



## Research Article

# PERFORMANCE OF STRAWBERRY F<sub>1</sub> HYBRIDS AND PARENTS FOR FLOWERING, FRUITING AND VEGETATIVE PARAMETERS

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**Abstract-** Assembling of hybrid varieties that had superior agronomic character in plant breeding programs was by crossing two or more plants that have superior character. The present study was carried out at the Department of Fruit Science, Dr YS Parmar University of Horticulture and Forestry with the aim of studying the performance of strawberry F<sub>1</sub> hybrids and parents for flowering, fruiting and vegetative parameters in field conditions. Seven strawberry cultivars were crossed in all possible combinations to provide a total of 42 F<sub>1</sub> hybrids and seven inbred lines used as parents. Among hybrids, 'Gorella x Selva' (8/2/17) was earliest in initiation of flowering followed by 'Chandler x Ofra' (11/2/17). F<sub>1</sub> Hybrid 'Sweet Charlie x Chandler' flowered late (16/3/17). 'Gorella' among parental lines, was earliest in flowering (10/2/17). On the other hand, 'Addie' was earliest in completion (end) of flowering (21/3/17). Hybrid combination 'Gorella x Selva' completed flowering very soon (10/3/17). Fruit weight ranged from 7.02 to 9.73 g among parents. Hybrid combination 'Gorella x Chandler' had heaviest fruit (15.64 g). Maximum number of fruit per plant was in parental line 'Gorella' (17.31) whereas amongst F<sub>1</sub> hybrids, it was in 'Chandler x Gorella' (28.59) which was statistically at par with 'Selva x Gorella' (26.47). Plant height ranged from 16.52 cm (Addie) to 25.87 cm (Gorella) among parental lines. 'Selva x Chandler' (28.61 cm) produced maximum plant height. Leaf number among parents and F<sub>1</sub> hybrids varied from 17.56 to 21.58 and 16.74 to 26.48 respectively. Hybrid, 'Chandler x Gorella' (26.48) registered maximum leaf number.

**Key words-** F<sub>1</sub> hybrids, inbreds, flowering, fruiting

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## Introduction

Strawberry (*Fragaria x ananassa* Duch.) is one of the most delicious fruits of the world, rich source of vitamins and minerals. It is natural hybrid of the South American *Fragaria chiloensis* (L.) and the North American *Fragaria virginiana* (Duch.). This intermingling of genetic characteristics has resulted in a fruit of great variety in taste and color with a cropping ability and season of such versatility that it can be grown from the tropics to the cool temperate regions of the world. The heterozygous genetic composition possessed by hybrid varieties makes them superior to non-hybrid varieties that had homozygous genetic composition. The plant breeding program in detail aims to assemble new varieties with high yield, good yield quality, improved agronomic characteristics, pest and disease resistance, and other properties. It is expected to contribute according to the criteria desired by the producers, consumers, and the breeders themselves [1]. Plant breeding activities to form varieties with high yield properties, good yield quality, and others that meet the commercial criteria one of them was to develop hybrid varieties. Assembling of hybrid varieties that had superior agronomic character in plant breeding programs is by crossing two or more plants that have superior character. Therefore, the purpose of evaluating the performance of hybrids and inbred lines result of crossing through diallel mating were to identify and select superior hybrids for various fruiting and vegetative traits for further utilisation in breeding programme.

## Materials and Methods

The investigation was aimed on assembling hybrids that had superior agronomic characters. In the present study, seven strawberry cultivars were crossed in all

possible combinations to provide a total of 42 F<sub>1</sub> hybrids and seven inbred lines used as parents. These populations were grown in the experimental field in mid-November 2016 at Dept. of Fruit Science, Dr YSPUHF, Solan and were evaluated for a number of traits in subsequent season. Special attention has been paid to date of flowering, number of fruits, fruit weight, plant height and leaf number. The data obtained were analysed following the ANOVA as given by Panse and Shuklatme [7] in Randomized Block Design (RBD) with three replications.

