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EVALUATION OF STRAWBERRY (*FRAGARIA × ANANASSA* DUCH.) CULTIVARS FOR MORPHOLOGICAL AND PHYSICO-CHEMICAL PARAMETERS IN SUBTROPICAL CLIMATE

M. M. Aziz, Amina, S. Rashid, M. M. Abbas and S. Riaz

Horticultural Research Institute, AARI, Jhang Road, Faisalabad, Pakistan

ABSTRACT

A field experiment was conducted at Horticultural Research Institute Faisalabad, Pakistan for selection of suitable cultivar of strawberry in subtropical climate. Two cultivars of strawberry (Chandler and Henyo) were grown under randomized complete block design (RCBD) with three replications. Runners were planted in the month of October-November. Some morphological and physicohemical traits were evaluated. It was observed that the cultivar Chandler displayed good success (45.50%), with more leaves (7.67) and roots (41.33). Chander cultivar produced heavy and lengthy fruit with more Juice, hence it gave more fruit yield (16.26 g), length (3.56 cm), juice contents (64.78 %) and gave more yield (371.43 g). On the other hand, the maximum total soluble solids (TSS) 7.90% was observed in Henyo with highest acidity (0.91%) and high pH (4.56). Therefore, it is recommended that Chandler cv. is most suitable for cultivation in subtropical climate of Pakistan.

Keywords: chandler, fruit yield, henyo, strawberry, subtropical climate

INTRODUCTION

Strawberry (*Fragaria* × *ananassa* Duch) fruit is appreciated for its tremendous and delightful flavor, eye-catching color, great nutrient profile and cosmic pharmaceutical worth (Rahman *et al,.* 2015). It is prospective source of protein, carbohydrates, fats and vitamins. It is used as fresh and is also processed to make squashes, jams and jellies that can be utilized all year round (Mitra, 1991). Strawberry is now sucessfully grown in Pakistan. The total area under strawberry cultivation in Pakistan is 179 ha with a production of 609 tons (Anonymous, 2014-15). Currently the Douglas and Toro are leading varieties in Pakistan which are grown in southern areas, while Chandler Cruz Pocahontas and Tufts are most suitable for Islamabad climate. Chandler has been found more resistant to high temperature (Sorkel *et al.,* 2006).

In Pakistan per acre yield of strawberry fruit is still lesser as compared to other growing areas in the world. This is due to adaptation of improper cultivation practices, lack of research work and less commercial and market value of strawberry cultivation. Subtropical environments are conducive for winter strawberry (Kirschbaum *et al.,* 2013). In Pakistan, there is particular one variety of strawberry which possesses characteristics to grow in subtropical climate. It is necessary to assess the variety that can be successfully grown in subtropical climate of Pakistan. There is negligible research conducted on fruit quality, yield and yield associated characters in subtropical climate. Hence, the present research was conducted to assess the performance of two strawberry cultivars under sub-tropical climate. Generally growth, yield and quality characters, were assessed.

MATERIALS AND METHODS

The present study was carried out at the Institute of Horticultural Research, Ayub Agricultural Research Institute (31.42° N, 73.09°E longitude, altitude 189 m Faisalabad Pakistan) during winter season of 2014-2016. This area falls in a sub-tropical zone, with warm summer and moderate winter. Approximately 18.88 mm rainfall throughout cropping duration along with relative humidity of 29.07%. Average maximum and minimum temperature throughout the cropping season were 36.46°C and 28.46°C, respectively. The soil was loamy in texture, alkaline (8.1) in reaction and low in organic matter (0.86%). Fertility status of soil was satisfactory containing available phosphorus 8.1 ppm with available potassium 200 ppm.

Corresponding author: aminaalvi51@yahoo.com

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Vigorous and disease free runners of two varieties of strawberry (Chandler and Henyo) were collected from indigenous source and considered as treatment. These runners were planted during the month of October-November. The experiment was arranged using randomized complete block design (RCBD) with three repetitions. Plot dimension was 1 x 2.8 m and the plant to plant distance was 2.2 × 3 m. Beds were 4.5 m long. Data was recorded from inside plants of each line to reduce the boundary influence. Ten plants were selected from each plot for recording data. To induce flowering, runners were removed with three or four days interval. Black plastic mulch was used around the plants to conserve soil moisture, maintain humidity and diminish weeds. Weeds were removed after 15 days interval until final harvesting. To achieve with healthier plants, irrigation was applied after way of the day or as per requirement of crop or when required to maintain the soil moisture in the field. Agronomic as well as plant protection operations were performed homogeneously in each treatments. During the month of March fruit was manually harvested by picking early in the morning at an interval of three to four days.

The fruit harvested was sorted on the basis of size and color for data recording. The vegetative characteristics like plant success (%), number of leaves per plant, fruit weight (g), length of fruit (cm) and fruit yield per plant were recorded. The weight of the representative fruit produced by each cultivar was recorded. Fruit length was measured in cm with Verniers caliper and mean was calculated. The yield was calculated by multiplying the mean weight with average number of fruits harvested per plant. Total soluble solids (TSS), titratable acidity (TA), pH, juice content (%) of fruit were determined. The TSS was determined in the juice by means of an Atago RX-1000 digital refractometer. The pH and titratable acidity of the samples were assessed using a pH meter. Strawberry juice was extracted then weighed and its quantity was expressed in percentage.

Data of different quantitative and qualitative traits of two years of experimentation were combined and analyzed using Statistix 8.1 software package. Significant difference among the mean values was compared with Least Significant Difference test *(P< 0.05)*.

