

EFFECTS OF DIFFERENT MULCH MATERIALS ON PLANT GROWTH, SOME QUALITY PARAMETERS AND YIELD IN MELON (*CUCUMIS MELO* L.) CULTIVARS IN HIGH ALTITUDE ENVIRONMENTAL CONDITION

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Abstract

A study was carried out to determine the effects of different mulch materials on plant growth, some quality properties and yield in melon cultivars in high altitude environmental condition. Clear mulch application affected more plant growth than the other applications. Fruit width, fruit length, dry matter in fruit, total soluble solid, color, husk thickness, fruit fresh thickness, fruit firmness, pH, total and reducing sugar of the cultivars were investigated. The effects of mulch application in terms of the characters were significant depending on the cultivars. Average fruit weight of the cultivars was significantly high in mulch application, especially clear mulch application when compared to control. Marketable yield in melon cultivars was different based on the years. The highest marketable yield was obtained from clear mulch application as compared to control. Average marketable yield in the study years increased by 25-28% in clear plastic mulch and 15% in black plastic mulch compared to the control application. Soil temperature in clear and black mulch applications were higher (5-8°C and 1-4°C respectively) than that of control application.

Introduction

Vegetable production is getting an increase all round of the world. Turkey has favorable ecological conditions for vegetable growth and is one of the most important vegetable producers in the world. Turkey is fourth important producer (25.3 million tons) country regarding of vegetable production in the world.

Vegetables commonly grown in Turkey today consist of annual crops including Solanaceous, Crucifers, Cucurbits, Bulb crops, Leguminous and other indigenous vegetable species. In terms of economic value, nutrition, consumers preference, general adaptability and extent of cultivation the most commonly grown vegetable crops are tomato, watermelon, cucumber, pepper (hot and sweet), eggplant, squash, onion, snap bean, melon etc.

Melon is one of the most important vegetable in Turkey and our country is 2nd producer country in the world (Anon., 2005). But, vegetation period is not enough to grow melon in some part of Turkey, especially east region having high altitude environmental conditions. In this region where cool season vegetable crops were generally grown, warm season vegetable crops are not adequately growing because of insufficient soil temperature. For this reason, some cultural treatment such as mulch must be applied to raise soil temperature. It is known that plant development and yield increase with balance of soil temperature and decrease of difference between night and daytime temperatures (Sevgican, 1999).

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To increase vegetable production, many applications such as mulch are applied in different environmental conditions. Mulching vegetables can increase yields, promote early harvest and reduce fruit defects. Moreover, mulches can reduce evaporation from the soil surface, prevent weed growth, modify soil temperature, reduce costs, protection of soil structure, and reduce insect number (Anon, 1980; Preeece & Read, 1993; Splittstoesser, 1990, Ekinci & Dursun, 2006a). Even though many researchers investigated mulch application on different vegetable species eg., melon (Abak *et al.*, 1991); pepper (Abak *et al.*, 1992); tomato (Arin & Ankara, 2001; Apaydin *et al.*, 1998; Tüzel & Boztok, 1990); muskmelon (Bonanno & Lamont, 1987) watermelon (Brinen an Locascio, 1979, Farios-Larios & Orozco-Santoz, 1997, Libik & Swiek, 1994, Pakyürek & Kaşka, 1992; Ekinci & Dursun, 2006b), on eggplant (Carter and Johnson, 1988), on cucumber (Çevik *et al.*, 1992) in different part of the world, but there is not enough research on it in high altitude environmental conditions.

This study was conducted to determine the effect of different mulch materials on plant growth, some quality properties and yield in melon cultivar and select available cultivars as alternative to traditional crops for Erzurum having short vegetation period, low soil temperature during summer period and high altitude environmental conditions.

Materials and Methods

The experiment was carried out at the research application area of Agricultural Faculty of Ataturk University in summer growing period of Erzurum province, having 1950 m altitude. Melon cultivars were used as plant materials in Galia F1, Falez F1, Kırkağaç 589, Kırkağaç 637 ve Sempati F1. Black and clear plastic sheets were used as mulch applications.

The seeds were sown in the beginning of May into the multiple trays having growing medium and growth in greenhouse conditions in all the years. Plant growth beds were prepared 1 m apart from each other. Black and clear polyethylene mulches were laid down on the beds and holes were opened at 1 m x 1 m for planting of the seedlings. Seedlings were planted on second week of June in all the study years.

The required cultural practices were made during the growing period. The soil temperatures at 10 cm depth of black polyethylene, clear polyethylene and control parcels were recorded at 8.30 am, 13.30 p.m. and 16.30 p.m. during growing periods of the plants.

The parameters of first flower and fruits, fruit diameter, fruit length, dry matter in fruit, total soluble solid, color, husk thickness, fruit fresh thickness, fruit firmness, pH, acidity, total and reducing sugar of the cultivars were determined on the plants and fruit. Average fruit weight and marketable yield of the cultivars were also determined.

Data were tested by analysis of variance and treatments were compared with Duncan's multiple range tests (Anon., 1982).

