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Biochemical and Yield Performance of Strawberry Cultivars Grown Under Polytunnel

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ABSTRACT

Strawberry is an important crop of temperate horticulture in India. There are several genotypes have been developed for getting qualitative and quantitative attributes in production of strawberry. Less area in temperate region enhances the introduction of new strains. Current study was undertaken at the Horticultural farm, and laboratory, School of Agriculture, Lovely Professional University, Phagwara, Punjab, in 2020-21. The biochemical and quantitative attributes of strawberry genotypes were analysed in 10 genotypes viz., Sweet Charlie, Florida, Tioga, Camerosa, Winter Dawn, Swiss, Red coat, San Andreas, Elista and Robinson under sub-tropical climatic conditions of Punjab. Experiment was laid down in a Randomized Block Design (RBD) with three replications. Results revealed that among all the genotypes, cv. Winter Dawn had the higher yield of heaviest fruit, cv. Tioga had the highest total soluble solid (TSS), ascorbic acid and total sugar whereas, cv. Sweet Charlie contained minimum acidity and cv. Florida hold maximum juice content. The finding can be helpful for grower to achieve consumers demand and researchers in crop improvement.

Key words: *Strawberry, Yield, Biochemical parameters, Tioga, Sweet Charlie, Winter Dawn*

Introduction

Strawberry (*Fragaria ananassa*) is a widely planted hybrid species of the genus Fragaria, which are cultivated worldwide for their fruit. It is one of the few crops that yields rapid and substantial returns per unit area on capital input, as the crop matures within six months after sowing (Bakshi *et al*., 2014). Strawberry is an aggregate fruit (Whitaker *et al*., 2011) and well known for its distinct aroma (Olbricht *et al*., 2008), sweet sour flavour (Fan *et al*., 2021), red coloured (Fischer *et al*., 2014) and perishable (Pott *et al*., 2020). Strawberry fruit's consumable component is non-ovarian and comprises of a swelling receptacle (the false fruit) and achenes (Tosetti *et al*., 2020). Ethylene is the primary hormone that regulates fruit ripening in climacteric fruits (Pholoma, 2020; Jin Gao *et al*., 2020). The fruit's red colour is mostly owing to the presence of an anthocyanin, pelargonidin 3-monoglucoside, and traces of cyanidin (Khoo *et al*., 2017). The most important smell compounds in strawberry are ethyl hexanoate, methyl hexanoate, ethyl heptanoate, ethyl propionate, ethyl butanoate, methyl butanoate, furanone, and linalool. Strawberry leaves may be utilised to extract essential oil as well. Strawberry oil's two primary constituents are linalool and nonanal (Kirillov *et al*., 2019). The strawberry (*Fragaria* × *ananassa*, Duch.) is a popular crop all over the world, and researchers are presently studying its potential advantages in the prevention of cardiovascular and neurological disorders, obesity, cancer, and ageing (Giampieri *et al*., 2012). Cancer-suppressing ellagic acid (a naturally occurring plant phenol) has been

identified in strawberries (Herrera and de Castro, 2005). The fresh, ripe fruits of the strawberry are a good source of vitamins and minerals, with vitamin A (17 IU) and vitamin C (84.7 mg/100g) being particularly good. Many strawberry cultivars have been developed over the world, and new kinds are introduced at regular intervals (Nielsen and Lovell, 2000). The growing number of strawberry cultivars on the market necessitates the development of effective identification and genetic diversity assessment tools (Degani *et al.*, 2001). With these considerations in mind, the current study was conducted with the goal of evaluating strawberry genotypes for yield and biochemical characteristics.

Materials and Methodology

The current study employed 10 genotypes and was undertaken at the Horticultural Farm, School of Agriculture, Lovely Professional University, Phagwara, Punjab, in 2020-21. Sweet Charlie, Florida, Tioga, Camerosa, Winter Dawn, SA, Swiss, Elista, Robinson, Red coat, runners were obtained from IARI regional station, Shimla -171004 with an undamaged earth ball. With a height of 232 metres above sea level, the experimental area is located at 31.2498190 N and 75.7084550 E on a map. The state's yearly average temperature is around 21 degrees Celsius (70 degrees Fahrenheit). In addition, the average monthly temperature ranges from 9°C (48 °F) in July to around 18 °C (64 °F) in November. The experiment plot's soil in the Polytunnel was thoroughly prepared by repeated ploughing and planking to achieve a fine tilth. The soil was ploughed, harrowed, and levelled, and weeds were dug out. In the experimental plots, strawberry runners with 2-3 complete open leaves were transplanted. For planting, only healthy and sound runners were chosen. The plants were promptly irrigated once they were planted. Post-planting procedures included nutrient spraying, watering, and plant protection measures, among other things. Light irrigation was used as needed to keep the soil moisture level in the plots at optimum levels. Various metrics on yield and fruit quality were recorded to measure the impact of different treatments. The experiment was planned in randomised block design with three replications in each treatment to evaluate the statistical analysis of research data.

