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Effect of Shading on the Growth and Producitivity of Some Tomato Cultivars in the Summer Season

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TWO FIELD experiments were carried out in El-Bosaily Protected Cultivation Unit, El-Behaira Governorate in 2000 and 2001 seasons to study the response of some tomato (*Lycopersicon esculentum*, Mill) cultivavs, *i.e.* Mader and Ain Shams 2 to plastic shading treatments, *i.e.* black or white as compared to the control (unshaded).

Data showed that plant height was increased with shading, especially black cover than the control, whereas number of leaves and dry matter content were deceased. Mader cultivar overcame Ain Shams 2, in both seasons.

Chlorophyl a,b and carotenoids were increased due to shading with black, followed by white cover with the superiority of Mader cultivar plants as compared to Ain Shams 2 cultivar.

Number of fruits per plant, average fruit weight and total fruit yield were improved with black shading and/or white shading with the superiority of Ain Shams 2 cultivar.

Shading decreased fruit T.S.S. and Vitamin C contents with a marked reduction with Mader cultivar . Fruits acidity was increased due to shading, especially black covered plants of Mader cultivar.

Tomato (*Lycopersicon esculentum*, Mill) is one of the major vegetable crops grown in Egypt throughout the whole year. However, fruit yield reduction occurs as a result to high temperatures during the late summer due to lower flower production ratio (El-Ahmadi & Stevens, 1979) and an increase in flower shedding (Abdalla & Verberk, 1968) as well as poor pollen grain viability (Rick

& Dempsy 1969). In addition, fruits production during late summer are smaller of those results in yield reduction (Moustafa *et al.*, 1981).

Shading increased plant height (Abd El-Aal & Waly, 1982, El-Aidy *et al.*, 1983 on tomato, Smith *et al.*, 1984 on tomato and cucumber, Moustafa, 1991, El-Gizawy *et al.*, 1992a and Abdel-Mawgoud *et al.*, 1996 on tomato). Shading decreased number of leaves, stem diameter, fresh and dry weight of leaves (Moustafa, 1991, Aldazabal *et al.*, 1999 and Koning, 2000). Shading was often suggested as a solution to overcome the effects of high temperature (El-Gizawy *et al.*, 1992a (35 % shade) and Abdel-Mawgoud , 1996). Increasing shade levels tended to increase chlorophyll and carotenoids concentrations of tomato leaves (Fayez, 1989, Moustafa, 1991 and El-Gizawy *et al.*, 1992a). Shading with black plastic net provide a 30 % reduction in solar radiation almost doubled total fruit yield and increased number of fruits per plant (El-Aidy *et al.*, 1983; Moustafa 1991, El-Gizawy *et al.*, 1992b; Abdazabal, 1999 and Koning 2000). Shading of tomato plants increased average fruit weight (Lagier & Brun, 1988, Moustafa, 1991 and El-Gizawy *et al.*, 1992b). Vitamin-C and T.S.S. contents of mature tomatoes were decreased with reducing radiation benefit, whereas T.S.S. and acidity were increased (Venter, 1979, Sagi, 1979, El-Aidy *et al.*, 1983, Moustafa, 1991, El-Gizawy *et al.*, 1992b, Aldazabal *et al.*, 1999 and Koning, 2000).

The objective of this study was to investigate the response of some tomato cultivars growth and productivity to different shading treatments in the summer season.

Material and Method

Two field experiments were carried out in El-Bosaily protected cultivation Unit, El-Behaira Governorate in 2000 and 2001 seasons to investigate the response of some tomato (*Lycopersicon esculentum*, Mill) cultivars to different shading treatments. Mader and Ain Shams 2 cultivars were used. Shading treatments were black and white provide 40% shading in addition to the control (unshaded).

