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YIELD, QUALITY AND CHEMICAL COMPOSTION OF TOMATO (*Lycopersicon Esculentum, Mill.*) AS AFFECTED BY IRRIGATION SYSTEMS, SALINITY LEVELS AND SOIL TYPES.

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Two field experiments were carried out during the summer seasons of 1999 and 2000 at Dina farm Km 80, Cairo, Alex. Road, Egypt to study the effects of different irrigation systems (surface, sprinkler and drip irrigation), three salinity levels (low 0.9-1.3; moderate 4.5-6.3 and high 9.0-12.4 dSm^{-1}) on tomato yield, quality and chemical composition, under the conditions of two soil types (calcareous and sandy). A spilt spilt plot design was used.

The most important finding could be summarized as follow:

The highest fruit yield of tomato (c.v. Peto 86) was obtained from calcareous soil (EC. 1.3 dSm^{-1}) under the drip irrigation system. The data also revealed that the lowest fruit yield was produced from the saline sodic calcareous soil (12.4 dSm^{-1} and 62.8 meq/L soluble Na+) also under the drip irrigation system. The data showed that there was an increase in total soluble salts and total acidity in tomato ripe fruit with drip irrigation during the two seasons. Fruit quality characters were also affected by soil types and salinity levels. The concentrations of N, P and K (%) in tomato plants decreased significantly with increasing salinity. Higher contents of nutrients were produced in tomato tissues under the calcareous soil conditions.

The results of this investigation recommended the drip irrigation system as the best method under the low and moderate salinity levels, while better results could be achieved with surface irrigation under the higher levels of soil salinity than those of sprinkler irrigation.

Keywords: Tomato, Soil types, Soil salinity, irrigation system, Chemical composition

المحصول والجودة والتركيب الكيماوى لنبات الطماطم (*Lycopersicon esculentum*, Mill.) تحت تأثير نظم الرى المختلفة ومستويات الملوحة ونوع التربة.

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أجريت تجربتان حقليتان خلال صيف ١٩٩٩ ، ٢٠٠٠ بمزارع دينا الكيلو "٨٠" طريق القاهرة –إسكندرية الصحراوى لدراسة تأثير نظم الرى المختلفة (الرى السطحى – الرى بالرش – الرى بالتنفيط) ، وثلاث مستويات ملوحة (منخفض ٠,٩-١,٣ ، متوسط ٣.٦-٥.٤ ، عالى ٩-١٢,٤ ديسمينز/م) على محصول الطماطم وصفات الجودة والتركيب الكيميائى تحت ظروف الأراضى الجيرية والرملية واستخدم تصميم القطع المنشقة مرتين باستخدام ثلاث مكررات. **وتتلخص أهم النتائج المتحصل عليها فيما يلى:-**

- تم الحصول على أعلى محصول من الطماطم صنف بيتو ٨٦ فى الأراضى الجيرية وتحت مستوى ملوحة (٠,٩-١,٣ ديسيمنز/م) باستخدام نظام الرى بالتنقيط. وتوضح النتائج كذلك أن أقل محصول تم الحصول عليه فى الأراضى الجيرية الملحية الصودية ذات مستوى ملوحة ١٢,٤ ديسيمنز/م وتركيز صوديوم ذائب ٦٢,٨ مللمكافئ/لتر .
- وتوضح النتائج أنه كان هناك زيادة فى المواد الصلبة الذائبة الكلية والحموضة الكلية فى عصير ثمار الطماطم تحت نظام الرى بالتنقيط خلال موسمى الدراسة.
- صفات الجودة للثمار المدروسة تأثرت أيضا بنوعى التربة ومستويات الملوحة وتأثرت النسب المئوية للنيتروجين والفوسفور والبوتاسيوم فى نباتات الطماطم حيث انخفضت بصورة معنوية مع زيادة مستويات الملوحة وتم الحصول على أعلى محتوى من العناصر الغذائية فى نسيج نباتات الطماطم تحت ظروف الأراضى الجيرية.
- وتوصى الدراسة بإتباع نظام الرى بالتنقيط كأفضل طريقة تحت المستويات المنخفضة والمتوسطة الملوحة. بينما يمكن الحصول على نتائج أفضل باستخدام الرى السطحى عندما تكون مستويات الملوحة عالية عما هو الحال تحت نظام الرى بالرش.

