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EFFECT OF USING HOT WATER TUBES ON GROWTH YIELD, AND FRUIT QUALITY OF CANTALOUPE PLANTS GROWN UNDER PROTICTED CULTIVATION CONDITIONS.

Kabil, N. M. T.
Veg., Res., Dep., Hort., Res., Ins., Agric. Res., Center

ABSTRACT

The effect of using heating system by hot water tubes on cantaloupe plants cv. "Galia hy" under the plastic house or low tunnels at Kaha Vegetable Station, Horticulture, Institute during early summer and autumn seasons of 1999–2000 were studied. It was found that heating treatment by hot water tubes enhanced plant growth and induced significant increment on fruit yield and led to an increase in Carotenids concentration in cantaloupe fruits. The best-obtained results were by using heating treatment in plastic house than in low tunnels.

INTRODUCTION

For producing off-season cantaloupe yield during the export period at late autumn and early summer seasons, the plants require some heating treatments against cold weather. By using greenhouse or low tunnel plantation without heating system, the night temperatures not differ more either or outside the plastic houses with out obvious influence on yield production (Holsteijn – SPF – Van, 1985) on tomato and cucumber.

On the contrary, Lee, YB. *et al* (1982) reported that by using hot water pipes under greenhouse condition the inside night temperature was above 10°C than the outside plastic house. Several investigators studied many heating systems under greenhouses or plastic low tunnels on the growth and yield of vegetable crops. One of these systems was hot water flowing through PVC plastic pipes.

In this regard, Lee YB. *et al* (1982) reported that by using PVC pipes filled with hot water inside plastic house raised air and soil temperature than outside greenhouse and increased, cucumber, tomato and lettuce yields. Ichimura, T. (1983) showed also that, by using hot water tubes below the soil surface under low tunnels or greenhouse raised the inside temperature, enhanced the growth of water melon, strawberries, chinese cabbage, radish and increased tomato yield. It was found also that, by using hot water tubes below soil surface improved harvesting dates of strawberries, beans, tomatoes and cucurbites by 25 days as compared with unheated greenhouse Rossi and Plaitano (1983).

In addition, Verlodt *et al* (1985) showed that by heating muskmelon plant grown under greenhouse by warm (36°C) geothermal water passed through PVC distribution pipes produced the highest leaf surface area, plant height, stem diameter, number of leaves per plant, average fruit weight, early and total fruit yield. The highest tomato and cucumber yields were obtained by using flexible plastic heating pipes placed on the soil surface under greenhouse plantation (Tsekleev and Solakov. 1986).

Esquira *et al* (1989) on melon and cucumber, and Sallonbas *et al* (1989) on tomato, pepper and cucumber, either of them used hot water sleeves in low plastic tunnel or greenhouse plantation obtained growth improvement, earlier and high yields. Tomato fruits ripened 2-3 weeks earlier and income was higher by heating the greenhouse by a passive solar system using E.V. A plastic tubes filled with water and capturing solar energy during the day and distributing it back during the night (Ben- Amor *et al* 1990). Moreover, Verlodt and Mougou (1990) obtained the highest total and exportable melon yields, best fruit size and weight with the best concentration of yield during the export period under geothermally heated greenhouse plantation,

Gaafer (1991) reported that, plant growth, early and total yields of both pepper or cucumber crops enhanced with heating soil (water sleeves) or raising air temperature with well fruit shaped under plastic house or low tunnel. In all cases of some heating system, i.e. hot water piper of passive solar sleeves, Muynck *et al* (1991) reported that the growth of muskmelon was better, producing earlier yields from one week up to eight weeks, but total yield were almost the same.

Abou-Hadid *et al* (1992) showed that, using warm air or water filled polyethylene tubes on pepper or cucumber grown under plastic house or low tunnels enhanced plant growth and increased fruit yields. Warmed the greenhouse soil by using hot water pipes below soil surface enhanced plant growth (height, number of leaves, leaf area, fresh weight) as well as cucumber yield comparing with the unheated treatment, (Lee-JaeWook *et al,* 1997).

On the contrary, Tanaka and Yasui (1986) on tomato by using some heating methods under greenhouse or low tunnel, reported that, yield and quality were unaffected by the presence or absence of heating, but leaf yellowing and abnormal fruit color accrued in a small greenhouse without heating.

The aim of this work is to investigate the effect of heating the soil of greenhouse and low tunnels by hot water tubes on the growth, yield and fruit quality of cantaloupe plants grown in autumn and early summer seasons.

MATERIALS AND METHODS

Two field experiments were carried out under plastic house and low tunnels at Kaha Vegetable Station, Horticulture Research Institute during autumn and early summer seasons of 1999 and 2000 to study the effect of using hot water tubes as a heating treatment on the growth, flowering, fruit yield and its quality of cantaloupe (Cucumis melo, vor. Cantalupensis).

