

Research Article

Effect of various planting times on growth, yield and quality of hydroponically grown tomatoes (*Lycopersicon esculentum* Mill)

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Citation

Qaisar Ali Khan, Shahid Javed Butt, Zia-Ul-Haq, Ismara Naseem, Arshad Iqbal and Muhammad Sajid. Effect of various planting times on growth, yield and quality of hydroponically grown tomatoes (*Lycopersicon esculentum* Mill). Pure and Applied Biology. Vol. 12, Issue 2, pp206-211. <http://dx.doi.org/10.19045/bspab.2023.120022>

Received: 21/03/2022

Revised: 07/06/2022

Accepted: 19/06/2022

Online First: 04/08/2022

Abstract

Hydroponics is an innovating agriculture production system to grow offseason vegetables in urban and water stressed environment. In this system plants are grown in inert media rather than soil for achieving higher yield. In hydroponic planting times is very important for achieving higher profit. Planting time play a significant role in the production and the eminence of tomatoes. To examine the effect of planting time on growing yield and quality of hydroponically tomatoes. A study was conducted at Institute of Hydroponic Agriculture, Pir Mehr Ali Shah Arid University Rawalpindi during 2018-19. During the study four different planting times were selected 2nd week, 3rd week and last week of April and 1st week of May respectively. The data collected were statistically analyzed by experimental design complete randomize design (CRD). Experimental result shown highly significant variation among various treatments. It was concluded from the experimental results that early planting (2nd week of April) showed the better performance on the quality as well production of hydroponically grown tomatoes as compare to late sowing.

Keywords: Hydroponics; Planting times; Tomatoes

Introduction

Soilless agriculture is a modern practise of growing different plants in the substrate culture that their roots dipped in fully nutrient water it might be inert media coco peat, coco coir, coco husk chips peat moss or rock wool [1]. The key greenhouse crops (with soil and soilless production) are tomato, strawberry, herbs, sweet pepper, eggplant, lettuce, cucumber and eggplant. Hydroponic vegetables are mainly used as

fresh Salad vegetables and as an important source of vitamins. Consumers uses vegetable every day as food because they are cheaper source of energy [2]. Crop Production depend on sowing times. Proper sowing time guarantees suitable plant progress and growth ensuing in maximum crop yield and economic land utilization [2]. Soilless agriculture is a technique standard for great efficiency and harmless output. The technique is adopted in our

country and normal yield of tomato was 162 ton/ha. While in soil system national average production 10 ton per ha. Tomato production under the exposed cultivated field situations is partial due to prevailing of little temperature and frost damage wound during winter. To insure their planting time effectively in winter and spring summer season, innovative technologies and hydroponic or glass-house is a vigorous key [3]. The late Sowing denies yield of tomato. Late planting time progressively diminished the physical parameter of fruit set, plant height, fruit weight, yield of tomato and fruit number [4]. In early sowing produce quality and marketing value is high [3]. Tomatoes yielded 245.3 t/ha when as under hydroponic system in trough by coco peat, shingle and stone as media in their study on efficiency, quality and economics of tomato farming in collective hydroponics [5]. Where as in Pakistan cultivated area of tomatoes is 601,098 ha with 363,979,813 tons of production. Tomato is an important horticultural fruit worldwide, with an estimated total production and used region of 164 mt and 4.76 million ha, correspondingly. China is a biggest producer, with 31 percent of entire worldwide production and 21% for over-all cultivated area, the highest mean yield recorded in Spain.

Materials and Methods

Study area

The study was conducted at Institute of Hydroponic Agriculture Pir Mehr Ali Shah Arid Agriculture University Rawalpindi, Punjab Pakistan, during 2018-19. Experiment lies in *Pothwar* region with semi-arid region with an average annual rain fall 1044mm.

Establishment of nursery

Seed of tomato cultivar Beef stick were procured from Karachi. The nursery was grown at Institute of Hydroponic Agriculture; seeds were sown in the seed germination tray in the month of March 2019 using sprinkler irrigation system. The seeds germinated after 7-10 days, when the

seedlings of tomato become established and spread up to 4-6 true leaves then seedlings were transplanted to hydroponic greenhouse and planted with different planting dates, however the media which were used in hydroponic that was coco peat and different type of chemicals were applied at the diverse stages of plant performance. In hydroponic unit 192 tomato plants were transplanted and the treatments were T₁, T₂, T₃ and T₄ respectively, tomato seedlings were transplanted in various dates which were 1st week T₁, 2nd week T₂, last week of April T₃ and 1st week of May T₄ and the total life span of tomato from the transplanting to harvest in hydroponic unit was six months. Planting times of tomato were late spring and early summer.

Analysis and observation

Data was recorded for follow observation was made to appraise the consequence of numerous sowing time on quality, yield and growth of soilless tomatoes. It was measure after the roots surface to the apical growth point when seedling reached at their full height with the help of measuring tape. The seedlings of tomato were planted in 1st week T₁, 2nd week T₂, last week of April T₃ and 1st week of May T₄.