Results and Discussion

Plant growth: Mulch applications significantly affected plant growth and increased plant length in the experiment made in high altitude environmental conditions. The highest plant growth was obtained from clear mulch application while it was the lowest in control application. The highest plant length among the cultivars was Kırkağaç 589 (Table 1). Similar results were reported by Pakyürek & Kaşka (1992) and Pakyürek *et al.*, (1992). Carter & Johnson (1988) also reported that growth index and development of eggplant improved with mulches.

Table 1. The effect of different mulch materials on plant length, first flowering and fruiting time in the melon cultivars.

Year	Applications	Cultivars					Mean
		Kırkağaç 637	Kırkağaç 589	Galia F ₁	Falez F ₁	Sempati F ₁	
First flowering time (day)							
2003	Control	49.67	32.33	35.00	40.33		39.33 A**
	Black PE	39.33	29.67	21.33	16.00		26.58 B
	Clear PE	30.67	25.67	19.33	22.00		24.42 B
	Mean	39.89 a**	29.22 b	25.22b	26.11b		
2004	Control	21.67	29.33	20.00	21.00	19.00	22.20 A*
	Black PE	23.67	26.67	18.00	19.00	18.67	21.20 AB
	Clear PE	21.67	23.67	17.00	18.00	17.00	19.47 B
	Mean	22.33 b**	26.56 a	18.33c	19.33c	18.22 c	
2005	Control	35.67	33.67	19.33	20.00	18.67	25.47A**
	Black PE	33.33	30.67	17.00	19.00	18.67	23.73B
	Clear PE	31.67	29.67	16.00	18.00	14.00	21.87C
	Mean	33.56 a**	31.33 b	17.44 cd	19.00 c	17.11 d	
First flowering time (day)							
2003	Control	67.67	62.00	54.33	59.00		60.75 A**
	Black PE	57.00	56.00	41.33	46.00		50.08 B
	Clear PE	47.67	52.33	46.67	44.33		47.75 B
	Mean	57.44 a**	56.78 a	47.44 b	49.78b		
2004	Control	47.33	47.00	36.00	36.00	34.00	40.07 A**
	Black PE	44.33	44.67	32.33	30.33	32.33	36.80 AB
	Clear PE	40.67	43.00	30.00	31.00	30.00	34.93 B
	Mean	44.11 a**	44.89 a	32.78 b	32.44 b	32.11 b	
2005	Control	47.67	39.33	35.00	37.67	36.00	39.13A**
	Black PE	46.00	37.00	34.00	34.67	34.00	37.13B
	Clear PE	46.33	36.00	32.67	33.33	32.67	36.20B
	Mean	46.67 a **	37.44 b	33.89 c	35.22 c	34.22 c	
Plant length (cm)							
2003	Control	105.82	133.15	101.98	90.95		107.97 B**
	Black PE	139.83	136.23	117.45	119.91		128.35 A
	Clear PE	156.14	168.60	117.73	128.05		142.63 A
	Mean	133.93 a**	145.99 a	112.38 b	112.9b		
2004	Control	141.94	167.56	112.56	129.39	107.22	131.73C**
	Black PE	151.44	169.17	145.22	133.67	126.45	145.19 B
	Clear PE	169.06	196.94	159.11	154.72	143.14	164.59 A
	Mean	154.15 b**	177.89 a	138.96bc	139.26bc	125.60 c	
2005	Control	134.56	133.28	130.56	118.78	116.28	126.69 C**
	Black PE	179.33	179.78	144.33	151.56	151.78	161.36 B
	Clear PE	190.11	192.72	171.17	168.69	169.11	178.40 A
	Mean	168.00 a**	168.59 a	148.69 b	146.41 b	145.72 b	

*: Significantly important according to p<0.05

**: Significantly important according to p<0.01

NS: Not Significant

There were significant differences among the applications in terms of first flowering and fruiting time of the cultivars (Table 1). The earliest flowering and fruit formation were firstly observed on clear mulch, then black mulch application in all of the study years when compared to control. The earliest flowering and fruiting among the cultivars were recorded at Galia F1 and Falez F1, respectively, in 2003 and at Sempati F1 in 2004 and 2005 (Table 1). Many researchers Abak *et al.*, 1991; Abak *et al.*, 1992; Arin & Ankara, 2001; Apaydin *et al.*, 1998; Bonanno & Lamont, 1987; Pakyürek & Kaşka, 1992; Paktürek *et al.*, 1992; Tüzel & Boztok, 1990) reported same as our results that using mulch affect on early yield in vegetable production.

Fruit quality: The effects of different mulches on quality of melon cultivars are give in Tables 2, 3, 4, and 5. Fruit diameter and length were significantly higher in clear and black mulches than control (Table 2). These results have similar response with those mentioned by Farios-Larios & Orozco-Santos (1997) where reported that lengths of fruit with clear and white plastic mulches were greater than control. There were no significant differences among the applications in terms of husk thickness, fresh thickness and firmness of fruit of the cultivars (Tables 2 and 3). However, these parameters were different and chanced based on the cultivar in all study years. Pakyürek *et al.*, (1992) and Çevik *et al.*, (1992) observed same difference in fruit diameter and length of melon with plastic mulching.

