

Research Article

Characterization and nutritional values of four tomato varieties in climatic conditions of District Layyah, Pakistan

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Abstract

This research work was conducted at District Layyah to evaluate the impact of ecoclimatic conditions, soils texture on growth parameters and nutritional values of three tomato varieties. The tested varieties were DT97/162A(R), DT97/215.A, local V₁ and local V₂. They were assigned randomly into different blocks in the fields as completely randomized block design (RBCD). In present results, physio-chemical properties of soil, nutritional values and morphometric characteristics of three tomato varieties were analyzed and documented. The pH 7.6 was measured. Available Phosphorus was calculated as 7.8 mg/kg. Total Nitrogen appeared in collected samples was 0.6%. Ca²⁺ indicated maximum exchangeable cation (2.9 mg/g) as comparison to other cations. In exchangeable acidity, Fe (ppm) indicated highest value (19.4 meg/100g). Maximum (42.55%) protein percentage produced by local variety V₂ while highest (41.50%) fat shown by variety DT97/162A(R). Fiber percentage appeared almost similar in all analyzed varieties. Vitamin C (0.37 mg/100g) was measured highest in local variety V₂. The highest values of Ca (0.395%), Mg (0.215%), K (0.182%) and P (0.572%) were also observed in tomato local variety V₂. However, tomato variety local V₂ showed higher plant height. Tomato variety DT97/162A(R) showed highest number of leaves while DT97/215A indicated minimum values. Number of flowers and number of fruits were produced almost similar in all varieties. Hence, local variety V₂ showed highest growth, better yield performance and high nutritional values. Therefore, it is concluded that a local variety (V₂) suggested as the suitable tomato variety for the environmental conditions of District Layyah, Pakistan.

Keywords: Climatic conditions; Growth parameters; Nutritional values; Tomato varieties

Introduction

Now a day, demand of food production is a main thread to achieve the requirements of increasing populations in sector of agriculture. It will be spreading day by day and continually explore in future due to over-population. Crop quality depends on many

factors for better food production and one of the main key factor is their system of fertilization. The growth and production of different vegetable crops are mainly depends on the quantity and quality of fertilizers [1]. So, different chemical fertilizers are often used to increase yield of crop as well as

increase soil fertility. Frequent use of these fertilizers correlates with ecoclimatic conditions and high rates of inorganic fertilizer have been influenced on some environmental pollution, modify soil textures and physical property of fertile soil. Moreover, the nutritional values of crops are also affected by continuous use of various synthetic fertilizers. Therefore, these fertilizers have both good and bad impacts on varieties of tomato. Farmers should try to improve tomato yield by alternate way of fertility in soil instead of adequate use of fertilizers [2].

Lycopersicon esculentum Mill. (Tomato) is the most important vegetable commonly used in different parts of the world. It is estimated that tomato crop is relatively very short duration crop as comparison to other crops. It produces good yield in a short duration. It is economically most attractive vegetable and the area under cultivation of the crop is increasing day by day [3]. Moreover, tomatoes contain a healthy, well balanced diet and rich in essential amino acids, minerals, vitamin B, C and E, iron and phosphorus, sugars and dietary fibers. Fresh tomatoes are used in making salads and good for soup. This vegetable is also used in cooking of meat and fish dishes. Tomato juices, pickled, ketchup and other forms of tomato are very common in food industry. Dried tomatoes and canned products of tomatoes are economically important everywhere in the world.

According to a rough estimation, every year 20 million metric tons (MMT) tomatoes were produced in the world. The United States, Spain, UAR and Italy are the leading producers of tomato crop. Among vegetable crops in the USA alone ranked on 2nd number in production of potatoes and contributes much more in his economy. It was estimated approximately 400 million dollars contributed in economy during each year [4]. In year 2010, global production of fresh fruit

was approximately 145.6 million tons with 2.7% of the world production [5].

