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Performance of strawberry cultivars in new alluvial zone of West Bengal

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Abstract

An investigation was carried out at Krishi Vigyan Kendra of Bidhan Chandra Krishi Viswavidyalaya, Gayeshpur, Nadia, West Bengal with eight strawberry cultivars (Barak, Crystal, Gilt, Hader, Sabrina, Sabrina 1, Sweet Charlie and Winter Dawn) to find out their performance in new alluvial zone of West Bengal. Wide variation was noted in plant height (14.16-24.4 cm), plant spread (27.27- 41.9 cm), number of runners per plant (2.26- 5.84), leaf area (79.21-113.85 cm²) and number of leaves per plant (24.83-35.32), fruit yield per plant (245.27- 1305.7 kg), fruit yield per ha (11.78-62.73 q), fruit weight (14.84-29.23 g) and breath (2.85- 4.32) and fruit length (3.95-5.02 cm). A prominent and significant variation was also obtained in chemical composition of fruits viz. total soluble solids (4.95-7.81 °brix), total sugar (3.71-5.07%), titratable acidity (0.48-0.93%), ascorbic acid (42.0-70.85 mg/100 ml juice) and anthocyanin (11.46-37.99 mg/100 ml juice). It may be concluded that the performances of Sweet Charlie and Winter Dawn are superior in growth, yield and fruit quality as compared to other cultivars in new alluvial zone of West Bengal.

Keywords: Yield, fruit weight, TSS, total sugar, ascorbic acid

Introduction

The modern cultivated strawberry (*Fragaria x ananassa* Duch.), a cross between two American wild species, *Fragaria virginiana* and *Fragaria chiloensis*, is octaploid (2n=8x=56). Commonly known as manmade hybrid, it belongs to the family Rosaceae and botanically known as tetraerio of achene. It is non climacteric and complete fruit with 98 percent edible portion. Strawberry gives the early and maximum economic returns per unit area in the shortest possible time, because fruits are ready for harvesting within six months after planting. They are good source of natural antioxidant (Wang *et al.*, 1996) [22]. It exhibits high level of antioxidant capacity against free radical species, superoxide radicals, hydrogen peroxide, hydroxyl radicals and singlet oxygen (Wang and Jiao, 2000) [23]. Fruits are good source of carotenoids, vitamins, phenols, flavonoids, dietary glutathione and metabolites (Larson, 1988) [7]. It constitutes about 90 per cent of water with low calorific value, no cholesterol and higher level of minerals like phosphorus, potassium, calcium, iron and vitamin C. The fruit is gaining popularity due to its medicinal properties as anticarcinogenic, antidiabetic and antioxidant (Asrey and Patel, 2003) [1]. It is consumed as fresh fruit and processed products and is specially demanded by the fruit processing industries for preparing jam, beverage, soft drink, wine, ice cream, candy, toffee, confectionary and chewing gum (Joshi *et al.*, 2005) [5]. Strawberry basically is a plant of temperate climate. However, in recent years, there has been phenomenal increase in its area and production in tropical and subtropical plains of India (Sharma and Sharma, 2006 [18]; Sharma *et al.*, 2006) [16]. It has adapted well to highly varying climatic conditions. U.S.A. is the world's largest strawberry producer followed by Spain, Turkey, Korea, and Egypt and Mexico. In India, strawberry (*Fragaria x ananassa* Duch.) was first introduced at NBPGR Regional Research Station, Shimla (Himachal Pradesh) in the early sixties. Now it is being cultivated in Himachal Pradesh, Uttarakhand, Maharashtra, Delhi, Punjab, Haryana, West Bengal, Rajasthan and Nilgiri hills (Chadha, 2001) [3]. A number of high yielding varieties viz. Chandler, Pajaro, Etna, Sweet Charlie, Selva, Douglas, Confictura, Dana, Belrubi, Gorella, and Addie have been introduced into India from Europe and North America. Some of the day neutral cultivars viz. Selva, Majesti, Etna, and Fern may be adapted for Indian climatic situation. It is fact that strawberry has a great potentiality of area expansion in different agro climatic zones of West Bengal. At present the area and production in West Bengal is much less. The less productivity of this crop is due to the poor performance of existing cultivars with improper management.

