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Evaluation of cultivars of strawberry, a temperate fruit for its adaptability as well as productivity in sub-tropical agro-climatic condition of Supaul district in Bihar

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ABSTRACT : The findings of a field trial conducted in 2012-13 and 2013-14 to assess different cultivars of strawberry in Supaul district of Bihar revealed that short day cultivars were more tolerant to insect pests than day neutral cultivars, particularly in later stage of fruit development leading to record higher yield. It was also revealed that a suitable micro-climate was required for optimum plant growth, higher crop yield and the best quality fruits. Festival was found to be the best performing variety in respect of weight per fruit, yield and marketable fruit quality having maximum growth, plant height (21.34cm), flowering duration (60.09 days), fruiting duration (55.62 days) and yield (15.26 tons/ha).

KEY WORDS : Strawberry, Festival, Camarosa, Sweet charlie

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Strawberry (Fragaria x Ananassa Duch) is a native of France and belongs to the family Rosaceae. All cultivated varieties are octaploid (2n=56). Botanically it is an aggregate fruit which is highly perishable in nature. In temperate climate condition, its plants behave like a small perennial herb (Finn and Strike, 2008) with shallow root system whereas in sub-tropical climate it behaves as annuals. Owing to its medicinal properties (anti-carcinogenic, anti-diabetic and anti-oxidant), strawberry is gaining popularity among all age group consumers (Asrey and Patel, 2003). Strawberries are good source of natural anti-oxidant (Wang *et al.*, 1996 and Heinonen *et al.*, 1998), carotenoids, vitamins, phenols, flavonoids, dietary glutathionone and metabolites (Larson, 1988). It exhibits high level of anti-oxidant capacity against free radical species, superoxide radicals, hydrogen peroxide, hydroxyl radicals and singlet oxygen (Wang and Jiao, 2000), lower calorific value, absence of cholesterol and higher level of minerals like phosphorus, potassium, calcium, iron and especially vitamin C (40-100mg/10g berries) (Kumar *et al.*, 2011), vitamin B, proteins, which make it ideal for health conscious consumers. It is in high demand for table purpose as well as for Jam making, canning, ice-cream preparation, beverages, wine, soft drinks and other quality products. It is a complete fruit with 98 per cent edible portions. Among the fruits it gives the maximum economic returns in the shortest possible time.

Fruit of strawberry is a modified receptacle, one seeded fruit or achenes which is located on the outer surface (Szczesniak and Smith, 1969). Strawberry is non-climacteric fruit (Coombey, 1976) and fruits reach in full red stage within 28-30 days after anthesis, having the maximum fruit weight and size. Strawberry is very short

duration temperate fruit crop but due to day neutral habit of growth and multi uses of polyethylene, crop may be successfully cultivated in sub-tropical reason also. Climate of Bihar is suitable for growth and better yield. Strawberry fruit due to excellent flavour, attractive colour and rich in nutritional contents has become a very popular fruit crop in Bihar. Strawberry contains 87.8 per cent water, 0.7 per cent protein, 0.2 per cent fat and 0.3 per cent iron in 100g of fresh fruit which provides approximately 30 calories of energy. It performed better under temperate ranges between 15°C to 35°C (Rani and Ahmad, 2012) necessarily having a temperate range of 14-18°C at flavouring and soil rich in organic contents with light clay to loam and pH (5.6 to 6.5). Plant growth parameters like plant height, plant spread and yield are significantly influenced by cultivars and climate. Poly tunnel might have created favourable micro-climate condition for faster growth as expressed by Kaska *et al.* (1988) in strawberry. According to response of varieties to photoperiod, two types of strawberry are now grown commercially *i.e.* day neutral and short day plant. Long day (ever bearing) varieties are also available but they are rarely grown outside the home garden. Short day types are actually facultative. The temperature and day-length (photo-periodism) have considerable effects on growth and yield of strawberry probably through the control of the production of plant hormones. High growth rates of strawberries are maintained at day temperatures of 22-23°C. An average growing temperature of 15°C has been reported for most of the strawberry cultivars and species. Mulching and essential cultural practices for strawberry cultivation has been found to be very effective for higher yield as it helps in soil moisture conservation, weed control keeping the fruits clean and avoiding fruit rotting due to soil contamination. Mulching should be done after proper establishment of runners and before flowering (30-45 days after planting). Climate of Supaul district having mild and shorter summer than other parts of Bihar enabling plant to sustain for a longer time in the field leading to more production as observed during trial.

Sweet Charlie is a day neutral cultivar and can adjust well with growing periods. The fruits are firm having deep red colour. Leaves are medium to dark green, slightly cupped and semi-glossy. Sweet Charlie plants have a typical ripening profile that can be quite variable. Sweet Charlie fruit has two week of early production and after initial two week, size tends to drop of drastically. In the early mid season and even in second crop, very large fruits are produced in the last week of season.

Camarosa is a short day pedigree having larger and fruits are firm than Chandler. Its fruits are very flute, conical over an extended period at low latitude.

Festival is a short day (Rosa linda x Rosa grande) cultivars. It produces numerous runners, fruit with long pedicles, fruits are firm, fleshy, conical and deep red on the outside and bright red inside.

Keeping in view the facts mentioned above, the present trial was planned and carried out to assess the performance of different cultivars in respect of quality and yield of strawberry in the climatic conditions of Supaul and to study the impact of change in weather parameters on flowering and fruiting behaviour of strawberry.