RESULTS AND DISCUSSION

The analysis of the data revealed that there was significant difference between the strawberry cultivars for success percentage of the plants. On the base of average performance, the highest number of success percentage (Table 1) was recorded in cv. Chandler (71.17%). The minimum success (%) was in Henyo (54.42%). Variation in success % between both cultivars might be due to climatic conditions and genetically resistance behavior against high temperature. Results of this study are in line with the findings of Rajwana *et al.* (2017), who noted 80% success of strawberry runners when transplanted in subtropical climate. There was no significant difference between Chandler and Henyo for number of leaves per plant (Table 1). The trend of performance of cultivars in subtropical conditions was more or less similar. These results are in line with the findings of Asadpoor *et al.* (2015), who observed that different strawberry cv. showed non-significant difference in number of leaves within the range of 7.75 to 5.5. In sub-tropical climate Chandler cv. showed (Table 1) maximum number of roots (41.33), followed by Henyo cv (33). Heaviest fruits were produced by Chandler cv. (16.26 g) while, the lowest fruit weight (15.42 g) has been found in cv. Henyo. It may be argued that the genotype significantly influenced on the fruit weight. Similarly DAS *et al.* (2015) noticed that strawberry cv. Festival showed maximum fruit weight (13.48 g) in sub-tropical agro-climatic conditions. Fruit weight recorded in the present experiment was strongly similar to the findings of Crespo (2010), who reported that cv. Asia produced heaviest fruit (26.4 g) and cv. Antea produced the lightest fruits (14.8 g) in sub-tropical climate.

The data (Table 1) showed significant variation in the length of fruit. Chandler was found with longest fruit (3.56 cm), while Henyo has shortest fruit (36 cm). Asrey *et al.* (2004) reported that the length of strawberry fruit between different cultivars varied significantly.

Total soluble solids (TSS) significantly differed between cultivars (Table 2). The results showed highest amount of TSS in cv. Henyo (7.9%) than cv. Chandler (6.5%). Capocasa *et al.* (2008) perceived that total soluble solids of strawberry fruit varied expressively and ranged between 5.8 and 9.7% among cultivars, which is in accordance with these results. Kadar (1991) described that TSS content of strawberry fruit picked at marketable maturity ranged between 5 to 12%, dependent on the cultivar and before harvesting factors. Resende *et al.* (2008) observed TSS contents in different cultivars of strawberries which were between 7.20 and

8.10%, this supports the findings of current study. Similarly, Asrey *et al.* (2004) noted that total soluble solids of strawberry fruit have strong variation, which was extended from 4.90 to 7.50% between the cultivars. It may be argued that the difference between TSS may be due to climatic factors as previously reported by Shaw (1988).

Table 1. Success, number of leaves, number of roots, fruit weight and length

Cultivars	Success (%)	No. of leaves/ plant	No. of Roots/ plant	Fruit Wt. (g)	Fruit length (cm)
Chandler	71.17a	7.67a	41.33a	16.26a	3.56a
Henyo	54.42b	7.42b	33b	15.42b	3.26b
S.E.D	0.94	0.67	1.23	0.29	8.54

Means followed by the same letter are not significantly different from each other at 5% level of significance

In both strawberry cultivars titratable acidity (TA) varied significantly, high acidity (0.91%) was observed in cv. Henyo while the minimum acid content (0.76%) was recorded in cv. Chandler (Table 2). The result of titratable acidity coincides with the results of Asrey *et al*. (2004) and Resende *et al.* (2008). They stated that TA differed significantly between 0.80 and 0.91%. Macit *et al*. (2007) defined that titratable acidity of strawberry cultivars ranged from 0.34 to 0.41%, that was lesser than the current results and this may be due to variation in both cultivars and cultivating locations.

Significant variation between Chandler and Henyo was observed (Table 2) concerning pH of juice content (4.36) and (4.57), respectively. Although, it was greatly influenced by environmental factors, significant differences among cultivars observed in our study are consistent with previous reports that confirm the heritability of this attribute (Belakud *et al.,* 2015). Juice contents varied significantly in both cultivars, 64.78% was noted (Table 2) in Chandler while the less juice contents was observed in Henyo (59.57%). Juice content differed significantly in both cultivars. Our results are confirmed by Belakud *et al.* (2015) who also reported 75.83% juice contents in Chandler.

The yield is an important feature of fresh fruit, maximum fruit yield per plant in Chandler was observed (371 g), followed by Henyo (294 g). The variation per plant performance might be due to the intrinsic character of genotypes. Belakud *et al.* (2015) reported that the maximum yield per plant was observed in Chandler (591 g). Crespo (2010) and Lutchoomun *et al.* (1997) have stated that the fruit yield per plant, varied considerably between strawberry cultivars, existing 179.00 to 312.40 g and 386.00 to 624.00 g per plant correspondingly.

Table 2. Fruit yield, total soluble solids, pH and acidity

Cultivars	TSS (%)	pH of Juice	Titratable Acidity (%)	Juice contents (%)	Fruit Yield/ Plant (g)
Chandler	6.50a	4.36a	0.76a	64.78b	371b
Henyo	7.90b	4.57b	0.91b	59.57a	294a
S.D	6.03	1.33	5.24	0.37	5.13

Means followed by the same letter are not significantly different from each other at 5% level of significance Probability at LSD Test.

CONCLUSION

On the basis of morphological and physico-chemical parameters, it is observed that the Chandler cultivar lead in success %, fruit weight, juice content, higher yield and with minimum acidity. So, it is concluded that Chandler is superior to Henyo and found to be promising under sub-tropical environment of Pakistan.

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