The differences between mulches were found non significant for the color values L* and b* in all the cultivars in the study years. However, color values a* with plastic mulches were significantly different when compared to the control (Table 3).

Reducing and total sugar content of fruit produced by plants in different plastic mulches were found as significant in 2004, but non significant in 2005 (Table 4). This situation can be explained that environmental conditions of the years differently effects on these parameters. The highest reducing and total sugar content of fruit were observed with clear and black mulches in all cultivars in experimental years.

There were no significant differences in term of titratable acidity, total soluble solids, pH and dry matter in fruit among the applications. However, significant differences were observed among the melon cultivars regarding of these parameters (Tables 4 and 5). Our results on total soluble solid were in good agreement those reported by Farios-Larios & Orozco- Santos (1997) who mentioned that different (clear, black and white) mulches applications did not affect total soluble solids of fruit.

Yield: Marketable yield (kg/parcel), fruit per plant and average fruit weight were influenced by plastic mulches (Table 6). These parameters were found significantly different among the mulch applications and cultivars in all the study years. In general, the highest marketable yield, fruit per plant and average fruit were determined at clear mulch application in all the study years (Table 6). There were significant differences among the melon cultivar in term of these parameters in all the study years. Galia F1 produced the more fruit per plant and marketable yield than other cultivars. But, Kırkağac 589 was of the more fruit weight than the other cultivars (Table 6). Çevik *et al.*, (1992) observed that number of fruit was higher in mulched treatments than non-mulched application. Abak *et al.*, (1991) reported that average fruit weight was 880 g in mulch plantations while it was only about 762 g in control plantations.

Table 2. The effect of different mulch materials on diameter, length, husk thickness and fresh thickness of fruit in the melon cultivars.

Year	Applications	Cultivars					Mean
		Kırkağaç 637	Kırkağaç 589	Galia F ₁	Falez F ₁	Sempati F ₁	
Fruit diameter (cm)							
2003	Control	10.30	12.76	11.21	11.75		11.50 B**
	Black PE	10.91	12.33	13.06	13.12		12.35 A
	Clear PE	12.76	12.87	12.98	13.23		12.96 A
	Mean	11.32 b*	12.65 a	12.41 a	12.70 a		
2004	Control	11.35	12.02	12.58	12.35	12.81	12.22 B**
	Black PE	12.73	13.28	13.23	13.87	13.37	13.29 A
	Clear PE	12.18	12.82	13.71	13.43	13.04	13.04 A
	Mean	12.09 b*	12.71 ab	13.17 a	13.21 a	13.07 a	
2005	Control	12.80	12.90	13.39	13.00	13.56	13.12 B**
	Black PE	14.02	13.79	13.72	14.49	13.85	13.93 A
	Clear PE	13.98	12.84	14.12	14.33	14.02	13.86 A
	Mean	13.60 ns	13.17	13.74	13.94	13.74	
Fruit length (cm)							
2003	Control	14.00	23.48	11.19	11.89		15.14 NS
	Black PE	14.68	21.74	13.66	14.07		16.04
	Clear PE	16.14	21.51	14.16	14.25		16.52
	Mean	14.94 b**	22.24 a	13.00 c	13.41 c		
2004	Control	15.44	20.76	12.38	12.53	11.38	14.49 B**
	Black PE	17.39	22.65	13.43	14.30	12.93	16.14 A
	Clear PE	16.38	22.91	13.80	13.87	13.19	16.03 A
	Mean	16.40 b**	22.10 a	13.21 cd	13.57 c	12.50 d	
2005	Control	17.06	19.25	13.55	13.39	13.51	15.35 C **
	Black PE	18.87	22.67	14.76	14.87	14.33	17.10 B
	Clear PE	19.63	24.51	14.89	15.48	14.54	17.81 A
	Mean	18.52 b **	22.14 a	14.40 c	14.58 c	14.13 c	
Husk thickness (mm)							
2003	Control	6.10	6.94	2.97	2.94		4.74 NS
	Black PE	5.83	6.02	3.58	2.89		4.58
	Clear PE	7.37	6.10	3.39	3.23		5.02
	Mean	6.43 a*	6.36 a	3.31 b	3.02 b		
2004	Control	10.95	11.68	4.83	4.74	6.04	7.65 NS
	Black PE	10.09	9.89	4.95	4.06	4.96	6.79
	Clear PE	8.77	9.17	4.57	4.31	4.99	6.36
	Mean	9.93 ns	10.25	4.78	4.37	5.33	
2005	Control	6.53	6.39	1.51	1.72	2.34	3.70 NS
	Black PE	6.67	6.78	1.45	0.98	1.75	3.53
	Clear PE	5.93	6.10	1.19	1.41	1.64	3.25
	Mean	6.38 a **	6.42 a	1.38 b	1.37 b	1.91 b	
Fruit fresh thickness (cm)							
2003	Control	2.75	3.48	3.91	3.89		3.51 B*
	Black PE	3.19	3.48	4.25	4.31		3.81 AB
	Clear PE	3.38	3.65	4.57	4.53		4.03 A
	Mean	3.11 c**	3.54 b	4.24 a	4.24 a		
2004	Control	2.52	2.42	4.31	4.08	3.89	3.44 NS
	Black PE	2.47	3.34	4.22	4.36	4.20	3.72
	Clear PE	2.41	2.52	4.57	4.67	4.35	3.70
	Mean	2.46 b **	2.76 b	4.37 a	4.37 a	4.15 a	
2005	Control	3.32	3.49	4.11	3.74	3.86	3.71 NS
	Black PE	3.51	3.46	3.99	4.88	3.90	3.95
	Clear PE	3.45	3.26	4.52	4.49	4.51	4.04
	Mean	3.43 ns	3.41	4.21	4.37	4.09	