Currently, tomato is very famous fruit and also used as a vegetable in most of the countries of the world. However, its production rate is low as comparison to demand of the peoples due to differences in variable environmental conditions, lack of high yielding varieties and poor cultural practices applied to fields of the crop. Furthermore, Lopes *et al.*, [6] described that tomato plant is very sensitive to water stress. Therefore, proper and good productions of tomatoes require suitable watering throughout the life cycle. The commercial values of the table tomato is measured by the characteristics and quality of tomato fruit. Tomato fruit quality is determined mainly by his original color, good texture, and suitable flavor. Among those, color and flavor are probably two key characteristics for estimation of maturity of tomato fruit. High quality of tomato correlates with redness of color and prominence of flavor. The flavor of a tomato fruit becomes pronounced when sugar content in it observed maximum [7].

Tomatoes are planted by an estimated 85% of the gardens each year. Tomato is highly productive if it will be well managed [8]. Tomatoes during the wet and dry seasons contributed very high yield at national level but in southern states, bulk of production of the tomato fruit is observed in dry season [9]. Vegetable production are often adopted as a technique for improving bread, butter and better nutritional standing. It is a good solution to recover the issues of hunger within a country [10].

This crop makes people healthier and reduce the risk of different diseases that includes; cardiovascular disease, breast cancer, stomic cancer, esophageal cancer, pancreatic cancer and many other types. Some recent findings revealed that control of cancer activities by taken of tomatoes and garlic together [22]. Actually, few newly explored organic

chemicals such as bioflavonoids from tomatoes are responsible for minimizing cancer fighting agents. Tomato fruit is also very effective for liver health. Detoxification effect was also noted in human body due to chlorine and sulfur content in tomato [23].

The objective of this preliminary study was to analyze the physio-chemical properties of soil of tomato growing areas in District Layyah, Pakistan. The growth parameters of commonly growing varieties of tomatoes were measured in this research project. Impacts of climatic conditions of the study area on fruit yields and nutritional values of selected tomato varieties were also under investigation. To recommend the best one variety for sowing in future in the study area.

Materials and methods

Collection of soil samples

Soil samples were taken from 10-16cm depth. The samples were taken randomly from different locations of the selected experimental site. Then the collected samples were put in sun light for air-dried. After few days, samples were grinded by passing from 2mm sieve tubes.

Determination of physio-chemical properties of soil

The collected soil samples were assessed for physio-chemical characteristics as following Bouyoucos and Walkley Black methods with some modifications. The size of soil particles were determined by applying Bouyoucos method [11]. Soil organic carbon was calculated by using Walkley black technique with few modifications [12]. Total nitrogen and phosphorus contents were determined separately which were present in the collected samples [13]. Similarly, other elements of soil collected samples were measured by use of atomic absorption spectrophotometer which includes exchangeable K, Ca, Mg and Na [14]. Soil samples pH in H₂O (1:1) was also calculated by pH meter.

Experimental design

The experiment was conducted in a nursery. For the experimental work, two hybrid varieties of tomatoes and two indigenous tomato varieties were selected. The seeds were sowing in prepared plots in a row with specific distance. First, the prepared nursery plots were watered regularly with help of water cans. It was observed seedling emergence after each day. The seedling should start on the 5th day after sowing. The nursery plots were mulched for good growth and germination of tomato plants. The plots prevented from excessive heat by a green sheet. The tomato nurseries were transplanted into their respective plots in the field after four weeks sowing periods [15]. Then, gradually measured the nutritional values and morphometric characteristics of the growing tomato varieties.

Results and discussion

The impact of climatic conditions and soils on growth and nutritional values of tomatoes were measured and documented in this current research work in the fields of District Layyah, Pakistan.

Analysis of physio-chemical properties of soil

The results of soil analysis viz., pH, exchangeable cations, acidity and physical characteristics of soils were indicated in (Table 1). The pH 7.6 was measured. Available Phosphorus was calculated as 7.8mg/kg. Total Nitrogen appeared in collected samples was 0.6%. Ca²⁺ showed maximum exchangeable cations (2.9mg/g) as compared to other cations. In exchangeable acidity, Fe (ppm) indicated highest values (19.4 meg/100g). Physio-metric characteristics of soil were measured as sand (76.5%), silt (18.7%) and clay (3.9%). The texture of soil appeared as sandy loam (Table 1). The nutritional values and soil characteristics of the investigated areas were also measured (Figure 1).

