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THE INFLUENCE OF DIFFERENT GROWING MEDIA ON TOMATO SEEDLING PRODUCTION

H.M. Ramadan

Vegetatively propagated vegetable crops, Horticulture Research Institute, Agricultural Research Center, Giza, Egypt.

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ABSTRACT: *Eighteen different growing media for tomato seedling production were used. The highest percentage of germination was obtained in media composed of equal parts of loam and sand 1:1 while the lowest one was observed in soil alone. The highest rate of germination was recorded in media composed of 3: 1 soil and manure. The least rate of germination was obtained in sand alone. The maximum seedling height was obtained in loam+ peat 1:3, while the lowest in sand. The highest number of leaves was obtained in soil+ manure 1: 3, soil+ peat 1:1 and soil+ manure 1:1 in a desending order with no significant difference between them, The smallest number of leaves was obtained in both two treatment soil and sand equally.*

The highest seedling diameter was obtained in loam+ peat 1:1, which was composed of equal parts of loam and peat while lowest diameter of seedling in sand only.

The highest fresh and dry weight was obtained in soil+ manure 1:1.Moreover, when sterilized a further significant increase was obtained than the unsterilized. The smallest fresh and dry weight was obtained from the sand specially when was not sterilized.

The highest dry matter percentage was obtained in loam+ sand 1:1, soil+ manure 1:1 and soil+ peat 1: 3. The last two treatments contained soil in their composition, while the least in soil alone.

The highest nitrogen concentration was obtained equally in both two media soil+ manure 1: 3 and loam+ peat 3: 1. increasing the proportion of peat added to the loam resulted in a significant high total protein.

Using soil+ manure 1:1 with sterilization gave the best results for vegetative growth comparing with the other different planting media used.

Key words: *Media, Seedling, Manure, Sterilization, Peat, Sand .*

INTRODUCTION

Growing media is one of the important aspects of seedling production. It need not to be necessary a rich soil to avoid too rapid development of seedling, at the same time a less fertile soil for seedling will result in greater root than top growth which may be an advantage in the approaching shelf.

Several workers previously investigated the effect of media on seedling and its components. Plecha (1960) found that tomato plants grown in peat, or in peat: sand mixtures in the ratios 1: 3, 1:1 or 3: 1 grew as well as, or slightly better than plants grown in compost. Puustjarvi (1962) demonstrated that the addition of peat to the growing media for tomato seedling has increased

production yields. Roll (1963 and 1965) recommended 4: 1 peat: soil mixture as the best media for raising tomato seedlings. Stene (1963) used peat mixed with soil at 75% for planting and reported that were similar to, or better than using of soil alone. Van (1963) reported that tomato seedlings raised in a 1: 3 peat: perlite mixture showed good root branching. Staten (1964) observed that yields and quality of tomatoes grown in sphagnum peat plus nutrients were as satisfactory as those were from plants grown in soil. Stene (1964) found peat mixed with the soil at 75% by volume gave the best yields. Also, soil sterilization is important in obtaining high tomato yields (Gamliel 1989). Steam sterilization is more effective than any chemical, although steam sterilization will kill the nitrifying bacteria in the soil. Szmidl (1989) obtained tomato crops successfully grown in the treated perlite by steam. Hellal et al (1996) and Sahin et al (1998) reported that growing media which consisted of 50% peat should be used to grow tomatoes . Also, Omar and Helmy (2001) recommended that sand + compost (1 : 1 v / v) mixture as the best media for vegetative growth. On the other words, Siria et al (1997) found that substrates as peat : perlite 1:1 had no significant effects on vegetative growth.

This study aimed to investigate the effect of some different growing media on tomato seedling production.

MATERIALS AND METHODS.

The present investigation was carried out in trays (30x50cm) under plastic house of Vegetable Research Department of the Horticulture Research Institute, Agriculture Research Center Ministry of Agriculture at Dokki Giza governorate.

Eighteen growing media for tomato seedling production were used on February 7 and 12 for both summer seasons of 1995 and 1996 respectively. Few main ingredients, i.e., sand; soil as clay, loam, peatmoss and stable manure were mixed at different proportions by volume. These mixtures were split to two latches, the first of, which was steam sterilized for half–hour at 140 c and 3 kg. pressure while the second, was unsterilized. The fertilizers as ammonium nitrate 250 g., potassium sulphate 150 g. and super-phosphate 250 g. were used for each 300 litre of media, according to EL-Beltagy and Abou- Hadid (1989). The chemical properties of the different growing media before sowing are presented in Table (1) according to the methods described by Jackson (1967). The different growing media were as follows:

1- Soil
2- Soil + Peatmoss (3 : 1 v/v)
3- Soil + Peatmoss (1: 1 v/v)
4- Soil + Peatmoss (1 : 3 v/v)
5- Soil + Manure (3 : 1 v/v)
6- Soil + Manure (1 : 1 v/v)
7- Soil + Manure (1 : 3 v/v)
8- Soil + Sand (3 : 1v/v)
9- Soil + Sand (1 : 1v/v)
10- Soil + Sand (1 : 3 v/v)
11- Loam
12- Loam + Peatmoss (3 :1v/v)
13- Loam + Peatmoss (1:1 v/v)
14- Loam + Peatmoss (1:3 v/v)
15- Loam + Sand (3:1v/v)
16- Loam + Sand (1:1v/v)
17- Loam + Sand (1:3 v/v)
18- Sand .

Treatments of each experiment were arranged in a split plots design with three replicates. The sterilized assigned to the main plots and the media being the sub-plot. One–handred seeds of tomato were sown in seedling trays filled with the different growing media which representing the sub–plot, to evaluate the suitable media for both the rate and percentage of germination. A count of the number of germinated seeds was recorded daily after ten days from seed sowing. Germination rate was calculated by the following equation (Bartlett 1937).

$$\frac{a_1d_1 + a_2d_2 + \ldots\ldots\ldots\ldots a_xd_x}{\text{Total number of germinated seeds}}$$

Where *a* = number of germinated seeds at a certain day from the beginning of germination (*d*) .

Three samples each of five seedling from different growing media were randomly taken for measuring the seedling development.. Seedling from these treatments were dried in an electrical oven at 70°c for a period of 48 hours up to constant weight samples of dry materials were ashes for chemical analysis of total nitrogen and protein content. .