Seed of cantaloupe Galia hybrid were sown in seedling trays on 25th and 27th of August and the seedlings were transplanted on the 20th and 25th of September during the autumn plantation of the first and second seasons respectively. Whereas, sown in the early summer in seedling trays on 11th of November and the seedlings were transplanted on 7th December under the greenhouse plantation. A complete randomized block design with three

replicates was adopted. Every experiment contained heating water tube comparing with non-heated treatment. Water sleeves (passive solar heating) using polyethylene tubes treated against U. V. rays, 200 Micron thickness and 15cm. in diameter. These tubes were placed on each bed between the rows of plants along the bed. The tubes were filled with hot water (35°C) after transplanting until 70 days at autumn season. Whereas, at early summer season until 90days from transplanting. The distance between the beds was 1m. and between plants was 50cm. plot area included 3 rows with the length 10 meter.

Other agronomic practices were allowed as the recommendation of the Ministry of Agriculture.

Data were recorded on the following characters:-

1- Vegetative growth: expressed as branches number and plant fresh weight, which a random sample of 3 plants from each plot was chosen 56 days from transplanting for these measurements.

2- Flowering characters: four plant were randomly chosen and labeled to determine: a) Number of days from transplanting until 25% of male and female flowers formation of the plants of each plot. b) Number of days from transplanting until the beginning of fruit setting.

3- Fruit yield and its components:-

a) Average of fruit weight (g.).

b) Fruit yield per plant (g.).

c) Fruit yield per feddan (ton)

4- Fruit characteristics: A round sample of 5 fruits was chosen after 10 **days from the beginning of the harvesting from each plot to determine:**

a) Total acidity.

b) Carotonoid pegments

c) Total Soluble Solids (TSS)

These characteristics were determined using the methods described by A.O.A. C. (1980).

The data were statistically analyzed according to Snedecor and Cochran (1971).

RESULTS AND DISCUSSION

1- Plant growth:

Plant growths in these study determined as, number of branches per plant and plant fresh weight. It is obvious from data in Tables (1, 2) that, hot water tubes as a heating system under plastic house condition in autumn season induced significant increases in plant growth, i.e. number of branches per plant as well as plant fresh weight during the two successive seasons. While the same treatment did not show significant increment in plant growth under low tunnel plantation, but induced slight increase in the two parameters of plant growth, i.e. branch number or fresh weight of cantaloupe plants.

The increment in plant growth of cantaloupe plants heated by using hot water tube system below soil surface might be attributed raising soil temperature (Lee, YB. *et al*, 1982) on cucumber and tomato which activate plant nutrient uptake. Several investigators came to similar results by using

heating systems under greenhouses or low tunnels plantation. Ichimura, T. 1983 on watermelon; Verlodt *et al* 1985 on muskmelon; Muyneck *et al*, 1991 on muskmelon and Lee-JaeWook *et al*, 1997, on cucumber.

2- Flowering characters:

Data in Table (1,2) show the effect of heating plastic house or low tunnels by using hot water tube on the earliness of flowering, i.e. number of days till the appearance of the first female or male flower as well as the first time of fruit set stage.

The results indicate that there was no significant effect on number of days from seed sowing until the appearance of the first male or female flowers due to the influence of heating treatment. The results show that, the reduction in number of days from sowing until flowering and fruit setting stage not reach to statistical level. The non- significant reduction in number of days from sowing to time of flowering might be attributed to the increment in vegetative growth as shown in Table (1, 2).

Table (1) :Effect of hot water tubes on the growth and flowering of cantaloupe plants grown under plastic house during autumn seasons of 1999 and 2000.

Treatments	Growth		Flowering		
	No- of branches per plant	Plant fresh weight (g.)	No- of days till first ♀ flower	No- of days till first ♂ flower	No- of days till the first fruit set stage.
1999 season					
Hot water tubes	10.3	745.5	42.2	43.4	46.8
Unheated (control)	7.5	542.5	46.0	44.5	52.4
L.S.D. at 5%	0.77	141.8	N.S	N.S	N.S
2000 season					
Hot water tubes	10.2	743.5	46.5	43.4	48.2
Unheated (control)	8.8	567.0	48.1	45.8	53.5
L.S.D. at 5%	1.8	115.2	N.S	N.S	N.S

Table (2):Effect of hot water tubes on the growth and flowering of cantaloupe plants grown under low tunnels during early summer seasons of 1999 and 2000.

Treatments	Growth		Flowering		
	No- of branches per plant	Plant fresh weight (g.)	No- of days till first ♀ flower	No- of days till first ♂ flower	No- of days till the first fruit set stage.
1999 season					
Hot water tubes	4.7	773.3	41.5	36.1	42.5
Unheated (control)	4.2	706.8	45.2	40.7	48.2
L.S.D. at 5%	N.S	N.S	N.S	N.S	N.S
2000 season					
Hot water tubes	4.8	719.8	47.1	32.1	38.7
Unheated (control)	4.6	671.3	49.1	34.5	40.8
L.S.D. at 5%	N.S	N.S	N.S	N.S	N.S

3-Fruit yield and its components:

Data in Table (3, 4) show that using heating system with hot water tube under greenhouse in autumn or low tunnels in early summer seasons induced slight increases on fruit weight without reaching to significant level. On the contrary heating treatment led to obvious significant increment on fruit yield per plant or per feddan during the two seasons either under plastic house or low tunnels comparing with the unheated treatment. The average relative fruit yield per feddan under low tunnels by using heating system reached to 36.5%, while under greenhouse reached to 31% per feddan. It can said that the increases in total fruit yield attributed to the significant increment in fruit weight per plant and the slight effect of average fruit weight. Obtained results are in agreement with those reported by Verlodt *et al* (1985) on muskmelon, Esquira *et al* (1989) on cucumber Sallanbas *et al* (1989) on tomato and melon, Verlodt and Mougou (1990) on melon, Gaafer (1991) on pepper and Cucumber and Lee-JaeWook *et al* (1997) on cucumber.

