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Proper planting systems improves yield, growth, and quality of strawberry by regulating soil moisture in humid tropical Terai region

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Abstract
There is a lack of knowledge regarding how strawberry (*Fragaria ananassa*, Duch.) planting geometry affects the physiological processes and biochemical components to increase yield and quality in the humid tropical Terai region. We investigate the growth and yield of strawberry in response of varying row to row and plant-plant spacing. Different planting geometry considered in the experiments areT0: 30×25 cm (Control), T1: 10 × 20 cm, T2: 10 × 30 cm, T3: 20 × 30 cm, T4: 20 × 40 cm, T5: 30 × 30 cm, T6: 30 × 40 cm. Overall mean fruit yield was the highest (10,707.02 kg ha^{-1}) in 30 × 40 cm spacing and lowest (6,341.56 kg ha^{-1}) was in 10 × 20 cm spacing. In humid tropical areas, increasing the productivity and profitability of strawberry cultivators may be advised by adjusting plant geometry to environmental conditions and physiological processes to improve strawberry fruit quality and yield.

Keywords: Strawberry, spacing, fruit quality

Introduction

Strawberries are currently one of the most popular fresh fruits with substantial nutritional content due to the recent dramatic growth in their consumption (Sharma, 2002) [11]. Due to its great market value, it is being quickly grown in India's humid, tropical climate.

In a humid tropical environment, challenges with strawberry cultivation include poor establishment, low quality, root damage, plant and fruit infection, etc. New methods are required by growers to enhance plant germination, boost yields in the future, and safeguard against plant damage. Another crucial element is that strawberry plants have runners that bring plants closer together. If runners are cut improperly, there is a risk of plant infection (Paranjpe *et al*., 2008) [9]. Having the right amount of space between plants supports healthy plant development and growth, which maximises crop yield and makes the most use of available area (Ahmad, 2009) [1]. Taking into account the aforementioned information, the current experiment was conducted to determine the ideal planting time and plant spacing for attaining the highest possible strawberry fruit output. Agriculture productivity is directly impacted by plant population (Antunes *et al*., 2010) [2].

However, spacing affects soil characteristics, water and nutrient availability, light absorption, and other input materials. They also appear to affect physiological processes in plants, including photosynthesis, respiration, nutrition, hormone functions, tropisms, nastic movements, photoperiodism, photo morphogenesis, circadian rhythms, seed germination, dormancy, and stomata function and transpiration, both of which are components of plant water relations. Additionally, these physiological mechanisms regulate the fruit's quality. Therefore, fruit quality and yield factors may be well controlled by spacing.

Understanding the mechanisms by which various plant geometries affect environmental and biochemical processes was the main goal of this study, which aimed to improve strawberry fruit output with improved quality and quantity under humid growing settings.

Materials and Methods

The field investigation was carried out for two years during 2017-2019, at Horticultural farm, university of Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar, West Bengal. The climate is humid subtropical, with maximum temperatures spanning from 30 °C to 43 °C in the summer and low temperatures falling from 10 to 12 °C in the winter. Before planting the crops, composite soil samples from all of the experimental plots were collected and examined. The soils are mostly sandy to sandy loam in texture, porous and greyish black in colour.

The soil was moderately acidic (pH = 5.25).

Strawberry plants were planted in different plant geometry, seven types of plant geometry were used, those wereT0: 30 × 25 cm; T1: 10 × 20 cm; T2: 10 × 30 cm; T3: 20 × 30 cm; T4: 20 × 40 cm; T5: 30 × 30 cm; T6: 30 × 40 cm, whereas, 30 × 25 cm spacing was used as control (T0). They were replicated thrice and distributed in a randomised block design. To evaluate the response of mulching material on performance of strawberry “chandler”. Planting materials were collected from COFAM (Centre for Floriculture and Agri-business Management), Siliguri, West Bengal, India and planted in the first week of November in individual plot (1 × 2 m^2).

In the month of September, the field was prepped. Land preparation included using farm yard manure (FYM). The bed measured 2 metres in length and 1 metres in width. The "Chandler" type of strawberry planting material (tissue cultured plant, height 4 to 5 cm) was sown in the field. After planting, 2 to 3 mg of carbofuran were immediately put to the planting hole. During the first week of November, planting was completed. For the first one and a half months after planting, irrigation was provided at one-day intervals, and subsequently it was irrigated as needed.