Similar results were measured by many researchers in past who described the initial cropping soil analysis. The soil indicated sandy loam texture with rich organic matter and suitable moisture properties. It was observed that most of the chemical nutrient elements remained below the critical values. Similar findings were shown by Adeoye and Agboola [16]. On the other hand, suitable pH and inorganic fertilizer are necessary for better growth of vegetables. The soil changing particles like pH (7.0) and appropriate inorganic fertilizer were observed for tomato growth. So, tomato belongs to such a range were able to grow in these conditions [17, 18]. The variation in nutritional values of tomato crop was incorporated due to presence of diversity of nutrients in soil [24, 26].

Analysis of nutritional values

Fruit analysis with special reference to cultivated tomato varieties were expressed in (Table 2). Statistically, the percentage of Magnesium, Protein contents, Calcium, Vitamin-C, Potassium and Phosphorus contents of tomato fruits were indicated significantly different values among the cultivated varieties. The statistical difference was also appeared in other nutritional contents. Highest (42.55%) protein percentage produced by local variety V₂ while lowest (24.65%) percentage appeared in variety DT97/162A(R). On the other hand, highest (41.50%) fat shown by variety DT97/162A(R). Fiber percentage appeared almost similar in all analyzed varieties. Vitamin C (0.37 mg/100g) was measured highest in local variety V₂ as compared to other varieties.

Table 1. Assessment of Physio-chemical properties of soil samples collected from the experimental sites (District Layyah, Pakistan)

S. No.	Parameters	Analyzed Values
1	pH in H ₂ O	7.6
2	pH in KCl	6.9
3	Total N (%)	0.6
4	P (mg/kg)	7.8
Cation exchangeable (mg/g)		
1	Ca ²⁺ (Calcium ions)	2.9
2	Mg ²⁺ (Magnesium ions)	2.6
3	K ⁺ (Potassium ions)	1.3
4	Na ⁺ (Sodium ions)	1.0
5	Al ³⁺ (Aluminum ions)	0.08
Acidity (meq/100g)		
1	C (Organic)	2.8
2	CEC	5.0
3	Nature of Acidity	0.08
4	Mn	5.4
5	Fe (ppm)	19.4
6	Cu	2.5
7	Zn	5.3
Physical characteristics		
1	Sand (%)	76.5
2	Silt (%)	18.7
3	Clay (%)	3.9
4	Textural class	Sandy loam