RESEARCH METHODS

The trials were conducted in the fields of seven innovative and receptive farmers in the years 2012-13 and 2013-14, which represented the replication. The treatments consisted of three cultivars of strawberry *viz*., Sweet Charlie (T_1), Camarosa (T_2) and Festival (T_3) which were replicated seven times. The plot size for each treatment was $3m^2$, recommended package of practices were followed uniformly in all the treatments. Healthy runners were transplanted on raised bed with two rows apart 50cm. Planting distance was 30cm. Mulching was done by paddy straw and irrigation was provided by sprinkler method. Observations were recorded and growth and yield parameters of fruits on 10 randomly selected plants in each treatments. Average plant height was recorded in centimetre with the help of metre scale. Average flowering duration was recorded as the number of days taken from initiation of flowering to fruit set. Fruiting duration was recorded as the number of days taken from first fruit set to the last fruit set. Total number of fruits per plant, fruit length and breadth in centimetre were recorded. Average fruit weight in gram was computed and yield of fruit per plant was recorded. The yield per hectare in tons and B:C ratio were recorded. Data pertaining to fruit size, fruit weight were recorded at each harvest and average was taken after completion of all harvests. These data were subjected to statistical analysis following standard procedures (Panse and Sukhatme, 1989).

RESEARCH FINDINGS AND DISCUSSION

The finding of the trial of different growth and yield

parameters are presented under the following heads :

Plant height :

The data in Table 1 showed that plant height varied significantly in different varieties, festival was found to have the maximum plant height (21.34 cm) being at par with Sweet Charlie (19.17cm) while Cemarosa had the minimum 17.78cm. The most profuse growth witnessed by festival might be cause of its maximum plant height which is in agreement with the views expressed by Rani and Ahmad (2012), varietal differences in plant spread and height was also noted by Singh *et al.* (2008) in Meghalaya which supports the present observation.

Flowering duration :

Data presented in Table 1 revealed that flowering duration varied significantly among the varieties. Festival cultivar recorded the maximum flowering duration (60.09 days), while Sweet Charlie recorded the minimum (54.30 days). The minimum flowering in Sweet Charlie might be attributed to its short crop period which is in conformity with the observations made by Montero *et al.* (1996). Variability in flowering period in different varieties might also be due to differences in their chilling requirement as suggested by Badiyala and Joolka (1983) or due to differences in their genetic makeup as opined by Li *et al.* (1993).

Fruiting duration:

A perusal of data (Table 1) revealed that the varieties differed significantly in respect of their fruiting period. Festival (T_3) witnessed the longest fruiting duration (55.62 days) while camarosa had the shortest fruiting period (46.76 days) although being at par with Sweet Charlie. Longer fruiting period in Festival might be attributed to its profuse growth.

Fruit size:

The data (Table 1) showed significant variation in the size (length and breadth) of fruits among the varieties. Festival was found to have the longest fruit (4.19 cm) though being at par with Sweet Charlie (3.28 cm) while Camarosa had the shortest length (2.90 cm). Similarly the varieties differed significantly in width also. Festival recorded the maximum width (3.09 cm) followed by Sweet Charlie (2.27 cm) while Camarosa had the minimum (2.00 cm). The variations in the size of the fruit might be due to differential genetic make of the genotypes. This observation finds support from the findings of Dwiwedi *et al.* (2004) in the cold condition of Ladakh.

Fruit weight :

It is apparent from the data (Table 1) that there was no significant difference in fruit weight of different varieties. Festival showed the maximum fruit weight (13.48 g).

Number of fruits/plant :

The data presented in Table 1 showed that the number of fruits/plant varied significantly in different varieties. Festival was observed to have maximum number (18.90) of fruits/plant being at par with Sweet Charlie (15.74), while Camarosa had the minimum (14.95) fruits/plant. It might be due to more number of shoots in Festival than other varieties. This finding is in confirmation with the observation made by Asrey and Singh (2004) on the varietal differences in respect of number of fruits/plant in semi-arid region of Punjab.

Yield/ha :

Data in Table 1 revealed that there was significant difference in yield/ha in different varieties. Festival was found significantly superior to other varieties in respect of yield of fruits/ha. It gave the highest yield (15.26 tons/ha) followed by Sweet Charlie (12.14 tons/ha) while camarosa had the lowest yield (11.16 tons/ha). The highest yield in Festival might be attributed to more

Table 1 : Comparison of the varieties of strawberry based on different parameters

Verities	Plant height (cm)	Flowering duration (days)	Fruiting duration on (days)	Fruit length (cm)	Fruit width (cm)	No. of fruit /plant	Fruit weight (g)	Yield /plant (g)	Yield /ha (ton)	B:C ratio
T_1-Sweet Charlie	19.17	54.30	50.07	3.28	2.27	15.74	12.85	202.37	12.14	2.33
T_2-Camarosa	17.78	56.24	46.76	2.90	2.00	14.95	12.44	186.04	11.16	2.14
T_3-Festival	21.34	60.09	55.62	4.19	3.09	18.9	13.48	254.38	15.26	2.92
C.D. (P=0.05)	2.48	7.94	8	1	0.45	3.27	NS	50.61	3.03	
CV(%)	8.13	8.13	8.85	16.3	10.37	11.14		13.27	13.27	

NS=Non-significant

number of fruits borne by its plant. This finding is in agreement with the observation made by Coombey (1976). Varietal differences in yields depend on a number of factors *viz.*, fruit bearing potential of the cultivar, development of growth of plants; weather conditions (Kiprijanovski and Arsov, 2004).

The findings of this trial also revealed that the farmers of Supaul (subtropical reason) can switch over to the cultivation of strawberry in place of their traditional crops for economic returns, as crop stands well and gives good economic returns in such an agro-climatic conditions of Bihar.

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