasons applied at a rate 14, 22 and 30 m^3 and 14, 18 and 22 m^3 water /fed./day during the first, second and the last three months of growth (productive phase) and or 16 m^3 water /fed. daily along the growing season in this respect, may be due to that such irrigation treatment provide plants with enough amounts of water during the period of maximum growth and productivity of plant in which the plant in its uptake requirement for water needed for maximum vegetative growth and fruit productivity. Also, such increase in total fruit yield and its components are connected with increasing the uptake of macronutrients (NPK) Table, 9 which inturne increased the vegetative growth (Table 8) and consequently the produced yield. On the contrary, irrigation the plants with 1800 and 2700 m^3 water /fed. added at the rate of 12 and 18 m^3 water /fed/day , respectively as constant level along the growing season reflected the lowest fruit set percentage , number and weight of fruit per plant as well as early and total yield/fed. compared with other irrigation treatments during both seasons of study .The decreasing effect of using the lower rates of irrigation water on yield and its components are related to the reduction in vegetative growth of plant (Table, 8) which in turne affected the

yielding ability of plant. Obtained results showing the effect of irrigation on produced yield and its components are similar to those reported by. Mikhailov (1979), Dell'Amico and Jerez (1982), Meek *et al.* (1982), El- Beltagy *et al.* (1984), Judah(1986), El-Shafei (1989), Annanurova *et al.* (1992), Fattahallah (1992), Locascio and Samjstral (1996), Alizadeh *et al.* (2001) and Cetin et al., (2002).

4-1-4- Fruit quality:

a- Physical fruit characters:

Data recorded in Table (11) show the effect of drip irrigation regime on physical characters of fruits during 2001-2002 and 2002–2003 seasons .Such data reveal that there were a significant differences among the tested irrigation rates in all measured fruit physical characters, i.e., average fruit weight, fruit length and diameter as well as the dry matter percentage of fruit during both seasons of study .In this respect , the highest values in all fruit physical characters (average fruit weight, length and diameter) were obtained in case of fruits produced from plants irrigated with 3780 m^3 water /fed. applied at a rate of 14 , 22 and 30 m^3 water /fed daily during the first , second and last three months of growth respectively, compared with other tested treatments. On the other hand, this treatment of irrigation (3780 m^3 /fed) reflected the lowest value of dry matter percentage of fruits. Increasing the fruit weight, length and diameter due to the increasing rate of irrigation may be due to the increase of fruit water content that affect the number and size of the fruit cells and cell turgidity that in turne affect the fruit

Table (11) Effect of drip irrigation rate on physical characters of tomato fruits.

Seasons	2001-2002				2002-2003			
Irrigation treatments m^3/fed.	Fruit fresh weight (g.)	Fruit dry matter (%)	Fruit length (cm)	Fruit diameter (cm)	Fruit Fresh weight (g.)	Fruit dry matter (%)	Fruit length (cm)	Fruit diameter (cm)
1800	76.5	5.1	6.1	5.9	80.0	5.1	6.0	5.9
2100	97.5	5.1	6.3	6.2	104.7	5.1	6.3	6.2
2400	124.5	4.5	6.5	6.4	125.0	4.6	6.4	6.3
2700	86.5	5.1	6.0	6.0	84.0	5.2	6.0	5.9
2640	87.2	5.0	6.2	6.2	89.5	5.0	6.2	6.1
3480	113.0	4.9	6.5	6.4	114.2	5.0	6.4	6.3
2940	128.7	4.8	6.7	6.6	127.0	4.9	6.6	6.5
3780	140.7	4.1	7.0	6.9	137.7	4.0	6.8	6.7
3240	116.7	4.7	6.1	6.0	116.0	4.3	6.1	6.1
4080	104.0	3.9	5.9	5.8	102.0	3.8	6.0	5.9
L. S.D at 0.05	4.5	0.4	0.1	0.2	4.9	0.5	1.2	0.9

weight and size. Similar results were reported by El- Beltagy *et al.* (1984), Fattahallah (1992-b), Bronthome *et al.*(1994), El-Kner *et al.* (1995), Colla *et al.* (1999) and Ortega *et al.* (2001 all working on tomato.

b- Chemical fruit quality.