Results and Discussion

Physical attributes

Fuit weight is significantly heaviest in Winter Dawn (11.04 g), followed by Sweet Charlie (7.87 g), San Andreas (7.72 g), Camerosa (6.26 g). In cultivar, Florida, the smallest fruit weight (2.70 g) was reported. Close findings in Winter Dawn cultivar's fruit weight (13.28 g) of strawberry was recorded by Rao and Swamy (2017). In another research Kahu *et al.* (2010) observed that strawberry fruit weight range between 11-13 g in organic and conventional method of cultivation.

Table 1. Mean performance of Strawberry genotypes for physical, chemical and yield attributes under polytunnel

Genotypes	Fruit weight (g)	Juice content (%)	TSS (°Brix)	Titratable Acidity (%)	Ascorbic acid (mg/100g)	Reducing sugar (%)	Non-reducing sugar (%)	Total sugar (%)	Yield (g/plant)
Sweet Charlie	7.87	67.47	4.92	0.45	29.99	2.06	0.86	3.03	31.18
Florida	2.70	74.06	9.98	0.65	40.52	5.49	2.85	8.52	12.70
Tioga	3.76	69.23	14.12	0.47	48.73	3.51	8.72	12.20	21.47
Camerosa	6.26	58.94	6.67	0.57	17.16	3.20	2.03	4.98	79.95
Winter Dawn	11.04	58.25	5.09	0.64	33.24	3.78	0.67	4.41	160.48
Swiss	4.19	64.62	8.70	0.54	24.69	4.45	2.17	6.51	18.82
Red coat	3.74	55.60	10.04	0.64	11.43	3.19	4.80	7.80	33.20
San Andreas	7.72	54.62	4.97	0.60	41.29	2.09	1.32	3.77	26.64
Elista	3.42	70.12	7.81	0.65	31.82	1.14	5.15	6.62	15.90
Robinson	4.77	58.12	10.83	0.52	29.35	5.14	4.18	9.19	24.08
Mean	5.55	63.10	8.31	0.57	30.82	3.4	3.27	6.7	42.44
CV	2.18	0.95	2.33	4.32	2.08	4.17	4.36	2.16	2.43
CD at 5%	0.21	1.03	0.33	0.04	1.10	0.24	0.25	0.25	1.77
SEM±	0.07	0.35	0.11	0.01	0.11	0.08	0.08	0.08	0.60

In cultivar, Florida the maximum juice content (74.06 %) followed by Elista (70.12 %) was recorded while minimum juice content (54.62 %) was recorded in cultivar San Andreas. In a research of Belakud *et al*. (2015), maximum juice content (89.98 %) was discovered in Dana cultivar of strawberry which is nearly of our findings. The variation in juice content among different genotype might be related to genetic variability.

Chemical attributes

Tioga had the highest TSS (14.12°Brix), followed by Robinson (10.83°Brix). The minimum TSS was identified in cv., Sweet Charlie (4.92°Brix) and San Andreas (4.97°Brix). Similarly Rao and Lal (2010) detected the highest TSS in cultivars of strawberry Shimla Delicious (11°Brix) and Sea Scape (11.93°Brix), respectively.

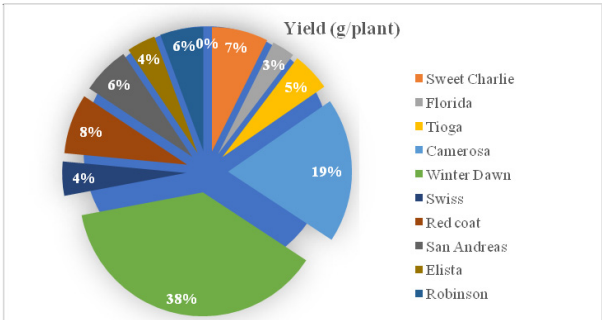
Florida and Elista had the highest acidity concentrations (0.65 % each), while cv. Sweet Charlie had the lowest acidity content (0.45 %). However, Seascape cultivar of strawberry recorded as having greatest acidity i.e., 1.15 % (Nagre *et al*., 2005).