Even the systematic research work for standardization of suitable strawberry cultivars of India under West Bengal condition is not carried out. A systematic study of performance of different varieties of strawberry is essential before taking up any planned programme for their commercial exploitation and also for breeding work. Hence, the present experiment was undertaken to study the "Performance of strawberry cultivars in new alluvial zone of West Bengal".

Materials and Methods

The experiment was carried out at Krishi Vigyan Kendra (KVK) of Bidhan Chandra Krishi Viswavidyalaya located at Gayeshpur, Nadia, West Bengal during the months of October to March, 2018-20. The experimental soil was Gangetic alluvial with sandy loam in texture and pH is nearly 6-6.5 with good drainage facilities and the climate was subtropical humid where summer and winter are short and mild. The maximum temperature ranged from 25.4 °C to 36.8 °C and minimum temperature from 8.55 °C to 19.4 °C during the period of investigation. Most rainfall occurred during October due to the influence of south-west monsoon with a maximum (23.46 mm) in the month of October. The average atmospheric relative humidity varied from 67.43 to 81.48 per cent. The experiment was laid out in Randomized Block Design with 8 treatments (cultivars) and 3 replications. The cultivars were Barak, Crystal, Gilt, Hader, Sabrina, Sabrina 1, Sweet Charlie and Winter Dawn. The tissue cultured plants were collected from Kumar Florist Bioplant, Pune as planting materials. Healthy plants were planted in a raised bed of 4×1m size for each replication in the month of October under shed net condition with the spacing of 30 cm × 30 cm (plant to plant and row to row). Each bed/replication consists of 42 plants. Pre planting application of manures and fertilizers were done with rate of 20 tonnes of FYM, 20 kg N, 40 kg P₂O₅ and 40 kg K₂O per ha. Two foliar applications (0.3%) of B, Zn, Cu during flower bud formation were applied for increasing yield and quality of fruits. Black polythene mulch was used for suppression of weed growth and for getting attractive fruits. Experimental plants were irrigated at regular intervals through drip. Necessary plant protection measures were taken to control the insect pest and diseases problem in field.

Data on plant height, plant spread and number of runners were taken from four plants in each replication at first harvesting stage when cessation of growth already took place. Leaf characters were recorded from matured leaves of almost same age. Number of leaves in a plant was recorded from randomly selected four plants in each replication. Twenty fully matured, healthy, disease-free fruits from each replication were harvested in the morning and brought to the laboratory immediately. The morphological, physical and chemical characters of fruits were recorded after thorough washing with tap water to remove adhering impurities. The data were analysed statistically by the analysis of variance method as suggested by Panse and Sukhatme (1978) [12] and the significance of different source of variation was tested by error mean square by Fisher's 'F' test of probability level of 0.05 per cent.

Results and Discussion

Plant and leaf characters

Perusal of the data presented in Table 1 revealed significant variation in plant height (14.16 - 24.4 cm), plant spread (27.27- 41.9 cm), number of runners per plant (2.26- 5.84),

leaf area (79.21-113.85 cm²) and number of leaves per plant (24.83-35.32) among different cultivars of strawberry. More or less similar results in terms of plant and leaf characters were obtained earlier by Mandal *et al.* (2001) [8], Rao and Lal (2010) [15] and Neetu and Sharma (2018) [10]. In contrast, Sharma *et al.* (2009) [17] obtained much higher plant height and lesser plant spread and number of leaves per plant in five varieties of strawberry under Allahabad condition. But Ram and Yadav (2006) [14] obtained much lesser plant height of strawberry at Lucknow, whereas the number of runners per plant is similar as that of present findings. The leaf area collected by Negi and Upadhyay (2016) [11] in different cultivars of strawberry at Palampur was much lesser as compared to present findings. In the present findings, vegetative growth in terms of plant height and plant spread was found maximum in Sabrina (24.4 cm and 41.9 cm, respectively) followed by Sweet Charlie (21.87 cm and 34.96 cm, respectively). The cultivar Gilt showed moderate vegetative growth (19.27 cm plant height and 34.4 cm plant spread). The leaf area was also found higher in Sweet Charlie (113.85 cm²) and Sabrina (108.78 cm²). However, the number of leaves per plant was recorded higher in Gilt (35.32), Crystal (34.17) and Barak (34.01). Interestingly, less vigorous cultivars Crystal (5.84) and Hader (4.08) produced higher number of runners per plant where as it was much less in vigorous cultivars Sabrina (3.66) and Sweet Charlie (3.22).