Seedling height (cm)

Seedling leaves were counted at the time of transplantation when seedlings established after 45 days of its germination [6].

Seedling branches

Tomato seedlings branches of were counted at the time of different planting dates [7].

Plant height (cm)

Height of plant were observed from the media surface to the upper most growth points of above ground when the plants reached their full height after two months of transplanting with the help of measuring tap [8].

Number of leaves per plant

Ten plants per repetition were separated and their leaves were calculated and average values were noted.

Days to flowering

The number of days were calculated from

seed transplanting dates up to first flower appeared in the branches.

Leaf area

Indiscriminately twenty leaves every plant were exposed to leaf area meter and their average value were noted [8].

Leaf fresh weight

Weighing balance was used for fresh weight of indiscriminately twenty leaves per repetition. Weighing measurement are in gram (gm) [6].

Leaf dry weight

Ten leaves per repetition were placed in oven for drying. Dry weight was measured by weighing balance [6].

Number of fruits per plant

Number of fruits were collected and then counting quantity of fruits which are randomly selected in the replication [7].

Fruit size

Fruit size were measured with the help of Venire caliper by taking average length and width of ten randomly selected fruits from each replication.

Fruit weight per plant

From each plant, ten fruits were selected physically and weighed. Average yield per plant were counted for every replication [7].

Total soluble solid (TSS)

Grind tomato, 1 g of sample in 100 ml distil water using mixer. The mixture was collected in a beaker. Place one drop of mixture on a glass surface of hand refractometer with a percent scale. Recorded the observed value in percentage [9].

Average fruit length

In every replication ten fruits were taken indiscriminately from every repetition were measured with measured scale in (cm) [7].

Average fruit diameter

Fruit were measured from ten marketable fruits of sample from each replication at red ripe and dried stage using venire calliper and mean values were being recorded [7].

Statistical analysis

The experiment strategy was complete randomize design with three repetitions and from treatments variables from different parameters were statistically analysed by

used analysis of variances (anova) and the means were compared by using the least significant difference (LSD) test at the 5% level of significance [10].

Results and Discussion

Packaging materials of fruit and vegetable are usually used postharvest training, keeping different carriage as well as storing food, contamination and market demand of the produce. The influence of the various wrapping tools on the postharvest tomatoes discussed next.

Seedling height, seedling branches and seedling leaves

The sowing time of tomato were in March 2019 and mean performance of different planting time of seedling height, seedling branches and seedling leaves were recorded on different planting dates. The highest growth rate 16.33 was recorded in the 1st week of (April 5-April-2019) and the lowest seedling height 13.53 was recorded in the 1st week of (May. 5-May-2019). While the highest seedling branches were also recorded on (5th-April-2019) plantation that was 5.00 and 2.66 was the minimum recorded seedling branches on the plantation of 5th-May-2019. Further on the highest number of seedlings leaves were also recorded on 5th-April-19 plantation while the lowest number of leaves were recorded on 5th-May-19 plantation as shown in the (Table 1).

The variation in seedling height, seedling branches and seedling leaves might be due to the negative effect of 1st week of May due to its late planting time which effected their reproductive stages and increase in seedling height, seedling branches and seedling leaves positive effect might be due to the proper planting time which was planted on the 1st week of April. Tomato planting leaves higher 8-9 leaves showing best result and started the flowering first compared to the other leaves planting time (1.1). It was perceived that prior planting date achieved well in relation of progress because the crop becomes sufficient time period to full fill their needs.

Tallest tomato transplants had 8–9 leaves and they were twice times higher than 5 leaves of plants, and 1.4 times higher than those which have 6-7 leaves. Their leaf area were 2.4 times higher than that of 5 leaves transplants, and 1.2 times higher than that of 6–7 leaves vegetables the highest vegetative growth was found in the 8-9 leaves old seedling at the time of transplanting.

Total soluble solid (TSS), height of plant cm, number of leaves, days to flowering and leaf area

Mean data concerning height of plant, Number of leaves, Days to flowering and leaf area are presented in (Table 1). The analysis of data showed a significant variation among this planting times.

Mean of data showed maximum height (260), leaves (258.33), Days to flowering and leaf area (2.7600) was showed maximum in the 5 April 2019 planting time. During experimental duration plant height and the leaves strawberry strawberry contents were determined in leaves and fruits (two times during vegetation).

It was observed that during the second measurement (after 20 days of transplanting) the leaf area of 2nd planting time and 3rd planting time was similar. After 30 days of transplantation the highest leaf area was measured in 1st planting time 5-April 2019.

Plant height in tomato production is an indirect factor. In late planting time plant height was mainly influenced by stacking. It is evident from (Table 2) which revealed significant variations in plant height. Late planting time affected the plant height as well as plant vegetative and reproductive stages.

Diminishing the number of leaves in plant height, changing in number of days, may be due to the improper planting time. The height of the tomato plant is an important selection criterion for detecting the best adequate planting time in order to increase overall production.