Data presented in Table (12) show the effect of drip irrigation regime on mineral and organic constituents of fruits during 2001-2002 and 2002-2003 seasons. From such data, it is evident that increasing the rate of irrigation either in case of irrigation with a constant level during the growth season (12, 14, 16 and 18 m^3 water /fed daily) or follow an increasing level during the second and the last three months of growth led to a significant decrease in all assayed mineral constituents (N,P, K and No_3-N) and organic constituents (total acidity, total sugars, vitamin C and total soluble solids) during both seasons of study . In this respect, irrigation with the lowest rate, i.e., 12 m^3 water /fed. daily (at 52.8 % of field capacity) reflected the highest values in all assayed macronutrients and organic constituents. On the other hand, irrigation the plants with the highest used level of irrigation water (4080 m^3 water /fed.) applied at a rate of 16 m^3 /fed daily increased to 24 m^3 during the second month and 32 m^3/fed.daily during the last three months of plant growth reflected the lowest values of such chemical constituents .Such results may be due to the increasing water content of fruits as a results of increasing the irrigation rate, increasing the water absorbed by plant and translocation to the fruit which in turn diluted the concentration of such assayed constituents of fruit.

Table (12) Effect of drip irrigation rate on mineral (mg/100 g D.W.) and organic constituents of tomato fruits.

Seasons	2001-2002								2002-2003							
Irrigation treatments m^3/fed.	N	P	K	NO_3-N	Acidity cm^3/l.	V. C cm^3/l.	Total sugar mg/100g D.W	TSS (%)	N	P	K	NO_3-N	Acidity cm^3/l.	V. C cm^3/l.	Total sugar mg/100g D.W	TSS (%)
1800	2755	316	3342	2293	5238	21.8	3561	5.2	2722	319	3356	2278	5311	21.5	3576	5.0
2100	2575	297	3214	2145	4329	20.9	3368	4.2	2564	291	3214	2153	4283	20.0	3372	4.2
2400	2342	244	287	2143	4237	20.1	31409	4.2	2381	242	2917	2139	3872	19.2	2956	4.1
2700	2195	259	2749	2097	4398	19.6	2783	4.3	2046	240	2791	2155	4410	20.1	2775	4.2
2640	2670	309	3277	2276	4761	21.0	3427	4.7	2645	301	3287	2246	4823	20.9	3462	4.6
3480	2467	288	3162	2089	4196	20.7	3346	4.1	2512	284	3197	2110	4187	20.3	3356	4.4
2940	2460	274	3176	2106	4069	22.0	3276	4.1	2446	273	3201	2039	3994	21.4	3261	4.1
3780	2420	258	3193	2088	4151	22.6	3140	4.1	2418	257	3218	1986	4096	22.4	3194	4.0
3240	2262	236	2713	1996	3722	18.8	2813	4.2	2232	239	2748	1926	3569	18.3	2871	4.1
4080	2182	227	2671	1822	3405	17.6	2676	4.1	2293	217	2676	1771	3498	17.3	2641	4.0
L. SD at 0.05	30	14	49	80	262	2.4	49	0.2	34	33	33	76	300	1.3	23	0.2

Obtained results are inconformity with those reported by El-Beltagy *et al.* (1984), Fattahallah (1992-b) Bronthome *et al.* (1994), El-Kner *et al.* (1995), Tan (1995), Hayata *et al.* (1998), Colla *et al.* (1999), Ortega *et al.* (2001) and Cohn *et al.* (2003).

4-2-Second Experiment: - Effect of fertilization level and plant pruning system on growth, yield and quality of tomato.

4-2-1- Vegetative growth characteristics.