The following characteristics were determined in each sample:

1- Height of seedling.
2-Leaf number.
3- Seedling diameter.
4- Fresh weight per plant.
5-Dry weight per plant.
6-Dry matter percentage.
7-Total nitrogen according to (A.O.A.C. 1975).
8- Protein content by using the conversion factor (N x 6.25).

Data were statistically analyzed using the analysis of variance method according to Snedecor and Cochran (1980). Least significant difference (LSD) test at 5 % level was used to verify differences between treatments means.

Table. (1). Chemical analysis of some different growing media.

Growing media	pH	S.P %	E.C. *	Cation mg./L.		Anions mg. / L.	
				Na	K	Cl^-	HCO_3
Soil	7.8	46	8.4	32	0.3	32	3.4
Soil + peat 1:1 v/v	8.3	72	4.6	24	0.2	16	4.0
Soil + manure 1:1 v/v	8.6	70	4.1	21	0.3	16	11
Soil + sand 1:1 v/v	8.2	22	1.9	11	0.1	6	3.0
Loam	7.9	73	10.3	48	0.8	26	2.2
Loam + peat 1:1 v/v	8.2	72	2.3	10	0.2	8	4.0
Loam + sand 1:1 v/v	8.1	28	1.8	10	0.2	6	3.0
Sand	7.8	20	1.3	8	0.1	4	1.4

* Electric conductivity.

RESU LTS AND DISCUSSION

Germination percentage.

Table (2) and Fig (1). Present the percentage germination of the seed sown in the various mixtures. Dealing with the effect of sterilization, data showed a significant reduction due to this process. This reduction is actually due to the significant reduction of the sterilized than the unsterilized only. Obviously when comparing the three main ingredients loam, sand and soil the last showed a significant decrease than the former two. When peatmoss was added to the loam (loam + peat 3: 1, loam + peat 2: 1 and loam + peat 1: 3) as compared to loam only, lower peat (loam + peat 3: 1) or higher peat (loam + peat 1: 3) significantly surpassed the respective of loam alone.

With respect to sand when mixed with loam (loam+ sand 3: 1, loam+ sand 1: 1 and loam+ sand 1: 3) the percentage germination significantly differed from that of sand only in case of treatment loam+ sand 1:1 composed of equal parts of both materials and there it was significantly less.

As regards to the soil treatment, when it received manure of different proportions (soil+ manure 3: 1, soil+ manure 1: 1 and soil+ manure 1: 3) significant increase than soil alone was shown in the last one which was composed of one part soil and three parts manure.

Concerning the addition of peat to soil (soil+ peat 3: 1, soil+ peat 1: 1 and soil+ peat 1: 3) this significantly caused an increase in germination compared to soil alone. The last three treatments did not significantly vary between each other. Moreover, the rates of increase in the three treatments (soil+ peat 3: 1, soil+ peat 1: 1 and soil+ peat 1:3) were higher than the corresponding rates of increase obtained when manure was added in treatments (soil+ manure 3:1, soil+ manure 1:1 and soil+ manure 1:3). On the contrary when the soil was mixed with sand (soil + sand 3: 1, soil + sand 1: 1 and soil+ sand 1: 3) significant increases were obtained as compared to soil alone. These increases were more when the level of sand was increased.

From the previous results of the various treatments, data showed that the highest percentage of germination was obtained in treatment composed of equal parts of loam and peat (loam+ sand 1: 1) while the lowest was obtained in treatment of the soil alone.

Table (2). Effect of soil sterilization and growing media on germination percentage of tomato seed during the two experimental seasons 1995 and 1996.

Growing media.	1995			1996		
	Ster.	Unster.	Mean	Ster.	Unster.	Mean
Soil	48.47	49.89	49.18	46.38	48.33	47.35
Soil + peat 3 : 1 v/v	54.42	59.30	56.86	52.25	54.65	53.45
Soil + peat 1 : 1 v/v	59.12	69.09	64.10	56.19	60.22	58.20
Soil + peat 1 : 3 v/v	68.20	74.13	71.16	69.80	72.71	71.25
Soil + manure 3 : 1 v/v	50.89	54.93	52.91	52.15	53.81	52.98
Soil + manure 1 : 1 v/v	53.73	53.41	53.57	55.22	52.58	53.90
Soil + manure 1 : 3 v/v	53.89	56.64	55.26	51.69	54.72	53.20
Soil + sand 3 : 1 v/v	61.90	62.65	62.27	62.10	63.51	62.80
Soil + sand 1 : 1 v/v	74.30	71.17	72.73	73.19	71.82	72.50
Soil + sand 1 : 3 v/v	72.05	64.06	68.05	74.16	63.99	69.07
Loam	66.32	61.67	63.99	68.30	65.81	67.05
Loam + peat 3 : 1 v/v	70.38	70.97	70.67	71.20	72.30	71.75
Loam + peat 1 : 1 v/v	61.13	64.08	62.60	62.17	63.21	62.69
Loam + peat 1 : 3 v/v	66.35	68.34	67.34	68.25	69.92	69.08
Loam + sand 3 : 1 v/v	61.90	62.65	62.27	62.40	63.71	63.05
Loam + sand 1 : 1 v/v	74.30	71.17	72.73	73.80	72.63	73.21
Loam + sand 1 : 3 v/v	72.05	64.06	68.05	74.15	68.13	71.14
Sand	67.90	69.50	68.70	68.71	66.42	67.56
Mean	63.18	63.76		63.45	63.24	

L.S.D.5 %

Sterilization	N.S.	0.39
Media	1.74	3.27
Sterilization x Media	2.46	4.63

Rate of germination.

The rate of germination in the different treatments is given in Table (3) and Fig. (2). The data reveal that sterilization caused a significant increase in the rate of germination contrary to the trend previously mentioned in the respective percent of germination.