INTRODUCTION

Tomato (*Lycopersicon esculentum*, Mill.) is one of the major and the most important vegetable crops grown in Egypt. There is a high demand on tomatoes for local and export. It is standing well all over the year in most of the Egyptian governorates.

Therefore, in order to achieve the maximum output of tomato per feddan with a good quality must apply proper agricultural practices. Among these agricultural practices are irrigation systems (Merghany, 1997).

Increasing salinity in some Egyptian soils represent a hard problem, which could face tomato production, especially on the new reclaimed soil.

Sonbol (1976) reported that under high saline conditions, the concentration of P in tomato plants was decreased, however, he added that N concentration in tomato shoots was increased as soil salinity increased. The depressive effect of salinity treatments on mineral content was also reported by Adams and EL-Gizawy (1986). Martlnez and Cerda, (1987). Adams and Ho (1989) showed that fruit size, fruit number and the yield were reduced by increasing the addition of NaCl salt. However Ohta *et. al*., (1991) found that higher concentration of NaCl and KCl resulted in an increase in TSS.% and titratable acidity of the fruits.

In recent years, modern methods of irrigation (drip and sprinkler) have become widely introduced as an important method of water application. It has been particularly successful in regions with sandy soils (Ibrahim,1992). The flexibility of the drip and sprinkler equipments and their efficient control of water application make this method adaptable to most topographic conditions without extensive land preparation. It is especially suitable for steep slopes or irregular topographic (Troeh and Thomson, 1993). It should be borne in mind that drip irrigation is not just another method of applying water to plants, it is a new agrotechnical approach to growing crops under highly controlled conditions of soil moisture, fertilization, salinity and pest control and it has a significant effect on crop response, timing of harvest, chemical composition of either plant or fruits physical fruit characters, fruit quality and total yield.

The present work was undertaken to study the effect of different irrigation systems on the productivity of tomato under the conditions of the calcareous and sandy soils, which have different levels of salinity.

MATERIAL AND METHODS

Two field experiments were undertaken on tomato cv. Peto 86 at Dina farms Km (80) Cairo/Alex. desert road during the two summer seasons of 1999, 2000. Three different systems were used for irrigation, they are the surface (I_1), center (pivot) sprinkler (I_2) and drip irrigation (I_3). These irrigation systems have been used under two soil types (calcareous and sandy soils). Each type of these soils contains three different levels of salinity, (1.34, 6.28 and 12.4 dSm^{-1} for the calcareous soil and 0.91, 4.45 and 9.03 dSm^{-1} for the sandy soil).

The experimental design was spilt, spilt plot , where soil types situated in the main plots, while the salinity levels were assigned in the sub plots and the three irrigation systems were in the sub-sub plots. Each treatment was replicate a three times, thus the experiment included 54 plots (3.0 $\times$ 3.5 m.)

The mechanical and chemical analysis results of the studied soil types under the irrigation systems are shown in Table (1). Data in Table (2) show the number of seedlings/feddan, amount of water (m^3/feddan), amount of organic (m^3/feddan) and chemical fertilizers (unit/feddan) and herbicides (gm/fed) which were fixed under all irrigation systems for the different soils.

All obtained data were subjected to statistical analysis according to Snedecor and Cochran (1980).

Table 2: Fixed additions under all irrigation system for the different soil.