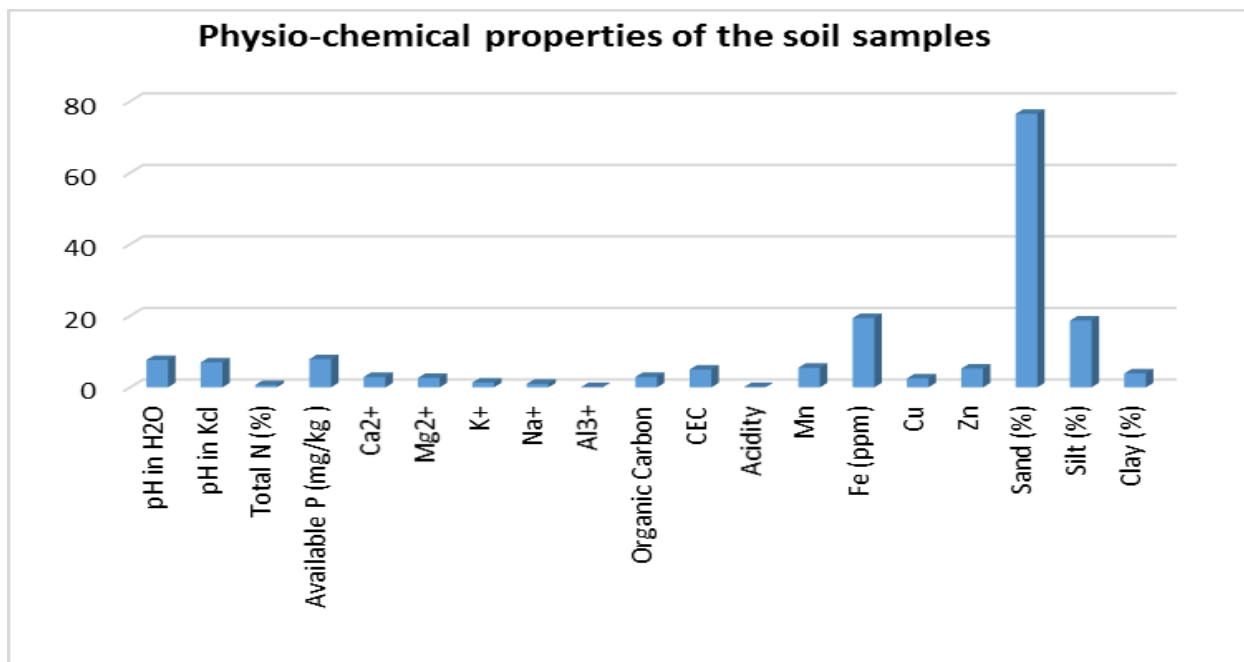


Figure 1. Assessment of Physio-chemical properties of soil samples

The highest values of Ca (0.395%), Mg (0.215%), K (0.182%) and P (0.572%) were calculated from tomato local variety V₂. These results were depicted that local variety V₂ produced high nutritional contents. It may be adopted the environmental conditions easily and adjusted in the soil textures of District Layyah (Table 2). The nutritional contents of four analyzed varieties of tomato fruits were also compared in more distinct way (Figure 2).

Tomato is rich in nutritional values. It is a source nutrient in many countries. It was observed that all the four selected tomato varieties are good source of mineral elements and showed good quality. The observed variation in nutritive point of view against selected varieties of tomato might be due to environmental effects of the study area or soil

textures in which they cultivated. The distribution of minerals is key factor which is needed for human health and required for human demand. Similar results were discussed previously by some authors in previous studies [19]. The proteins present in tomato fruit helpful in building up a new cells in the body and enhances growth of cells. Fats are also important part of balanced diet which is used as source of energy for man. Calcium supported the stiffness to body bones while Iron served as a source of blood production in human body [10, 18]. Sometimes environmental stress or water stress was also influenced on nutritional variation of tomato fruit [25]. Therefore, in this study preferred the analysis of nutritional contents of tomato varieties in climatic conditions of the study area.

Table 2. Analysis of nutritional values of four selected tomato lines

Tomato lines	Protein (%)	Fat (%)	Fiber (%)	Vit. C (Mg/100g)	Ca (%)	Mg (%)	K (%)	P (%)
DT97/162A(R)	24.87	41.50	5.9	0.32	0.243	0.108	0.084	0.429
DT97/215.A	34.56	4.42	7.1	0.29	0.273	0.155	0.068	0.457
Local V1	29.34	3.72	6.7	0.19	0.302	0.185	0.137	0.455
Local V2	42.55	3.86	7.4	0.37	0.395	0.215	0.182	0.572