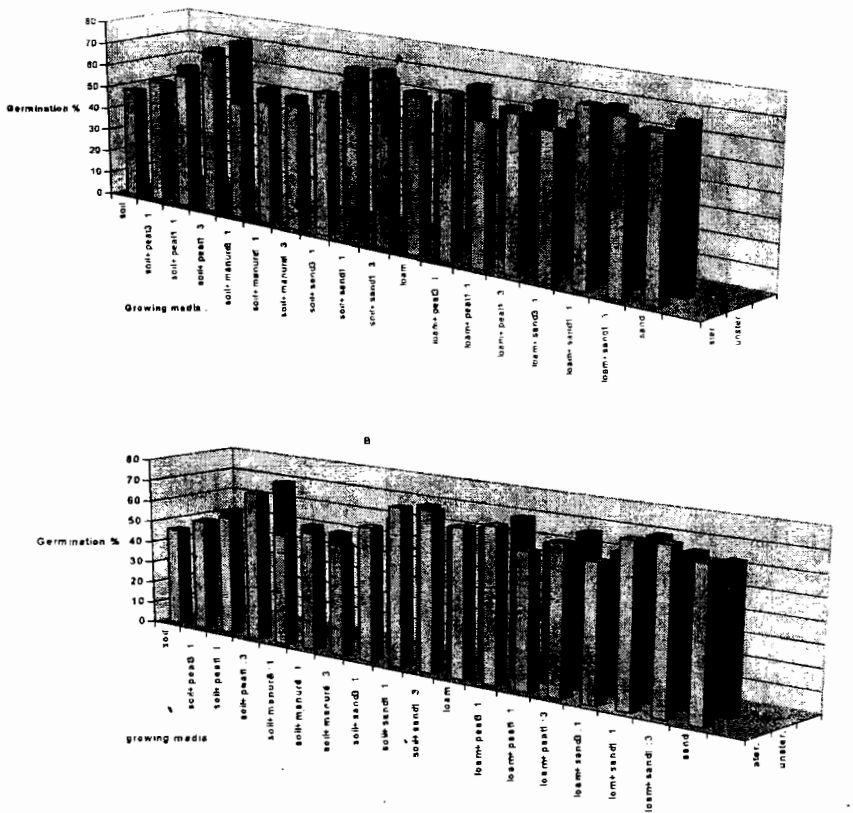

Fig.(1). Effect of soil sterilization and growing media on germination percentage of tomato seed during the two experimental seasons 1995 (A) and 1996 (B).

Table (3). Effect of soil sterilization and growing media on germination rate of tomato seed during the two experimental seasons 1995 and 1996.

Growing media.	1995			1996		
	Ster.	Unster.	Mean	Ster.	Unster.	Mean
Soil	4.81	4.15	4.48	4.52	4.16	4.34
Soil + peat 3 : 1 v/v	4.79	4.47	4.63	4.68	4.53	4.60
Soil + peat 1 : 1 v/v	4.84	4.08	4.46	4.73	4.17	4.45
Soil + peat 1 : 3 v/v	4.40	3.89	4.14	4.33	3.90	4.11
Soil + manure 3 : 1 v/v	5.27	5.08	5.17	5.33	5.14	5.23
Soil + manure 1 : 1 v/v	4.66	4.55	4.60	4.69	4.51	4.60
Soil + manure 1 : 3 v/v	4.79	4.57	4.68	4.78	4.62	4.70
Soil + sand 3 : 1 v/v	4.75	4.68	4.71	4.66	4.58	4.62
Soil + sand 1 : 1 v/v	3.93	4.12	4.02	3.88	4.30	4.09
Soil + sand 1 : 3 v/v	3.65	3.10	3.37	3.61	3.18	3.39
Loam	3.72	3.40	3.56	3.73	3.42	3.57
Loam + peat 3 : 1 v/v	4.24	3.65	3.94	4.26	3.66	3.96
Loam + peat 1 : 1 v/v	3.47	3.26	3.36	3.49	3.15	3.32
Loam + peat 1 : 3 v/v	2.94	2.95	2.94	2.99	3.09	3.04
Loam + sand 3 : 1 v/v	3.14	2.74	2.94	3.21	3.07	3.14
Loam + sand 1 : 1 v/v	3.25	2.66	2.95	3.30	2.79	3.04
Loam + sand 1 : 3 v/v	2.91	3.12	3.01	3.19	3.19	3.19
Sand	2.81	2.76	2.78	3.27	2.89	3.08
Mean	4.02	3.73		4.04	3.80	

L.S.D. 5 %

Sterilization	**0.25**	**0.13**
Media	**0.20**	**0.15**
Sterilization x Media	**0.29**	**0.21**

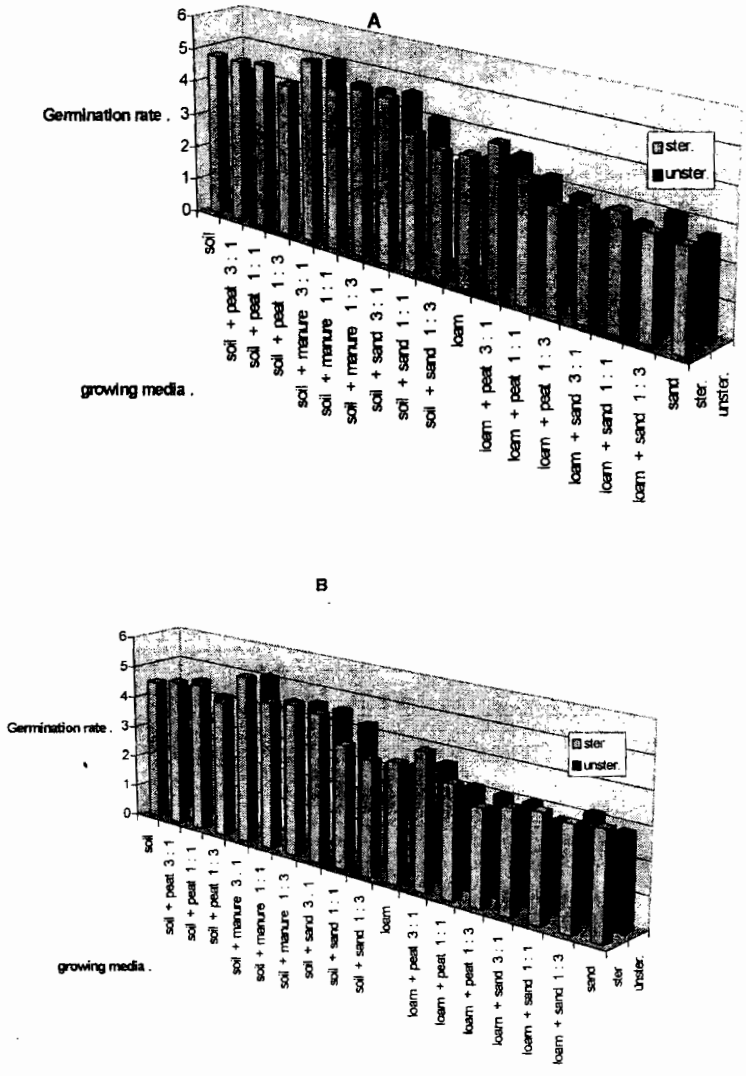

Fig. (2). Effect of soil sterilization and growing media on germination rate of tomato seed during the two experimental seasons1995 (A) and 1996 (B).