Yield and yield attributing characters

The variation was also significant in fruit yield per plant (245.27- 1305.7 g), fruit yield per ha (11.78-62.73 q), fruit weight (14.84- 29.23 g), fruit length (3.95-5.02 cm) and fruit diameter (2.85-4.32 cm) among different cultivars of strawberry (Table 2; Fig. 1). The present findings revealed much higher yield, fruit weight and fruit size as compared to the earlier findings of Pradipkumar *et al.* (2002) [13], Asrey and Singh (2004) [2], Nagre *et al.* (2005) [9], Sharma and Thakur (2008) [19] and Singh *et al.* (2012) [20]. However, more or less similar observations of yield and yield attributing characters were noted earlier by Giongo *et al.* (2006) [4] and Singh and Patel (2008) [21]. In the present studies, the cultivar Winter Dawn produced maximum fruit yield (1305.7 kg/plant and 62.73 q/ha) followed by Gilt (971.08 g/plant and 46.65 q/ha) and Sweet Charlie (765.34 g/plant and 36.77 q/ha). The cultivar Winter Dawn also produced fruits having maximum weight (29.23 g), fruit length (5.02 cm) and fruit diameter (4.32 cm). The maximum fruit yield of Winter Dawn might be due to the higher fruit weight and size. However, higher fruit weight and fruit size were also recorded in Crystal, Gilt and Hader.

Bio-chemical characters

A prominent and significant variation was obtained in chemical composition of fruits viz. total soluble solids (4.95-7.81 °brix), total sugar (3.71-5.07%), reducing sugar, (2.83-3.93%), non reducing sugar (0.18-1.09), titratable acidity (0.48-0.93%), TSS/acid ratio (6.95-11.97), ascorbic acid (42.0-70.85 mg/100 ml juice) and anthocyanin (11.46-37.99 mg/100 ml juice) among different cultivars of strawberry (Table 3). The ranges of bio-chemical characters in the present studies are in conformity with the earlier findings of Nagre *et al.* (2005) [9] and Kumar *et al.* (2011) [6]. But Sharma and Thakur (2008) [19] had obtained higher TSS and acidity on fruits of strawberry. The fruits of Sweet Charlie in the present studies exhibited maximum TSS/acid ratio (11.97) with

minimum titratable acid (0.48%) content. The higher TSS/acid ratio in Sweet Charlie was due to the presence of least acidity (0.48%) in fruits. Winter Dawn fruits contained maximum amount of ascorbic acid (70.85 mg/100 ml juice) with moderate amount of total sugar (4.23%) and anthocyanin (33.34 mg /100 ml juice) content. The cultivar Crystal showed

higher amount of TSS/acid ratio (10.16), total sugar (5.07%) and ascorbic acid (57.90 mg /100 ml juice) in fruits. Barak had a moderate amount of TSS (6.06 °brix) and TSS/acid ratio (9.27). Though, fruits of cultivar Sabrina had maximum TSS but it has less TSS/acid ratio (8.42). The lesser TSS/acid ratio in Sabrina might be due to maximum acidity (0.93%) in fruits.

