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Comparison in Quantity Characters (seed germination and seedling growth) of ten selected tomato (*solanum lycopersicum* L.) Genotypes under subtropical climate conditions (Ahvaz)

Seyed Morteza Zahedi, Naser Alemzadeh Ansari

Department of Horticulture, Shahid Chamran University of Ahvaz, Iran.

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ABSTRACT

In Iran, several traditional tomato (*Solanum lycopersicum* L.) cultivars exist, that are very popular in their own local zones. However, these cultivars have, as some main problems, the lack of resistance to high temperature and low water and lack of resistance to some particular viruses, which decrease tomato yield. There are several thousand cultivars of tomatoes and the number keeps climbing as growers continue to create new cultivars and hybrids. Choosing an appropriate variety for planting depends on several factors including genotype, climate, maintenance, soil, harvest time and purpose. The aim of the present work was to Comparison in seed germination and seedling growth of ten selected tomato genotypes under subtropical climate conditions. This experiments with ten tomato genotypes of different origins (Netherlands, Russia and some cultivar native mass in Iran, with numbers M48, 21, 16, 19, 28, 33, 34, 36, 18, 25) and control (Cheff) cultivar were conducted in the physiology laboratory and Department of Horticulture Orchard, Faculty of Agriculture, Shahid Chamran University of Ahvaz, Iran (2009, 2010). Tomato genotypes seed were placed evenly on filter paper in sterilized 9 cm Petri dishes. Petri were placed in the growth chamber in darkness at 25 °C temperature. Then, Seedlings were transplanted into planting plate containing a coco peat mix. Data showed that all growth parameters such as germination percentage, germination rate, plant height, time of leaf advent, seedling fresh weight and seedling dry weight, as well as leaf area, responded different as the subtropical climate conditions (Ahvaz).

Key word: germination, seedling growth, tomato genotypes, subtropical.

Introduction

In tropical and subtropical lowlands both air temperature (T) and relative humidity (rH) exceed the optima for tomato almost throughout the year. Mean daily T's in the range of 21– 27 C [1,13] and around 60% rH [10] have been reported to be optimal for tomatoes. High temperature is one of the important factors affecting seed germination in nature. When the seeds are exposed to high temperature conditions, both germination [4, 5,12] and seedling growth [15, 14] are generally inhibited. Increases in the medium temperature cause enhance in transpiration and evaporation and so, deficiency of water in plants [6]. Besides heavy rain, insect pests and diseases, a major constraint for the production of vegetables in the subtropics is heat stress, particularly in combination with high levels of rH [10]. Heat stress is known to adversely affect vegetative and generative growth of tomato plants, e.g. excessive T's induce stomata closing leading to reduced transpiration and photosynthesis, whereas respiratory processes are enhanced [8]. Consequently, biomass production and xylem transport rates decrease [2] possibly entailing reduced yield or fruit quality.

Tomato (*Solanum lycopersicum* L.), is one of the most popular vegetables in Iran. It is cultivated in an area of 139 thousand hectares with an average yield of 34.4 t/h average of yield is below than average of yield being achieved in some of developed countries of the world [16]. During the recent past; much attention has been focused on this crop by the farming community of Iran due to its multifarious benefits in income, export potential, human nutrition, health and employment avenues. Cultivar selection is one of the critical decisions that the commercial grower must make each season. Variety selection is a dynamic process. Some varieties may retain favor for many years while others might be supplanted by newer cultivars after a few seasons. Breeding over the past 50 years has substantially changed the

Corresponding Author
Seyed Morteza Zahedi, Department of Horticulture, Shahid Chamran University of Ahvaz, Iran.
E-mail: S.M_Zahedi@gmail.com, s.m_zahedi@yahoo.com

tomato plant and its fruit characteristics. Varieties available today for use by both the commercial and home gardener have a wide range of plant characteristics. They are resistant to many of the blight and wilt diseases that affect tomatoes [16]. They are specifically adapted to a particular set of growing conditions, such as high tropical temperatures, field and greenhouse conditions, and fresh market versus processing tomato-type fruit. A good variety will provide by horticultural traits desired by the market, maturity needed to match the cropping season, supply the market, and reduce the risk of weather-related crop failure, high marketable yield potential, dependable resistance to diseases, insects, stress, and physiological disorders [16].