Data presented in Table (13) show the effect of fertilization levels and plant pruning on vegetative growth of tomato plants grown under sandy soil condition.

a- Effect of fertilization

Data in Table (13) indicate that the vegetative growth aspects expressed as plant stem length, fresh and dry weight of plant were significantly increased as a result of increasing compound fertilizer application during both seasons of study. In this respect, the highest values in all recorded growth parameter were obtained in case of using the highest fertilizer level, i.e., 900 kg N P K / feddan when compared with the medium (600 Kg / fed) and the lower (300 kg / fed) one. Obtained results are true during both seasons of growth .The increment in vegetative growth traits as a result of compound fertilizer application may be due to the main role of tested macro–nutrients (N, P and K) in increasing the meristematic activity of the plant tissues, building protein molecules, cell division, increasing the photosynthetic assimilation rate, production and export of growth hormones especially cytokinin to shoots and these above mentioned effects

Table (13) Effect of fertilization level and plant pruning system on vegetative growth characteristics of tomato plants

Seasons / Treatments	2001-2002			2002-2003		
NPK levels (kg/fed.) Pruning system	Stem length (cm)	Fresh weight /plant (g.)	Dry weight / plant (g.)	Stem length (cm)	Fresh weight plant /(g.)	Dry weight / plant (g.)
300	150.2	1718.2	301.5	149.1	1070.3	289.1
600	159.5	1926.4	369.1	159.6	2005.1	382.6
900	166.1	2171.6	458.6	166.5	2204.3	454.3
L. S. D at 0.05	4.9	65.7	15.03	1.8	149.5	15.6
One stem	166.1	1745.3	390.4	165.5	1746.2	379.4
Two stems	159.5	1973.2	385.7	159.4	1922.1	372.6
Without pruning	150.2	2098.2	353.7	150.3	2247.1	381.1
L. S. D at 0.05	3.5	73.8	15.41	2.017	107.3	13.2

in turne affect tomato growth. These results agree with those reported by Khalil (1982), Omran *et al.* (1985), Brun *et al.* (1986), Ezuddin and Abdal–Jabbar (1986), El-Sawy (1988), Abd- Alla *et al.* (1990-a), Eid 1991, Melton and Dufault (1991), El- Gizaw (1993-b), Sharma (1996), Hassan (1997), Nainar and Pappiah (1997), Mohamed and Emara (2000), Darwesh (2002) and Kadam and Sahane (2002).

b-Effect of pruning.

Concerning the effect of plant pruning, the same data in Table (13) show that pruning the plant to leave one main stem or two stems to grow significantly affected all the studied morphological characters of plant, i.e., plant stem length, fresh and dry weight per plant during both seasons of the experiment. In this regard, irrespective of the plant stem length which was increased with pruning the plant either by allow one or two stems to grow, both fresh and dry weight of plant were significantly decreased as a result of pruning. In this respect, the highest values of plant height were reported in case of plants trained on one stem (the main stem). On the contrary, the highest values for fresh and dry weight of plant were reported in case of un- pruned plants (control). These results are true during both seasons of study. obtained results are confirmed with those reported by Roberts and Gorski (1985), Roberts and Gorski (1985), El- Attar (1988), Al- Harbi *et al.* (1996) and Srinivasn *et al.* (1999).

c- Effect of the interaction.

Data in Table (14) show that increasing the level of compound fertilizer (NPK) and allow the plant to grow normally without pruning increased fresh and dry weight of plant. Such increments reach the level of 0.05 of significancy during the first season in case of fresh and dry weight and fresh weight in case of the second season. On the other hand, increasing the level of NPK fertilizer combined with pruning the plant to leave one or two stems per plant increased plant stem length compared with the chick treatment. In this regard, application of the highest compound fertilizer level (900 kg NPK / fed.) combined with pruning the plant on one stem or without pruning reflected the highest values of plant stem length and fresh and dry weight in case of the pruning and without training, respectively.

4-2-2- Chemical composition of plant foliage:

Data in Table (15) show the effect of NPK fertilization level and plant pruning on total nitrogen, phosphorus and potassium content of plant foliage during 2001/2002 and 2002/2003 season.

a- Effect of NPK fertilization

Data in Table (15) show that total nitrogen, phosphorus and potassium content of plant foliage were steadily increased with increasing the level of NPK fertilization from 300 Kg/ fed. up to 900 kg NPK / fed . These results are true during both seasons of study. Obtained results due to increasing of such nutrients in the root zone as a result of fertilization which in turne increased the absorbed amounts of these nutrients. Such

results are in agreement with those reported by Bagal *et al.* (1989), Abd-Alla *et al.* (1990), Khalil (1990), Al-Afifi *et al.* (1991), Smith *et al.* (1992), Shahien *et al.* (1995), Hassan (1997), Ouda (2000) and Darwesh (2002).

