

The effect of phosphate fertilizer on the quantitative and qualitative features of tomato in three type of soils texture

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ABSTRACT: Tomato, with scientific name of *Lycopersicum Sculentum* L., is one of the most important vegetable that is planted in various areas of Iran and is a profitable product for farmers. This plant is from Solanacea family . In the study, we evaluated and studied the co-action effect of sandy, clayish and silty soils with super phosphate triple in three levels (0, 40, 80 mg of phosphorus in 1 kg of soil) in a form of completely random design with 9 treatments and 3 repetition in the growth features of tomato. The measured factor involved: the number of flower, the wet weight of plant, degree of performance, the amount of PH, and the amount of vitamin C. At the end of the study, 80 mg phosphate treatment showed better results compared with the other treatments.

Keywords: Tomato, phosphate fertilizer, soil texture.

INTRODUCTION

Tomato, with scientific name of *Lycopersicum Sculentum* L., and from solanacea family , is the multiannual plant that due to climatic limitations and economical conditions is transplanted in annual form (Ahmadi and Hosseinpoor, 2011). It is the most important greenhouse product in Canada (Papadopoulos, 1991) , Florida and the other parts of the world (Hochmuth and Hochmuth, 2009). Suitable soil, for planting vegetable is a kind of soil that has enough mineral matters, soil deep, drain, organic matters, and suitable aeration (Daneshvar, 2010). Furthermore, the soil should be fertile, deep and should has medium texture and suitable drain. The soil PH should be 6/5 to 7. Salty, alkalice, and acidic soils are not suitable for planting tomato (Khoshkhoy et al, 1992). Sandy soils are those ones that have less than 15% ailt or clay. Such soils have a suitable aeration and quickly drain and warm. They are poor in organic matters and are not able to keep water and organic matters un themselves. Silty soils are the mixture of sand , silt, and clay. They have less than 20% clay, 35 to 50% silt, and 30 to 50% sand. Clayish soils have more than 60% clay. Such soils keep water in themselves for a time and drain very late and working in such soils is difficult (splittstoesser, 1990). Phosphate fertilizer is one the most important elements for plant nourishment. It improves the color, vitamin C, the fruit hardness and speed up the plant maturity. Enough phosphorus in root environment causes the plant to improve quickly and to make better use of water and the other nutrient matters. In this study, the effect of super phosphate triple, as one of the most important phosphate fertilizer , was evaluated and studied in on tomato performance in three types of soils with sandy, clayish, and silty texture. According to Hojabrian et al (2010), the main role of phosphorus is in the adjustment of the tomato's ripeness. They believe that it increases the plant's resistance against diseases and improve the quality and appearance of the fruit. Mahdavi and Rezaeean (2005) believe that the tomato needs more phosphorus in the beginning of the growth period. In another study by Kazemian et al (2013), it was stated that the soil and its texture have a significant role in the provision of water and nutrient matters for plant. They , also, are an environment for keeping roots in themselves. Necessary oxygen reaches to plant by soil pores and harmful gases leave the soil by these pores.

MATERIALS AND METHODS

In other to investigate the effect of various phosphate treatments on the quantitative and qualitative features of tomato in three types of soils with sandy, clayish, and silty texture, this study was conducted in a completely random design with 9 treatments and 3 repetition. 27 vases were divided into 3 groups of 9 (9 vases for every type of soil) each of which was filled by 5 kg of related soil and was treated by super phosphate triple. Treatment levels involved in 0, 40, 80 mg. We planted 2 seeds in each vase. For the provision of potassium, iron, manganese, zinc, and copper, we added 80 mg of potassium, 10 mg of iron and manganese, 5 mg of zinc and cooper for each kg of soil equally to each vase. After germinating, the weaker plants were eliminated from the vases. At the end of the test, the features of flowers, wet weight of plant, the degree of performance, the amount of PH and vitamin C were measured seperatly in each treatment. The analysis of data was done by MSTATC software and the comparison of means was conducted, using Duncan's multiple range test in 5% level.