Table 1: Plant and leaf characters in different strawberry cultivars

| Cultivars | Plant height (cm) | Plant spread (cm) | Number of leaves/plant | Leaf area (cm ²) | Number of runners /plant |
|---------------|-------------------|-------------------|------------------------|------------------------------|--------------------------|
| Barak | 14.16 | 27.27 | 34.01 | 102.74 | 3.38 |
| Crystal | 16.4 | 30.25 | 34.17 | 90.79 | 5.84 |
| Gilt | 19.27 | 34.4 | 35.32 | 79.21 | 2.27 |
| Hader | 16.52 | 30.59 | 33.29 | 104.98 | 4.08 |
| Sabrina | 24.4 | 41.9 | 32.99 | 108.78 | 3.66 |
| Sabrina-I | 18.3 | 33.53 | 26.55 | 102.46 | 2.55 |
| Sweet Charlie | 21.87 | 34.96 | 24.83 | 113.85 | 3.32 |
| Winter Dawn | 16.98 | 30.68 | 26.81 | 85.98 | 2.26 |
| SE(m)± | 0.57 | 1.17 | 1.95 | 1.10 | 0.36 |
| C.D. (0.5%) | 1.75 | 3.60 | 7.71 | 5.09 | 1.09 |

Table 2: Yield and yield attributing characters in different strawberry cultivars

| Cultivars | Yield/plant (g) | Yield/ha (t) | Fruit weight (g) | Fruit length (cm) | Fruit breadth (cm) |
|---------------|-----------------|--------------|------------------|-------------------|--------------------|
| Barak | 330.78 | 15.89 | 14.84 | 4.1 | 3.06 |
| Crystal | 432.85 | 20.8 | 24.58 | 4.4 | 3.52 |
| Gilt | 971.08 | 46.65 | 22.09 | 4.77 | 3.47 |
| Hader | 432.71 | 20.79 | 22.49 | 4.45 | 3.44 |
| Sabrina | 245.27 | 11.78 | 17.42 | 4.22 | 2.85 |
| Sabrina-I | 638.98 | 30.7 | 16.78 | 3.95 | 3.03 |
| Sweet Charlie | 765.34 | 36.77 | 18.86 | 4.16 | 3.45 |
| Winter Dawn | 1305.7 | 62.73 | 29.23 | 5.02 | 4.32 |
| SE(m)± | 8.01 | 5.43 | 1.41 | 0.06 | 0.13 |
| C.D. (0.5%) | 26.55 | 16.54 | 4.33 | 0.19 | 0.391 |

Table 3: Bio-chemical characters of fruits in different strawberry cultivars

| Cultivars | TSS (°brix) | Titratable Acidity (%) | TSS/Acid Ratio | Total Sugar (%) | Ascorbic acid (mg/100 ml juice) | Anthocyanin (mg/100 ml juice) |
|---------------|-------------|------------------------|----------------|-----------------|---------------------------------|-------------------------------|
| Barak | 6.06 | 0.65 | 9.27 | 4.02 | 51.22 | 22.12 |
| Crystal | 5.73 | 0.57 | 10.16 | 5.07 | 57.90 | 21.38 |
| Gilt | 4.95 | 0.62 | 7.95 | 3.92 | 56.63 | 23.20 |
| Hader | 5.58 | 0.81 | 6.95 | 3.71 | 57.58 | 30.78 |
| Sabrina | 7.81 | 0.93 | 8.42 | 4.38 | 51.68 | 32.37 |
| Sabrina-I | 5.71 | 0.68 | 8.38 | 4.16 | 53.05 | 37.99 |
| Sweet Charlie | 5.78 | 0.48 | 11.97 | 4.21 | 42 | 11.46 |
| Winter Dawn | 5.72 | 0.73 | 7.89 | 4.23 | 70.85 | 33.34 |
| SE(m)± | 0.16 | 0.02 | 0.29 | 0.17 | 1.39 | 0.67 |
| C.D. (0.5%) | 0.48 | 0.07 | 0.89 | 0.51 | 4.26 | 2.06 |



Fig 1: Fruits of strawberry cultivars

Conclusion

It was concluded that the performance of Sweet Charlie and Winter Dawn were superior in the alluvial zone of West Bengal considering yield, fruit size and fruit quality. However, the performance of Gilt in respect of fruit weight, fruit size and yield was also good.

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