Number of plants/ fed.	Amount of water m^3/fed.	amount of Organic fertilizer m^3/fed.	Amount of chemical fertilizer										Herbicide g/fed.
			Kg/ fed.	Unit/fed.			g/fed.						
			S	N	P_2O_5	K_2O	Fe	Mn	Zn	Cu	Bo		
28000	3000	30	50	121.5	52.6	120	300	300.	300	300	300		200 Sinkor

Data Recorded

I. Fruit Yield and Yield Components:-

a- Average fruit weight (g). b- No. of fruits/plant.

c- Average fruit yield/plant (kg). d- Average fruit yield/feddan (ton).

II. Physical Fruit Characters:-

The following physical fruit characters were estimated:

1- Fruit length cm (L).
2- Fruit diameter cm (D).
3- Fruit shape index (L/D).

III.Fruit quality characters:-

Data were obtained by using 5 fruits from each treatment to determinate the following constituents:-

1- TSS.% in ripe fruits assayed using hand refractometer. (Karl Zeiss hand refractometer).
2- Total acidity% in fruits was estimated as citric acid percent according to (Stevens 1972).

IV.Mineral Content in Tomato Plant :-

All samples (5 plants) from each treatment were chosen at random, 75 days after transplanting.

Phosphorus contents were determined colorimetrically in the tomato plant parts “leaves and stems” as described by Jackson (1967).

Potassium content was estimated by flame photometer while nitrogen was determined by microkieldahl procedure (Jackson,1967).

RESULTS AND DISSCUTION

1. Yield and Yield Components:

Data recorded in Table 3 show that soil type affected significantly tomato fruit yield and its components during both seasons. Average fruit yield (ton/fed) reached to 17.08 and 16.62 ton/fed. On the calcareous soil during the first season and second season respectively, while the sandy soil produced the average fruit yield of 13.799 and 13.126 ton/fed. This results could be attributed to the fact that the calcareous soil has the ability to supply tomato plants with more nutrients and moisture which in turn produced high vegetative growth and more mineral accumulation in plants and consequently high fruit yield and its components. Similar results were obtained by Gomez *et. al.* 1992.

Regarding the effect of sodic salinity levels on tomato fruit yield and its components the data of Table 3 reveal that increasing the level of salinity decreased the yield of tomato plants and its components in both seasons. Increasing salinity reduced gradually both average fruit weight (g.) and number of fruit per plant, consequently the fruit yield was decreased. These results are in agreement with those reported by Soliman and Doss (1992). The depression in fruit yield of tomato under saline conditions could be explained on the basic that salt stress leads to an increase in osmotic pressure under which plants can not absorb sufficient water from the soil (EL-Hamady, 1996) he also added that, increasing salinity may changes the hormone balance in plants.

Table 3 : Effect of soil types, salinity levels and irrigation systems and their interactions on average fruit weight (gm), No. of fruit per plants, average fruit yield per plant (kg) and average fruit yield/feddan (ton) during 1999 and 2000 season

Treatments	Average fruit weight (g)		No. of fruits per plant		Average fruit yield per plant (kg)		Average fruit yield /fed. (ton)	
	1999	2000	1999	2000	2000	1999	1999	2000
(A) Soil types								
1- Calcareous	49.074	49.630	16.926	17.092	0.887	0.882	17.082	16.619
2- Sandy	44.037	44.111	14.286	14.690	0.683	0.695	13.799	13.126
LSD. at 5%	**0.664**	**0.934**	**0.289**	**0.361**	**0.019**	**0.014**	**0.166**	**0.112**
(B)Salinity levels								
Low	62.167	61.556	19.204	19.130	1.241	1.199	24.550	23.951
Moderate	45.389	46.556	14.936	15.386	0.703	0.732	14.214	13.601
High	32.111	32.500	12.677	13.157	0.410	0.434	7.556	7.006
LSD. at 5%	**0.814**	**1.144**	**0.354**	**0.442**	**0.023**	**0.018**	**0.203**	**0.137**
C) Irrigation system								
- Surface	48.000	49.278	15.397	15.240	0.795	0.797	16.144	15.048
- Sprinkler	37.000	37.389	14.310	14.981	0.541	0.575	10.090	9.765
- Drip	54.000	53.944	17.111	17.452	0.919	0.993	20.087	19.805
LSD. at 5%	**1.245**	**2.029**	**0.981**	**1.179**	**0.049**	**0.019**	**0.193**	**0.381**
Sig. Int.								
A ÷ B	1.151	1.619	0.501	0.625	0.032	0.025	0.287	0.194
A ÷ C	1.151	1.619	0.501	0.625	0.032	0.025	0.287	0.194
B ÷ C	1.410	1.985	0.613	0.766	0.039	0.030	0.351	0.237
A ÷ B ÷ C	1.994	2.804	0.868	1.083	0.056	0.043	0.497	0.396