The experimental soil was sandy in texture with pH 7.92 and E.C. 3.0 mmhos. Soil chemical analysis showed that it contains 11.6 meq/l of Mg, 12.77

Meq/l of Na meq/l of Ca, 2.95 meq/l of HCO_3 and 13.46 meq/l of Cl.A split plot design with 4 replicates was adapted. The two culttivars were assigned in the main plots where as the shading treatments were distsibuted as sub plots. Therefore, the experiment included six treatment.

Tomato seedlings were transplanted in 5^{th} and 7^{th} of May in 2000 and 2001 seasons, respectively. Drip irrigation system was conducted with 6000 drippers per feddan.

Shade treatments were low tunnels covered with shade net (black or white). Each replicate consisted of 3 tunnels which was 7.0 m length, 1.0 m width and 0.60 m height. Sixty days after transplanting, a random sample of 3 plants of each replicate was taken to determine the vegetative growth characteristics, *i.e.* plant height, number of leaves per plant and dry matter content. Chlorophyll a,b and carotenoids were determined in the first fully expanded leaf following the method of Wettestein (1957). At harvest, fruits were collected for total yield, frits number per plant and average fruit weight measurements. A random sample of ten fruits of each treatment was kept for determinations of Vitamin C, total acidity and T.S.S. according to A.O.A.C. (1975).

Statistical analysis was done according to Snedecor and Cochran (1980) and means were compared using the L.S.D. method at 5% level of significance.

Results and Discussion

1. Plant growth

Presented data in Table 1 showed that plant height was significantly increased due to shade treatments, especially with black cover, compared with the control plants (unshaded) in both cultivars and seasons. The highest values of plant height were recorded with Ain Shams 2 cultivar plants under black cover treatments while the lowest was with the control plants (unshaded) of Mader cultivar, in both seasons. However, number of leaves per plant as well as dry matter content showed opposite response, *i.e.* scoring its highest values in the control plants (unshaded) of Ain Shams 2 cultivar plants followed by white covered plants and lastly with Mader cultivar plants black shaded treatments, in both seasons. Obtained results agreed with Moustafa (1991), El-Gizawy *et al.* (1992), Abdel-Mawgoud *et al.* (1996), Aldazabal *et al.* (1999) and Koning

(2000), and could be explained by an increase in water content in the shaded plants which increased the ability of leaves in absorbing radiation and decreasing reflection (Jones, 1992). The reduction in total dry matter production resulted from the reduction in light intercepted by the plants as reported by Cockshull *et al.* (1992). Data also indicated the superiority of Ain Shams 2 cultivar as compared with Mader concerning all the recorded vegetative growth characters, in both seasons.

Pigments content was significantly increased due to shade (Table 1). Black shaded plants recorded the highest values of chlorophyll a, b, carotenoids and total chlorophylls, in both cultivars and seasons and overcame those of white and unshaded plants. Data indicated that the highest pigments contents were recorded with Ain Shams 2 plants black shaded while the lowest accompanied unshaded Mader cultivar plants. Data indicated the superiority of Ain Shams 2 cultivar plants over those of Mader in both seasons with insignificant difference. The increase of pigments contents under shading treatments may be due to the photo oxidation conditions occure under high illamination (Abd El-Hamid *et al.*, 1985). The findings of El-Aidy *et al.* (1983), Fayez (1989) , Moustafa (1991) and El-Gizawy *et al.* (1992a) supported our results.

2. Fruit yield

Number of fruits per plant, average fruit weight and the total fruit yield were significantly increased due to shade compared to unshaded plants (Table 2). This finding was true in both cultivars and seasons with the superiority of black shade over white shade treatments.

Data showed that Mader cultivar produced lower fruit yield than that of Ain Shams 2, in both seasons. Data showed that the most favourable treatments for fruit yield production were Ain Shams 2 plants black shaded, and the lowest were with unshaded Mader cultivar plants. The greater fruit yield produced by shaded plants could be due to the assumption that during summer, high temperature increases shedding of tomato flowers (Abdalla & Verberk, 1968) and reduces fruit set (Levy *et al.*, 1978). Moreover, fruits produced under such conditions are smaller (Sakiyma, 1968) which will also contribute to reduced yield. The obtained results agreed with El-Aidy *et al.* (1983), Lagier & Brun (1988), Mostafa (1991) and El-Gizawy *et al.* (1992b).