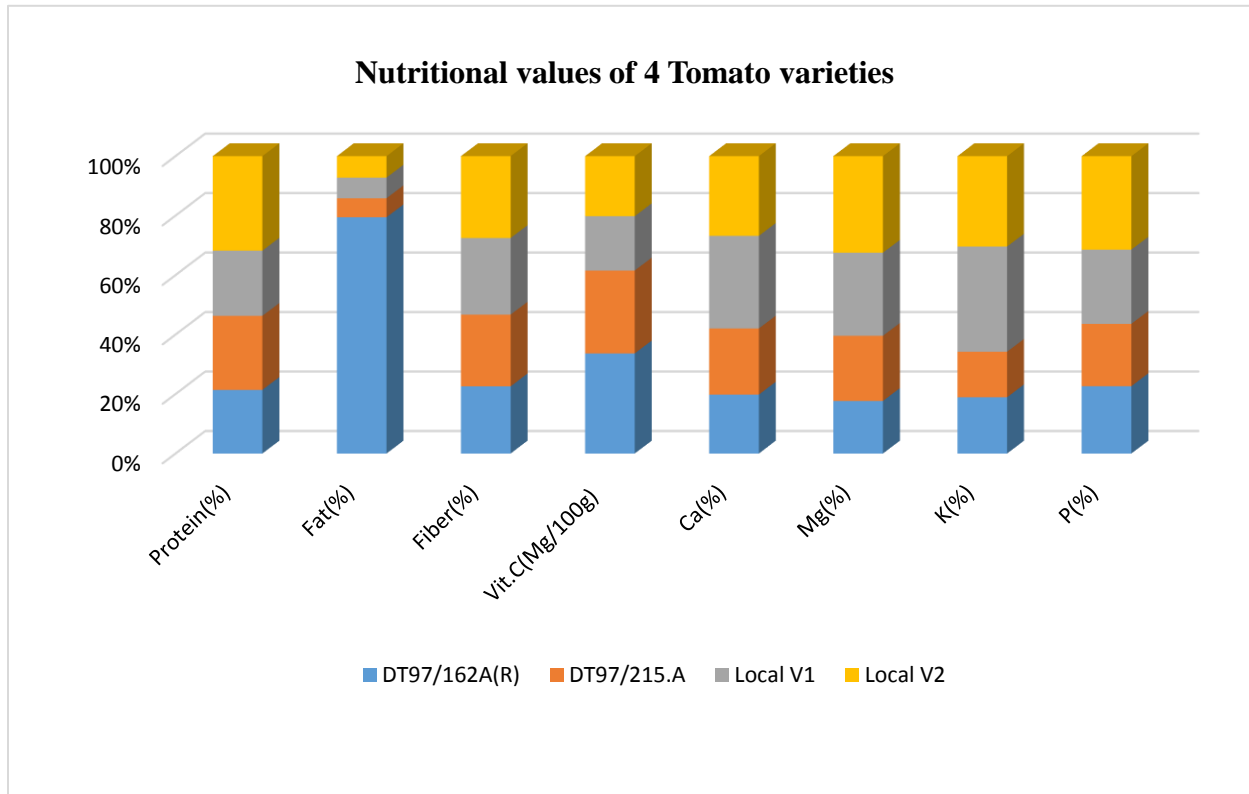


Figure 2. Analysis of nutritional values of four selected tomato varieties

Measurement of morphometric characteristics

The height of tomato plants, number of tomato leaves, number of flowers and fruits per plant of four tomato varieties were measured and it was observed that these characteristics were increased according to plant age as mentioned in (Table 3). These properties indicated significant differences between treatments against four varieties. However, variety V₂ had maximum plant height while DT97/215A variety indicated least height. The highest numbers of leaves were recorded from variety DT97/162A(R) while variety DT97/215A explored the less number of leaves. The number of leaves was increased as the tomato plants became mature. It was also observed that the statistical analysis showed significantly different readings among different treatments

(Table 3). Similarly, number of flowers and fruits were showed significantly similar distribution (Figure 3).

The growth patterns of tomato plants showed slow growth initially in the nursery plots and the growth accelerated more in the field after transplanting. These findings were strongly supported by many other scientist research papers [18, 20, 21]. All these findings revealed that environmental conditions distributes the better tomato production. Agro-diversity was also influenced on morphological characteristics of tomato fruit [27]. So, climatic conditions and soil contents were influenced on the growth and nutritional values of tomato varieties. Therefore, suitable environmental conditions should be provided for good production of tomato varieties in any country.

Table 3. Measurement of characteristics of tomato plants after different treatments with regular time intervals

Treatments	plant height	No. of leaves	No. of flower	Fruits per plant
Local V1	1cm	3	4	3
Local V2	1.5cm	3	5	3
DT97162A®	1cm	3	3	2
DT97/215A	1cm	3	5	2
Local V1	3cm	5	5	3
Local V2	4.5cm	6	6	4
DT97162A®	4cm	5	7	4
DT97/215A	5cm	5	7	4
Local V1	5cm	7	6	4
Local V2	7cm	8	6	4
DT97162A®	6cm	7	7	5
DT97/215A	7cm	8	7	5
Local V1	6.8cm	10	6	4
Local V2	9cm	11	6	5
DT97162A®	8cm	10	8	6
DT97/215A	8.7cm	11	8	6
Local V1	7.4cm	11	7	6
Local V2	9.6cm	13	7	7
DT97162A®	8.7cm	13	9	8
DT97/215A	9cm	13	8	7
Local V1	8.8cm	12	8	8
Local V2	10cm	15	8	8
DT97162A®	9.5cm	15	9	9
DT97/215A	9.8cm	16	9	9
Local V1	9.3cm	15	8	9
Local V2	10.8cm	16	9	9
DT97162A®	10.4cm	16	10	11
DT97/215A	11cm	17	10	10
Local V1	9.9cm	17	9	10
Local V2	11.3cm	19	9	9
DT97162A®	11cm	19	11	11
DT97/215A	12.3cm	20	10	12