The morphological parameters of each plants were observed. Weight of fruit (Khalid *et al*., 2013) [6], specific gravity, length and breadth of fruit no of fruits per plant fruit (Khalid *et al*., 2013) [6], yield per ha (Khalid *et al*., 2013) [6], days to flowering, no of flowers per plant (Khalid *et al*., 2013) [6] were observed at 15 days interval, and lastly the mean was calculated for each parameter. The total soluble solid (TSS) (Mazumdar and Majumder, 2003) [7], total sugar, reducing sugar, and acidity of the fruit juice was determined (Rangana, 1977) [10].

Shapiro–Wilk test (p<0.05) was employed to test data normality. The data from the field and laboratory were statistically evaluated, and the treatment variability was tested for significance using the F test (Gomez and Gomez, 1983) [3]. All of the tables show the standard error of the mean and the crucial difference at the 5% level. Fisher and Yates table were used to determine crucial differences at a 5% level of significance.

Results and Discussions

Spacing had significant impact on fruit weight of strawberry. Fruit weight with 30 × 40 cm spacing was the highest and was 62% and 40% heavier than 10 ×20 cm and 10 × 30 cm spacing, respectively (Table 1). Breadths of fruits in plots with spacing 30 × 40 cm and 30 × 30 cm were higher than other spacing plots. Fruit length was the highest in 30 × 40 cm; moreover fruit breadth of 30 × 40 cm plots were also the highest and it was 26% higher than closed spaced plots (Table 2). Widely spaced crop would result in better number of fruits and flowers per plant, the greatest number of flowers per plant at wider spacing might be due to greater number of primary and secondary branches per plant. 30 × 40 cm and 30 × 30 cmspacing had higher number of fruits and flower per plant, followed by 20 × 40 cm, 20 x 30 cm respectively. 30 × 40 cm spacing had 118% and 76% higher number of fruits than spacing 10 × 20 cm and 10 × 30 cm. For both the cases days to flowering and flowering to fruiting highest days was seen in lowest spaced plans and highest was seen in wider spaced plants (Table 2). Consequently, spacing with 30 × 40 cm and 30 × 30 cms pacing folds higher number of runners per plant compared to control and other closed spaced plants (Table 3). Moreover the highest leaf area was recorded under spacing 30 × 40 cm and lowest in 10 × 20 cm (Table 3). Overall mean fruit yield was the highest (10,707.02 kg ha^{-1}) in 30 x 40 cm and lowest (6,341.56 kg ha^{-1}) was in spacing 10 x 20 cm.

Spacing improved light penetration resulting to appropriate environment for crop growth. Wider spacing also improves significantly greater nutrient uptake such as N, P and K.The enhanced growth of runner of strawberry under wider spacing might be attributed to optimum soil moisture, spare weed population, less completion for nutrients, better aeration etc. which might have formed increased number of runners and their better growth.

Strawberry under wider spacing allows grasping more light by photosynthetic leaves due to their higher canopy. The efficiency of photosynthetic photon interception relies on plant and ecological factors. It could be accomplished by altering the plant spacing. Management of plant spacing to optimise photosynthetic photon flux density interception is, therefore, a likely approach for boosting strawberry yields.

Widely spaced crop 30 × 40 cm would result in better TSS (7.35^0 Brix) of fruits. Lowest total sugar was seen in the plots with 10 × 20 cm and 10 × 30 cm of fruits (Table 4). However 30 × 40 cm had 20% higher sugar than closer spacing plots (Table 4). Mean titratable acidity of fruits in plots with 30 × 40 cm and 30 × 30 cm spacing were ~ 19% and 16% lower than 10 ×20 cm, respectively.

As wider spacing allowed to increased photosynthesis and consequently improved soluble solid content of strawberry. Incidentally, light penetration in widely spaced crops was greater in comparison with close spacing plots. However, stage of crop also had a major impact on TSS and as it influences moisture content of fruit. The highest total sugar (TS) and reducing sugar (RS)was witnessed under 30 cm × 40 cm. Spacing had phoney effect on TS and RS of fruits. Widely spaced crop would result in better TS and RS of fruits (Nautiyal *et al*., 2016) [8]. Wider spacing reduces intra-plant completion for water, nutrient and other resources. Higher water supply negatively impacted acidity in ripe fruits (Kallsen *et al.*, 2011) [5]. Under moisture stress, plant tissues accrue solutes such as organic acids to reduce osmotic potential and maintain cell pressure (Hummel *et al*., 2010) [4]. Thus, plots with wider spacing had lower acidity in comparison to closely placed crops.