On seed germination, a taproot emerges and the stem elongates with the cotyledons encased in the seed coat. The seed coat falls away and the cotyledons emerge horizontal to the stem (hypocotyl). In several days, the first true leaves emerge (Figure 1). The root system begins to branch, producing fibrous roots with adventitious roots emerging from the lower stem. A young vegetative seedling is shown in Figure 2. A detailed description of seed germination and the developing seedling from seed to full maturity is given by Picken et al. (1986) [11]. There are two systems for seedling production. The first is for the production of bear-root plants for transplanting into the field fo r both fresh market and processing tomato production. The method is highly specialized in terms of seedbed preparation and management, since direct seeding can result in poor seed germination and seedling development. Planting seeds directly into the soil is not recommended because of the relatively high cost of seed, the time required to prepare and manage the seedbed, and the low germination rate in soil, which makes the procedure impractical and costly. Therefore seedling production is done in a germination cube or cell in a controlled environment for transplanting into the greenhouse or home garden [3].

The production of a seedling, frequently referred to as a ‘‘transplant,” is an extremely important procedure because future plant growth and fruit production are affected by the character of the seedling produced.

When preparing to either produce or purchase transplants, four preplanting factors must be considered: (1) variety, (2) seed quality and seed handling procedures, (3) equipment and material, and (4) the market. Seed quality relates to genetic, physical, and physiological aspects. Genetic factors relate to hybrid vigor, genetic superiority, and being true to type. There are three uses for transplants: (1) for setting in the field for eith er processing or fresh market tomato production, (2) for greenhouse production, and (3) for planting in the home garden. Although all these uses are related in terms of the quality of the transplant desired, the production procedures for each use are different [3].

Presently large numbers of imported tomato varieties including hybrids are available in the market, and seeds of these varieties are sold at exorbitant prices. Field vegetable growers use these varieties without knowing the performance of these under climate conditions. Therefore, the objectives of this research were to evaluate the germination and seedling growth of ten selected tomato genotypes including hybrids under subtropical climate conditions and to select promising genotypes for Ahvaz cultivation at commercial level. The finding will help the grower to overcome the problems inherent to varieties and at the same time achieve increased yields with high quality, typical to this system of agriculture.

Materials And Methods

I. Experimental site:

The experiment was carried out for two consecutive growing seasons (2009 and 2010) at the Shahid Chamran University of Ahvaz. (Ahvaz state: The latitude and longitude of Ahvaz is: 31° 19' 45" N / 48° 41' 28" E, also the city has an average elevation of 20 meters above sea level, in subtropical climate in the southwest of Iran, where the summers are dry and hot while the winters are cool).

II. Bioassays:

The experiments with ten tomato genotypes of different origins (Netherlands, Russia and some cultivar native mass in Iran, with numbers M48, 21, 16, 19, 28, 33, 34, 36, 18, 25) and control (Cheff) cultivar were conducted in the physiology laboratory and Department of Horticulture Orchard, Faculty of Agriculture, Shahid Chamran University of Ahvaz, Iran. The experiment was a completely randomized design with three replications. To prevent the growth and activity of microbes, experimental dishes and 100 seeds surface were sterilized with water: bleach solution (10:1) and were placed evenly on filter paper in sterilized 9 cm Petri dishes. Petri were placed in the growth chamber in darkness at 25 °C temperature. Then, Seedlings were transplanted 11 to 15 days from sowing into planting plate containing a coco peat mix. This planting plate put on under plastic tunnel. Then, germination percentage and germination rate was determined by counting the number of germinated seeds and expressed as percentage, after 10 days.

Also, data recorded included plant height (cm) which were measured (45 days after planting) from cotyledons level to plant top, time of leaf advent (first, second, third, fourth leaf), root and shoot elongation (cm), leaf area (mm^2) for the fourth leaf from the top and was determined using leaf area meter machine model Delta-T Divises LTD, UK, seedling fresh weight (g), seedling dry weight (g): Sample of plant per replicate was dried in oven (70°C).