## Results and Discussion

The observations recorded on various parameters are presented [Table-1]. Parental lines 'Gorella' was earliest in initiation of flowering as flower bud appeared on 10/2/17 followed by 'Ofra' (16/2/17) and 'Addie' (19/2/17). 'Chandler' (11/3/17) flowered late. Among hybrids, 'Gorella x Selva' (8/2/17) was earliest in initiation of flowering followed by 'Chandler x Ofra' (11/2/17) whereas hybrid 'Sweet Charlie x Chandler' was late in initiation of flowering (16/3/17). On the other hand, 'Addie' was earliest in completion (end) of flowering (21/3/17). 'Confectura' (30/4/17) took more time to cease flowering. Among hybrids, 'Gorella x Selva' (10/3/17) was earliest in ceasing flowering followed by 'Chandler x Ofra' (19/3/17) whereas Selva x Chandler (20/04/17) was late in completion of flowering. In present study earliest initiation of flowering was seen in inbred line 'Gorella' and earliest in completion (end) of flowering was in 'Addie'. Hybrids of 'Gorella' also exhibited early flowering in F<sub>1</sub> seedlings. 'Yotsuboshi' an F<sub>1</sub> hybrid of 'Miebohon 1 gou' and 'A8S4-147', exhibited earliness under natural conditions with a lower temperature and shorter day length, while flower initiation was also induced under long-day treatment [6]. Significant differences were obtained among the parents

and hybrids for fruit weight [Table-1]. Fruit weight ranged from 7.02 to 9.73 g among parents. Maximum fruit weight was observed in 'Gorella', while minimum was in 'Addie' (7.02 g). Amongst F<sub>1</sub> hybrids, fruit weight ranged from 9.00 g (Ofra x Sweet Charlie) to 15.64 g (Gorella x Chandler). Eight F<sub>1</sub> hybrid families viz., Chandler x Gorella (15.09 g), Chandler x Selva (14.48 g), Selva x Chandler (13.73 g), Selva x Confectura (13.55 g), Gorella x Confectura (13.55 g), Chandler x Confectura (13.49 g), Selva x Gorella (13.44 g), Confectura x Chandler (13.09 g) were statistically similar with maximum value. Present study indicated higher fruit weight in F<sub>1</sub> hybrids than inbred parental lines. Chuan (2005) in heterosis studies in strawberry found maximum fruit weight in cross Belrubi x Chandler (12.8 g) followed by 'Fairfax x Chandler' (12.70 g) and Selva x Chandler (12.30 g). F<sub>1</sub> hybrids between *F. ananassa* and *F. ovalis* were intermediate between their parents in fruit weight [15]. Present findings were also supported by Pshikhacheva and Marchenko, [8] and Hancock, *et al.* [4] who found average fruit weight of more than 12 g and 20 g in various crosses.

The perusal of data [Table-1] revealed maximum number of fruits per plant in 'Gorella' (17.31) which was at par with 'Chandler' (16.00), 'Selva' (15.45) and 'Sweet Charlie' (15.18). Whereas, minimum was recorded in 'Addie' (11.00), 'Ofra' (12.74) and 'Confectura' (12.85). Amongst F<sub>1</sub> hybrids, maximum number of fruits per plant was in 'Chandler x Gorella' (28.59) which was statistically at par with 'Selva x Gorella' (26.47). On the other hand, 'Confectura x Addie' (15.50) produced least number of fruits per plant. This study indicated maximum fruits in F<sub>1</sub> crosses than parental lines and are in line with the work of Roudeillac [11] who indicated that 'Chandler' transmits high yield to the progeny. In line with the present results, Recupero, *et al.* [9] compared cultivar Chandler with cross combination 81.143.4 x Chandler, observed high yield in Chandler (836 g/plant) than the cross combination (664g/plant) whereas 'Fern' as parent resulted in over productive plants with small berries [13]. As per the mean performance of F<sub>1</sub>'s and parents [3], number of fruits among parents ranged from 8.50 to 13.60 and among hybrids it varied from 8.40 to 24.80 highest being in 'Torrey x Blackmore' followed by 'Fairfax x Chandler' (23.50).