Concerning the effect of irrigation systems on yield of tomato and its component, the obtained results show that drip irrigation gave the highest values of fruit yield, average fruit weight and number of fruits per plant in both growing seasons. Fruit yields were increased by 25.5% and 31.6% over that produced from the surface irrigation system in both seasons, respectively. These results show clearly the superiority of drip trickle irrigation method that achieved high efficiency by delivering water directly to each plant. This method also permits irrigation with relatively saline water. These results are in agreement with those reported by Merghany, 1997 and Yohannes and Tadesse, 1998.

It is worthy to note that the statistical data reveal that all ways of interaction have significant effects on fruit yield and its components (Table 3). During both seasons of experimentation.

2. Physical Fruit Characters:

Results at Table 4 indicate that both fruit length, fruit diameter average means were affected significantly due to the studied treatments.

Data presented in Table 4 reveal that all the physical characters of tomato fruits tended to be higher on the calcareous soil than on the sandy soil.

Table 4: Effect of soil types, salinity levels and irrigation systems and their interactions on fruit length (cm), fruit diameter (cm) and fruit index during 1999 and 2000 seasons.

Treatment	Fruit length (cm)		Fruit Diameter (cm)		Fruit index (L/D)	
	1999	2000	1999	2000	1999	2000
(A)Soil types						
Calcareous	4.830	4.759	4.074	4.015	1.173	1.180
Sandy	4.519	4.452	3.926	3.904	1.148	1.147
LSD. at 5%	0.064	0.116	0.075	0.076	N.S.	N.S.
(B) Salinity levels						
Low	5.567	5.433	4.667	4.556	1.194	1.193
Moderate	4.761	4.661	4.000	3.967	1.187	1.185
High	3.694	3.722	3.333	3.356	1.101	1.112
LSD. at 5%	0.078	0.142	0.092	0.093	0.034	0.041
(C)Irrigation systems						
Surface I_1	4.817	4.694	4.078	4.033	1.171	1.169
Sprinkler I_2	4.100	4.083	3.617	3.567	1.131	1.143
Drip I_3	5.106	5.039	4.306	4.278	1.180	1.177
LSD. at 5%	0.103	0.154	0.062	0.135	0.028	N.S.
Sig. Int.						
A ÷ B	0.110	0.201	0.129	0.131	0.049	N.S.
A ÷ C	0.110	0.201	N.S.	0.131	N.S.	N.S.
B ÷ C	0.135	0.246	0.159	0.160	0.060	N.S.
A ÷ B ÷ C	0.191	0.348	0.225	0.227	0.084	0.100

On the other hand increasing salinity level caused significantly depression in all characters in this table during the two growing seasons. Obtained results are in accordance with those reported by Faiz *et. al.* (1994).