TABLE 1. Effect of shading on the vegetative growth and pigments contents of tomato leavs in 2000 and 2001 seasons.

Treatments		Plant height (cm)		No. of leaves/plant		Dry matter g/plant		Leaves pigments mg/g dry matter							
								Chl. a		Chl.b		Carotenoids		Total pigments	
Cultivars	Shading	2000	2001	2000	2001	2000	2001	2000	2001	2000	2001	2000	2001	2000	2001
Mader	Unshaded	43.6	47.2	58.4	62.1	40.6	41.2	2.18	2.19	1.22	1.32	1.46	1.42	4.86	4.93
	Black	47.9	49.8	51.2	54.3	35.1	35.3	2.63	2.62	1.56	1.67	1.88	1.95	6.07	6.24
	White	45.1	49.0	53.0	57.6	37.7	38.4	2.36	2.33	1.50	1.53	1.73	1.72	5.59	5.58
Average		45.5	48.7	54.2	58.0	37.8	38.3	2.39	2.38	1.43	1.51	1.69	1.70	5.51	5.58
Ain Shams$_2$	Unshaded	53.6	53.0	73.1	78.0	46.8	47.4	2.23	2.31	1.27	1.35	1.45	1.47	4.95	5.13
	Black	60.2	61.7	65.6	67.3	39.2	41.0	2.65	2.69	1.71	1.73	1.93	1.91	6.29	6.33
	White	55.1	55.8	69.5	72.9	42.1	42.9	2.42	2.39	1.59	1.62	1.69	1.74	5.70	5.75
Average		56.3	56.8	69.4	72.7	42.7	43.7	2.43	2.46	1.52	1.57	1.69	1.71	5.65	5.74
Main effect of shading	Unshaded	48.6	50.1	65.8	70.1	43.7	44.3	2.21	2.25	1.25	1.34	1.46	1.45	4.91	5.03
	Black	54.1	55.8	58.4	60.8	37.2	38.2	2.64	2.65	1.64	1.70	1.91	1.93	6.18	6.28
	White	52.1	52.4	61.3	62.1	39.9	40.6	2.39	2.36	1.55	1.58	1.71	1.73	5.65	5.66
L.S.D. at 5 %	Interaction	2.4	3.1	3.9	4.8	3.6	5.8	0.36	0.32	0.41	0.38	0.31	0.37	1.01	0.97
	Cultivars	5.6	5.1	6.7	7.8	4.1	3.6	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S
	Shading	3.8	3.4	4.2	3.7	3.9	4.2	0.14	0.21	0.31	0.26	0.39	0.33	1.07	0.82

TABLE 2. Effect of shading on the fruit yield and fruit quality characters of tomato in 2000 and 2001 seasons.