Wider spacing also enhances nutrient absorption, particularly of N, P, and K. Furthermore, widely separated crops experience less competition for moisture, nutrients, and so on; as a result, the availability of these inputs per plant is increased, and greater spacing improves soil aeration and microbial activity. Plants absorb more nutrients as a consequence, and widely spread strawberry plants produce more quality fruit.

Table 1: Effect of different plant geometry fruit length and fruit breadth of strawberry in humid tropical India. LSD is the Least Significant Difference among treatments calculated from Duncan Multiple Range test (DMRT; $p<0.05$).

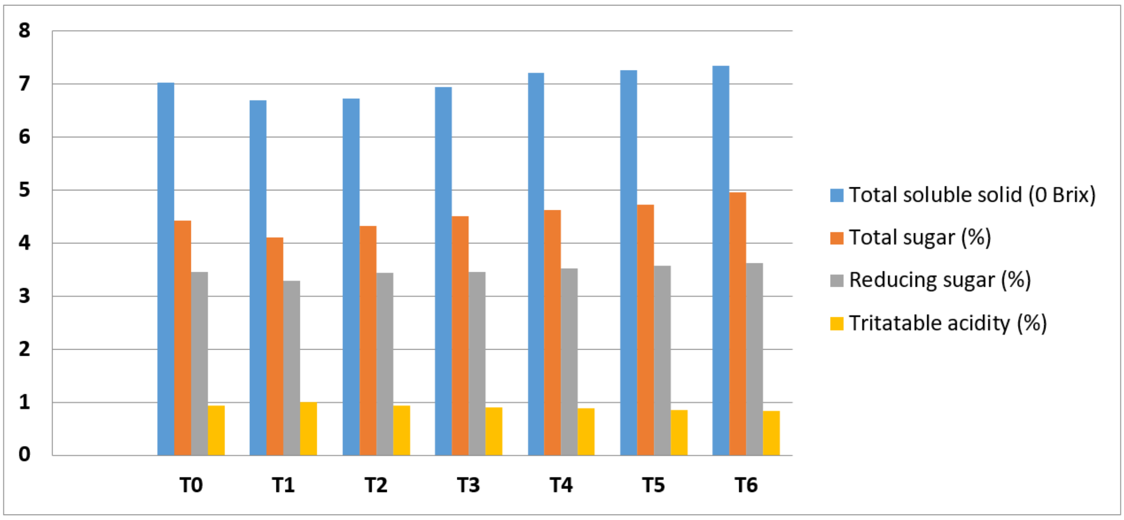
Treatments*	Fruit weight (g)	Fruit length (cm)	Fruit breadth (cm)	Number of runners per plant	Fruit yield (kg	Leaf area (cm^2)
T0	19.71	4.45	2.80	5.33	8,068.05	41.09
T1	15.91	4.21	2.54	3.50	6,341.57	37.24
T2	18.40	4.36	2.73	4.67	7,933.04	40.96
T3	21.32	4.65	2.85	5.33	8,385.17	41.91
T4	22.55	4.71	2.98	6.50	9,178.61	42.89
T5	23.73	4.93	3.05	7.50	9,367.74	44.29
T6	25.89	5.12	3.21	8.33	10,707.02	45.21
LSD ($P<0.05$)	4.12	0.39	0.28	1.68	281.91	2.13

*T0: 30 × 25 cm; T1: 10 × 20 cm; T2: 10 × 30 cm; T3: 20 × 30 cm; T4: 20 × 40 cm; T5: 30 × 30 cm; T6: 30 × 40 cm

Table 2: Effect of different plant geometry on number of flowers per plant, number of fruits per plant, days to flowering, flowering to fruiting and fruiting duration of strawberry in humid tropical India. LSD is the Least Significant Difference among treatments calculated from Duncan Multiple Range test (DMRT; $p<0.05$).