b- Effect of pruning

The same data in Table (15) illustrate that there were significant increases in total nitrogen, phosphorus and potassium content of plant foliage with pruning the plant to allow one or two stems to grow compared with allowing the plant to grow normally without pruning during both seasons of study. In this connection, plants trained on one stem exhibited the highest N, P and K content compared with those trained on two stems or without training. The highest concentration of N P K in vegetative parts for plants pruned to leave on stem to grow may be attributed to the distribution of absorbed amounts of such nutrients on a districted area of leaves in case of pruned plants compared with the control plant which in turne increased their concentration in pruned plant foliage. These results are in agreement with those reported by Wien and Minotti (1988) and Loures *et al.* (1998).

c- Effect of the interaction

Data recorded in Table (16) show the effect of the interaction between NPK fertilization level and system of plant training on total nitrogen, phosphorus and potassium concentration in plant foliage. Such data reveal that the concentration of total nitrogen, phosphorus and potassium in

Table (16) Effect of the interaction between fertilization level and plant pruning system on N. P and K concentration (mg/100 g. dry weight) in tomato plant foliage.

Treatments / Seasons		2001-2002			2002-2003		
NPK levels (kg/fed.)	Pruning system	N	P	K	N	P	K
300	One stem	4165	446	4453	4978	433	4562
	Two stems	3918	427	4197	3876	419	4067
	Without pruning	3561	385	3854	3451	387	3806
600	One stem	4786	519	5014	4766	514	5074
	Two stems	4589	483	4512	4617	477	4531
	Without pruning	4392	451	4279	4428	456	4290
900	One stem	5213	563	5543	5391	569	5616
	Two stems	4794	524	5371	4813	529	5251
	Without pruning	4543	520	4867	4545	519	4838
L. S. D at 0.05		52	N.S	159	N.S	N.S	123

plant foliage was significantly increased with increasing the level of compound fertilizer application up to the highest used level (900 Kg NPK /fed .) and pruning the plant to leave one stem to grow. Obtained results are true during both seasons of the experiment.

4-2-3- Yield and its components.

Data presented in Table (17) show the effect of NPK fertilization level and pruning system on fruit set and total fruit yield and its components of tomato plant during 2001 / 2002 and 2002 / 2003 growth seasons.

a- Effect of NPK fertilization.

Data in Table (17) illustrate that fruit set percentage as well as total fruits yield and its components expressed as number and weight of fruits per plant, early and total fruit yield / fed. were significantly affected during both seasons of study with tested different fertilizer levels. In this respect, fruit set percentage and total fruit yield and its components were continuously increased with increasing the fertilizer level from 300 up to 900 kg NPK / fed. Similar trend was obtained during the two seasons of growth. Increasing the fruits set percentage may be due to the increase in NPK concentration in plant foliage (Table, 15) which play essential in plant flowering, pollen grain viability and flower fertilization which in turne increased fruits set. In addition, increasing the total fruit yield/fed. was connected with fruit set percentage. Such increment in total yield and its components also due to the increasing of vegetative growth of plant as a result of NPK fertilization (Table, 13) which

Table (17) Effect of fertilization level and plant pruning system on fruit set percentage, total yield and its components.

Seasons / Treatments	2001-2002					2002-2003				
NPK levels(kg /fed.) Pruning system	Fruit set (%)	Number of fruits plant	yield / plant (kg)	Early yield (ton /fed.)	Total yeild (ton /fed.)	Fruit set (%)	Number of fruits plant	yield / plant (kg)	Early yield (ton /fed.)	Total yield (ton /fed.)
300	86.06	106.0	12.70	12.975	53.532	85.66	108.5	12.86	12.841	54.162
600	90.43	111.1	14.83	16.216	62.506	90.36	108.63	15.10	16.622	63.598
900	93.16	110.6	15.96	17.840	67.993	93.16	113.1	16.33	18.227	68.822
L. S. D at 0.05	0.81	1.1	0.25	4.348	8.070	0.72	0.88	0.38	4.496	6.260
One stem	93.56	75.8	10.9	16.051	45.991	93.53	72.83	11.06	16.239	46.587
Two stems	95.66	109.2	14.66	16.692	61.761	95.8	107.90	14.86	17.582	62.709
Without pruning	80.43	149.6	17.93	13.905	76.280	79.86	154.40	18.36	13.870	77.287
L. S. D at 0.05	0.04	1.7	0.22	0.274	0.592	0.51	1.25	6.26	0.225	0.948