RESULTS AND DISCUSSION

Results

The comparison of the effect of soil texture on the features studied

The comparison of data mean, using Duncan's test in 5% level showed that the soil texture had a significant effect on the number of flowers. The least number of flowers related to clayish soil with 12/8 and then related sandy soil with 14/2. According to table 1, the best flowering relates to silty soil with 15/5 flowers.

The comparison of data mean, using Duncan's test in 5% level showed that the soil texture had a significant effect on the plants performance. The best degree of performance related to clayish soil with 67/520 g and then related to sandy soil with 94/070 g. The best performance related to silty soil with 116/44 g. As the soil becomes heavy, the performance reduced significantly.

Table 1. The comparison of the soil texture on the features studied

Soil texture features	silty	sandy	clayish
The number of flower	15.5 ^a	14.2 ^b	12.8 ^c
The bush performance (g)	114.440 ^a	94.070 ^b	67.520 ^c
The wet weight of bush (g)	63.036 ^a	62.955 ^a	53.328 ^b
pH	5.58 ^a	5.48 ^a	5.54 ^a
Vitamin C (mg)	49.38 ^a	50.91 ^a	50.84 ^a

The means in each row which have at least a common letter, are not different significantly in 5% level of Duncan's test

The comparison of data mean, using Duncan's test in 5% level showed that the soil texture had a significant effect on the wet weight of plants. The least amount of wet weight related to clayish soil with the average weight of 53/328 g in each vase and then related to sandy soil with 62/ 955 g and was different significantly with clayish soil. The most amount of wet weight related to silty soil with 63/036 g in a each vase that increased significantly compared to the clayish soil, Although was not different significantly with sandy soil but its amount was more than sandy soil (table 1).

The comparison of data mean, using Duncan's test in 5% level showed that the soil texture had a significant effect on the fruit essence PH. The least amount PH related to sandy soil with 5/48 and than related to clayish soil with 5/54 and finally related to silty soil with 5/58 (table 1).

The comparison of data mean, using Duncan's test in 5% level showed that the soil texture had not a significant effect on the tomato's vitamin C in 5% level. According to table 1, the amount of vitamin C in sandy, silty, and clayish soils was respectively 50/91 mg, 49/38 mg, and 50/84 mg.

The comparison of the effect of the various treatments of super phosphate triple fertilizer on the features studied The comparison of data mean, using Duncan's test in 5% level showed that the various levels of phosphate fertilizer had a significant effect on the number of flowers in tomato, as with the increase of phosphate fertilizer level, the number of flower increases, too.

According to table 2, the number of flower in 0 level is 12/2, in 40 level is 14/4, and in 80 level is 15/9 flowers in tomato.

Table 2. the comparison of the effect of the various treatments of super phosphate triple fertilizer of the features studied

Phosphorus (mg in kg soil)	0	40	80
features			
The number of flower	12.2 ^c	14.4 ^b	15.9 ^a
The bush performance (g)	73.6 ^c	90.1 ^b	104.4 ^a
The wet weight of bush (g)	57.178 ^b	55.353 ^b	66.788 ^a
pH	5.85 ^a	5.34 ^{ab}	5.02 ^b
Vitamin C (mg)	45.84 ^c	48.69 ^b	56.60 ^a

The means in each row which have at least a common letter, are not different significantly in 5% level of Duncan's test

The comparison of data mean, using Duncan's test in 5% level showed that the various levels of phosphate has a significant effect on the tomato's performance, as with the increase of the various levels of phosphate, the performance of the tomato, increase, too. The lowest degree of performance, in o level of phosphate related to 73/6 g, and then related to 40 level with 90/1 g. The highest degree of performance related to 80 level with 104/4 g (table 2).

The comparison of data mean, using Duncan's test in 5% level showed that the increase of phosphate level had not a significant effect on the wet weight of tomato plants. The wet weight of plants in 0 level was 57/178 g, 55/353 g in 40 level, and 66/788 g in 80 level that increase significantly compared with 40 level (table 2).

