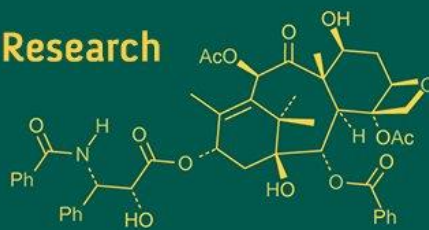
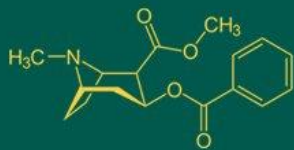


International Journal of Advanced Biochemistry Research



ISSN Print: 2617-4693
ISSN Online: 2617-4707
NAAS Rating (2026): 5.29
IJABR 2026; SP-10(7): 1942-1946
www.biochemjournal.com
Received: 24-05-2026
Accepted: 28-06-2026

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Effect of different varieties and planting dates on growth and yield of strawberry (*Fragaria x ananassa*)

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DOI: <https://www.doi.org/10.33545/26174693.2026.v10.i7Sw.9342>

Abstract

The present investigation entitled “Effect of different varieties and planting dates on growth and yield of strawberry (*Fragaria × ananassa* Duch.)” was conducted during the *Rabi* season of 2025-26 at the College of Horticulture, Anand Agricultural University, Anand, Gujarat. The experiment was laid out in a Factorial Completely Randomized Design with twelve treatment combinations comprising three varieties, viz., Nabila (V_1), Camarosa (V_2) and Winter Dawn (V_3), and four planting dates, viz., 15th October (S_1), 1st November (S_2), 15th November (S_3) and 1st December (S_4), replicated thrice. Among the varieties, Winter Dawn (V_3) recorded superior vegetative growth, with the highest leaf area (44.14 cm^2). However, Nabila (V_1) performed best in terms of yield, recording the highest number of flowers (14.88), fruit length (4.32 cm) and yield per plant (207.19 g). Among the planting dates, 15th October (S_1) recorded maximum vegetative growth, with the highest leaf area (68.85 cm^2) and number of leaves (7.28). However, 1st November (S_2) proved most suitable for obtaining higher yield, recording the maximum number of flowers (18.56) and yield per plant (277.46 g). The interaction effect of variety and planting date was significant for leaf area, number of flowers, fruit length and yield per plant. The treatment combination S_1V_3 (Winter Dawn planted on 15th October) produced maximum vegetative growth, with the highest leaf area (74.83 cm^2), whereas S_2V_1 (Nabila planted on 1st November) recorded the maximum number of flowers (19.00), fruit length (5.01 cm) and yield per plant (320.07 g). Therefore, Nabila planted on 1st November was found to be the most suitable treatment combination for achieving higher yield under 50% shade-net conditions in the agro-climatic conditions of Middle Gujarat.

Keywords: Strawberry, Nabila, Camarosa, winter dawn, planting dates, growth, yield

Introduction

Strawberry (*Fragaria × ananassa* Duch.) is an important high-value fruit crop belong to family Rosaceae. Although traditionally cultivated in temperate regions, its cultivation has expanded to subtropical and tropical. Strawberry fruits are highly appreciated for their attractive appearance, pleasant flavour, nutritional value, and rich content of antioxidants, vitamin C, minerals, and bioactive compounds, making them popular among health-conscious consumers (Verma *et al.* 2018) [16]. Environmental factors such as temperature, photoperiod, and light intensity significantly influence the growth, flowering, yield, and fruit quality of strawberry. Planting time determines the exposure of plants to favourable environmental conditions, while varietal characteristics govern their adaptability and productivity under specific agro-climatic conditions. Information on the performance of different strawberry varieties under varying planting dates is limited under the agro-climatic conditions of middle Gujarat. Hence, the present investigation was undertaken to evaluate the effect of different varieties and planting dates on the growth, yield of strawberry under 50% shade-net conditions.

Materials and Methods

The experiment was conducted during *Rabi* season of 2025-26 under 50% shade-net conditions at College of Horticulture, Anand Agricultural University, Anand, Gujarat, India ($22^\circ 33' \text{ N}$ latitude, $72^\circ 55' \text{ E}$ longitude and 45.1 m above mean sea level). The region falls under Middle Gujarat Agro-Climatic Zone with a semi-arid subtropical climate. During experimental period, the mean temperature and relative humidity inside the shade-net were 26.8°C and 68.5%, respectively.

The experiment was laid out in factorial Completely Randomized Design (CRD) with three replications comprising three strawberry varieties, viz., Nabila (V_1), Camarosa (V_2) and Winter Dawn (V_3), and four planting dates, viz., 15th October (S_1), 1st November (S_2), 15th November (S_3) and 1st December (S_4), resulting in 12 treatment combinations.