consequently increased the expected fruit yield. Obtained results on total yield and it components are similar to those indicated by El-Sayed *et al.*(1985), Ahmed and Saha (1986), Beresniewicz *et al.* (1986), Blatt and Merae (1986), Abed and Eid (1987), El-Sawy(1988),Geczi (1988), Hutt and Dettmann (1988), Zhang *et al.*,(1988), Singh *et al.* (1989), Voican *et al.*,(1989), Abd-Alla *et al.* (1990-b), Gianquinto and Borin (1990), Eid (1991), Annanurova *et al.* (1992), Eid *et al.* (1992), Chung et al. (1992) Smith *et al.* (1992), Oiken and Asiegbu (1993), Satti and Lopez (1994), Yommi *et al.* (1995), El- Sayed *et al.* 1996), Sharma (1996), Vasil *et al.* (1997), Rumpel (1998), Hossain and Mohanty (1999), Mohamed and Emara (2000) and Darwesh (2002).

b- Effect of plant pruning

The same data in Table (17) prove that fruits set percentage, total fruit yield and its components i.e., number and weight of fruits per plant, early and total yield / fed. were significantly affected with pruning system of plant. In this regard, the highest values of fruit set percentage was noticed in case of training the plant on two stems compared with pruning the plant leaving only the main stem to grow and without pruning. This increase in fruit set percentage in case of training the plant allowing two stems to grow may be due to that such treatment results in more balance between the vegetative growth and flowering in nutrients distribution which affect and increase the fruit set.

As for the effect of pruning on total fruit yield and its components, the same data in Table (17) declared that except the early fruit yield which was significantly increased by pruning , number and weight of fruits per plant and total fruit yield produced per feddan were significantly decreased as a result of plant training either leaving one or two stems to grow in comparison with the check treatment (without training). Obtained results are connected with the effect of plant pruning on vegetative growth (Table, 13) and also such decrease in total yield and its components in case of plant pruning may be due to the effect of pruning on decreasing the number of lateral branches which constitute the main organs for carrying flowers and fruits. Obtained results are similar to those reported by. Mangal and Pandita (1979), Sumiati (1987), Matiar *et al.*(1988), Ulinski and Glaps (1989), Hernandez *et al.*, (1991), Hanna and Adoms (1993), Salinas *et al.* (1994), Oliveira *et al.* (1995) and Cockshull and Fenlon (2001).

c- Effect of the interaction.

Data presented in Table (18) show the effect of the interaction between fertilization level and plant pruning system on fruit set percentage and number and weight of fruits per plant as well as early and total yield / fed. It is evident from such data that using the highest level of NPK fertilization (900 kg NPK / fed) and training the plant to allow two stems to grow reflected the highest increment in fruit set percentage and early fruit yield, while the highest level of NPK fertilizer combined with the unpruned treatment (control) gave the highest number and

Table (18) Effect of the interaction between fertilization level and plant pruning system on fruit set percentage, total fruit yield and its components of tomato.