The comparison of data mean, using Duncan's test in 5 %level showed that the various levels of phosphate had not a significant effect on tomato's PH. The highest amount of PH related to 0 level with 5/85, and then related to 40 level with 5/34 that reduce non-significantly. According to table 2, the most amount of PH relates to 80 level with 5/02.

The comparison of data mean, using Duncan's test in 5%level showed that the various levels of phosphate had a significant effect on the amount of vitamin C in tomato, as with the increase of phosphate level, the amount of vitamin C increases, too. The lowest amount of vitamin C related to 0 level with 45/84 mg, and then related to 40 level with 48/69 mg. The highest amount related to 80 level with 56/60 mg (table 2).

The co-action effect of soil texture and phosphate fertilizer on the features studies

The comparison of data mean, using Duncan's test in 5%level showed that, the number of flower had increased significantly with the increase of phosphate level in silty soil, as the lowest number related to 0 level with 14/4 flowers and the highest to 80 level with 17 flowers. The number of flowers increased significantly in sandy soil, too, as the lowest number related to 0 level with 11/7 and the highest to 80 level with 16/4 flowers. In clayish soil, too, with the increase of various phosphate levels, the number of flower increased significantly, as the lowest number related to 0 level with 10/3 and the highest to 80 level with 16/1 flowers. Among various levels of phosphate in three types of soil, the highest number of flower related to silty soil and 80 mg phosphate level, and the lowest number related to clayish soil and 0 level of phosphate (table 3).

The comparison of data mean, using Duncan's test in 5% level shows that the bush performance increased significantly with the increase of phosphate level in silty soil, as the lowest degree of performance related to 0 level with 86/6 g and the highest related to 80 level with 149/7 g. The increase of phosphate level increased the performance, too, Although this increase was not significant. In clayish soil, too, with the increase of phosphate level, the performance increase significantly (table 3).

The comparison of data mean , using Duncan's test in 5%level showed that the increase of phosphate level had a significant effect on the wet weight in silty soil, as the wet weight from 55/8 g in 0 level reached to 68/6 g in 80 level. In sandy soil, the increase of phosphate level from 0 to 80 had a significant effect on the wet weight of tomato, as the wet weight from 60/4 g in 0 level reached to 68/7 g in 80 level. In clayish soil, we can see a significant increase with the increase of phosphate level, as the least amount of wet weight with 46/4 g in 0 level reached to 63/1 g in 80 level that showed a significant increase in 5 % level. Among the three type of soils and level of phosphate, the highest amount of wet weight related to silty and sandy soils in 80 mg level of phosphate (table 3).

Table 3. the comparison of the effect of treatments resulted from the co-action effect of soil texture and phosphate fertilizer on the features studied

features Soil texture X	super triple phosphate	The number of flower	The bush performance (g)	The wet weight of bush (g)	pH	Vitamin (mg)	C
Silty	0	14.4 ^c	86.6 ^{bc}	55.8 ^{cd}	5.67 ^a	45.03 ^c	
	40	15.1 ^{bc}	113.1 ^b	64.8 ^{ab}	5.54 ^{ab}	47.13 ^{bc}	
	80	17 ^a	149.7 ^a	68.6 ^a	5.52 ^{ab}	55.98 ^a	
Sandy	0	11.7 ^d	83.9 ^{bcd}	60.4 ^{bc}	5.52 ^{ab}	64.74 ^{bc}	
	40	14.4 ^c	81.9 ^{bcd}	59.8 ^{bc}	5.48 ^b	47.81 ^{bc}	
	80	16.4 ^{ab}	116.4 ^{ab}	48.7 ^a	5.46 ^b	58.18 ^a	
clayish	0	10.3 ^d	50.9 ^d	46.4 ^e	5.60 ^{ab}	45.76 ^c	
	40	13.8 ^c	68.1 ^{cd}	50.5 ^{de}	5.53 ^{ab}	51.14 ^b	
	80	16.1 ^{ab}	83.6 ^{bcd}	63.1 ^{ab}	5.48 ^b	55.64 ^a	

The means in each column which have at least a common letter, are not different significantly in 5% level of Duncan's test

The comparison of data mean, using Duncan's test in 5% level showed that the soil texture with various levels of phosphate had not a significant effect on the PH in 5% level. In three type of soils, the average of PH reduced with the increase of phosphate level but this reduction was not significant (table 3).

