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Effect of Organic Fertilizers on Yield Components of Some Tomato Cultivars

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The aim of the study was to determine the effects of organic fertilizers on yield components in furrow irrigated some tomato cultivars in Konya, Turkey. As plant materials; H-2274, Olga F_1, Abundance, V-200 F_1, Topkapi F_1, ACN-55 F_1, ACN-112 F_1, Porsuk F_1, H-12-63-208 F_1 and ACN-90 F_1 tomato cultivars were used. Two different organic fertilizers namely organic mineral fertilizer (OMF) (1 t ha^{-1}) and farmyard manure (10 t ha^{-1}) were applied to soil before planting. In results, the highest yield, fruit number, mean fruit weight, fruit size, fruit height, total soluble solid (TSS) were obtained from ACN-55 F_1 (86.161 t ha^{-1}) and H-2274 (76.771 t ha^{-1}); H-2274 (1473.3 number ha^{-1}) and ACN-55 F_1 (1578.9 number ha^{-1}); ACN-112 F_1 (100.92 g) and Porsuk F_1 (102.33 g); ACN-112 F_1 (7.42 cm) and Porsuk F_1 (7.08 cm); ACN-112 F_1 (6.48 cm) and H-12-63-208 F_1 (6.65 cm) and H-2274 (5.78 %) and H-12-63-208 F_1 (5.52 %), respectively. The mean fruit weight was found higher in farmyard manure applied plots (84.01 g) than control.

Key Words: Organic fertilizer, Farmyard manure, Tomato cultivar, Yield, Furrow.

INTRODUCTION

Konya is a closed basin with both surface and groundwater resources are widely used in irrigation. The annual rainfall is almost 300 mm but, recently almost 260-270 mm. The evaporation is higher especially during summer season. The climate is almost arid and irrigation is vital important in such season.

Fertilizer application and selection of tomato cultivars are two of the most important factors in improvement the crop yield[1-5].

Recently, chemical fertilizer applied to obtain the higher and qualified production without considering the environmental pollution. This causes some serious threats in human health as well as ecology. Excess inorganic fertilizers contained nitrate in Antalya Province resulted in ground water contamination by NO_3 accumulation[6].

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Improvement of soil conditions and establishing balanced plant nutrients are important for soil productivity. To achieve this, organic matter and similar materials are frequently applied to soils, to improve their physical, chemical and biological properties[2,7-9]. For improvement the crop growth media, some efforts have been attempted and one of the most important techniques is organic fertilizer application. Farmyard manure, sewage sludge and organic wastes were positively affected physical and chemical properties of soil and tomato yield[10,11].

More than 90 % of open irrigated area in the Turkey has been irrigated by furrow system in tomato irrigation and also mostly used methods in the world[12].

The aim of this study is to determine the effects of different organic fertilizer applications on productivity of different tomato cultivars.

EXPERIMENTAL

The research was conducted at Konya with 1016 m above mean sea level in 2004 irrigation season.

Tomato has an economically important vegetable in most parts of Turkey. Research tomato cultivars were H-2274, Olga F_1, Abundance, V-200 F_1, Topkapi F_1, ACN-55 F_1, ACN-112 F_1, Porsuk F_1, H-12-63-208 F_1 and ACN-90 F_1. Seeds were sown on the 20th March 2004 in a seedbed (peat media) under greenhouse conditions (to protect seedling from cold weather). After hardening, seedlings were transplanting to field on 20th May 2004 on rows of 100 cm and 50 cm between each other. The plots were 5 m^2 and distance between the adjacent plots was not less than 1.5 m. A randomized split plot design was used for the experiment with three replicates.

Two organic fertilizers were applied, **(1) Organic mineral fertilizer (OMF):** 2.68 % humidity, 27.45 % ash, pH 7.12, EC (electrical conductivity) 1.97 dS m^{-1}, 64.84 % organic matter, 2.53 % nitrogen, 0.11 % phosphorus, 0.91 % potassium, 4.78 % calcium, 0.73 % magnesium, 0.87 % iron, 148.8 mg L^{-1} zinc, 258.5 mg L^{-1} manganese, 73.4 mg L^{-1} copper; and **(2) Farmyard:** 83.0 % humidity, pH 6.62, 84.15 % organic matter, 1.65 % nitrogen, 1.35 % phosphorus, 1.77 % potassium, 0.27 % CaO, 17.04 % dry matter, 17.40 mg L^{-1} boron, 82.10 mg L^{-1} zinc, 217.80 mg L^{-1} manganese, 9.80 mg L^{-1} copper. Organic mineral fertilizer and farmyard manure were applied 1 t ha^{-1} and 10 t ha^{-1}, respectively[13].