Treatments / Seasons		2001-2002					2002-2003				
NPK levels(kg/fed.)	Pruning system	Fruit set (%)	Number of fruits /plant	Yield /plant (kg)	Early yield (ton /fed.)	Total yield (ton /fed.)	Fruit set (%)	Number of fruits /plant	Yield /plant (kg)	Early yield (ton /fed.)	Total yield (ton /fed.)
300	One stem	90.7	75.0	10.1	13.124	42.756	90.5	76.1	10.2	13.088	43.071
	Two stems	92.0	106.0	12.4	13.814	52.111	92.5	108.9	12.6	13.941	53.056
	Without pruning	75.5	144.8	15.6	11.986	65.730	74.0	149.5	15.8	11.496	66.360
600	One stem	94.0	75.5	10.7	16.700	44.950	94.0	77.6	10.9	17.194	45.843
	Two stems	96.5	111.6	15.4	17.844	64.984	96.6	116.7	15.7	18.215	66.244
	Without pruning	80.8	151.2	18.4	14.103	77.584	80.5	155.2	18.7	14.457	78.708
900	One stem	96.0	76.7	11.9	18.330	50.268	96.1	78.2	12.1	18.437	50.848
	Two stems	98.5	109.7	16.2	19.563	68.187	98.3	110.1	16.3	20.590	68.827
	Without pruning	85.0	152.3	19.8	15.628	85.525	85.1	157.9	20.6	15.656	86.793
L. S. D at 0.05		**0.9**	**1.54**	**0.2**	**0.274**	**0.592**	**0.44**	**1.08**	**0.4**	**0.225**	**0.948**

weight of fruits per plant and the highest fruit yield / fed. Such results are true during both seasons of growth.

4-3-4- Fruit characteristics.

4-3-4-1-Physical fruit characteristics.

Data in Table (19) show the effect of NPK fertilization and plant pruning system on physical quality of fruits expressed as average fruit weight, Fruit length and diameter as well as dry matter percentage of fruit during 2001 –2002 and 2002 / 2003 seasons.

a- Effect of NPK fertilization.

It is obvious from data recorded in Table (19) that all measured fruit parameters i.e., average fruit weight, fruit length, fruit diameter and dry matter % of fruit were significantly affected by NPK fertilization during both seasons of study. In this concern, the highest fruit parameters were noticed as a result of using the highest level of fertilization i.e., 900 kg NPK / fed. compared with medium (600 kg) and low (300 kg /fed) level of fertilization . These results were true during the two seasons of the experiment. Obtained results are agreeable with those reported by Kanesiro *et al.*(1978), Belichki(1984), Abd-Alla *et al.* 1990), Al-Afifi *et al.*(1991), Eid *et al.*(1992), Simth *et al.*(1992), Arya and Singh(1999), Hossain and Mohanty (1999), and Darwesh (2002).

b- Effect of pruning.

The same data in Table (19) show that pruning the plant to leave one or two stems to grow significantly increased average fresh weight, fruit length and diameter as well as dry matter

Table (19) Effect of fertilization level and plant pruning system on physical characteristics of tomato fruits

Seasons / Treatments	2001-2002				2002-2003			
NPK levels (kg/fed.) Pruning system	Fruit fresh weight (g)	Fruit dry matter (%)	Fruit length (cm)	Fruit diameter (cm)	Fruit fresh weight (g)	Fruit Dry matter (%)	Fruit length (cm)	Fruit diameter (cm)
300	119.8	5.1	6.2	6.2	118.4	5.2	6.2	6.1
600	133.5	5.6	6.9	6.8	131.8	5.6	6.8	6.8
900	144.2	5.9	7.0	7.0	144.4	5.9	7.2	7.1
L. S. D at 0.05	**2.49**	**0.12**	**0.13**	**0.13**	**1.4**	**0.07**	**0.13**	**0.14**
One stem	143.8	5.9	7.2	7.2	143.1	6.0	7.2	7.1
Two stems	134.2	4.5	7.0	7.0	132.7	5.5	6.9	6.9
Without pruning	119.8	5.2	5.9	5.9	118.9	5.2	6.1	6.0
L. S. D at 0.05	**1.66**	**0.08**	**0.11**	**0.12**	**1.55**	**0.09**	**0.13**	**0.16**

percentage of fruit compared with plant left without pruning. In addition, pruning the plant leaving only one main stem to grow reflected the highest fruit parameters compared with fruits produced by plants trained allowing two stem to grow and those fruit produced by control plants . The highest fruit parameters in case of training the plant on one main stem may be due to the less competition occur between leaves and fruits on water and nutrients molecules and consequently increased the amounts devoted to fruits which in turne increased number and size of the fruit cells which resulted in increasing fruit weight and size. Similar results were recorded by Sumiati (1987), Hernandez *et al.* (1991), Oliverira *et al.* (1995), Dawa *et al.* (1998), Saglam *et al.* (1999) and Mohamed (2001).

c- Effect of the interaction

Data illustrated in Table (20) show clearly that application of the highest used level of NPK fertilizer (900 kg / fed). combined with pruning the plant on one main stem reflected the highest values for physical fruit quality i.e., average fruit weight, length , diameter and dry matter % of fruit compared with other tested treatments during both seasons of study. On the contrarily the lowest values for fruit characteristics were reported in case of using 300 kg NPK / fed. and leave the plants without training (Control treatment).