Treatments		No. of fruits/plant		Average fruit weight (gm)		Fruit yield (ton/fed.)		Fruits quality					
								Titratable acidity %		T.S.S. %		Ascorbic acid (mg/100 g fresh)	
Cultivars	Shading	2000	2001	2000	2001	2000	2001	2000	2001	2000	2001	2000	2001
Mader	Unshaded	18.3	20.7	75.3	71.0	8.28	8.82	0.76	0.81	6.43	6.12	28.82	29.71
	Black	24.7	27.4	86.0	87.2	12.75	14.34	1.49	1.49	4.72	4.23	20.65	22.13
	White	23.0	25.9	81.7	82.3	11.27	12.70	1.16	1.22	5.11	4.93	24.37	26.04
Average		22.0	24.7	81.0	80.2	10.77	11.95	1.14	1.17	5.42	5.09	24.61	25.96
Ain Shams$_2$	Unshaded	23.6	27.2	83.6	85.4	11.84	13.94	0.83	0.85	6.82	6.63	32.15	33.0
	Black	28.5	32.8	97.2	97.0	16.62	19.09	1.48	1.46	5.23	5.11	25.12	26.14
	White	27.1	30.6	92.7	93.6	15.07	17.18	1.23	1.27	5.71	5.86	27.34	28.60
Average		26.4	30.2	91.17	92.0	14.51	16.74	1.18	1.19	5.98	5.87	28.20	29.25
Main effect of shading	Unshaded	21.0	24.0	79.5	78.2	10.06	11.38	0.80	0.83	6.63	6.28	30.49	31.36
	Black	26.6	30.1	91.6	92.1	14.69	16.72	1.48	1.48	4.98	4.67	22.89	24.14
	White	25.1	28.3	87.2	88.0	13.17	14.94	1.20	1.22	5.41	5.40	25.86	27.32
L.S.D. at 5%	Interaction	4.6	3.9	8.6	7.9	1.83	2.26	0.17	0.13	0.57	0.46	2.13	2.44
	Cultivars	4.1	4.2	6.7	5.9	1.35	1.22	N.S	N.S	0.41	0.45	2.31	2.62
	Shading	3.6	4.0	8.3	7.8	1.62	1.56	0.43	0.39	0.97	0.89	4.11	4.36

Fruit quality, *i.e.* T.S.S. and Vitamin C contents were decreased due to shade, compared to the control plants, in both cultivars and seasons (Table 2). However, black shading significantly reduced fruit quality than white shade. Obtained results agreed with Venter (1979) and El-Gizawy *et al.* (1992b). Data also indicated that Ain Shams 2 cultivar produced higher fruit quality values (T.S.S. and V.C.) than Mader and lower acidity, with insignificant difference, in both seasons. An opposite trend was recorded for fruits acidity, *i.e.* being highest with black shaded plants and lowest with the unshaded plants, in both cultivars and seasons. Data indicated that fruit acidity was highest with Mader plants black shaded and lowest with unshaded Mader plants. Whereas, T.S.S. and Vitamin C contents were highest with unshaded Ain Shams 2 plants and lowest with black shaded Mader plants. The obtained results agreed with those of El-Aidy *et al.* (1983) and El-Gizawy *et al.* (1992b).

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تأثير التظليل على نمو وانتاجية بعض اصناف الطماطم فى العروة الصيفية

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اجريت تجربتان حقليتان فى وحدة الزراعة المحمية بالبوصيلى - محافظة البحيرة فى عامى ٢٠٠٠ ، ٢٠٠١ وذلك لدراسة استجابة صنفى الطماطم (مادير ، عين شمس ٢) للتظليل (بشبك البلاستيك الاسود او الابيض تظليل ٤٠ %) مقارنة بنباتات الكونترول (بدون تظليل)

اوضحت النتائج ان :

١- ارتفاع النبات زاد بدرجة معنوية باستخدام شبك البلاستيك الاسود عنه فى شبك البلاستيك الابيض عن الكنترول .

٢- تفوق الصنف عين شمس ٢ فى صفة ارتفاع النبات .

٣- نقص كل من عدد الاوراق والمادة الجافة للنبات باستخدام التظليل .

٤- زاد محتوى النبات من الكلوروفيلات باستخدام التظليل خاصة شبك البلاستيك الاسود - وقد تفوق صنف عين شمس ٢ على صنف مادير.

٥- زاد عدد الثمار للنبات ومتوسط وزن الثمرة والمحصول الكلى باستخدام التظليل وبصفة خاصة باستخدام شبك البلاستيك الاسود مع تفوق محصول الصنف عين شمس ٢ على الصنف مادير .

٦- ادى التظليل الى انخفاض محتوى الثمار الناتجة من فيتامين C ، المواد الصلبة الكلية الذائبة بينما زاد محتوى الحموضة الكلية .