*: Significantly important according to p<0.05

**: Significantly important according to p<0.01

NS: Not Significant

Table 3. The effect of different mulch materials on fruit firmness, value of L, a and b color of the melon cultivars.

Year	Applications	Cultivars					Mean
		Kırkağaç 637	Kırkağaç 589	Galia F ₁	Falez F ₁	Sempati F ₁	
Fruit firmness							
2003	Control	116.67	105.00	76.55	73.95		93.04 NS
	Black PE	110.00	95.50	80.11	56.11		85.43
	Clear PE	113.05	98.55	90.94	61.45		90.99
	Mean	113.24 a**	99.68 ab	82.54 bc	63.83c		
2004	Control	60.72	57.78	34.84	32.38	32.27	43.59 NS
	Black PE	73.17	55.31	29.45	29.99	31.58	43.89
	Clear PE	67.78	62.17	32.14	35.48	35.23	46.56
	Mean	67.22 a **	58.42 a	32.14 b	32.62b	33.03 b	
2005	Control	60.83	43.08	52.05	42.92	46.25	49.03 NS
	Black PE	62.08	39.58	42.35	31.50	42.50	43.60
	Clear PE	56.42	33.33	43.33	32.67	55.83	44.32
	Mean	59.78 a **	38.67 cd	45.91 bc	35.69 d	48.19 b	
L (Color)							
2003	Control	62.75	68.74	65.13	66.03		65.66 NS
	Black PE	68.02	67.60	62.04	63.37		65.26
	Clear PE	63.73	66.36	67.28	61.90		64.82
	Mean	64.83 ns	67.57	64.82	63.77		
2004	Control	72.35	73.54	67.03	65.54	65.09	68.71 NS
	Black PE	68.01	68.48	64.85	66.19	68.08	67.12
	Clear PE	65.09	69.99	65.43	64.66	70.26	67.09
	Mean	68.48 ab**	70.67 a	65.77 c	65.46c	67.81 bc	
2005	Control	65.27	72.52	67.19	67.69	71.88	68.91 NS
	Black PE	66.34	69.63	66.71	66.72	71.05	68.09
	Clear PE	66.81	67.60	68.52	68.97	70.49	68.48
	Mean	66.14 ns	69.91	67.48	67.79	71.14	
a (Color)							
2003	Control	6.74	8.68	9.03	9.59		8.51 A*
	Black PE	6.11	6.52	8.35	9.26		7.56 AB
	Clear PE	6.76	6.22	6.34	7.74		6.76 B
	Mean	6.54 b*	7.14 b	7.91 ab	8.86 a		
2004	Control	6.38	6.57	8.92	9.68	9.68	8.24 A*
	Black PE	7.02	6.16	8.63	8.51	9.10	7.88 AB
	Clear PE	3.91	6.41	8.05	9.30	7.41	7.02 B
	Mean	5.77 b**	6.38 b	8.53 a	9.16 a	8.73 a	
2005	Control	4.98	5.41	9.86	9.13	8.81	7.64 NS
	Black PE	2.87	4.61	8.95	8.89	8.11	6.69
	Clear PE	4.95	3.76	8.06	8.03	7.85	6.53
	Mean	4.27 b **	4.60 b	8.27 a	8.68 a	8.26 a	
b (Color)							
2003	Control	16.54	19.74	27.37	26.97		22.66 NS
	Black PE	14.07	15.52	28.21	27.32		21.28
	Clear PE	16.06	15.06	26.92	26.76		21.20
	Mean	15.56 b**	16.77 b	27.50 a	27.02a		
2004	Control	16.00	15.21	24.75	25.99	23.14	21.02 NS
	Black PE	15.97	15.26	24.76	23.52	21.05	20.11
	Clear PE	13.75	15.14	26.01	26.86	19.58	20.27
	Mean	15.24 c**	15.21 c	25.17 a	25.45a	21.26 b	
2005	Control	15.74	15.65	29.02	26.40	24.71	22.30 NS
	Black PE	16.97	15.22	26.90	24.74	22.48	21.26
	Clear PE	14.45	18.94	25.09	26.41	22.59	21.49
	Mean	15.72 c **	16.60 c	27.00 a	25.85 a	23.26 b	

*: Significantly important according to p<0.05

**: Significantly important according to p<0.01

NS: Not Significant

Table 4. The effect of different mulch materials on reducing sugar, total sugar and titratable acidity of fruit of the melon cultivars.