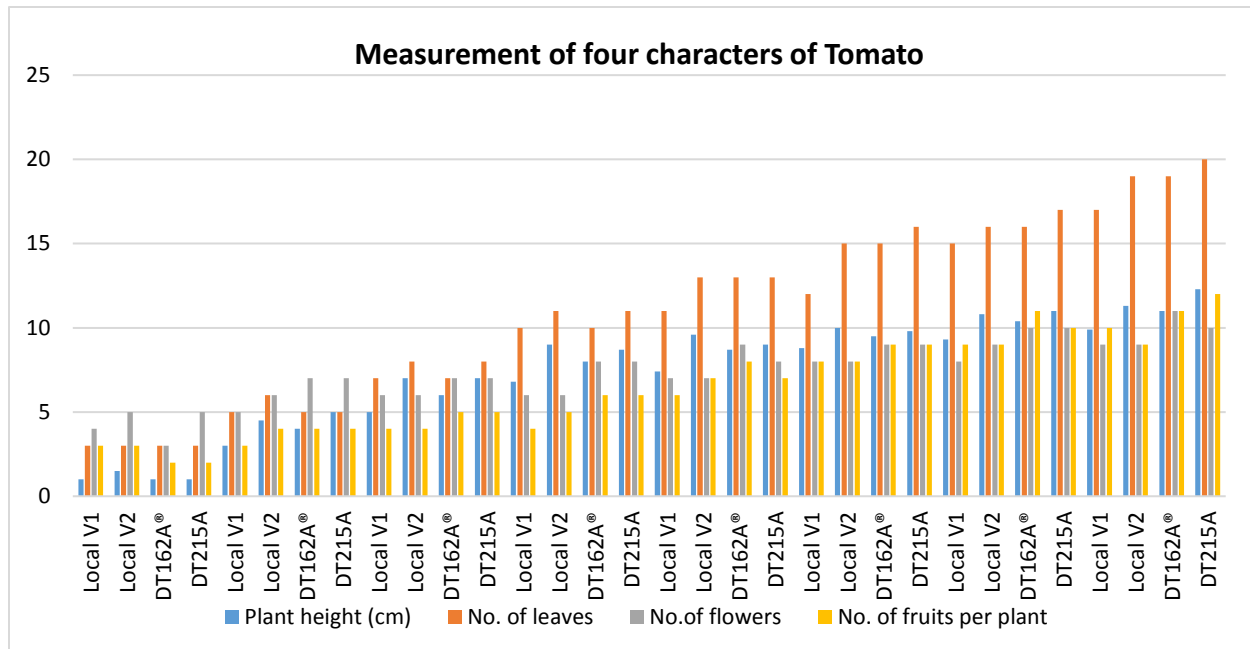


Figure 3. Measurement of morphological characteristics of tomato plants after different treatments with regular intervals

Conclusion

It was concluded that the fluctuated environmental diversity and other yield constraints prohibited by the selected tomato varieties during the period of growth and reproduction but still local variety V_2 produced highest yield, remarkable quality and better performance in the study area. This variety also indicated maximum nutritional contents. So, the variety V_2 tolerated the environmental conditions nicely in the study area and adjusted itself in the soil textures due to better genetic and resistant quality as comparison to remaining three investigated varieties. Therefore, local variety V_2 recommended as the best tomato variety for future in District Layyah, Pakistan.

Authors' contributions

Conceived, designed and analyzed the experimental data: T Hussain, The experimental work was performed in nursery: S Thind, The paper was written: S Thind & T Hussain, The other facilities like reagents, materials and analysis tools provided: I Hussain.

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