Table (3):Effect of hot water tubes on fruit yield of cantaloupe plants grown under plastic house during autumn seasons of 1999 and 2000.

Treatments	Average fruit weight (g.)	Yield per plant (g.)	Total fruit yield (Ton/ fed)	Relative Fruit yield(%)
1999 season				
Hot water tubes	575.9	854.4	7.4	129.82 %
Unheated (control)	567.4	634.3	5.7	100%
L.S.D. at 5%	N.S	58.2	1.2	-
2000 season				
Hot water tubes	650.0	1102.5	6.4	133.33%
Unheated (control)	632.0	851.7	4.8	100%
L.S.D. at 5%	N.S	86.8	1.4	-

Table (4):Effect of hot water tubes on fruit yield of cantaloupe plants grown under low tunnels during early summer season of 1999 and 2000.

Treatments	Average fruit weight (g.)	Yield per plant (g.)	Total fruit yield (Ton/ fed)	Relative Fruit yield(%)
1999 season				
Hot water tubes	597.5	834.5	6.05	143.02
Unheated (control)	545.0	607.5	4.23	100%
L.S.D. at 5%	N.S	48.6	0.98	-
2000 season				
Hot water tubes	625.3	926.0	6.18	130.1
Unheated (control)	609.3	713.0	4.75	100%
L.S.D. at 5%	N.S	26.2	1.4	-

4-Fruit Quality:

Total soluble solids, carotenoids continents as well as total acidity of cantaloupe fruits as affected by heating the plants grown under low tunnels or plastic house are shown in Tables (5, 6). Either total soluble solids (TSS) or

total acidity of fruit produced from hot water tube treatment or unheated treatment did not show any differences during the two successive seasons. While, Carotenoids content of fruits produced from plants heated with hot water tubes plastic house condition showed significant values comparing with the fruits produced from the unheated plants (control). With regard to low tunnel plantation, fruit carotenoids did not show significant increases as shown in Table (5, 6).

Generally, it can said that heating cantaloupe plants grown under plastic houses in autumn or under low tunnels in early summer by hot water tubes system enhanced plant growth and increased fruit yield.

Table (5):Effect of hot water tubes on fruit quality of cantaloupe plants grown under plastic house during autumn seasons of 1999 and 2000.

Treatments	TSS	Carotenoids Mg/100 F.W.	Total acidity %
1999 season			
Hot water tubes	10.9	0.62	3.6
Unheated (control)	10.8	0.47	3.9
L.S.D. at 5%	N.S	0.12	N.S
2000 season			
Hot water tubes	10.9	0.62	3.7
Unheated (control)	10.3	0.48	3.8
L.S.D. at 5%	N.S	0.17	N.S

Table (6):Effect of hot water tubes on fruit quality of cantaloupe plants grown under low tunnels during early summer seasons of 1999 and 2000.

Treatments	TSS	Carotenoids Mg/100 F.W.	Total acidity %
1999 season			
Hot water tubes	10.5	0.39	3.6
Unheated (control)	10.7	0.33	3.2
L.S.D. at 5%	N.S	N.S	N.S
2000 season			
Hot water tubes	11.1	0.38	3.7
Unheated (control)	10.6	0.35	3.5
L.S.D. at 5%	N.S	N.S	N.S

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تأثير استخدام أنابيب التدفأه بالماء على النمو، المحصول وصفات جودة ثمار نباتات الكنتالوب النامية تحت ظروف الزراعات المحمية

نبيل محمد طلعت قابيل
أقسام بحوث الخضر – معهد بحوث البساتين – مركز البحوث الزراعية

تم دراسة تأثير استخدام التدفأه بأنابيب الماء الساخن على نباتات الكنتالوب (هجين جاليا) المنزرعة تحت ظروف البيوت البلاستيكية والأنفاق بمحطة بحوث الخضر بقها معهد بحوث البساتين وذلك بالعروة الخريفية تحت البيوت البلاستيكية وفى العروة الصيفية المبكرة تحت الأنفاق خلال موسمى ١٩٩٩/٢٠٠٠ وقد وجد أن معاملة التدفأه بأنابيب الماء الساخن أحدثت تحسينا فى النمو وزيادة واضحة فى محصول الثمار الناتجة، كما أدت إلى زيادة محتوى الثمار من الكاروتينات وكانت النتائج أفضل تحت ظروف زراعية البيوت البلاستيكية عن الأنفاق باستخدام هذا النظام من التدفأه.