III. Data analysis:

The Data were subjected to ANOVA using statistical software, SPSS 16.0 for Windows (SPSS Inc., 233 S Wacker Drive, Chicago, IL, USA). Means were separated by Duncan's Multiple Range Test (DMRT) at $P \leq 0.05$.

Results and Discussion

The performance of different tomato genotypes under laboratory and plastic tunnel in Ahvaz was investigated. The means under plastic tunnel conditions are combined measurements of two seasons. The results showed that different genotype of tomato had a significant effect on germination percentage and rate, time of leaf advent (first, second, third, fourth leaf), root and shoot elongation and leaf area ($p<0.05$) (Table 1 and 2)

Table 1: Comparison of averages germination percentage and germination rate in different genotypes of tomato

	25	18	28	19	33	M48	36	21	34	16	Cheff
Germination percentage (%)	93 ab	95ab	98 a	90b	94ab	94 ab	97 a	91 b	90 b	98 a	95ab
Germination rate	0.81a	0.6c	0.75 b	0.65 c	0.70b	0.68 c	0.75b	0.68 c	0.65 c	0.80 a	0.78 b

Comparison of averages has been done by use of Duncan multiple range test (P=%5) has been done. Letters which are relevant to the comparison of averages are comparable within their treatments.

Table 2: Analysis of variance in some trait of different genotypes of tomato

		Time of leaf advent									
Source of variation	df	First leaf	Second leaf	Third leaf	Fourth leaf	Plant Height	root elongation	shoot elongation	seedling fresh weight	seedling dry weight	Leaf area
cultivar	10	22.84 **	13.65 **	9.32 **	14.31 **	12.31 ns	4.24 *	7.15 *	0.03 ns	0 ns	554161.1 *
Error	20	0.84	0.57	0.26	0.41	6.6	1.56	3.5	0.03	0	223593.7
Total	33										

ns non-significant, *significant in 5% level, ** significant in 1% level

3.1. Germination percentage and Germination rate:

The results of seed germination are shown in Table 1. The results showed that maximum germination percentage and Germination rate seeds of tomato, obtained in No.16 genotype with 98%, but all genotype and cultivar had a higher than 90% seeds germination. The tomato seed is 3 to 5 mm in size, silky in appearance, flat, and light cream to brown in color. It contains a large coiled embryo surrounded by a small amount of endosperm. The weight of an individual seed varies considerably, with 300 to 350 seeds weighing l gram (Benton Jones, 2008). Also, the highest germination rate of all genotype seeds was obtained from No.16, 21 genotypes and the lowest rate were obtained from genotypes lead to lack of germination (Table 1).

3.2. Time of leaf advent (First, Second, Third and Fourth leaf):

Number of days taken to leaf advent in all leaf measurement (First, Second, Third and Fourth leaf) is significantly different. Genotypes No.21, M48, 18, 19 in First, Second, Third and Fourth leaf took the shortest period for advent from transplanting, respectively, and genotype No.28 had taken the longest period to leaf advent (Table 2 and Figure 3, 4, 5, 6). The initial leaves are called cotyledons, followed by the development of two initial true leaves 4 to 6 days later [3].

3.3. Plant Height in tomato seedling:

Plant height not differed significantly among the genotypes and cheff cultivar at seedling stage The lowest plant height was recorded in the cheff cultivar (control) and the highest plant height was observed with genotype, No. 34 (Table 2 and Figure 7).The best air temperature for seedling growth at this stage is between 16°and 18.5°C [3].

3.4. Root and shoot elongation in tomato seedling

The highest root elongation in tomato seedling was observed in the genotype, No.21. The lowest root elongation in tomato seedling was recorded in the genotype, No.33 (Table 2 and Figure 8). Whereas the highest shoot elongation in tomato seedling was observed in the genotype, No.34 and the lowest shoot elongation in tomato seedling were recorded in the cultivar, Cheff and it was not significantly different from the other genotypes (Table 2 and Figure 9). Hormonal balance of the destruction can be one of the most important reasons for reducing root growth and shoot seedlings [17].