Year	Applications	Cultivars					Mean
		Kırkağac 637	Kırkağac 589	Galia F ₁	Falez F ₁	Sempati F ₁	
Reducing sugar (%)							
2004	Control	2.39	2.38	2.78	2.07	2.82	2.49 B **
	Black PE	2.42	2.25	2.59	2.33	3.12	2.54 B
	Clear PE	2.56	2.28	13.71	3.34	4.49	3.15 A
	Mean	2.46 c **	2.30 c	2.81 b	2.58bc	3.48 a	
2005	Control	2.43	1.72	3.19	2.64	2.83	2.56 NS
	Black PE	3.01	2.37	5.09	3.33	2.93	3.35
	Clear PE	2.65	2.02	4.56	3.37	2.71	3.06
	Mean	2.70 bc **	2.04 c	4.28 a	3.11 b	2.82 bc	2.99
Total sugar (%)							
2004	Control	2.60	3.14	8.31	10.32	9.27	6.73 B **
	Black PE	2.95	5.46	9.39	11.20	10.60	7.92 A
	Clear PE	5.54	2.89	10.84	11.26	11.00	8.31 A
	Mean	3.70 c **	3.83 c	9.51 b	10.92a	10.29 ab	
2005	Control	5.23	3.49	7.53	8.10	9.05	6.68 NS
	Black PE	6.81	4.50	8.91	9.99	8.34	7.71
	Clear PE	5.05	5.73	10.82	8.46	8.07	7.63
	Mean	5.70 b **	4.57 b	9.08 a	8.85 a	8.49 a	
Titratable acidity (g/100ml)							
2003	Control	0.27	0.21	0.18	0.23		0.22 B *
	Black PE	0.26	0.25	0.29	0.36		0.29 AB
	Clear PE	0.32	0.49	0.46	0.24		0.38 A
	Mean	0.28 ns	0.32	0.31	0.28		
2004	Control	0.24	0.27	0.21	0.23	0.20	0.23 NS
	Black PE	0.25	0.28	0.24	0.23	0.17	0.23
	Clear PE	0.27	0.29	0.24	0.21	0.22	0.24
	Mean	0.25 ab *	0.28 a	0.23 bc	0.22bc	0.20 c	
2005	Control	0.42	0.40	0.44	0.45	0.38	0.42B ^{NS}
	Black PE	0.39	0.38	0.48	0.49	0.47	0.44AB
	Clear PE	0.43	0.41	0.52	0.50	0.49	0.47A
	Mean	0.41ab *	0.40 b	0.48 a	0.48 a	0.45 ab	

*: Significantly important according to p<0.05

**: Significantly important according to p<0.01

NS: Not Significant

Mulch applications were significantly effective on hectare yield when compared to the control. Hectare yields of mulched treatments (black and clear) were 22.42 and 32.53 t/ha, respectively, as compared to 11.44 t/ha in the control application (Table 6).

Table 5. The effect of different mulch materials on soluble solid, dry matter and pH in fruit of melon cultivars.

Year	Applications	Cultivars					Mean
		Kırkağaç 637	Kırkağaç 589	Galia F ₁	Falez F ₁	Sempati F ₁	
Soluble solid (%)							
2003	Control	4.03	4.23	8.67	9.30		6.55 NS
	Black PE	4.93	3.61	8.99	8.83		6.59
	Clear PE	5.93	5.44	10.07	8.81		7.56
	Mean	4.97 b **	4.42 b	9.24 a	8.98 a		
2004	Control	6.85	5.94	12.49	12.14	11.31	9.75 NS
	Black PE	6.41	9.33	10.78	13.56	11.48	10.31
	Clear PE	7.84	7.48	12.87	11.92	12.04	10.43
	Mean	7.03 b **	7.58 b	12.05 a	12.54 a	11.61 a	
2005	Control	6.30	5.07	11.01	10.08	10.21	8.53B **
	Black PE	7.81	6.61	11.37	12.10	10.14	9.61A
	Clear PE	7.24	7.76	12.99	11.96	10.73	10.14A
	Mean	7.12 c **	6.48 c	11.79 a	11.38 ab	10.36 b	
Dry matter in fruit (%)							
2003	Control	3.79	7.56	9.02	7.32		6.92 NS
	Black PE	9.15	6.38	6.92	8.23		7.67
	Clear PE	8.43	6.96	6.89	9.09		7.48
	Mean	7.12 ns	6.96	7.61	8.21		
2004	Control	2.81	8.65	12.66	10.65	12.88	9.53 NS
	Black PE	3.75	9.21	8.99	10.82	9.68	8.49
	Clear PE	5.36	5.46	12.34	8.29	10.15	8.32
	Mean	3.97 b **	7.77 a	11.33 a	9.92 a	10.91 a	
2005	Control	6.00	5.41	6.47	7.56	7.76	6.64B *
	Black PE	7.52	5.96	8.14	10.98	8.15	8.15A
	Clear PE	5.70	8.06	9.29	10.25	8.55	8.37A
	Mean	6.40 c **	6.47 c	7.97 bc	9.60 a	8.15 ab	
pH							
2003	Control	5.24	5.26	6.30	6.24		5.76 NS
	Black PE	5.47	5.16	5.87	5.81		5.58
	Clear PE	5.60	4.80	5.32	6.26		5.49
	Mean	5.44 bc**	5.07 c	5.83 ab	6.11 a		
2004	Control	5.39	5.31	6.32	6.21	6.36	5.92 NS
	Black PE	5.39	5.91	6.20	6.23	6.21	5.99
	Clear PE	5.65	5.45	6.31	6.27	6.34	6.00
	Mean	5.48 b **	5.56 b	6.28 a	6.24 a	6.30 a	
2005	Control	5.73	5.79	6.38	6.32	6.18	6.08B *
	Black PE	5.86	5.82	6.46	6.43	6.29	6.17A
	Clear PE	5.72	5.90	6.52	6.46	6.36	6.19A
	Mean	5.77 c **	5.84 c	6.45 a	6.40 a	6.28 b	