Regarding the effect of irrigation systems on the studied physical fruit characters i.e., fruit length, fruit diameter and fruit index data of Table 4 show that these characters were significantly differed due to the different irrigation systems in the two growing seasons except fruit index which was not significant only in the 2nd season. The greatest values of all physical characters were obtained by the drip irrigation, while the lowest values were obtained by sprinkler irrigation. This effect could be due to the efficient control of water supply makes this method adaptable to most topographic conditions without extensive land preparation. Also help in overcoming disease spreading and high soil salinity level, and also by irrigation building of metabolites could be stimulated (Troeh and Thompson, 1993).

The statistical data in Table 4 show the responses of the studied physical fruit characters to the different ways of interactions during the two growing seasons of experimentation.

3- Fruit quality:

results of Table 5 reveal that soil type has significant effects on fruit quality parameter (total acidity and T.S.S. %) during both seasons. The calcareous soil produced higher values of these parameters mainly due to the ability of this soil to hold more water and supply the tomato plants with more nutrients than the sandy soil (Troeh and Thompson, 1993).

Table 5: Effect of soil types , salinity levels and irrigation systems and their interactions on some fruit quality parameters during 1999 and 2000 seasons.

Treatments	Total acidity		TSS.%	
	1999	2000	1999	2000
(A) Soil types				
1- Calcareous (S_1)	0.490	0.490	6.460	6.410
2- Sandy (S2)	0.487	0.476	6.222	6.194
LSD. at 5%	0.003	0.002	0.073	0.021
(B) Salinity levels				
Low (L)	0.473	0.460	5.648	5.586
Moderate (M)	0.479	0.480	6.322	6.303
High (H)	0.514	0.509	7.052	7.017
LSD. at 5%	0.018	0.003	0.089	0.026
(C) Irrigation systems				
1- Surface (I_1)	0.447	0.475	6.050	.6.011
2- Sprinkler (I_2)	0.488	0.485	6.422	6.418
3- Drip (I_3)	0.501	0.489	6.551	6.477
LSD. at 5%	0.022	0.003	0.131	0.039
Sig. Int.				
A ÷ B	N.S.	0.004	N.S.	0.037
A ÷ C	N.S.	0.004	N.S.	0.037
B ÷ C	N.S.	0.005	0.155	0.046
A ÷ B ÷ C	N.S.	0.007	0.219	0.064

Data of Table 5 illustrate that there was an increase in total soluble solids and total acidity in tomato ripe fruit with drip irrigation during the two seasons. These results suggested that these quality characters (total acidity & T.S.S. %) developed better under drip irrigation in comparison with the other irrigation systems.

Regarding the influence of the interactions on the values of total acidity and T.S.S.% the statistical data recorded in Table 5 show clearly that the different ways of interactions produced significant differences only in the second season, while in the 1st season the effects of B×C , A×B×C were only significant on T.S.S.%.

4. Chemical Composition of Tomato Plants:

Data of Table 6 reveal that N, P and K% in the dry matter of tomato plants were significantly affected due to soil types. Plants grown on the calcareous soil resulted in higher content of N, P and K% than those grown on the sandy soil during both season mainly due to the lower nutrient contents of the sandy soil (Table 1).

Data also show that there were significant differences between the effect of the three levels of salinity on the content of NPK in tomato plants. Higher values were in the low salinity level soil but the lowest value were in the plants grown on high salinity level similar results were obtained by Faiz et. al. (1994). More recently Pascale et. al. (2001) reported that salinity reduced P, K. Mg and N concentrations in tomato plants.

Table 6: Effect of soil types, salinity levels and irrigation systems and their interactions on the content of NPK (%).