Concerning the three main ingredient loam, sand and soil, the highest rate of germination was found in soil which was significantly more than loam and sand respectively.

Dealing with the addition of peat to the soil (soil+ peat 3: 1, soil+ peat 1: 1 and soil+ peat 1: 3) also caused no significant changes in the rate of germination comparatively to that of soil alone.

When peatmoss was added to loam (loam+ peat 3: 1, loam+ peat 1: 1 and loam+ peat 1: 3) no significant change occurred in the rate of germination comparatively to the respective of loam alone.

With respect to the sand when mixed with loam (loam+ sand 3: 1, loam+ sand 1: 1 and loam+ sand 1: 3) this cased no significant change in the respective rate of germination of these treatments.

As regards to the soil treatment, application of various rates of manure (soil+ manure 3: 1, soil+ manure 1: 1 and soil+ manure 1: 3) a significant increase was shown only in treatment (soil+ manure 3:1) where the proportion of the added manure was one part to three parts of soil.

As well when the sand was added to the soil (soil+ sand 3: 1, soil+ sand 1:1 and soil+ sand 1:3) no significant variation was obtained in their respective rate of germination comparatively to that of soil alone. To the contrary on comparing these three treatments to that of sand alone, only the two former ones (soil+ sand 3: 1 and soil+ sand 1: 1) were significantly of higher rate.

It is also clear from the presented data that the highest rate of germination was obtained in treatment, which was composed of 3: 1 soil and manure. The least rat e of germination was obtained in treatment of the sand alone

Seedling height.

The data for the seedling height obtained in the various treatments is presented in Table (4). Adding peatmoss at various proportions to the loam (loam+ peat 3:1, loam+ peat 1:1 and loam+ peat 1:3) significant high increments were obtained.

With regards to the sand when mixed with the loam (loam+ sand 3:1, loam+ sand 1:1 and loam+ sand 1:3) comparatively significant increases were obtained in the three cases which were in an ascending order with the increase of sand proportion in the mixture.

Dealing with the soil when manure was added to it at different proportions (soil+ manure 3:1, soil+ manure 1:1 and soil+ manure 1:3) highly significant increases occurred in the plant height at rates that was more with increased manure in treatments soil+ manure 1:1 and soil+ manure 1:3 than the respective in treatment soil+ manure 3:1 which contained relatively the least quantity of manure. When adding peat to the soil (soil+ peat 3:1, soil+ peat 1:1 and soil+ peat 1:3) significant increases were obtained as compared to soil alone. The rate of increase positively coincided with the increase in the proportion at peat added to the mixture. As well when the soil received various sand proportions (soil+ sand 3:1, soil+ sand 1:1 and soil+ sand 1:3) significant increases were obtained in the two last treatments comparatively to soil alone. It is evident from the data that the maximum plant height was obtained in treatment (loam+ peat 1:3) and the lowest in sand treatment. Similar results have been reported by Pudelski (1960), EL-Beltagy (1986) and Papadoponlos (1991).

Leaf number.

The leaf number obtained on seedling from the various treatments is presented in Table (5). These data reveal a significant increase in leaf number due to sterilization. This effect was true for the treatments (loam and soil+ manure 1: 3) only while a reverse significant effect was obtained in case of treatment (soil+ sand 1: 3) only. Considering the loam, sand and soil no significant differences were obtained between the sand and soil but the loam treatment was significantly better than soil. Adding peatmoss to the loam (loam+ peat 1:1 and loam+ peat 1:3) significant increases were found compared to loam alone. As regards to the sand when mixed with loam (loam+ sand 3:1, loam+ sand 1:1 and loam+ sand 1:3) that contained significantly higher number of leaves than the respective sand alone. Dealing with the soil, the addition of manure (soil+ manure 3:1, soil+ manure 1:1 and soil+ manure 1:3) led to significant increases in treatment soil more in rate in treatment (soil+ manure 1:3). Similarly in case of adding the peat to the soil (soil+ peat 3:1, soil+ peat 1:1 and soil+ peat 1:3) significant increases were obtained with the use of two higher levels of peat (soil+ peat 1: 1 and soil+ peat 1:3). To the contrary when the soil was mixed with variable proportions of sand (soil+ sand 3:1, soil+ sand 1:1 and soil+ sand 1:3) only in case of soil+ sand 1:3 which contained the highest sand proportion that the leaves showed a relatively significant increase than soil alone.

It is also evident from the results that the highest number of leaves was obtained in treatments soil + manure 1:3, soil+ peat 1:1 and soil+ manure 1:1 in a decreasing order with no significant differences between them. The smallest number of leaves was obtained in treatment soil or sand.

Table (4). Effect of soil sterilization and growing media on tomato seedling height (cm.) during the two experimental seasons 1995 and 1996.

Growing media.	1995			1996		
	Ster	Unster.	Mean	Ster.	Unster	Mean
Soil	8.52	8.65	8.58	9.10	9.00	9.05
Soil + peat 3 :1 v/v	14.08	13.40	13.74	14.80	15.10	14.95
Soil + peat 1 : 1 v/v	14.62	13.48	14.05	15.40	14.85	15.12
Soil + peat 1 : 3 v/v	15.57	16.17	15.87	15.84	15.60	15.72
Soil + manure 3 : 1 v/v	16.42	11.77	14.09	15.26	14.47	14.86
Soil + manure 1 : 1 v/v	17.50	14.12	15.81	18.28	14.60	16.44
Soil + manure 1 : 3 v/v	17.03	13.32	15.17	17.34	15.93	16.63
Soil + sand 3 : 1 v/v	9.23	9.70	9.46	11.12	11.38	11.25
Soil + sand 1 : 1 v/v	12.13	12.53	12.33	13.64	12.57	13.10
Soil + sand 1 : 3 v/v	14.10	12.75	13.42	14.02	12.65	13.33
Loam	11.90	9.50	10.70	11.14	11.14	11.14
Loam + peat 3 : 1 v/v	11.40	12.80	12.10	11.90	11.52	11.71
Loam + peat 1 : 1 v/v	14.63	13.08	13.85	14.23	13.44	13.83
Loam + peat 1 : 3 v/v	16.70	17.00	16.85	17.46	15.07	16.26
Loam + sand 3 : 1 v/v	12.12	11.58	11.85	13.38	12.64	13.01
Loam + sand 1 : 1 v/v	12.73	12.40	12.56	13.20	11.21	12.20
Loam + sand 1 : 3 v/v	11.85	13.87	12.86	11.74	10.16	10.95
Sand	8.58	8.53	8.55	10.36	8.78	9.57
Mean	13.28	12.48		13.78	12.78	

L.S.D 5%

Sterilization	0.06	0.28
Media	0.14	0.63
Sterilization x Media	0.20	0.90

Table (5). Effect of soil sterilization and growing media on number of leaves of tomato seedling during the two experimental seasons 1995 and 1996.