Table (20) Effect of the interaction between fertilization level and plant pruning system on characteristics of tomoto fruits

Seasons / treatments		2001-2002				2002-2003			
NPK levels(kg)	Pruning system	Fruit fresh weight (g.)	Fruit Dry matter (%)	Fruit length (cm)	Fruit diameter (cm)	Fruit fresh weight (g.)	Fruit Dry matter (%)	Fruit length (cm)	Fruit diameter (cm)
300	One stem	134.7	5.5	6.7	6.7	134.0	5.6	6.6	6.5
	Two stems	117.0	5.0	6.4	6.4	115.7	5.1	6.2	6.2
	Without pruning	107.7	4.9	5.5	5.6	105.7	4.9	5.8	5.7
600	One stem	141.7	6.0	7.4	7.3	140.5	6.1	7.3	7.3
	Two stems	138.0	5.5	7.3	7.2	134.5	5.6	7.1	7.1
	Without pruning	121.7	5.3	6.1	6.0	120.5	5.3	6.1	6.1
900	One stem	155.0	6.2	7.6	7.6	154.7	6.3	7.7	7.7
	Two stems	147.7	5.9	7.4	7.4	148.0	6.0	7.5	7.4
	Without pruning	130.0	5.6	6.2	6.1	130.5	5.6	6.4	6.3
L. S. D at 0.05		1.44	NS	0.11	0.05	1.35	N S	0.11	0.14

4-3-4-2- **Chemical constituents.**

Data indicated in Table (21) show the effect of NPK fertilization level and pruning system on chemical constituents of fruit during both seasons of the experiment.

a- Effect of fertilization.

Such data in Table (21) indicate that organic (total acidity, vitamin C, total sugars and total soluble solids) and non-organic constituents (N, P, K and No_3-N) concentrations were significantly increased with increasing the amounts of fertilizers applied during the two seasons of growth. In this respect, the highest concentration of organic and non-organic constituents were assayed in case of fruits produced by plants received the highest level of compound fertilizer i.e., 900 kg NPK / fed. On the other hand, the lowest concentration for all determined fruit chemical nutrients was noticed in case of fruits produced by using the lowest fertilization level, i.e., 300 kg NPK / fed. Such results are connected with those reported by Matev 1974, El-Sayed *et al.* (1985), Abed and Eid (1987), El- Sawy (1988), Al-Najum and Neimmah (1989), Bagal *et al.*(1989), Voican *et al.* (1989), Abd–Alla *et al.* (1990-c), Khalil (1990), Al-Afifi *et al.* (1991), Eid (1991), Avackyan *et al.* (1992), Eid *et al.* (1992), Yadav *et al.* (1992) and Darwesh (2002).

b- Effect of plant pruning.

The same data in Table (21) indicate that pruning the plant to leave one or two stems to grow significantly increased all determined organic and non-organic constituents of fruit

Table (21) Effect of fertilization level and plant pruning system on mineral (mg/100 g) and organic constituents in dry matter of tomato fruits.