Tioga had the greatest ascorbic acid content (48.73 mg/100g) among the strawberry cultivars based on mean average performance. Red coat, on the other hand, has the lowest ascorbic acid concentration (11.43 mg/100g). Similarly, according to Belakud *et al*. (2015), among different cultivars of strawberry, Phenomenal had the highest ascorbic acid content (50 mg/100g).

Tioga cultivar had significantly the highest total sugar (12.2 %), followed by Robinson (9.19%) while the minimum was noticed in Sweet Charlie (3.03 %). Reducing sugar was greatest in Florida (5.49%), followed by Robinson (5.14%), and lowest in Elista (1.14%), whereas non-reducing sugar was highest in Tioga (8.72%), followed by Elista (5.15 %). In a study, maximum total sugars (9.40%), non-reducing sugars (2.30%), and reducing sugars (7.01%) have been determined in Barak cultivar of strawberry by Rao and Swamy (2017).

Yield (g/plant)

Data analysis demonstrates that there is significant variance in the number of fruits per plant among distinct strawberry cultivars. Based on the average performance, cv. Tioga (160.48 g) had the most fruits per plant followed by Camerosa (79.95 g) and Florida had the least (20.14 g). However, Neetu *et al*. (2020) observed the highest yield (35.40 t/ha) in cv. Nabila. Similarly, Kadir *et al*. (2006) discovered a maximum yield in cv. Chandler.



Hence, the fruit weight, juice content, TSS, acidity, ascorbic acid, sugar and yield was significantly different in all genotypes of strawberry. Variation in Fruit weight, yield per plant, juice content, TSS, total sugar, acidity, ascorbic acid, reducing and non-reducing sugar of distinct strawberry genotypes may be related to their adaption capability under Punjab agro-climatic conditions and it may be due to genotypic variances. Scientists also had similar findings namely, Singh *et al*. (2012), Sahu and Chandel (2014) and Kelly *et al*. (2016), etc.

Conclusion

Based on the findings, it was determined that among the 10 genotypes of strawberry tested, the cultivar Winter Dawn produced a higher yield (160.48 g/plant) of larger fruits. Winter Dawn had the heaviest fruit weight (11.04 g), Tioga had the highest TSS (14.12°Brix), Ascorbic acid (48.73 mg/100g) and Total Sugar (12.20 %), Sweet Charlie (0.45%) had the minimum acidity and Florida was richest in juice (74.06%) content among all the genotypes of strawberry. According to consumer demand and breeding aspects theses genotype can be used with their characters.

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Conflict of Interest: On behalf of all authors, the corresponding author states that there is no conflict of interest.

References

Bakshi, P., Bhat, D.J., Wali, V.K., Sharma, A. and Iqbal, M. 2014. Growth, yield and quality of strawberry (*Fragaria ×ananassa* Duch.) cv. Chandler as influenced by various mulching materials. *African J. Agric. Res*. 9 : 701-706.

Belakud, B., Bahadur, V. and Prasad, V.M. 2015. Performance of strawberry (*Fragaria × ananassa* Duch.) varieties for yield and biochemical parameters. *The Pharma Innovation Journal*. 4(10) : 05-08

Degani, C., Rowland, L.J., Saunders, J.A., Hokanson, S.C., Ogden, E.L. and Golan-Goldhirst, A. 2001. A comparison of genetic relationship measures in strawberry (*Fragaria x ananassa* Duch.) based on AFLP, RAPDs, and pedigree data. *Euphytica*. 117:1-12.

Fan, Z., Hasing, T. and Johnson, T.S. 2021. Strawberry sweetness and consumer preference are enhanced by specific volatile compounds. *Hortic Res.* 8: 66.

Fischer, T.C., Mirbeth, B., Rentsch, J., Sutter, C., Ring, L., Flachowsky, H. and Habegger, R. 2014. Premature and ectopic anthocyanin formation by silencing of anthocyanidin reductase in strawberry (*Fragaria × ananassa*). *New Phytol.* 201 : 440– 451.

Giampieri, F., Tulipani, S., Alvarez-Suarez, J.M., Quiles, J.L. Mezzetti, B. and Battino, M. 2012. The strawberry: composition, nutritional quality and impact on human health. *Nutrition*. 28 : 9-19.

Herrera M.C. and de Castro M.D. 2005. Ultrasound-assisted extraction of phenolic compounds from strawberries prior to liquid chromatographic separation and photodiode array ultraviolet detection. *J. Chromatogr. A*., 1100 : 1–7. doi: 10.1016/j.chroma.2005.09.021.