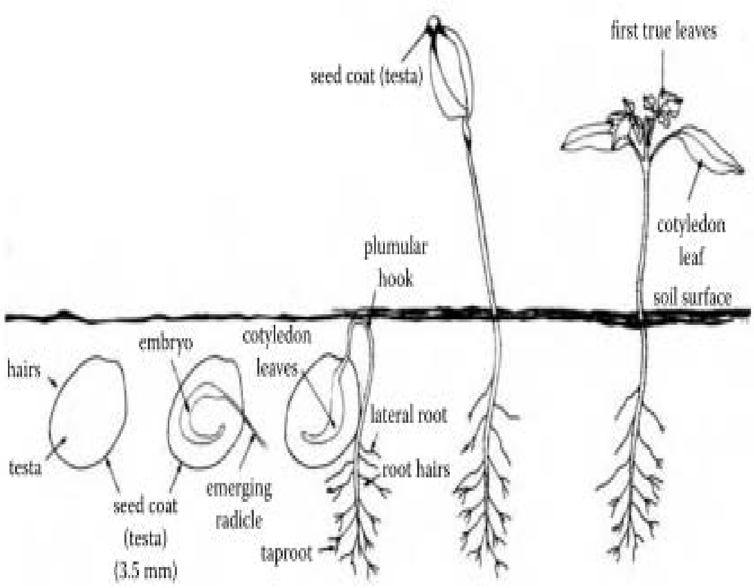

Fig. 1: Tomato seed components and the process of germination to produce a tomato plant seedling [9].

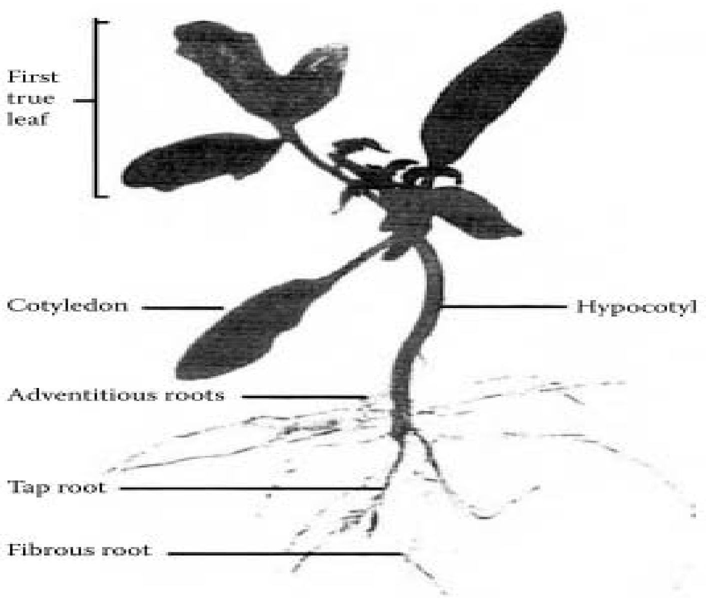

Fig. 2: Young tomato plant seedling components [11].

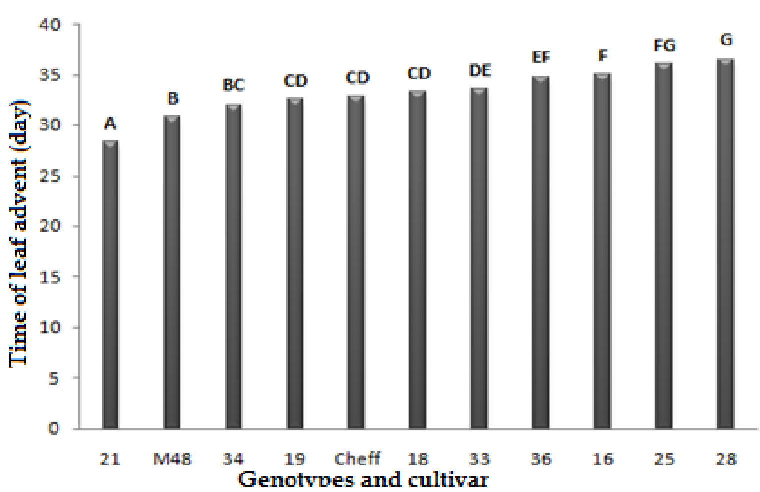

Fig. 3: Time of leaf advent (First leaf) in seedling stage of tomato genotypes under subtropical climate conditions (Ahvaz)