Treatment	N %		P %		K %	
	1999	2000	1999	2000	1999	2000
(A) Soil types						
Calcareous(S_1)	3.899	3.931	0.282	0.276	2.978	2.987
Sandy (S_2)	3.787	3.799	0.267	0.265	2.864	2.900
LSD. at 5%	**0.021**	**0.023**	**0.002**	**0.002**	**0.025**	**0.017**
(B) Salinity levels						
Low (L)	3.988	4.024	0.289	0.284	3.042	3.099
Moderate (M)	3.805	3.831	0.272	0.269	2.939	3.001
High (H)	3.736	3.740	0.262	0.258	2.782	2.771
LSD. at 5%	**0.026**	**0.027**	**0.002**	**0.002**	**0.031**	**0.021**
(C) Irrigation systems						
Surface (I_1)	3.712	3.723	0.248	0.242	2.731	2.758
Sprinkler (I_2)	3.824	3.861	0.279	0.275	2.979	3.031
Drip (I_3)	3.993	4.011	0.296	0.294	3.053	3.042
LSD. at 5%	**0.024**	**0.049**	**0.004**	**0.003**	**0.024**	**0.049**
Sig. Int.						
A ÷ B	0.037	0.039	0.003	0.003	0.044	0.029
A ÷ C	0.037	0.039	0.003	0.003	N.S.	0.029
B ÷ C	0.045	0.048	0.004	0.003	0.053	0.036
A ÷ B ÷ C	N.S.	0.067	0.005	0.005	N.S.	0.051

Data of Table 6 also show that there were significant difference between the three studied methods of irrigation concerning N, P and \K contents of tomato plants. The highest values of N, P and K% were in drip irrigation then sprinkler irrigation and lowest values were produced due to the surface irrigation in both growing seasons.

Increasing N, P and K content of tomato plants due to drip irrigation could be attributed to the fact that nutrient absorption is most rapid at an optimum water content of the soil (Mackay and Barber, 1985)

Data also reveal that the good distribution of water is a very important factor in the distribution of the other environmental factors (oxygen, nutrients).

Regarding the interaction effects on N, P and K% the statistical data in Table 6 reveal that AxB, AxC, BxC and AxBxC interactions affected significantly N% and P% in the two seasons. while the AxB and BxC interactions have significant effect on K% during both seasons.

The results show clearly that the drip irrigation has the efficiency to make water more available for tomato plants under desert conditions. The net result is that nutrients absorption became more rapid at an optimum water supplying by drip irrigation.

CONCLUSION

The results of this investigation recommended the drip irrigation for tomato production under the conditions of the new reclaimed soils of Egypt. Drip irrigation achieves high efficiency by delivering water directly to each plant. This method not only reduces evaporation losses under arid conditions, but it also permits irrigation with relatively saline water. The method (drip irrigation) produced the highest fruit yield improve fruit quality and nutrients contents.

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المحصول والجودة والتركيب الكيماوى لنبات الطماطم (*Lycopersicon esculentum*, Mill.) تحت تأثير نظم الرى المختلفة ومستويات الملوحة ونوع التربة.

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أجريت تجربتان حقليتان خلال صيف ١٩٩٩ ، ٢٠٠٠ بمزارع دينا الكيلو "٨٠" طريق القاهرة –إسكندرية الصحراوى لدراسة تأثير نظم الرى المختلفة (الرى السطحى – الرى بالرش – الرى بالتنفيط) ، وثلاث مستويات ملوحة (منخفض ٠,٩-١,٣ ، متوسط ٥.٤-٦,٣ ، عالى ٩-١٢,٤ ديسمينز/م) على محصول الطماطم وصفات الجودة والتركيب الكيميائى تحت ظروف الأراضى الجيرية والرملية واستخدم تصميم القطع المنشقة مرتين باستخدام ثلاث مكررات. **وتتلخص أهم النتائج المتحصل عليها فيما يلى:-**

- تم الحصول على أعلى محصول من الطماطم صنف بيتو ٨٦ فى الأراضى الجيرية وتحت مستوى ملوحة (٠,٩-١,٣ ديسيمنز/م) باستخدام نظام الرى بالتنقيط. وتوضح النتائج كذلك أن أقل محصول

تم الحصول عليه فى الأراضى الجيرية الملحية الصودية ذات مستوى ملوحة ١٢,٤ ديسيمنز/م وتركيز صوديوم ذائب ٦٢,٨ مللمكافئ/لتر .