*: Significantly important according to p<0.05

**: Significantly important according to p<0.01

NS: Not Significant

Table 6. The effect of different mulch materials on parameters of yield of different melon varieties.

Year	Applications	Cultivars					Mean
		Kırkağaç 637	Kırkağaç 589	Galia F ₁	Falez F ₁	Sempati F ₁	
Fruits of per plant (number)							
2003	Control	0.49	1.15	1.51	1.56		1.18 B*
	Black PE	3.38	1.55	2.67	2.56		2.54 A
	Clear PE	1.20	2.38	4.07	2.35		2.50 A
	Mean	1.69 ns	1.69	2.75	2.16		
2004	Control	2.00	1.16	2.69	2.65	1.89	2.08C**
	Black PE	2.36	2.27	3.91	3.56	2.53	2.93 B
	Clear PE	3.51	2.96	5.40	5.07	3.36	4.01 A
	Mean	2.62 b**	2.13 b	3.99 a	3.76 a	2.59 b	
2005	Control	1.55	0.93	1.98	1.53	1.49	1.50C **
	Black PE	1.73	2.02	3.22	4.11	4.13	3.04B
	Clear PE	2.20	2.62	6.93	5.07	5.56	4.48A
	Mean	1.83 b **	1.86 b	4.04 a	3.57 a	3.73 a	
Average fruit weight (kg)							
2003	Control	1.12	1.89	1.02	1.39		1.36 B **
	Black PE	1.54	1.75	1.17	1.53		1.50 AB
	Clear PE	1.78	1.96	1.38	1.48		1.65 A
	Mean	1.48 b **	1.87 a	1.19 c	1.47 b		
2004	Control	1.12	1.50	0.99	1.13	1.03	1.16 B **
	Black PE	1.34	1.79	1.25	1.43	1.19	1.40 A
	Clear PE	1.40	1.63	1.28	1.37	1.30	1.40 A
	Mean	1.29 b **	1.64 a	1.17 b	1.31 b	1.17 b	
2005	Control	1.11	1.31	0.99	1.11	1.01	1.11B **
	Black PE	1.45	1.69	1.25	1.19	1.10	1.34A
	Clear PE	1.46	1.64	1.65	1.34	1.09	1.44A
	Mean	1.34b **	1.55 a	1.30 b	1.21b c	1.07 c	
Marketable yield (kg/parcel)							
2003	Control	16.81	31.56	23.68	33.33		26.35 B**
	Black PE	36.31	39.17	48.09	58.50		45.52 A
	Clear PE	31.23	69.96	83.95	52.10		59.31 A
	Mean	28.12 ns	46.89	51.91	47.98		
2004	Control	33.25	25.60	39.61	45.06	29.79	34.66 C**
	Black PE	46.81	61.13	73.30	76.17	44.98	60.48 B
	Clear PE	73.10	71.86	102.00	104.26	64.93	83.23 A
	Mean	51.05 b **	52.87 b	71.64 a	75.16 a	46.57 b	
2005	Control	22.33	17.74	29.64	25.41	22.73	23.57C **
	Black PE	36.23	46.22	55.37	70.47	68.07	55.27B
	Clear PE	47.16	56.95	148.52	97.22	88.77	87.73A
	Mean	35.24 c **	40.30 c	77.84 a	64.37 ab	59.85 b	
Yield of hectare (kg/hectare)							
2003	Control	5985.60	8428.90	11236.50	11866.70		9379.42B**
	Black PE	12925.20	17121.20	13944.50	20826.00		16204.24A
	Clear PE	11116.70	29885.00	24904.60	18547.60		21113.47A
	Mean	10009.16 ns	18478.38	16695.21	17080.09		
2004	Control	11838.20	14099.90	9113.60	16042.60	10606.40	12340.15C**
	Black PE	16665.50	26094.80	21763.50	27116.50	16014.10	21530.89B
	Clear PE	26022.40	36313.20	25583.30	37162.80	23116.30	29639.61A
	Mean	18175.38 b**	25502.67 a	18820.13b	26773.97a	16578.93b	
2005	Control	11924.20	15827.60	9474.90	13568.94	12137.82	12586.69C**
	Black PE	19348.00	29567.80	24679.70	37630.98	36347.60	29514.82B
	Clear PE	25185.20	79309.80	30413.80	51917.26	47401.40	46845.49A
	Mean	18819.13 c **	41568.40 a	21522.80c	34372.39ab	31962.27b	