Parental lines viz., Gorella (25.87), Chandler (25.47), Selva (23.89) and Sweet Charlie (23.66), were statistically similar with each other in producing more plant height. Among hybrids 'Selva x Chandler' (28.61 cm) produced maximum plant height which statistically did not differ from hybrids viz., 'Sweet Charlie x Gorella' (28.50 cm), 'Chandler x Selva' (28.29 cm), 'Gorella x Selva' (28.14 cm), 'Chandler x Gorella' (28.07 cm), 'Selva x Gorella' (27.83 cm), 'Gorella x Chandler' (27.81 cm), Sweet Charlie x Chandler (27.73 cm), Sweet Charlie x Selva (27.02 cm), Selva x Sweet Charlie' (26.70), 'Gorella x Sweet Charlie' (26.63 cm), and 'Confectura x Chandler' (26.50 cm). Wide variation with respect to plant height has also been noticed by Sharma and Thakur [12] and Singh, *et al.* [14]. Recupero, *et al.* [9] observed good plant vigour in the progeny of cross combination 'Douglas' x 78.165.1 [(Titan' x 'Belrubi') x 'Toro'] and small plant in 'Pajaro' x 81.142.1 [(Dover' x Douglas)]. The F<sub>1</sub> crosses 'Blackmore x Chandler' (16.00 cm) and 'Chandler x Belubi' (17.60 cm) had more plant height than their parents [3]. Plant vigour and yield in inbred lines were low compared with the original cultivar but completely recovered in the F<sub>1</sub> hybrid [10]. According to Zubov and Volkova [15] F<sub>1</sub> hybrids between *F. ananassa* and *F. ovalis* were intermediate between their parents for plant height.

Leaf number among parents and F<sub>1</sub> hybrids varied from 17.56 to 21.58 and 16.74 to 26.48 respectively. Line 'Gorella' had maximum leaf number and minimum was in 'Addie'. On the other hand F<sub>1</sub> hybrids, 'Chandler x Gorella' (26.48) registered maximum leaf numbers and was statistically at par with 'Chandler x Selva' (25.13), Selva x Chandler (23.55), Selva x Confectura (24.48), Gorella x Chandler (26.44), Gorella x Selva (24.52), Sweet Charlie x Chandler (23.26). Cross 'Confectura x Ofra' registered minimum leaf number (16.74) most of the remaining crosses were statistically similar with minimum values [Table-1]. Significant variation with respect to leaf number has also been indicated by Asrey and Singh [2] and Singh, *et al.* [14]. Work of Matsuda, *et al.* [5] revealed similar or intermediate leaf number of F<sub>1</sub> strawberry plants compared to those of the parents. Variation in leaf number among hybrids and parents was also reported by Chuan [3] and trait ranged from 5.8 to 14.60 which is quite lower than present study.

## Conclusion

Most of the F<sub>1</sub> hybrids exhibited superior performance in terms of flowering, fruit weight, number of fruits and vegetative parameters. 'Gorella' and 'Chandler' with most of the cross combinations produced heavier, more number of fruits and vigorous plants. Hence, could be utilized in strawberry breeding programme for incorporating particular trait.

**Application of research:** Superior hybrids in terms of yield and quality could be utilised to meet farmers demand.

**Research Category:** Fruit Science

## Abbreviations:

g- grams; cm-centimetres; viz.,- namely

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## Author Contributions: All author equally contributed

**Author statement:** All authors read, reviewed, agree and approved the final manuscript

## Conflict of Interest: None declared

**Ethical approval:** This article does not contain any studies with human participants or animals performed by any of the authors.

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**Table-1** Mean performance of hybrids and parents for flowering, fruiting and vegetative characters