- وتوضح النتائج أنه كان هناك زيادة فى المواد الصلبة الذائبة الكلية والحموضة الكلية فى عصير ثمار الطماطم تحت نظام الرى بالتنقيط خلال موسمى الدراسة.
- صفات الجودة للثمار المدروسة تأثرت أيضا بنوعى التربة ومستويات الملوحة وتأثرت النسب المئوية للنيتروجين والفوسفور والبوتاسيوم فى نباتات الطماطم حيث انخفضت بصورة معنوية مع زيادة مستويات الملوحة وتم الحصول على أعلى محتوى من العناصر الغذائية فى نسيج نباتات الطماطم تحت ظروف الأراضى الجيرية.
- وتوصى الدراسة بإتباع نظام الرى بالتنقيط كأفضل طريقة تحت المستويات المنخفضة والمتوسطة الملوحة. بينما يمكن الحصول على نتائج أفضل باستخدام الرى السطحى عندما تكون مستويات الملوحة عالية عما هو الحال تحت نظام الرى بالرش.

Table 1: Particle size distribution, calcium carbonates, organic matter content and chemical analysis of soil paste for the studied soil profiles.

Soil type	Profile No.	Depth	Gravel %	Mechanical analysis				Total $CaCO_3$ %	O.M.%	Chemical analysis of soil paste												SAR
													Cations meq/l				Anions meq/l					
				Coarse sand %	Fine sand %	Silt %	Clay %			Sp	pH	EC dSm^{-1}	Ca^{+2}	Mg^{+2}	Na^{+}	K^{+}	Cl^{-}	HCO_3^{-}	CO_3^{-2}	SO_4^{-2}		
Calcareous soil	1 Low	0-30	11.2	26	49	13	12	16.2	0.34	35	7.9	1.34	3.9	1.5	7.6	0.43	5.4	1.43	--	6.6	4.63	
		30-60	8.7	56	25	10	9	14.4	0.11	30	7.8	1.41	4.0	1.2	8.2	0.5	5.2	1.8	--	6.9	5.09	
	2 Mode	0-30	13.4	44	31	15	10	18.8	0.25	37	8.0	6.28	10.2	8.6	43.07	0.92	25.6	2.4	--	34.8	14.07	
		30-60	14.6	25	56	11	8	15.6	0.19	33	7.8	7.69	23.25	13.9	38.5	1.2	43.1	2.5	--	31.25	8.93	
	3 High	0-30	12.4	40	42	12	6	14.6	0.43	32	7.8	12.4	37	24	62.8	0.9	57.5	2.8	--	64.4	4.85	
		30-60	16.7	35	48	10	7	12.8	0.16	30	7.5	14.3	50	43	50.2	1.1	79.2	3.1	--	62	7.36	
Sandy soil	4 Low	0-30	4.2	20	73	4	3	1.9	0.27	20	7.2	0.91	3.3	1.56	3.8	0.67	4.7	1.03	--	3.6	2.43	
		30-60	5.0	22	73	3	2	1.5	0.09	19	7.3	1.95	4.70	2.2	11.7	0.61	9.4	1.7	--	8.41	6.29	
	5 Mode	0-30	4.5	25	68	2	5	2.2	0.22	21	7.3	4.45	15.8	8.07	20.1	0.56	21.8	2.53	--	20.2	5.82	
		30-60	2.7	33	59	4	4	1.7	0.14	20	7.2	7.1	19.6	14.5	35.1	1.8	41.0	2.8	--	27.2	8.5	
	6 High	0-30	3.9	19	74	2	5	3.4	0.31	23	7.4	9.03	20	13	56.55	0.75	55.7	1.6	--	32.9	13.93	
		30-60	4.1	38	53	4	5	2.1	0.11	22	7.3	17.15	36.3	24.6	112.5	0.8	157.7	1.3	--	15.2	20.38	