*: Significantly important according to $p < 0.05$

**: Significantly important according to $p < 0.01$

NS: Not Significant

Table 7. Effect of different mulch materials on soil temperature

Applications	June				July				August				September			
	8. ³⁰	13. ³⁰	16. ³⁰	8. ³⁰	13. ³⁰	16. ³⁰	8. ³⁰	13. ³⁰	16. ³⁰	8. ³⁰	13. ³⁰	16. ³⁰	8. ³⁰	13. ³⁰	16. ³⁰	
Control	14.29	20.33	18.50	18.57	22.50	24.02	19.32	22.25	23.58	18.00	20.67	21.17				
Black PE	17.61	23.50	21.70	21.08	24.29	28.18	20.22	23.72	26.75	19.17	23.00	23.90				
Clear PE	20.35	26.11	24.06	23.21	28.02	31.65	22.10	28.89	31.59	20.50	24.83	25.67				

Farios-Larios & Orozco-Santos (1997) reported that marketable yield from the mulched treatments were higher than those produced on bare soil. Similarly, Bonanno & Lamont (1987); Bhella (1988), Brinen & Locascio (1979), Taber & Lawson (1997) and Carter & Johnson (1988) reported that total and early yields increased with polyethylene mulches. Abak *et al.*, (1991) also observed an increase in total yield (62%) and yield of early (120%) melon cover by plastic mulch. Similar results with other vegetables were obtained by Pakyürek & Kaşka (1992) in watermelon, Apaydin *et al.*, (1998) in tomato, Çevik *et al.*, (1992) in cucumber, Pakyürek *et al.*, (1992) in tomato, pepper and eggplant, Abak *et al.*, (1992) in pepper and Tüzel & Boztok (1990) in tomato. Our results with the clear and black mulches were coherent with previous research. Mulches particularly clear plastic mulches always gave the higher yields and affected on other yield factors when compared to the black mulch and non-mulch applications.

Soil temperature: Soil temperature at 10 cm depth under each treatment during the crop cycle is shown in Table 7. The average mean soil temperatures under clear and black mulches were higher 5-8°C and 1-4°C, respectively as compared to control application. Soil temperature increased in plastic mulches and with clear plastic mulch resulting in the highest soil temperature (Bonanno & Lamont, 1987). Farios-Larios & Orozco-Santos (1997) stated that maximum soil temperatures under clear polyethylene reached 38.5°C and were greater than under white, black and unmulched soil. Similarly, Libik & Swiek (1994) reported that soil temperatures increased markedly under both clear polyethylene and clear polyethylene on black paper mulches. Similar results with other experiments were obtained by Abak *et al.*, (1990), Çevik *et al.*, (1992) and Apaydin *et al.*, (1998). The variations in soil temperature are due to plastic mulches which modify the amount of heat received and stored in the soil (Bonanno & Lamont, 1987; Preece & Read, 1993; Splittstoesser, 1990).

References

Abak, K., A.Y. Pakyürek, N. Gürsöz and R. Onsinejad. 1990. Malç Uygulamalarının Serada Toprak Sıcaklığı ile Sebzelerin Verim ve Erkenciliği Üzerine Etkisi. *Türkiye 5. Seracılık Sempozyumu, Ege Üniversitesi Ziraat Fakültesi, İzmir*, 55-62.

Abak, K., Y. Pakyürek and N. Sarı. 1992. Malç ve Alçak Tünel Uygulamalarının Serada Yetiştirilen Biberin Erkenciliği, Verimi ve Kök Gelişmesi ile Toprak Sıcaklığı Üzerine Etkileri. Çukurova Üniversitesi Ziraat Fakültesi Dergisi, 7(1): 1-12.

Abak, K., Y. Pakyürek, N. Sarı and S. Büyükalaca. 1991. Sera Kavun Yetiştiriciliğinde Malç ve Farklı Budama Yöntemlerinin Verim, Erkencilik ve Meyve İriliği Üzerine Etkileri. Çukurova Üniversitesi Ziraat Fakültesi Dergisi, 6(4): 39-50.

Anonymous. 1980. Vegetables. The American Horticultural Society. Mount Vernon, Virginia-USA. p. 144.