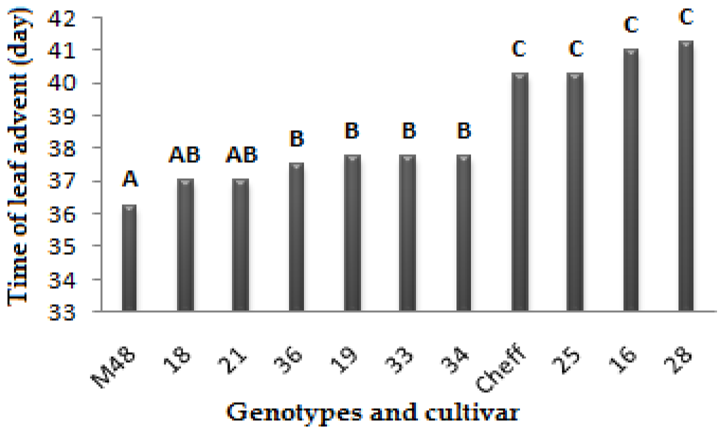

Fig. 4: Time of leaf advent (Second leaf) in seedling stage of tomato genotypes under subtropical climate conditions (Ahvaz)

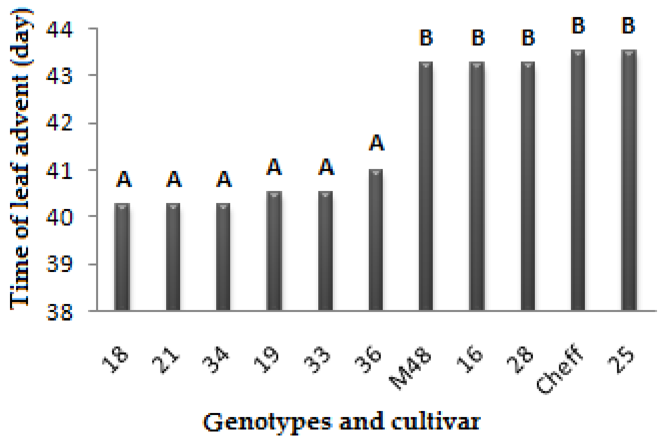

Fig. 5: Time of leaf advent (Third leaf) in seedling stage of tomato genotypes under subtropical climate conditions (Ahvaz)

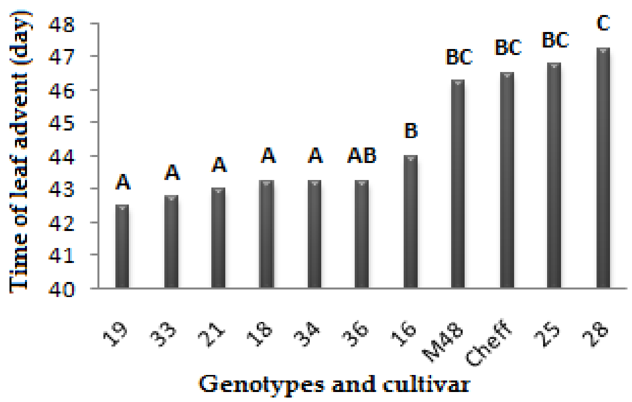

Fig. 6: Time of leaf advent (Fourth leaf) in seedling stage of tomato genotypes under subtropical climate conditions (Ahvaz)