Runner plants were transplanted into 10' × 12' polybags filled with a growing medium consisting of cocopeat, perlite and vermicompost in a 3:1:1 (v/v). Plants were maintained at spacing of 30 × 30 cm. A recommended fertilizer dose of 75:60:80 kg ha⁻¹ NPK was applied, with 25% as basal dose and the remaining nutrients supplied through monthly drenching of water-soluble fertilizer (19:19:19) at 0.5 g L⁻¹. Observations on vegetative growth parameters, leaf area and number of leaves per plant, were recorded at 30 days after planting. Yield attributes such as number of flowers, fruit length and yield per plant were recorded during the harvesting period. The data were subjected to analysis of variance (ANOVA) following the procedure described by Panse and Sukhatme (1985) [12].

Results and Discussion

Growth parameter

Effect of varieties and planting dates on number of leaves per plant and leaf area: The perusal of data (Table 1) revealed that at 30 DAP, the number of leaves per plant

did not differ significantly among the varieties. Among the varieties V_3 (Winter Dawn) recorded the highest number of leaves per plant (5.86), followed by V_1 (Nabila) (5.53) and V_2 (5.49). Similarly, leaf area differed significantly among the varieties, with V_3 (Winter Dawn) recording the maximum leaf area (44.14 cm²), Followed by V_1 (Nabila) (42.97 cm²), while the minimum leaf area was recorded in V_2 (Camarosa) (38.10 cm²). These findings are in agreement with those of Bhamini *et al.* (2017) [1], Kousalya Bai *et al.* (2023) [7] and Gogoi *et al.* (2025) [4], who reported significant varietal differences in vegetative growth parameters among strawberry cultivars, with Winter Dawn exhibiting superior vegetative growth under protected cultivation conditions. Planting date significantly influenced both the number of leaves and leaf area. Among the planting dates S_1 (15th October) recorded the highest number of leaves per plant (7.28) and leaf area (68.85 cm²), whereas S_4 (1st December) recorded the lowest value (3.83 leaves per plant and 21.79 cm², respectively). The highest leaf production and leaf area under early planting might be due to favourable temperature and photoperiod conditions, which promoted better plant establishment and early vegetative growth. These finding are in agreement with the observations of Bhamini *et al.* (2017) [1], who reported better vegetative growth and higher leaf area under early planting conditions.

Table 1: Effect of different varieties and planting date on number of leaves per plant and leaf area

Treatment	Number of leaves per plant	Leaf area (cm ²)
	30 DAP	
Factor A: Variety		
V ₁ : Nabila	5.53	42.97
V ₂ : Camarosa	5.49	38.10
V ₃ : Winter Dawn	5.86	44.14
S.Em. ±	0.18	0.85
C.D. at 5%	NS	2.48
Factor B: Planting date		
S ₁ : 15 th October	7.28	68.85
S ₂ : 1 st November	6.33	42.65
S ₃ : 15 th November	5.07	33.64
S ₄ : 1 st December	3.83	21.79
S.Em. ±	0.21	0.98
C.D. at 5%	0.60	2.87
CV%	11.15	7.07

Interaction effect of variety and planting dates on number of leaves per plant and leaf area

The table 2 shows the interaction effect of varieties and planting dates on the number of leaves per plant was non - significant, whereas the interaction effect on leaf area was significant at 30 DAP. The maximum number of leaves per plant was recorded in V_3S_1 (Winter Dawn planted of 15th October) (7.63), followed by V_1S_1 (Nabila planted on 15th October) (7.20) and V_2S_1 (Camarosa planted on 15th October) (7.00). The minimum number of leaves per plant was observed in V_1S_4 (Nabila planted on 1st December) (3.13). In the case of leaf area V_1S_4 (Winter Dawn planted

on 15th October) recorded the maximum leaf area (74.83 cm²), followed by V_1S_1 (Nabila planted on 15th October) (74.63 cm²), whereas the minimum leaf area was recorded in V_2S_4 (Camarosa planted on 1st December) (16.77 cm²). The superior leaf area under the 15th October planting, particularly in Winter Dawn, might be attributed to favourable environmental conditions during the early growth period which promoted better plant establishment, leaf expansion and vegetative growth. In contrast, delayed planting, particularly on 1st December, resulted in reduced leaf area, possibly due to less favourable environmental conditions during the early growth phase.