Jin Gao, Yaoxin Zhang, Zhengguo Li and Mingchun Liu, 2020. Role of ethylene response factors (ERFs) in fruit ripening, *Food Quality and Safety*. 4(1): 15–20. https://doi.org/10.1093/fqsafe/fyz042

Kadir, S., Carey, E. and Ennahli, S. 2006. Influence of high tunnel and field conditions on strawberry growth and development. *Hort Sci*. 41(2): 329-335.

Kahu, K. Klaas, L. and Kikas, A. 2010. Effect of cultivars and different growing technologies on strawberry yield and fruit quality. *Agron. Res.* 8: 589–594.

Kelly, K., Whitaker, V.M. and do Nascimento Nunes, M.C. 2016. Physico-chemical characterization and postharvest performance of the new Sensation 'Florida127'strawberry compared to commercial standards. *Sci. Hortic.* 211 : 283-294.

Khoo, H.E., Azlan, A., Tang, S.T. and Lim, S.M. 2017. Anthocyanidins and anthocyanins: colored pigments as food, pharmaceutical ingredients, and the potential health benefits. *Food & Nutrition Research.* 61(1:

Kirillov, V., Stikhareva, T., Atazhanova, G., Makubayeva, A., Serafimovich, M., Kabanova, S., Rakhimzhanov, A. and Adekenov, S. 2019. Composition of essential oil of leaves and fruits of green strawberry (*Fragaria viridis* Weston) growing wild in Northern Kazakhstan. *J. Appl. Bot. Food Qual*. 92 : 39-48. https://doi.org/10.5073/JABFQ.2019.092.006

Nagre, P.K., Garad, B.V., Bulbule, A.V. and Patil, V.S. 2005. Varietal performance of strawberry under Igatpuri conditions of Western Ghat Zone. *J. Maharashtra Agric. Univ*. 30(1) : 120-122.

Neetu, Sharma, S.P. and Verma, G. 2020. Varietal screening of strawberry (*Fragaria x ananassa* Duch.) under open field condition for fruit quality and yield in plain region of Chhattisgarh, India. *J. Pharmacogn. Phytochem*. 9(1) : 405-407.

Nielsen, J.A. and Lovell, P.H. 2000. Value of morphological characters for cultivar identification in strawberry (*Fragaria ananassa*). *NZ J Crop Hortic Sci*. 28 : 89-96.

Olbricht, K., Grafe, C., Weiss, K. and Ulrich, D. 2008. Inheritance of aroma compounds in a model population of *Fragaria × ananassa* Duch. *Plant Breed.* 127 : 87–93.

Pholoma, S.B. 2020. Is Ethylene the Ripening Hormone. *J. Exp. Agric. Int*. 42(5) : 1-7. https://doi.org/10.9734/jeai/2020/v42i530510

Pott, D.M., Lima, F.A., Soria, C., Willmitzer, L., Fernie, A.R., Nikoloski, Z., Osorio, S. and Vallarino, J.G. 2020. Metabolic reconfiguration of strawberry physiology in response to postharvest practices, *Food Chem.* 321 : 126747.

Rao V.K. and Lal B. 2010. Evaluation of promising strawberry genotypes under Garhwal Himalayan conditions. *Inc. Horti.* 67(4): 470-474.

Rao, V. and Swamy, G.S.K. 2017. Performance of Strawberry (Fragaria x ananassa Duch.) Genotypes for Yield and Quality Parameters. *Int. J. Curr. Microbiol. App. Sci.* 6(9) : 1904-1908.

Sahu, A. and Chandel, J.S. 2014. Studies on the comparative performance of strawberry cultivars under mid-hill conditions of north-western Himalayas. *Indian J. of Hortic.* 71 (3) : 330-334.

Singh, S.R., Srivastava, K.K., Sharma, M.K. and Singh, L. 2012. Screening of strawberry (*Fragaria × ananassa*) varieties under organic production system for Kashmir valley. *Ind. J Agri. Sci.* 82(6) : 538-42.

Tosetti, R., Elmi, F., Pradas, I., Cools, K. and Terry, L.A. 2020. Continuous Exposure to Ethylene Differentially Affects Senescence in Receptacle and Achene Tissues in Strawberry Fruit. *Front. Plant Sci.* 11 : 174.

Whitaker, V.M., Hasing, T., Chandler, C.K., Plotto, A. and Baldwin, E. 2011. Historical trends in strawberry fruit quality revealed by a trial of University of Florida cultivars and advanced selections. *Hort Sci*. 46(4) : 553-557.