Anonymous. 1982. SAS users guide. SAS Institute, Cray, N. C.

Anonymous. 2005. www.fao.org

Apaydın, A., N. Kapla and F. Yamak. 1998. Polietilen Malç ve Alçak Tünel Uygulamalarının Domatese Verim ve Erkenciliğe Etkisi. Ondokuz Mayıs Üniversitesi Ziraat Fakültesi Dergisi, 13(2): 105-116.

Arin, L. and S. Ankara. 2001. Effect of Low-Tunnel, Mulch and Pruning on the Yield and Earliness of Tomato in Unheated Glasshouse. *J. Appl. Hort.*, 3(1): 23-27.

Bhella, H.S. 1988. Tomato Response to Trickle Irrigation and Black Polyethylene Mulch, *J. Amer. Soc. Hort. Sci.*, 113(4): 543-546.

Bonanno, A.R. and W.J. Lamont. 1987. Effect of Polyethylene Mulches, Irrigation Method And Row Covers on Soil and Air Temparature and Yield of Muskmelon. *J. Amer. Soc. Hort. Sci.*, 112(5): 735-738.

Brinen, G.H. and S.J. Locascio. 1979. Plant and Row Spacing, Mulch, and Fertilizer Rate Effects on Watermelon Production. *J. Amer. Soc. Hort. Sci.*, 104(6): 724-726.

Carter, J. and C. Johnson. 1988. Influence of Different Types of Mulches on Eggplant Production, *Hort. Science*, 23(1): 143-145.

Çevik, B., R. Kanber, M. Biçici, Y. Pakyürek and H. Köksal. 1992. Sera Koşullarında Yetiştirilen Hiyarda Değişik Toprak Örtü Materyallerinin Verim, Kalite ve Su Tüketimine Etkileri, Türkiye I. Ulusal Bahçe Bitkileri Kongresi, Cilt II, Ege Üniversitesi Ziraat Fakültesi, İzmir, s: 209-212.

Ekinci, M. and A. Dursun. 2006a. Sebze Yetiştiriciliğinde Malç Kullanımı. *Derim Dergisi*, 23(1): 20-27.

Ekinci, M. and A. Dursun. 2006b. Farklı Malç Materyallerinin Karpuz (*Citrillus lunatus* L.)'da Bitki Gelişimi, Bazi Kalite Özelliklerine ve Verime Etkisi. VI. Sebze Tarımı Sempozyumu, 19-22 Eylül 2006, Kahramanmaraş-Türkiye, s:325-329.

Farias-Larios, J. and M. Orozco-Santos. 1997. Effect of Polyethylene Mulch Colour on Aphid Populations, Soil Temperature, Fruit Quality and Yield of Watermelon Under Tropical Conditions. *New Zealand Journal of Crop and Horticultural Science*, 25: 369-374.

Libik, A and P. Siwek. 1994. Changes in Soil Temparature Affected by the Application of Plastic Covers in Field Production of Lettuce and Watermelon. *ISHS Acta Horticulture* 371: VII International Symposium on Timing Field Production of Vegetables, p. 269-273.

Pakyürek, A. Y and N. Kaşka. 1992. Tünel Tipleri ve Toprak Örtülerinin Karpuzlarda Bitki Gelişmesi ile Erkenci ve Toplam Verimleri Üzerine Etkileri, 13-16 Ekim 1992 Türkiye I. Ulusal Bahçe Bitkileri Kongresi, Cilt II, Ege Üniv. Ziraat Fak., Bornova, İzmir, s: 385-388.

Pakyürek, A.Y., K. Abak, N. Sarı and Y. Güler. 1992. Harran Ovası Koşullarında Toprak Örtüsü (Malç) Kullanımının Domates, Biber ve Patlıcanda Verim, Erkencilik ve Kalite Üzerine Etkileri, 13-16 Ekim 1992 Türkiye I. Ulusal Bahçe Bitkileri Kongresi, Cilt II, Ege Üniv. Ziraat Fak., Bornova, İzmir, s: 165-168.

Preece, J.E. and P.E. Read. 1993. The Biology of Horticulture in Introductory Textbook, p. 263-269.

Sevgican, A. 1999. Örtüaltı Sebzeciliği. Ege Üniversitesi Ziraat Fakültesi Yayınları No: 528, 302 s, Bornova-İzmir.

Splitstoesser, W.E. 1990. Vegetable Growing Handbook, Organic and Traditional Methods, Plant Physiology in Horticulture University of Illinois, Urbana, Illinois, p. 112-115.

Taber, H.G. and V. Lawson. 1997. Melon Row Covers. Commerical Vegetables Horticulture, Department of Horticulture, Iowa State University, <http://www.public.iastate.edu/~taber/Extension/Melon/melonrc.html>

Tüzel, Y and K. Boztok. 1990. Farklı Malç Materyali Kullanımının İlkbahar Dönemi Sera Domates Yetiştiriciliğinde Verim ve Kalite Üzerine Etkileri. Ege Üniversitesi Ziraat Fakültesi Dergisi, 27(2): 119-130.