Table 2: Interaction effect of variety and planting dates on number of leaves per plant and leaf area

Treatment	Number of leaves per plant	Leaf area (cm ²)
	30 DAP	
V ₁ S ₁	7.20	74.63
V ₁ S ₂	6.53	40.20
V ₁ S ₃	5.27	34.95
V ₁ S ₄	3.13	22.07
V ₂ S ₁	7.00	57.09
V ₂ S ₂	6.27	47.60
V ₂ S ₃	4.87	30.95
V ₂ S ₄	3.83	16.77
V ₃ S ₁	7.63	74.83
V ₃ S ₂	6.20	40.16
V ₃ S ₃	5.07	35.02
V ₃ S ₄	4.53	26.54
S.E.m. ±	0.36	1.70
C.D. at 5%	NS	4.85
CV%	11.15	7.07

Yield parameter

Effect of different varieties and planting date on number of flowers per plant

The results pertaining in table 3 to the number of flowers and fruits per plant as influenced by different varieties and planting dates are presented in Tables 4.6. Among the varieties, V₁ (Nabila) recorded the highest number of flowers per plant (14.88) and fruits per plant (11.83), which were significantly superior to V₂ (Camarosa) and V₃ (Winter Dawn). The superior performance of Nabila may be attributed to its higher genetic potential and efficient assimilate partitioning towards reproductive growth. Similar findings on varietal differences in flowering, fruit number, and yield components in strawberry were reported by Neetu and Sharma (2018) [9], Verma *et al.* (2018) [16], Gaikwad *et al.* (2018) [3], Panigrahi *et al.* (2019) [11], Diwakar *et al.* (2019) [2], Verma *et al.* (2022) [15], Karthikeyan *et al.* (2023) [5], and Manivannan *et al.* (2024) [8]. Planting dates significantly influenced both parameters. S₂ (1st November) recorded the maximum number of flowers (18.56) and fruits per plant (16.00), followed by S₁ (15th October), whereas S₄ (1st December) recorded the minimum number of flowers (7.44) and fruits per plant (4.96). The increased flower and fruit production under 1st November planting may be attributed to favourable environmental conditions during flowering and fruit set. These findings are in agreement with the reports of Paul *et al.* (2017) [13] and Bhamini *et al.* (2017) [1].

Effect of different varieties and planting date on fruit diameter and fruit length

The results pertaining to fruit size parameters, namely fruit length, as influenced by different varieties and planting dates are presented in Table 3. Among the varieties, fruit diameter was not significantly influenced by varietal differences; however, V₁ (Nabila) recording the maximum fruit length (4.32 cm), which was significantly superior to V₃ (Winter Dawn) (3.52 cm) and V₂ (Camarosa) (3.42 cm). The superior fruit size observed in Nabila may be attributed to its favourable genetic makeup, efficient translocation of photosynthates, and better sink strength of developing fruits. Similar findings were reported by Verma *et al.* (2018) [16], Panigrahi *et al.* (2020) [10], Verma *et al.* (2022) [15], Karthikeyan *et al.* (2023) [5], and Manivannan *et al.* (2024) [8]. Planting dates significantly influenced fruit length. S₁

(15th October) recorded the maximum fruit length (4.20 cm). The minimum fruit length (3.27 cm) were observed under S₄ (1st December). The larger fruit size under early planting may be attributed to favourable environmental conditions and lower fruit load, which enabled greater assimilate availability for individual fruit growth and development. These findings are in agreement with Bhamini *et al.* (2017) [1] and Sadiq and Kaur (2017) [14].

Effect of different varieties and planting date on yield per plant

The results pertaining to yield per plant as influenced by different varieties and planting dates are presented in Table 3. Among the varieties, V₁ (Nabila) recorded the maximum yield per plant (207.19 g), which were significantly superior to V₃ (Winter Dawn) (170.72 g) and V₂ (Camarosa) (139.55 g). The higher yield observed in Nabila may be attributed to its superior genetic potential, efficient assimilate partitioning, and a better source-sink relationship. Similar findings were reported by Neetu and Sharma (2018), Verma *et al.* (2018), Diwakar *et al.* (2019), Panigrahi *et al.* (2020), Verma *et al.* (2022), Manivannan *et al.* (2024), and Kasture *et al.* (2024). Planting dates significantly influenced both fruit weight and yield per plant. S₂ (1st November) recorded the yield per plant (277.46 g), followed by S₁ (15th October) (228.71 g, respectively), whereas S₄ (1st December) recorded the minimum fruit weight yield per plant (55.86 g). The enhanced fruit weight and yield under 1st November planting may be attributed to favourable environmental conditions during flowering and fruit development, which promoted better fruit set, assimilate accumulation, and biomass production. Similar findings were reported by Paul *et al.* (2017) [13], Bhamini *et al.* (2017) [1], and Sadiq and Kaur (2017) [14].