Growing media.	1995			1996		
	Ster.	Unster.	Mean	Ster.	Unster.	Mean
Soil	3.83	3.67	3.75	4.50	4.40	4.45
Soil + peat 3 : 1 v/v	3.75	4.25	4.00	4.53	3.90	4.21
Soil + peat 1 : 1 v/v	5.33	4.83	5.08	4.95	4.55	4.75
Soil + peat 1 : 3 v/v	5.25	4.58	4.91	4.33	4.33	4.33
Soil + manure 3 : 1 v/v	4.16	4.00	4.08	3.55	3.42	3.48
Soil + manure 1 : 1 v/v	5.33	4.67	5.00	5.93	5.06	5.49
Soil + manure 1 : 3 v/v	5.50	4.75	5.12	5.10	4.91	5.00
Soil + sand 3 : 1 v/v	4.25	3.58	3.91	3.92	3.66	3.79
Soil + sand 1 : 1 v/v	4.00	3.58	3.79	3.77	3.22	3.49
Soil + sand 1 : 3 v/v	3.83	4.83	4.33	3.75	3.18	3.46
Loam	4.75	3.67	4.21	4.99	4.36	4.67
Loam + peat 3 : 1 v/v	4.33	4.75	4.54	3.96	4.29	4.12
Loam + peat 1 : 1 v/v	4.92	4.42	4.67	5.21	4.91	5.06
Loam + peat 1 : 3 v/v	4.83	4.33	4.58	5.06	4.69	4.87
Loam + sand 3 : 1 v/v	4.66	4.67	4.66	4.72	4.67	4.69
Loam + sand 1 : 1 v/v	4.33	4.08	4.20	4.28	3.93	4.10
Loam + sand 1 : 3 v/v	4.16	4.75	4.45	4.17	3.88	4.02
Sand	4.00	3.75	3.87	3.81	3.50	3.65
Mean	4.51	4.28		4.47	4.15	

L.S.D. 5 %

Sterilization	0.04	0.07
Media	0.13	0.32
Sterilization x Media	0.19	N.S.

Seedling diameter.

The data indicated that no significant effect on this character though significant increases were obtained in favor of the sterilized in treatment soil+ manure 1:3 and loam+ sand 3:1. (Table 6). On adding peatmoss to the loam only when both materials were at equal proportions (loam+ peat 1:1) a significant increase in the diameter was obtained.

Concerning the sand mixed with loam; significant increases were obtained in the three cases particularly, the first one, which contained relatively the least proportion of sand. Regarding to the soil, the addition of various proportions of manure (soil+ manure 3:1, soil+ manure 1:1 and soil+ manure 1:3) significant increases were obtained at rates that positively coincided with more manure applied. Dealing with the addition of peat to the soil, a significant trend of increase was obtained identical in trend to the respective obtained in the former case of manure. As well when sand was mixed with the soil, significant increases were obtained compared to soil alone.

It is also clear from the data that the biggest diameter was obtained in treatment (loam + peat 1: 1). The smallest diameter of transplant was

obtained in treatment, which contained sand only. This may due to the poor nutrient contents of this media compared with the other growing media.

Table (6). Effect of soil sterilization and growing media on Seedling diameter (mm.) during the two experimental seasons 1995 and 1996.

Growing media.	1995			1996		
	Ster.	Unster.	Mean	Ster.	Unster.	Mean
Soil	2.00	1.83	1.91	3.21	2.00	2.60
Soil + peat 3 : 1 v/v	1.92	2.25	2.08	2.41	2.18	2.29
Soil + peat 1 : 1 v/v	1.92	2.58	2.25	2.33	2.29	2.31
Soil + peat 1 : 3 v/v	2.58	2.75	2.66	3.69	2.78	3.23
Soil + manure 3 : 1 v/v	1.92	2.17	2.04	2.25	2.15	2.20
Soil + manure 1 : 1 v/v	2.50	2.42	2.46	2.99	2.45	2.72
Soil + manure 1 : 3 v/v	3.17	2.67	2.92	4.01	3.08	3.54
Soil + sand 3 : 1 v/v	2.08	2.17	2.12	2.81	2.35	2.58
Soil + sand 1 : 1 v/v	2.42	2.08	2.25	2.90	2.48	2.69
Soil + sand 1 : 3 v/v	2.17	2.42	2.29	2.71	2.66	2.68
Loam	2.08	2.00	2.04	2.24	2.15	2.19
Loam + peat 3 : 1 v/v	2.42	2.42	2.42	2.88	2.99	2.93
Loam + peat 1 : 1 v/v	3.oo	3.05	3.02	3.09	2.96	3.02
Loam + peat 1 : 3 v/v	2.95	2.67	2.81	2.71	2.61	2.66
Loam + sand 3 : 1 v/v	2.58	2.17	2.37	2.44	2.55	2.49
Loam + sand 1 : 1 v/v	2.33	2.00	2.16	2.29	2.65	2.47
Loam + sand 1 : 3 v/v	2.17	2.00	2.08	2.14	2.39	2.26
Sand	1.62	1.50	1.56	2.01	2.28	2.14
Mean	2.32	2.28		2.72	2.50	

L.S.D. 5 %

Sterilization	N.S.	0.22
Media	0.29	0.29
Sterilization x Media	0.41	0.42

Fresh weight of seedling.