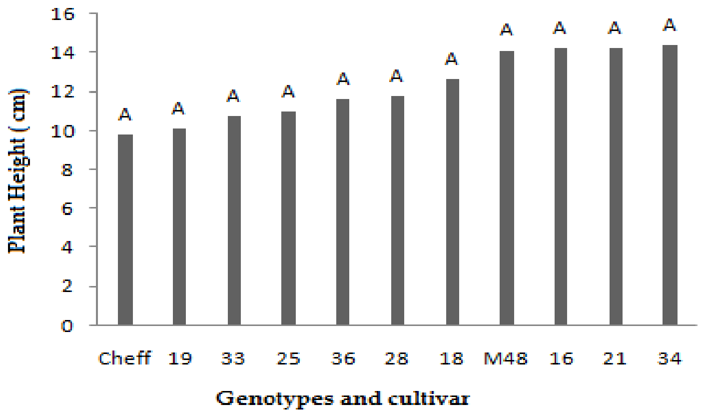

Fig. 7: plant height in seedling stage of tomato genotypes under subtropical climate conditions (Ahvaz)

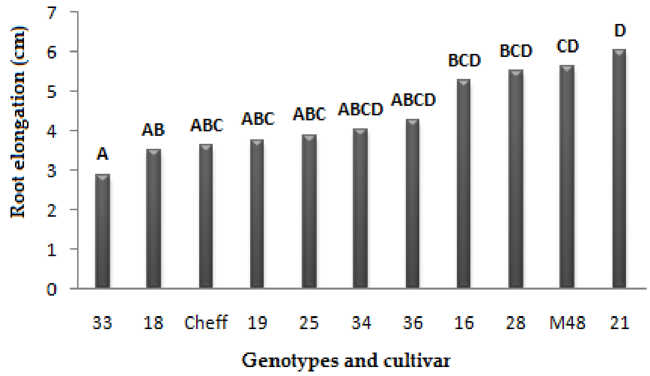

Fig. 8: Root elongation in seedling stage of tomato genotypes under subtropical climate conditions (Ahvaz)

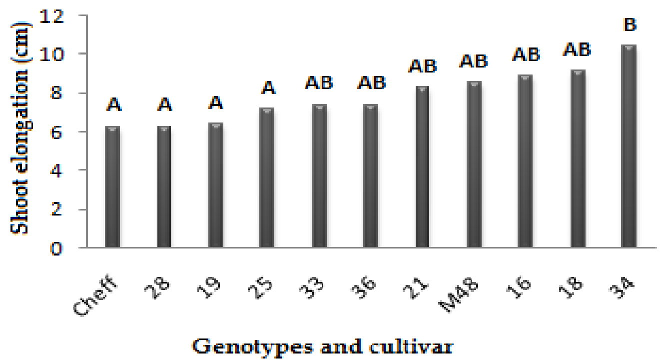

Fig. 9: Shoot elongation in seedling stage of tomato genotypes under subtropical climate conditions (Ahvaz)

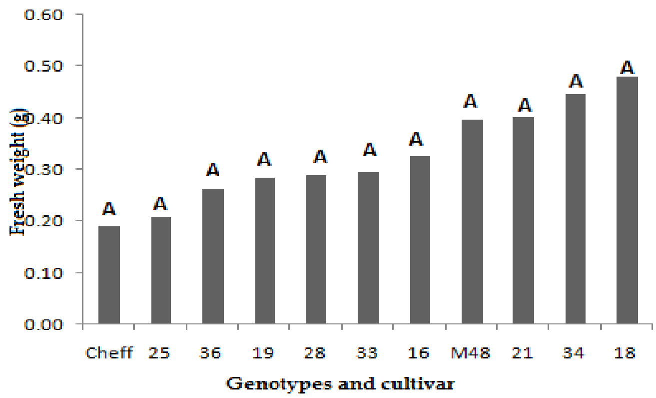

Fig. 10: Fresh weight in seedling stage of tomato genotypes under subtropical climate conditions (Ahvaz)