Treatments*	Number of flowers per plant	Number of fruits per plant	Days to flowering (day)	Flowering to fruiting (day)	Fruiting duration (day)
T0	28.33	19.50	38.83	5.83	76.50
T1	22.33	14.83	49.33	6.50	74.17
T2	25.72	18.33	44.67	6.33	74.17
T3	30.39	22.00	39.17	5.50	81.50
T4	31.83	24.17	38.00	5.83	84.00
T5	33.28	26.67	36.00	5.67	83.67
T6	37.00	32.33	32.67	4.83	86.50
CD ($P<0.05$)	4.14	4.76	3.47	NS	2.48

*T0: 30 × 25 cm; T1: 10 × 20 cm; T2: 10 × 30 cm; T3: 20 × 30 cm; T4: 20 × 40 cm; T5: 30 × 30 cm; T6: 30 × 40 cm



*T0: 30 × 25 cm; T1: 10 × 20 cm; T2: 10 × 30 cm; T3: 20 × 30 cm; T4: 20 × 40 cm; T5: 30 × 30 cm; T6: 30 × 40 cm

Fig 1: Effect of different plant geometry on biochemical quality of strawberry fruit in humid tropical India. LSD is the Least Significant Difference among treatments calculated from Duncan Multiple Range test (DMRT; p<0.05)

Conclusion

The study evaluated the impact of different plant geometry on yield and quality of strawberry fruits in humid tropical India. In these regions, wider spacing significantly improved strawberry fruit yield. Importantly, wide spaced plants improved physical and quality parameter and also decrease interplant competition. Leaf area and TSS are two important factors which determine the quality of plant and fruit. The 30×40 cm spacing regulated these two factors to improve sweetness, fruit shape and yield in humid tropical regions. Wide spacing adjusted environmental factors and physiological process to boost productivity and quality of strawberry fruits and hence could be recommended to increase productivity and profitability of strawberry cultivators in humid tropical regions.

Declaration

The authors declare that they do not have any conflict of interest.

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References

1. Ahmad MF. Effect of planting density on growth and yield of strawberry. Ind J Hort. 2009;66:132-134.
2. Antunes LEC, Ristow NC, Krolow ACR. Carpenedo, S. and Reisser Júnior, C. Yield and quality of strawberry cultivars. Hortic Bras. 2010;28:222-226.
3. Gomez MH, Aguilera JM. Changes in the starch fraction during extrusion-cooking of corn. J Food Sci. 1983;48:378-3781.
4. Hummel I, Pantin F, Sulpice R, Piques M, Rolland G, Dauzat M, *et al*. Arabidopsis plants acclimate to water deficit at low cost through changes of carbon usage: an integrated perspective using growth, metabolite, enzyme, and gene expression analysis. Plant Physio, 154, 357-72.
5. Kallsen CE, Sanden B, Arpaia ML. Early navel orange fruit yield, quality, and maturity in response to late-season water stress. Hortic Sci. 2011;46:1163-9.
6. Khalid S, Qureshi KM, Hafiz IA, Khan KS, Qureshi US. Effect of organic amendments on vegetative growth, fruit and yield quality of strawberry. Pak J Agric Res. 2013;26:2.
7. Mazumdar BC, Majumder K. Methods on physico-chemical analysis of fruits. University college of Agriculture, Calcutta University; c2003. p. 664- 807
8. Nautiyal P, Lal S, Dimri DC, Arora I. Effect of mulching on total sugar (%) of fruits of strawberry plant during crop growth period in a subtropical Inceptisol. In J Agri Sci. 2016;8:2427-2423.
9. Paranjpe AV, Cantliffe DJ, Stoffella PJ, Lamb EM, Powell CA. Relationship of plant density to fruit yield of ‘Sweet Charlie’ strawberry grown in a pine bark soilless medium in a high-roof passively ventilated greenhouse. Sci Hortic. 2008;115:117-123.
10. Rangana S. Ascorbic acid. Manual Analysis of Fruit and Vegetable Products; c1977. p. 94-101.
11. Sharma RR. Growing strawberry. Int. Book Distributing Co., India; c2002. p. 1-2.
12. Sharma VK. Effect of mulching and row spacing on growth and yield of strawberry. Ind J Hort. 2009;66:271-273.