Table (7) show the fresh weight of seedling obtained from the various treatments. The data showed no significant effect of sterilization in general with the exception of treatments soil+ peat 3:1, soil+ manure 1:1 soil+ manure 1:3 and loam+ sand 1:1 where the sterilized were significantly higher than the unsterilized. It is also clear from these results that the fresh weight in case of loam significantly increased that the respective of sand but not that of soil. When peatmoss was added to the loam at various proportions (loam+ peat 3:1, loam+ peat 1:1 and loam+ peat 1:3) only in the last treatment a significant increase was obtained as compared to loam alone.

Concerning sand on receiving various proportions of loam (loam+ sand 3:1, loam+ sand 1:1 and loam+ sand 1: 3) significant increases particularly in

the last one which contained the highest proportion of sand. As regards to the soil mixed with manure at various rates (soil+ manure 3:1, soil+ manure 1:1 and soil+ manure 1:3) significant increases were obtained in the last two treatments which contained higher manure proportions than the first.

Similarly when peat was added to the soil (soil+ peat 3:1, soil+ peat 1:1 and soil+ peat 1:3) significant increases were obtained comparatively to the soil. To the contrary when sand was added to the soil (soil+ sand 3:1, soil+ sand 1: 1 and soil + sand 1: 3) a significant increase was obtained only in the last treatment which contained the highest rate of sand.

It is also clear from the data that the highest fresh weight was obtained in treatments soil + manure 1: 1, soil + peat 1: 3 and soil + manure 1: 3 in a descending order with no significant differences between them. More over in treatment soil + manure 1: 1 when sterilized a further significant increase was obtained than the unsterilized.

Table (7). Effect of soil sterilization and growing media on fresh weight (g. / seedling) during the two experimental seasons 1995 and 1996.

Growing media.	1995			1996		
	Ster.	Unster.	Mean	Ster.	Unster.	Mean
Soil	0.95	0.94	0.94	1.04	1.01	1.02
Soil + peat 3 : 1 v/v	1.81	1.21	1.51	1.96	1.89	1.92
Soil + peat 1 : 1 v/v	1.42	1.47	1.44	1.55	1.43	1.49
Soil + peat 1 : 3 v/v	1.55	1.78	1.66	1.66	1.58	1.62
Soil + manure 3 : 1 v/v	1.34	1.27	1.30	1.33	1.41	1.37
Soil + manure 1 : 1 v/v	1.94	1.44	1.69	1.56	1.72	1.64
Soil + manure 1 : 3 v/v	1.94	1.38	1.66	1.76	1.70	1.73
Soil + sand 3 : 1 v/v	0.99	0.85	0.92	1.02	1.10	1.06
Soil + sand 1 : 1 v/v	1.05	1.02	1.03	1.07	1.14	1.10
Soil + sand 1 : 3 v/v	1.31	1.68	1.49	1.36	1.32	1.34
Loam	1.06	0.97	1.01	1.12	1.25	1.18
Loam + peat 3 : 1 v/v	0.88	1.41	1.14	0.92	0.88	0.90
Loam + peat 1 : 1 v/v	1.09	1.03	1.06	0.99	0.95	0.97
Loam + peat 1 : 3 v/v	1.32	1.57	1.44	1.21	1.24	1.22
Loam + sand 3 : 1 v/v	0.93	1.79	1.36	1.03	1.06	1.04
Loam + sand 1 : 1 v/v	1.20	0.98	1.09	1.24	1.16	1.20
Loam + sand 1 : 3 v/v	1.57	1.49	1.53	1.67	1.66	1.66
Sand	0.85	0.77	0.81	0.92	0.79	0.85
Mean	1.28	1.28		1.30	1.29	
L.S.D. 5 %						
Sterilization		N.S.		N.S.		
Media		0.16		0.14		
Sterilization x Media		0.23		N.S.		

It is also clear from the data that the highest fresh weight was obtained in treatments soil + manure 1: 1, soil + peat 1: 3 and soil + manure 1: 3 in a descending order with no significant differences between them. More over in treatment soil + manure 1: 1 when sterilized a further significant increase was obtained than the unsterilized.

Dry weight of seedling.

Data pertaining to the dry weight of seedling are presented in Table (8). The sterilized treatments were significantly higher than the unsterilized as shown in treatments (soil + peat 3: 1, soil + peat 2: 2, soil + manure 1: 1, soil+ manure 1: 3, loam + sand 3: 1, loam + sand 1: 3 and soil + sand 2: 2). All these treatments except (loam + sand 3: 1 and loam + sand 1: 3) contained soil with other ingredients. It is also clear from the data that in the loam sand and soil treatments; soil was significantly less than loam. When peatmoss was added to loam (loam + peat 3: 1, loam + peat 1: 1 and loam + peat 1: 3) only in the last treatment a significant increase than loam alone was obtained. When sand was mixed with loam (loam + sand 3: 1, loam + sand 1: 1 and loam + sand 1: 3) significant increases were obtained in the three cases.

Concerning the soil when mixed with manure (soil + manure 3: 1, soil + manure 1: 1 and soil + manure 1: 3) significant increases were shown particularly in the last two cases that contained relatively higher rates of manure. Further increase in these two treatments was obtained when they were sterilized.

When peat was added to the soil (soil+ peat 3:1, soil+ peat 1:1 and soil+ peat 1:3) significantly increases were obtained compared to the soil alone. The rates of increase positively coincided with raising the level of peat. Similar significant increases were obtained when sand was added to the soil (soil+ sand 3:1, soil+ sand 1:1 and soil+ sand 1:3). However these rates of increase were less than the corresponding in each of peat and manure with the soil.

It is also clear from the presented data that the highest dry weight was obtained in (soil+ manure 1:1 and soil+ peat 1:3) and the least was from sand.

Dry matter percentage.

Table (9) present the dry matter as percentage in transplants from the various treatments. No significant differences in general were found due to sterilization.

When peatmoss was added to the loam (loam + peat 3: 1, loam + peat 1: 1 and loam+ peat 1:3) no significant increases comparatively to loam treatment. A similar trend was obtained in treatments (loam + sand 3: 1, loam+ sand 1: 1 and loam + sand 1: 3). With respect to the soil application of stable manure at various proportions (soil + manure 3: 1, soil + manure 1: 1 and soil + manure 1: 3) significant increases than soil alone were obtained in the last two treatments containing high manure proportions. Identical trend was obtained with peat addition (soil + peat 3: 1, soil + peat 1: 1 and soil +

peat 1: 3) where the last two treatments were significantly higher. When sand was added to the soil (soil + sand 3: 1, soil + sand 1: 1 and soil + sand 1: 3) significantly increases were obtained compared to soil alone.