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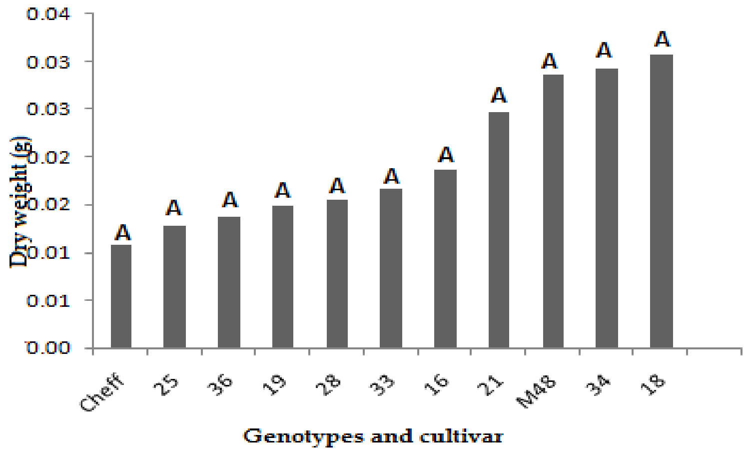

Fig. 11: Dry weight in seedling stage of tomato genotypes under subtropical climate conditions (Ahvaz)

3.5. Seedling fresh and dry weight:

The results showed that lowest fresh and dry weight of seedling obtained in the Cheff cultivar (control) (Table 2 and Figure 10) and the highest fresh and dry weight in tomato seedling were recorded in the genotype, No. 18 (Table 2 and Figure 11).

3.6. Leaf area in tomato seedling:

The highest leaf area was observed in the genotype, No.19. The lowest leaf area was recorded in the genotype, No.33 (Table 2 and Figure 12). As reported by kinet and peet (1986) [7] if only a few leaf area from before floral initiation, assimilate supply may be insufficient to support flower and fruit development.

In conclusions, Tomato cultivars have the main role for yield production in various conditions, and they have a special place in global trade. Various tomato genotypes are in the world that they applied for different aims. New tomato cultivars are required for increasing yield in unit area in spring cultivation of subtropical climate conditions (Ahvaz). There are several thousand varieties and genotypes of tomatoes and the number keeps climbing as growers continue to create new varieties and hybrids. Selecting the right tomato variety may mean the difference between success and failure in the garden. This is especially true in the season areas of southeastward Iran where harvest of the first tomato is often a harbinger of the first frost. But, there are also many other reasons to select a particular variety, such as intended use, size, flavor, and appearance. Based on results obtained from this study (2010) and previous study (2009), the genotype ‘No.16’ proved to be high germination percentage, rate and other characters under high subtropical conditions (Ahvaz) in comparison to other genotypes and control cultivar (Cheff). Nevertheless, of all the reasons to select a tomato variety, adaptation to your local climate is one of the most important.

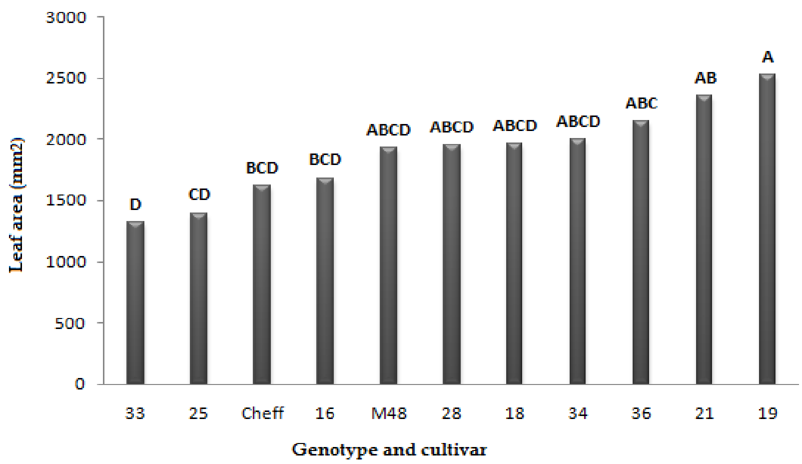

Fig. 12: Leaf area in seedling stage of tomato genotypes under subtropical climate conditions (Ahvaz)

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