Some soil physical and chemical properties of the experimental area are presented in Table-1. Salt content is lower than 3-5 dS m^{-1} so it is not deleterious for tomato growing[14]. The irrigation water was delivered to furrows by Hflume[15] with local practice of 10 d irrigation interval.

In this study, total yield, fruit number, mean fruit weight, fruit size, fruit height, total soluble solid content (TSS), pH were recorded.

Research data were statistically analyzed by the Minitab program and means compared by Tukey test.

TABLE-1
SOME PHYSICAL AND CHEMICAL PROPERTIES OF RESEARCH SOIL

Soil properties	Soil depth (cm)	
	0-30	30-60
Texture	Loam	Loam
Bulk density (g cm^{-3})	1.48	1.44
Available water capacity, AWC (mm)	52.0	50.8
Electrical Conductivity, EC (dS m^{-1})	1.20	1.18
pH	7.30	7.27
$CaCO_3$ (%)	8.72	1.66

RESULTS AND DISCUSSION

Total yield: The effect of organic fertilizers on yield of different tomato cultivars grown under field condition was evaluated. Tomato cultivars and cultivar × organic fertilizer interaction significantly affected ($p < 0.05$), but different organic fertilizers had no significant effect on yield.

In Table-2 the highest yield was obtained from H-2274 (76.771 t ha^{-1}) and ACN-55 F_1 (86.161 t ha^{-1}) but lower in other cultivars.

TABLE-2
EFFECTS OF ORGANIC FERTILIZER APPLICATIONS ON YIELD OF TOMATO (t ha^{-1})

Cultivars	Treatments			Means ($D_{0.05}$=12.742)
	OMF	Farmyard	Control	
H-2274	49.012cdef	97.374ab	83.928abcd	76.771a
Olga F_1	38.858def	37.419ef	24.065f	33.447b
Abundance	62.304abcdef	41.925cdef	51.159cdef	51.796b
V-200 F_1	53.180bcdef	49.740cdef	28.964ef	43.961b
Topkapi F_1	64.727abcdef	40.633cdef	50.042cdef	51.800b
ACN-55 F_1	73.059abcde	85.539abc	99.885a	86.161a
ACN-112 F_1	35.475ef	61.333abcdef	36.060ef	44.289b
Porsuk F_1	28.390ef	44.323cdef	42.915cdef	38.542b
H-12-63-208 F_1	42.448cdef	40.848cdef	39.030def	40.775b
ACN-90 F_1	49.167cdef	64.951abcdef	48.419cdef	54.179b
Means	49.662	56.408	50.447	

Cultivars × Treatment: S ($D_{0.05}$ = 7.916).

In examine cultivar × organic fertilizer interaction; there was a significant reduction in yield of Olga F_1 as 24.065 t ha^{-1} obtained from control plot. The highest yield (99.885 t ha^{-1}) was determined from ACN-55 F_1 from control plot.

The total yields were obtained from OMF (49.662 t ha^{-1}), farmyard manure (56.408 t ha^{-1}) and control (50.447 t ha^{-1}) plots were higher than the result of Imtiyaz *et al.*[16]. This may be resulted from the soil, cultivars and ecological conditions of the study area. Similar results were reported in the literatures[2,7-9,13].

Fruit number: The fruit numbers for OMF, farmyard manure and control plots were 897.3, 972.7 and 844.0, respectively.

All the cultivar factors and cultivar × organic fertilizer interactions significantly affected fruit number ($p < 0.05$) but, no significant difference was found between organic fertilizer factors (Table-3).