It is clear that the highest dry matter percentage was obtained in soil + peat 1: 3, soil + manure 1: 1 and soil + sand 3: 1. These three treatments contained soil in their composition. The least was obtained in soil alone which did not vary significantly from those of treatments (loam + peat 3: soil + peat 3: 1, soil + manure 3: 1, loam + sand 3: 1, loam + sand 1: 3, soil + sand 1: 1 and soil + sand

Table (8). Effect of soil sterilization and growing media on dry weight (g. / seedling) during the two experimental seasons 1995 and 1996.

Growing media.	1995			1996		
	Ster.	Unster.	Mean	Ster.	Unster.	Mean
Soil	0.09	0.08	0.08	0.07	0.08	0.07
Soil + peat 3 : 1 v/v	0.18	0.12	0.15	0.20	0.19	0.19
Soil + peat 1 : 1 v/v	0.19	0.16	0.17	0.18	0.19	0.18
Soil + peat 1 : 3 v/v	0.19	0.27	0.23	0.21	0.20	0.20
Soil + manure 3 : 1 v/v	0.14	0.14	0.14	0.13	0.13	0.13
Soil + manure 1 : 1 v/v	0.32	0.15	0.23	0.29	0.23	0.26
Soil + manure 1 : 3 v/v	0.24	0.17	0.20	0.23	0.24	0.23
Soil + sand 3 : 1 v/v	0.12	0.12	0.12	0.12	0.11	0.11
Soil + sand 1: 1 v/v	0.14	0.09	0.11	0.15	0.13	0.14
Soil + sand 1 : 3 v/v	0.16	0.19	0.17	0.16	0.16	0.16
Loam	0.11	0.12	0.11	0.12	0.10	0.11
Loam + peat 3 : 1 v/v	0.10	0.15	0.12	0.10	0.09	0.09
Loam + peat 1 : 1 v/v	0.13	0.13	0.13	0.12	0.11	0.11
Loam + peat 1 : 3 v/v	0.17	0.18	0.17	0.18	0.17	0.17
Loam + sand 3 : 1 v/v	0.11	0.21	0.16	0.13	0.14	0.13
Loam + sand 1 :1 v/v	0.14	0.16	0.15	0.14	0.13	0.13
Loam + sand 1 : 3 v/v	0.19	0.11	0.15	0.17	0.16	0.16
Sand	0.09	0.10	0.09	0.07	0.06	0.06
Mean	0.15	0.14		0.15	0.14	

L.S.D. 5 %

Sterilization	0.01	0.01
Media	0.02	0.03
Sterilization x Media	0.03	N.S.

Table (9). Effect of soil sterilization and growing media on dry matter percentage during the two experimental seasons 1995 and 1996.

Growing media	1995			1996		
	Ster.	Unster.	Mean	Ster.	Unster.	Mean
Soil	10.46	8.99	9.72	11.05	11.50	11.27
Soil + peat 3 : 1 v/v	10.03	10.55	10.29	10.91	11.19	11.05
Soil + peat 1 : 1 v/v	13.86	11.39	12.62	14.38	13.84	14.11
Soil + peat 1 : 3 v/v	12.34	15.64	13.99	12.77	13.71	13.24
Soil + manure 3 : 1 v/v	10.83	11.14	10.98	11.08	10.53	10.80
Soil + manure 1 : 1 v/v	16.96	10.92	13.94	15.64	15.33	15.48
Soil + manure 1 : 3 v/v	12.36	13.04	12.70	13.18	12.00	12.59
Soil + sand 3 : 1 v/v	12.68	14.38	13.53	13.70	13.21	13.45
Soil sand 1 : 1 v/v	13.39	9.97	11.68	12.82	12.43	12.62
Soil + sand 1 : 3 v/v	11.95	11.44	11.69	11.79	10.97	11.38
Loam	11.01	12.41	11.71	11.22	10.55	10.88
Loam + peat 3 : 1 v/v	11.76	10.90	11.33	12.64	12.30	12.47
Loam + peat 1 :1 v/v	11.77	12.56	12.16	11.98	12.09	12.03
Loam + peat 1 : 3 v/v	13.12	11.66	12.39	14.32	12.71	13.51
Loam + sand 3 : 1 v/v	11.72	12.13	11.92	12.15	11.09	11.62
Loam + sand 1 : 1 v/v	11.35	17.13	14.24	12.01	12.20	12.10
Loam + sand 1 : 3 v/v	12.04	7.53	9.78	11.99	12.50	12.24
Sand	11.57	12.93	12.25	10.86	12.00	11.43
Mean	12.17	11.92		12.47	12.23	

L.S.D. 5 %

Sterilization	0.02	N.S.
Media	0.63	1.37
Sterilization x Media	0.89	N.S.

Total nitrogen.

As clear from the data in Fig. (3) which show the nitrogen concentration in transplants from the various treatments, no significant variation was observed due to sterilization in general. Only in (loam + peat 3: 1 and soil) significant increase in nitrogen of the sterilized media were obtained compared to the unsterilized ones.

It is evident from the data that the nitrogen concentration was the poorest in all treatments in the sand. Adding soil to the sand or loam significantly led to increased nitrogen concentration in both cases.

It is obvious that adding the manure to the soil caused no significant increase than soil alone. To the contrary increasing the peat added to the loam led to significant increase in the nitrogen concentration. The highest nitrogen concentration in all treatments was obtained equally in (soil + manure 1: 3, and loam + peat 1: 1) while the poorest was obtained in sand alone.

Protein content.

Fig (3) presents the protein concentration in transplants from the various treatments. The data reveal no significant effect of sterilization on this character with the exception of treatments (loam + peat 3: 1 and soil) where the sterilized surpassed the unsterilized by 8 .14% and 10.58% respectively.