Parents/Hybrids	Date of initiation of flowering	Date of end of flowering	Fruit weight (g)	Number of fruits per plant	Plant height (cm)	Leaf number
Chandler (P <sub>1</sub> )	11-03-2017	20-04-2017	9.20	16.00	25.47	20.40
Selva (P <sub>2</sub> )	18-02-2017	27-03-2017	8.29	15.45	23.89	19.81
Gorella (P <sub>3</sub> )	10-02-2017	22-03-2017	9.73	17.37	25.87	21.58
Sweet Charlie (P <sub>4</sub> )	03-03-2017	16-04-2017	9.22	15.18	23.66	18.27
Confectura (P <sub>5</sub> )	25-02-2017	30-04-2017	9.51	12.85	21.84	18.55
Addie (P <sub>6</sub> )	19-02-2017	21-03-2017	7.02	11.00	18.51	17.56
Ofra (P <sub>7</sub> )	16-02-2017	02-04-2017	7.74	12.74	16.52	17.91
Chandler x Selva	14-03-2017	15-04-2017	14.48	25.15	28.29	25.13
Chandler x Gorella	18-02-2017	25-03-2017	15.09	28.59	28.07	26.48
Chandler x Sweet Charlie	16-03-2017	22-04-2017	12.03	21.02	25.24	19.35
Chandler x Confectura	10-03-2017	07-04-2017	13.49	20.00	25.40	22.37
Chandler x Addie	28-02-2017	30-03-2017	11.20	16.09	23.58	18.00
Chandler x Ofra	11-02-2017	19-03-2017	10.85	18.54	21.67	18.42
Selva x Chandler	13-03-2017	20-04-2017	13.73	23.96	28.61	23.55
Selva x Gorella	12-02-2017	20-03-2017	13.44	26.47	27.83	21.19
Selva x Sweet Charlie	12-02-2017	22-03-2017	11.00	21.43	26.70	20.36
Selva x Confectura	19-02-2017	23-03-2017	13.55	19.26	25.87	24.48
Selva x Addie	18-02-2017	21-03-2017	10.25	16.73	20.62	17.69
Selva x Ofra	21-02-2017	30-03-2017	10.55	16.21	19.04	20.05
Gorella x Chandler	02-03-2017	06-04-2017	15.64	25.11	27.81	26.44
Gorella x Selva	08-02-2017	10-03-2017	12.77	23.81	28.14	24.52
Gorella x Sweet Charlie	21-02-2017	30-03-2017	12.07	22.73	25.14	19.63
Gorella x Confectura	07-03-2017	20-04-2017	13.55	20.47	24.27	22.85
Gorella x Addie	15-02-2017	17-03-2017	11.34	17.00	19.79	18.83
Gorella x Ofra	19-02-2017	26-03-2017	10.95	19.00	20.96	20.25
Sweet Charlie x Chandler	16-03-2017	19-04-2017	12.84	20.83	27.73	23.26
Sweet Charlie x Selva	09-03-2017	11-04-2017	10.85	18.02	27.02	23.00
Sweet Charlie x Gorella	04-03-2017	12-04-2017	12.32	21.33	28.50	19.86
Sweet Charlie x Confectura	11-03-2017	16-04-2017	11.79	18.68	22.00	20.77
Sweet Charlie x Addie	20-02-2017	19-03-2017	9.31	16.88	19.78	19.10
Sweet Charlie x Ofra	09-03-2017	10-04-2017	10.00	17.00	19.56	17.35
Confectura x Chandler	22-02-2017	01-04-2017	13.09	19.09	26.50	21.96
Confectura x Selva	23-02-2017	28-03-2017	11.13	21.66	24.31	19.18
Confectura x Gorella	20-02-2017	31-03-2017	12.81	19.78	24.26	20.35
Confectura x Sweet Charlie	08-03-2017	13-04-2017	11.48	17.69	22.19	19.09
Confectura x Addie	22-02-2017	31-03-2017	11.22	15.50	17.35	18.36
Confectura x Ofra	28-02-2017	02-04-2017	10.87	18.14	15.88	16.74
Addie x Chandler	03-03-2017	06-04-2017	10.62	21.47	25.17	19.13
Addie x Selva	02-03-2017	10-04-2017	10.97	19.40	24.94	18.51
Addie x Gorella	20-02-2017	21-03-2017	11.05	20.48	25.41	19.30
Addie x Sweet Charlie	05-03-2017	12-04-2017	9.69	19.00	22.89	18.17
Addie x Confectura	12-03-2017	09-04-2017	10.00	16.00	22.04	18.00
Addie x Ofra	22-02-2017	30-03-2017	9.81	16.02	20.04	18.00
Ofra x Chandler	08-03-2017	10-04-2017	10.33	19.62	24.50	21.00
Ofra x Selva	06-03-2017	08-04-2017	10.63	17.00	24.47	18.48
Ofra x Gorella	13-02-2017	15-03-2017	11.00	18.94	24.33	20.03
Ofra x Sweet Charlie	11-03-2017	16-04-2017	9.00	19.80	24.66	19.22
Ofra x Confectura	12-03-2017	08-04-2017	11.18	16.59	23.62	18.17
Ofra x Addie	04-03-2017	05-04-2017	9.27	15.59	21.05	17.52
CD <sub>0.05</sub>	-	-	2.13	2.30	2.40	3.33