The comparison of data mean, using Duncan's test in 5% level showed that the increase of phosphate level, in each soils of sandy, and clayish had a significant increase in the amount of vitamin C. In silty soil, the lowest amount of vitamin C related to 0 level with 45/03 mg, and then related to 40 level with 47/13 mg, and the highest amount related to 80 level with 55/98 mg. In sandy soil, the increase of phosphate level had a significant effect in the amount of vitamin C, too, as the lowest amount related to 0 level with 46/74 mg, and then related to 40 level with 47/81 mg, and the highest amount related to 80 level with 58/18 mg. In clayish soil, also the increase of phosphate level caused a significant increase in the amount of vitamin C, as the lowest amount related to 0 level with 45/76 mg, and then to 40 level with 51/14 mg, and the highest amount related to 80 level with 55/64 mg (table 3).

Discussion

The results of data variance analysis showed that the application of phosphate fertilizer is an important factor in planting tomato because they always have various positive effects on the quantity of tomato. The soil texture, also, is an influential factor in planting tomato.

Conclusion

It can be concluded that the use of phosphate is very effective for increasing the productive and germinative factor in tomato and these effects are different in various levels. According to the results of this study, the 80 mg level of phosphate has better effects and is the best choice compared with the other levels. The silty texture also has better results for the features studied compared with the other textures. In the simultaneous application, it can be concluded that the use of simultaneous application treatment (silty soil texture +80 mg level of phosphate in each kg of soil) has better results and is the best choice.

Suggestions

- 1) The use and the application of the silty soil texture and phosphate fertilizer in 80 mg level in each kg of soil for planting tomato.
- 2) Performing complementary researches with various treatments by the researchers in this case.
- 3) Performing complementary researches with similar levels on the other plants.

REFERENCES

- Ahmadi M and Hosseinpoor R. 2011. The principle of producing tomato. Mowood Eslam Publications . P . 208.
- Daneshvar MH. 2010. Planting vegetable. Sixth Edition. Ahvaz Shahid Chamran University Press.P. 56. Ahvaz. Iran.
- Hochmuth GJ and Hochmuth RC. 2009. keys to successful tomato and cucumberproduction in perlite media,site at <http://edis.ifas.ufl.edu>.
- Hojabrian M, Ejraee A and Behrooznam B. 2012. The effect of various PHs soil on the absorbtion of phosphoures and potassium in tomato. M. A. thesis, Islamic Azad university, Jahrom branch. Jahrom, Iran.

- Khoshkhoy M, Sheibani B, Rohani A and Tafzili A. 1992 . The principle of horticulture. First edition. Shiraz university press. Shiraz , Iran.
- Kazemi S, Ejraee A and Behrooznam B. 2013. The effect of nitrogen fertilizer on the growth and the amount of flowering in tomato in a clacic soil. M. A. Thesis, Islamic Azad university, Jahrom branch. Jahrom, Iran.
- Mahdavi M and Rezaeean S. 2005. The effect of various levels of nitrogen and potassium with irrigation fertilizer method on tomato. The Ninth congress of Iran's soil sciences. Tehran, the center of protecting soil and water. Teran, Iran.
- Papadopoulos AP. 1991. Growing greenhouse tomatoes in soil and in soilless media, Research station Horrow Canada publication 1902.
- Splittstoesser WE. 1990. Vegetable growing handbook, principles and procedures for producing an abundance of quality vegetable. Forth edition. The AVI publishing Company, Inc. Westpott, New Yourk, U.S.A.