Tomato production, output, and attributes were significantly influenced by sowing

timing in the late season. Late sowing progressively reduced the height of plant, Days to flowering, number, weight and total tomato product. Transplanting on early spring output in better plant height and fruit as compare to late planting affected adversely yield components.

Tomatoes flourish best in temperatures ranging from 18 to 25 degrees Celsius, as low values affect production more than blossom formation.

Number of fruits, fresh weight and dry weight

Mean data concerning number of fruits, fresh weight and dry weight are presented in (Table 3). The analysis of data showed a significant variation among this planting times.

Mean data showed that that the higher leaf fresh and dry weight was recorded in the 1st planting time which were planted in the 5th April and the lowest were recorded in the late planting time and the middle data was also recorded in the middle time of the planting of tomato.

The dry weight of leafs were somewhat unstable depending on the transplants growth stage, however giving to the average data (average of the four sizes) the 1st planting data (T₁) accumulated highest of dry matter in their leaves waterless matter were the maximum. Throughout the full yielding in the fruits of all tomatoes the content of dry matter was comparable and it changed from 4.8 to 5.0%.

Permitting to data the tomatoes transplant growth stage took no result on the average fruit weight. The size of tomatoes has different growth stages so the tomato transplants is slightly identical. Scientist also attained the highest yield of tomatoes (86.40 t ha⁻¹) as he planting early and lowest were obtained as planting late [11].

The planting dates presented clear inspiration on all the production and aspects of tomato fruit. In current experiment planting date 5th April (T₁) exhibited significant higher values (75.333) and the lowest data recorded (51.000) in 5th May (T₄)

Fruit Weight, Total Soluble Content, Average Fruit Length and Average Fruit Diameter

Mean data concerning fruit weight, total soluble content, Average fruit diameter and Average fruit length presented in (Table 4). The analysis of data showed a significant variation among this planting times. Mean of data showed maximum fruit weight per plant (255.87), Total soluble

solid (4.8667), Average fruit length (8.0667) and average fruit diameter were showed maximum in the 5 April 2019 planting time while the minimum fruit weight per plant (223.80), Total soluble solid (3.6000), average fruit length (6.7333) and average fruit diameter (6.7333) all are recorded in the 1st week of May 2019.

Table 1. Effect on various planting time on the Performance of Height, Leaves, Days to Flowering and Leaf Area

Treatments	Plant height (cm)	Number of leaves	Days to flowering	Leaf area (cm ²)
T ₁	260a	258.33a	51.667a	2.7600a
T ₂	252b	252.67b	47.000b	2.5600b
T ₃	246c	245.67c	43.000c	2.3670c
T ₄	242.33d	241d	40.000d	2.2333d
LSD(0.05)				

Table 2. Effect of various planting time on Seedling Height (cm), Seedling Branches and Seedling Leaves

Treatments	Seedling Height(cm)	Seedling Branches	Seedling Leaves
T ₁	16.33a	5.00a	8.66a
T ₂	15.60b	4.00ab	6.66b
T ₃	14.40c	3.66ab	5.66bc
T ₄	13.53d	2.66b	5.00c
LSD(0.05)	2.3		

Table 3. Effect on various planting time on the Performance of Number of Fruit, Fresh Weight and Dry Weight

Treatments	Leaf fresh weight (cm)	Leaf dry weight (gm)	Number of fruits
T ₁	3.1100a	0.4867a	75.333a
T ₂	2.9533b	0.4367b	60.667b
T ₃	2.8600c	0.3900c	51.667c
T ₄	2.7467d	0.3467d	51.000d

Table 4. Effect of various planting times on the Performance of Fruit Weight, Total Soluble Content, Average Fruit Length and Average Fruit Diameter

Treatments	Fruit weight per plant	Total soluble solid	Average fruit length	Average Fruit diameter
T ₁	255.87a	4.8667a	8.0667a	2.9333a
T ₂	244.93b	4.3333b	7.5333b	2.5667b
T ₃	235.67c	3.9333c	7.2000c	2.3667b
T ₄	223.80d	3.6000d	6.7333d	2.0667c
LSD(0.05)				

Conclusion

It was concluded from the experimental results that early planting (2nd week of

April) showed the better performance with respect to seedling height, seedling branches, days to flowering, plant height,

fresh weight, dry weight, number of leaves per plant, number of branches, fruit colour, fruit size, number of fruit per plant, fruit weight per plant, leaf area, total soluble solid, average fruit diameter and weight on the quality as well production of hydroponically grown tomatoes as compare to late sowing.

Authors' contributions

Conducted experiment and wrote first draft of manuscript: QA Khan, Supervised the experiment and helped in technical writing: SJ Butt, Technical guidance throughout the research: ZU Haq. Corrected this manuscript: I Naseem & A Iqbal, Helped in data collection: M Sajid.

Acknowledgments

I am highly thankful to Director, Institute of Hydroponic Agriculture for providing me facilities and infrastructure required during this research.

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