Table 3: Effect of different varieties and planting date on number of flowers per plant, fruit length and yield per plant

Treatment	Number of flowers	Fruit length (cm)	Yield per plant (g)
Factor A: Variety			
V ₁ : Nabila	14.88	4.32	207.19
V ₂ : Camarosa	13.53	3.42	139.55
V ₃ : Winter Dawn	13.30	3.52	170.72
S.E.m. ±	0.14	0.04	4.45
CD at 5%	0.40	0.12	12.98
Factor B: Planting dates			
S ₁ : 15 th October	16.71	4.20	228.71
S ₂ : 1 st November	18.56	3.98	277.46
S ₃ : 15 th November	12.90	3.57	127.92
S ₄ : 1 st December	7.44	3.27	55.86
S.E.m. ±	0.16	0.08	5.14
CD at 5%	0.45	0.24	14.99
CV%	3.43	3.82	8.93

Interaction effect of variety and planting dates on number of flowers per plant

The interaction effect between varieties and planting dates shows in table 2.2 significantly influenced the number of flowers per plant. Among the treatment combinations, V₁S₂ (Nabila planted on 1st November) recorded the maximum number of flowers per plant (19.00), which was significantly superior to the other treatment combinations and remained at par with V₃S₂ (18.80). The minimum number of flowers per plant (6.43) was observed in V₂S₄ (Camarosa planted on 1st December). The higher number of flowers and fruits

under V₁S₂ may be attributed to the superior genetic potential of Nabila and favourable environmental conditions associated with 1st November planting, which promoted better flowering, fruit set, and assimilate partitioning.

Interaction effect of variety and planting dates on fruit length

The interaction effect between varieties and planting dates presented in Table 4 revealed that fruit length was significantly influenced by the interaction between varieties and planting dates. Among the treatment combinations, V₁S₁ (Nabila planted on 15th October) recorded the maximum fruit length (5.01 cm), which was significantly superior to the other treatment combinations, followed by V₁S₂ (Nabila planted on 1st November) with 4.54 cm. The minimum fruit length (2.92 cm) was recorded in V₃S₄ (Winter Dawn planted on 1st December). The superior fruit size under early planting of Nabila might be attributed to favourable environmental conditions, better plant establishment and efficient translocation of photosynthates towards developing fruits, resulting in enhanced fruit growth and elongation.

Interaction effect of variety and planting dates on yield per plant

The interaction effect between varieties and planting dates significantly influenced yield per plant, as presented in Table 4. Among the treatment combinations, V₁S₂ (Nabila planted on 1st November) recorded the highest yield per plant (320.07 g), which was statistically at par with V₃S₂ (Winter Dawn planted on 1st November) (306.06 g). The lowest yield per plant (47.91 g) was recorded in V₂S₄ (Camarosa planted on 1st December). The higher yield observed in V₁S₂ might be attributed to the combined effect of the superior genetic potential of Nabila and favourable environmental conditions under 1st November planting, which enhanced fruit development and overall yield accumulation.

Table 4: Interaction effect of variety and planting dates on number of flowers per plant, fruit length and yield per plant

Treatment	Number of flowers	Fruit length(cm)	Yield per plant (g)
V ₁ S ₁	17.50	5.01	286.64
V ₁ S ₂	19.00	4.54	320.07
V ₁ S ₃	14.67	4.01	154.68
V ₁ S ₄	8.33	3.71	67.39
V ₂ S ₁	16.60	3.57	182.73
V ₂ S ₂	17.87	3.62	206.25
V ₂ S ₃	13.23	3.31	121.32
V ₂ S ₄	6.43	3.18	47.91
V ₃ S ₁	16.03	4.02	216.78
V ₃ S ₂	18.80	3.77	306.06
V ₃ S ₃	10.80	3.39	107.78
V ₃ S ₄	7.57	2.92	52.28
S.Em. ±	0.28	0.08	8.90
C.D. at 5%	0.80	0.24	25.97
CV%	3.43	3.82	8.93

Conclusion

It can be concluded that among the different strawberry varieties evaluated, Winter Dawn exhibited superior vegetative growth, whereas Nabila recorded the highest yield and better fruit quality attributes. Among the planting dates, 15th October proved to be most favourable for vegetative growth, while 1st November was found superior

for obtaining higher yield. Winter Dawn planted on 15th October was ideal for achieving vigorous vegetative growth whereas, Nabila planted on 1st November was found most suitable for maximizing yield under 50% shade-net conditions in the agro-climatic conditions of middle Gujarat.

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