TABLE-3
EFFECTS OF ORGANIC FERTILIZERS ON FRUIT NUMBER OF TOMATO CULTIVARS (number ha^{-1})

Cultivars	Treatments			Means (D%5 = 8.29)
	OMF	Farmyard	Control	
H-2274	1320.0abc	1850.0a	1250.0abcd	1473.3a
Olga F_1	836.7cdefg	673.3cdefg	390.0fg	633.3cde
Abundance	1250.0abcd	946.7bcdefg	983.3bcdefg	1060.0b
V-200 F_1	956.7bcdefg	850.0bcdefg	483.3defg	763.3bcde
Topkapi F_1	1223.3abcde	683.3cdefg	1163.3abcdef	1023.3bc
ACN-55 F_1	1256.7abcd	1666.7ad	1813.3a	1578.9a
ACN-112 F_1	286.7g	503.3cdefg	566.7cdefg	452.2e
Porsuk F_1	400.0efg	663.3cdefg	400.0efg	512.2de
H-12-63-208 F_1	663.3cdefg	753.3cdefg	563.3cdefg	660.0cde
ACN-90 F_1	780.0cdefg	1063.3abcdefg	826.7cedfg	890.0bcd
Means	897.3	972.7	844.0	

Cultivars × Treatment: Significant, S, ($D_{0.05}$ = 14.36).

In examine the cultivars, the highest mean fruit numbers were 1578.9 and 1473.3 in ACN-55 F_1 and H-2274, respectively but the lowest as 452.2 in ACN-112 F_1. The other cultivars were between these two groups.

In Table-3, the highest and the lowest fruit numbers were obtained from ACN-55 F_1 × control (1813.3) and ACN-112 F_1 × OMF (286.7), respectively.

Fruit weight: The fruit weights for organic mineral fertilizer, farmyard manure and control plots were 78.42, 84.01 and 76.83 g, respectively (Table-4).

Cultivars, organic fertilizers and cultivars × organic fertilizers highly affected the mean fruit weights ($p < 0.05$). The highest mean fruit weights were 102.33 and 100.92 g from Porsuk F_1 and ACN-112 F_1, respectively, but lowest in H-2274 (60.23 g) and ACN-55 F_1 (64.44g).

In Table-4, the highest and the lowest fruit weights were obtained from ACN-112 F_1 × farmyard manure (117.86 g) and H-2274 × OMF (44.96), respectively. Similar result was cited in previous study[8,13].

Fruit size: The data in Table-5 showed that the highest mean fruit size was obtained from ACN-112 F_1 with 7.42 cm and Porsuk F_1 with 7.08 cm but, the lowest from H-2274 with 5.76 cm. In examine the cultivars x organic fertilizer interaction, it was found that the highest fruit size was obtained from ACN-112 F_1 (7.67 cm) with OMF but, the lowest from ACN-55 F_1 with OMF (5.39 cm). Tomato cultivars and cultivar × organic fertilizer significantly affected the fruit size of tomato ($p < 0.05$). Similar results were also mentioned elsewhere[2,7,13].

TABLE-4
EFFECTS OF ORGANIC FERTILIZERS ON MEAN FRUIT WEIGHT OF TOMATO CULTIVARS (g)

Cultivars	Treatments			Means ($D_{0.05}$ = 3.75)
	OMF	Farmyard	Control	
H-2274	44.96g	67.34defg	68.39defg	60.23c
Olga F_1	75.65cdefg	93.43abcdef	77.88bcdefg	82.32b
Abundance	80.00bcdefg	72.98cdefg	72.35cdefg	75.11bc
V-200 F_1	73.37cdefg	74.86cdefg	84.02abcdef	77.41bc
Topkapi F_1	69.37defg	78.17bcdefg	71.42cdefg	72.99bc
ACN-55 F_1	56.32fg	66.87defg	70.14defg	64.44c
ACN-112 F_1	107.92abc	117.86a	76.99bcdefg	100.92a
Porsuk F_1	113.58ab	103.21abcd	90.20abcdef	102.33a
H-12-63-208 F_1	83.22abcdef	87.20abcdef	95.82abcde	88.75ab
ACN-90 F_1	79.85bcdefg	78.14bcdefg	61.05efg	73.01bc
Means ($D_{0.05}$=2.05)	78.42ab	84.01a	76.83b	

Cultivars × Treatment: S ($D_{0.05}$ = 6.49).

TABLE-5
EFFECTS OF ORGANIC FERTILIZER APPLICATIONS ON FRUIT SIZE OF TOMATO CULTIVARS (cm)

Cultivars	Treatments			Means ($D_{0.05}$ = 0.10)
	OMF	Farmyard	Control	
H-2274	5.61gh	5.63gh	6.04efgh	5.76e
Olga F_1	6.22efgh	6.56bcdefg	6.51cdefg	6.43c
Abundance	6.92abcde	5.83fgh	6.34efgh	6.36c
V-200 F_1	6.52cdefg	6.44defg	6.64abcdefg	6.53bc
Topkapi F_1	6.11efgh	6.06efgh	5.99efgh	6.05cde
ACN-55 F_1	5.39h	5.66gh	6.38efgh	5.81de
ACN-112 F_1	7.67a	7.00abcde	7.57abc	7.42a
Porsuk F_1	7.49abcd	6.97abcde	6.80abcdef	7.08a
H-12-63-208 F_1	6.94abcde	7.61ab	6.56abcdefg	7.04ab
ACN-90 F_1	6.40efgh	6.33efgh	6.11efgh	6.28cd
Means	6.52	6.41	6.49	

Cultivars × Treatment: S ($D_{0.05}$ = 0.18).