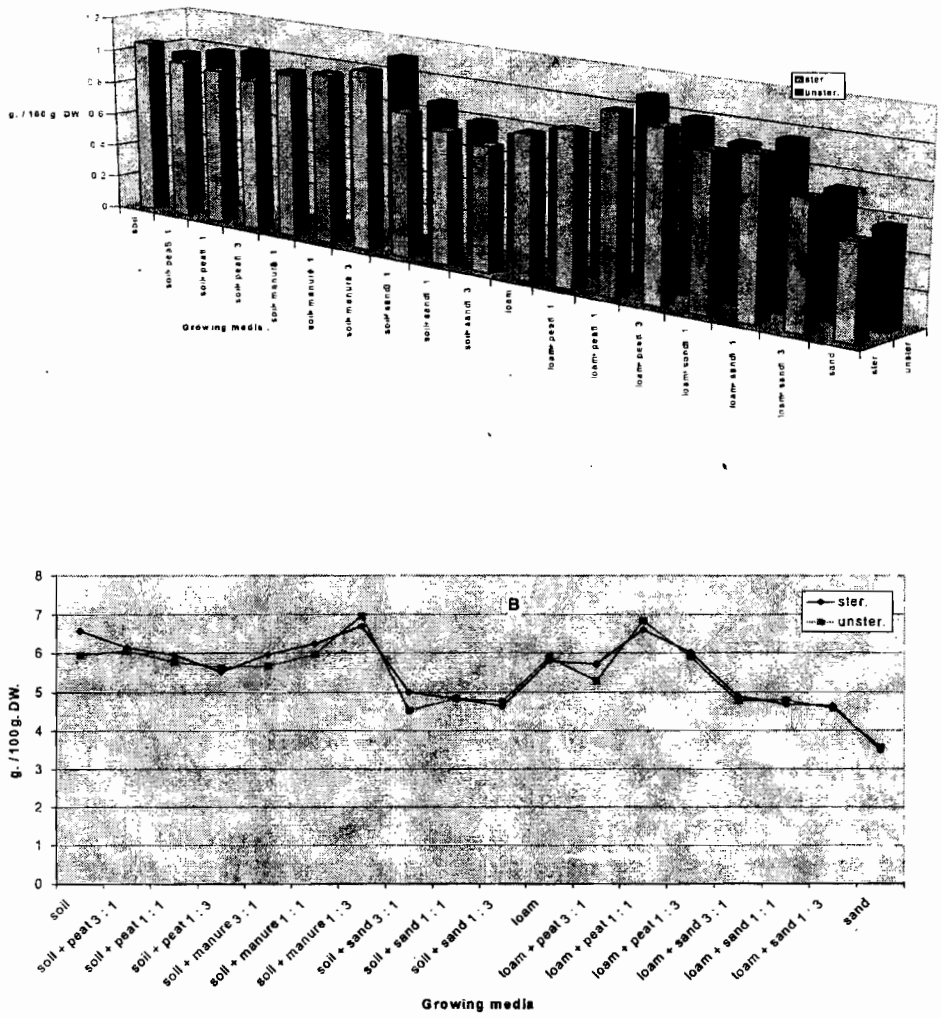

Fig. (3). Effect of soil sterilization and growing media on the nitrogen concentration (A) and protein content (B) of tomato seedling (Average of 1995 and 1996 seasons).

It is also clear from the data that the highest protein content was found in treatments soil+ manure 1: 3 and loam + peat 1: 1 and the lowest in treatment containing sand only. When the soil was added to the sand a significant increase was shown comparatively to the sand alone. The same was true in case of adding the loam to the sand, which also significantly surpassed the respective of sand alone. It is also evident that increasing the proportion of peat added to the loam resulted a significant high protein content compared to loam alone.

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تأثير بيئات النمو المختلفة لإنتاج شتلات الطماطم

حسين محمد رمضان

قسم بحوث البطاطس والخضر خضريه التكاثر ــ معهد بحوث البساتين

مركز البحوث الزراعية ــ جيزة . مصر .

الملخص العربي

أستخدمت ١٨ بيئة نمو بنسب مختلفة لإنتاج شتلات الطماطم وكانت النتائج كما يلي :

١-لوحظ ارتفاع نسبة إنبات بذور الطماطم في البيئة المكونة من رمل + طمي بنسبة ١: ١ بينما انخفضت في البيئة المتكونة من تربة فقط .

٢- كان معدل الإنبات مرتفعا في البيئة المكونة من سماد عضوي + تربة بنسبة ١ : ٣ بينما انخفض هذا المعدل في البيئة الرملية فقط .

٣- أنتجت البيئة المكونة من بيتموس + طمي بنسبة ١ : ٣ أعلى ارتفاع في أطوال الشتلات بينما كان اقلها ارتفاعا في البيئة المكونة من الرمل فقط.

٤ ــ ازداد عدد الأوراق في البيئات المكونة من سماد عضوي + تربة بنسبة ١ : ٣ وبيتموس + تربة بنسبة ١ : ١، سماد عضوي + تربة بنسبة ١ : ١ مع ملاحظة عدم وجود فروق معنوية بينهم بالمقارنة بالبيئات الأخرى بينما أنتجت كل من البيئة المكونة من تربة أو الرمل أقل عدد من الأوراق.

٥ــ كان اكبر قطر للشتلات في البيئة المكونة من بيتموس + طمي بنسبة ١ : ١ وكان اقلها في البيئة المكونة من الرمل فقط.

٦ــ كان أعلى زيادة في الوزن الطازج والجاف للشتلات في البيئة المعقمة والمكونة من السماد العضوي + تربة بنسبة ١ : ١ بالمقارنة بالغير معقمة وأنتجت البيئة المكونة من الرمل والغير معقمة اقلها في كل من الوزن الطازج والجاف.

٧ ــ ارتفعت النسبة المئوية للمادة الجافة للشتلات في البيئات المكونة من الرمل + طمي بنسبة ١ : ١ ، السماد العضوي + تربة بنسبة ١ : ١ والبيتموس + تربة بنسبة ١ : ٣

ولوحظ أن البيئتين الأخيرتين تحتوى على التربة بينما البيئة المكونة من التربة فقط أعطت اقل نسبة مئوية للمادة الجافة .

٨ ــ كان أعلى تركيز للنتروجين في البيئتين المكونة من السماد العضوي + تربة بنسبة ١ : ٣ وطمي + بيتموس بنسبة ١ : ٣ كما أدى إضافة البيت إلى الطمي نتائج افضل بالنسبة للبروتين الكلى في الشتلات.

٩ ــ من نتائج التجربة يمكن التوصية باستخدام البيئة المعقمة والمكونة من السماد العضوي + التربة بنسبة ١ : ١ لإنتاج افضل نمو خضري لشتلات الطماطم وذلك بالمقارنة بالبيئات المستخدمة الأخرى.