Seasons / Treatments	2001-2002								2002-2003							
NPK levels (kg/fed.) / Pruning system	N	P	K	NO_3-N	Acidity cm^3/l.	V. C cm^3/l.	Total sugar mg/100 g.	TSS (%)	N	P	K	NO_3-N	Acidity cm^3/l.	V. C cm^3	Total sugar mg/100 g.	TSS (%)
300	2656	229	2726	2065	5818	20.2	3043	4.7	2634	240	2748	2039	5837	20.1	3061	4.7
600	2973	286	3304	2236	5910	21.6	3356	5.2	2980	289	3301	2211	5980	21.6	3322	5.1
900	3126	319	3415	2444	6209	23.3	3474	5.3	3133	312	3445	2467	6219	23.7	3473	5.3
L. S. D at 0.05	33.9	9.2	38	56	143	0.1	68	0.1	19.9	8	52	71	105	0.3	95	0.1
One stem	3074	299	3303	2447	6320	23.4	3486	5.3	3083	301	3326	2403	6379	23.8	3433	5.3
Two stem	2900	278	3184	2279	6031	21.6	3305	5.1	2898	282	3190	2249	6085	21.6	3324	5.1
Without pruning	2782	258	2958	2020	5586	20.1	3083	4.7	2767	258	2977	2065	5572	20.0	3099	4.7
L. S. D at 0.05	20.7	9.8	23.9	52	101	0.3	58	0.1	25	6	79	62	83	0.2	80	0.1

during both seasons of growth compared with the control treatment . Such increasing of organic and non organic constituents may be due to the suitable environmental condition to which the fruits in case of pruned plant exposed, to more lighting, more assimilation rate and more nutrients which in turne increase fruit chemical constituents. Similar results were reported by Sato (1981), Mangal and pandita (1986), Buwalda and freeman (1986), Dawa *et al.* (1998) and Mohamed (2001).

c- Effect of the interaction

Data in Table (22) show the effect of the interaction between fertilization and plant training on total acidity, vitamin C, total sugars, total soluble solids, total nitrogen, phosphorus, potassium and nitrate contents of fruits during 2001- 2002 and 2002–2003 seasons. In this respect, the highest concentration for the above mentioned organic and non-organic chemical constituents were connected with application of the highest used level of NPK mineral fertilizer (900 kg NPK) combined with pruning the plant to allow one main stem to grow. These results are true during both seasons of the experiment. On the contrarily the lowest values for assayed organic and non–organic constituents were noticed in case of using the lowest level of fertilization (300 Kg NPK / fed) and leave the plants without training. From the previous results and discussion, it could be concluded that under such conditions application of the highest used level of compound fertilizer (900 kg NPK / fed.) and pruning the plant to leave two stems to grow were recommended for good growth and production of higher early fruit yield with

Table (22) Effect of the interaction between fertilization level and plant pruning system on mineral (mg/100 g) and organic constituents in dry matter of tomato fruits.

Seasons / treatments		2001-2002								2002-2003							
NPK levels(kg/fed.)	Pruning system	N	P	K	NO_3-N	Acidity cm^3/l.	V. C cm^3/l.	Total sugar mg/100 g.	TSS (%)	N	P	K	NO_3-N	Acidity cm^3/l.	V. C cm^3	Total sugar mg/100 g.	TSS (%)
300	One stem	2867	245	2887	2266	6128	21.8	3267	5.0	2860	267	2937	2172	6233	22.0	3220	5.0
	Two stems	2647	227	2772	2057	5842	20.6	3117	4.8	2647	242	2757	2013	5868	20.3	3147	4.8
	Without pruning	2454	217	2520	1874	5486	18.2	2747	4.4	2395	212	2547	1934	5411	18.0	2817	4.5
600	One stem	3145	310	3477	2423	6249	23.4	3477	5.4	3155	207	3457	2364	6336	23.7	3430	5.4
	Two stems	2941	287	3335	2276	6026	20.9	3367	5.3	2930	290	3341	2235	6098	20.9	3347	5.2
	Without pruning	2835	262	3100	2011	5457	20.5	3225	4.9	2857	270	3105	2036	5507	20.3	3190	4.8
900	One stem	3210	342	3545	2652	6585	25.1	3714	5.7	3234	330	3585	2675	570	25.8	3650	5.7
	Two stems	3112	320	3447	2504	6227	23.3	3432	5.4	3117	315	3472	2501	6291	23.7	3480	5.3
	Without pruning	3057	295	3255	2176	5816	21.7	3277	5.0	3050	292	3280	2227	5798	21.7	3290	5.0
L. S. D at 0.05		13.4	N.S	13	N.S	N.S	0.456	N.S	N.S	14	N.S	N.S	50	N.S	0.358	N.S	N.S

best quality. Moreover, for high yield fruit production application of 900 kg NPK / fed. and leave the plants without pruning were recommended in this respect.

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