Fruit height: The highest mean fruit height (Table-6) was determined from cultivars of ACN-112 F_1 with 6.48 cm and H-12-63-208 F_1 with 6.65 cm but, the lowest from Topkapi F_1 with 5.28 cm. The results of cultivar × organic fertilizer interaction showed that the highest fruit height was measured from H-12-63-208 F_1 (6.89 cm) with control but, the lowest from abundance with farmyard manure (5.18 cm) and ACN-55 F_1 with OMF (5.18 cm). Tomato cultivars and cultivar × organic fertilizer interaction significantly influenced the fruit height of tomato ($p < 0.05$). No significant difference was found between organic fertilizer factors. That is in agreement with findings of some previous results[2,8,13].

TABLE-6
EFFECTS OF ORGANIC FERTILIZER APPLICATIONS ON FRUIT HEIGHT (cm) OF TOMATO CULTIVARS

Cultivars	Treatments			Means ($D_{0.05}$ = 0.08)
	OMF	Farmyard	Control	
H-2274	5.60cdefg	5.74cdefg	5.99bcdefg	5.78bc
Olga F_1	5.44efg	5.50defg	5.60cdefg	5.51cd
Abundance	5.81cdefg	5.18g	5.45efg	5.48cd
V-200 F_1	5.60cdefg	5.55cdefg	5.72cdefg	5.63bcd
Topkapi F_1	5.21fg	5.25efg	5.39efg	5.28d
ACN-55 F_1	5.18g	5.40efg	6.00bcdef	5.53cd
ACN-112 F_1	6.69ab	5.99cdefg	6.76ab	6.48a
Porsuk F_1	6.31abc	6.06bcde	5.55cdefg	5.97b
H-12-63-208 F_1	6.29abcd	6.77ab	6.89a	6.65a
ACN-90 F_1	5.76cdefg	5.63cdefg	5.44efg	5.61bcd
Means	5.79	5.71	5.88	

Cultivars × Treatment: S ($D_{0.05}$ = 0.14).

Total soluble solid (TSS) and pH: Table-7 revealed that TSS was found to be between 5.12 and 5.78 % depending on cultivars. It was higher in H-2274 (5.78 %) and H-12-63-208 F_1 (5.52 %) than other cultivars. Tomato cultivars significantly influenced the TSS ($p < 0.05$) but, no significant difference was found between organic fertilizer factors and interactions. Study results are similar to report of Paksoy[13].

TABLE-7
TOTAL SOLUBLE SOLID CONTENTS (TSS) AND pH OF TOMATO CULTIVARS

Cultivars	TSS (%)	pH
H-2274	5.78a	4.31
Olga F_1	5.12b	4.22
Abundance	5.31ab	4.29
V-200 F_1	5.50ab	4.26
Topkapi F_1	5.35ab	4.34
ACN-55 F_1	5.48ab	4.38
ACN-112 F_1	5.32ab	4.31
Porsuk F_1	5.34ab	4.26
H-12-63-208 F_1	5.52a	4.24
ACN-90 F_1	5.42ab	4.18
$D_{0.05}$	0.08	Not significant (NS)

No significant difference was found among pH in different cultivars and organic fertilizers. The pH data of cultivars are given in Table-7. The findings of individual effect of cultivars and organic fertilizers on pH are same conclusion of literature results[8,13].

Conclusion

From the present investigation, yield of tomato can be increased significantly by selecting suitable tomato cultivars and organic fertilizers. The results showed conclusively that cultivars were more effective in increasing tomato yields. Organic mineral fertilizer and farmyard manure increased the mean fruit weights significantly comparison to control. Organic fertilizer application can be strongly recommended for sustainable agriculture. Organic fertilizer application is also very efficient way in improvement of soil productivity without causing the harmful effect on environment. For sustainable water uses, irrigation water should be managed properly especially in arid and semi-arid regions.

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