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Influence of sowing date on fruit yield of okra varieties

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Abstract
A field experiment was conducted at the Instructional Farm, College of Agriculture, Vellayani, Kerala, from October 2024 to May 2025 to determine the optimum sowing date and suitable variety for maximizing yield of okra. The study evaluated five sowing dates *viz*., 01 October 2024, 01 November 2024, 01 December 2024, 01 January 2025, and 01 February 2025, and three varieties *viz*., Anjitha, Aruna, and Arka Anamika, in a split-plot design. Results revealed that sowing date and varietal choice exert a significant and interactive influence on crop duration, growing degree days (GDD), leaf area index (LAI), and yield performance of okra. Among the five sowing dates, February and January provided the most favourable thermal and environmental conditions, resulting in superior growth and yield attributes. February sowing recorded the highest LAI (2.28), dry matter accumulation (63.58 g plant^{-1}), fruit weight (20.48 g), and fruit yield (404.85 g plant^{-1}), all of which were statistically comparable with January. In contrast, December sowing resulted in the lowest performance, reflected in shortest crop duration (94 days), and lowest GDD accumulation (1620 °C·days). Among the varieties, Arka Anamika was the most productive, recording the highest values for crop duration (102 days), GDD (1762 °C·days), LAI (2.15), dry matter (57.96 g plant^{-1}), fruits per plant (19.29), fruit weight (19.74 g), and fruit yield (394.49 g plant^{-1}). The Arka Anamika × February interaction exhibited superior performance, characterised by maximum GDD (1808 °C·days)**,** LAI (2.45)**,** dry matter (71.49 g plant^{-1}), fruit weight (21.43 g), and fruit yield (479.49 g plant^{-1}), confirming its thermal responsiveness. Correlation analysis further revealed that fruit yield had strong positive associations with dry matter (r = 0.97), fruit weight (r = 0.97), number of fruits per plant (r = 0.96), and LAI (r = 0.88), while showing moderate correlation with GDD (r = 0.53). These results underscore the central role of canopy development, biomass accumulation, and assimilate partitioning in yield expression. The study concluded that sowing okra, particularly the variety Arka Anamika during January or February provides the most favourable thermal environment, thereby maximizing vegetative growth, higher biomass accumulation, and improved fruit yield under the agroclimatic conditions in Southern Laterites of Kerala.

Keywords: Correlation, Growing degree day (GDD), okra, southern laterites, sowing date

Introduction
Okra (*Abelmoschus esculentus* (L.) Moench) is an important warm season vegetable crop belonging to the family Malvaceae and is extensively cultivated in tropical and subtropical regions worldwide (Swamy, 2023) [28]. Ethiopia is recognized as its primary centre of origin (Lamont, 1999) [14]. In India, okra is cultivated across diverse agro-climatic zones due to its adaptability, nutritional value, and high market demand. Enhancing its production and quality remains a major priority for farmers. Among agronomic factors, optimum date of sowing is a critical non-monetary input influencing both yield and quality. The productivity of okra is largely determined by prevailing weather conditions such as temperature, rainfall, relative humidity, and bright sunshine hours during different phenological stages. Timely sowing ensures favourable climatic exposure, promoting adequate vegetative growth, uniform flowering, and fruit set. Bake *et al.*, (2017) [4] reported that appropriate planting date provides a congenial growing period with well distributed rainfall and optimum temperature during early crop growth. Okra is grown during both dry and wet seasons. However, production during the rainy season is often constrained by waterlogging due to heavy rainfall. Being sensitive to excess moisture, okra experiences physiological stress under flooded conditions, leading to oxygen depletion in the root zone, disruption of nutrient uptake, and reduced plant growth and

yield (Lee *et al.*, 1990; Schippers, 2000) [15, 24]. Similarly, sudden fluctuations in temperature can adversely affect flowering, pollination, and fruit development, thereby reducing productivity (Afroza *et al.*, 2010) [2]. Growing Degree Days (GDD) is a key agro-meteorological index that governs phenological development in okra, as the crop requires specific heat unit accumulation to progress through each growth stage. A strong positive correlation between accumulated heat units and fruit yield has been reported, confirming the importance of GDD in predicting okra growth and productivity under varying thermal regimes (Dhankhar and Singh, 2013) [8]. Different okra varieties exhibit specific responses to climatic conditions; therefore, selection of appropriate sowing date for each variety is crucial. Even high yielding varieties may perform poorly and result in reduced economic returns if sown under unsuitable weather conditions, leading to premature flowering or exposure to extreme temperatures or rainfall (Ghannad *et al.*, 2014) [9]. The information on suitable varieties and optimum sowing dates for maximizing okra production is limited. Hence, considering the impact of seasonal weather variability on crop performance, the present study was undertaken to identify the optimum sowing date and suitable variety for maximizing growth, and yield of okra.

Materials and Methods

A field experiment was conducted at the Instructional Farm, College of Agriculture, Vellayani, Thiruvananthapuram, Kerala, located at 8.42959 ° N Latitude and 76.98358 ° E Longitude, with an altitude of 24.15 m above mean sea level. The trial was carried out from 01 October 2024 to 16 May 2025, covering the *rabi* and summer seasons. During the experimental period, the total rainfall was 907.8 mm. The mean maximum temperature ranged from 30.1°C to 33.6°C, and the mean minimum temperature varied between 19.9°C and 23.6°C. The mean bright sunshine hours averaged 5.7 h per day. The cumulative growing degree day (GDD), calculated using a base temperature of 10°C, ranged from 114 to 133°C days. The experimental field was characterized by sandy clay loam soil, moderately acidic in reaction (pH 5.95), with normal electrical conductivity (0.12 dS m^{-1}). The soil had high organic carbon content (1.32%). Available nutrient status indicated low nitrogen (276 kg ha^{-1}), medium phosphorus (19 kg ha^{-1}), and low potassium (94 kg ha^{-1}). The experiment was laid out in a split plot design with 15 different treatment combinations each replicated thrice. The main plot treatments comprised of five sowing dates *viz*., D_1: 01 October 2024, D_2: 01 November 2024, D_3: 01 December 2024, D_4: 01 January 2025, and D_5: 01 February 2025. The sub plot treatments consisted of three okra varieties *viz*., V_1: Anjitha, V_2: Aruna, and V_3: Arka Anamika. The treatments were replicated thrice. The field was ploughed to a fine tilth. Seeds pre-soaked in water for 24 hours were sown. *Trichoderma*-enriched farmyard manure was applied @ 20 t ha^{-1} as basal dose. Inorganic fertilizers were applied at 110:35:70 kg N:P_2O_5:K_2O ha^{-1}. The full dose of phosphorus and potassium, along with half of nitrogen, was incorporated at final ploughing. The remaining half of nitrogen was top dressed 30 days after sowing (DAS). Fertilizers were applied in the form of urea, Rajphos, and muriate of potash. All cultural practices were carried out as per the Package of Practices Recommendations: Crops (KAU, 2024) [11].

Six plants were randomly selected and tagged in each plot for recording observations. Fruits were harvested at their maximum size while still tender, and fruit yield per plant was recorded by weighing green fruits at each picking. Days to final harvest represented the total crop duration up to the last fruit harvest.The Growing Degree Day (GDD) was calculated from daily maximum (T_{max}) and minimum (T_{min}) air temperature data using the formula: GDD = $[(T_{max} + T_{min})/2] - T_{base,}$ where T_{base} is 10°C for okra (Monteith, 1984; Dhankhar and Singh, 2013) [18, 8]. The total leaf area per plant was estimated from the dimensions of the third leaf from the plant apex. The length (L) and breadth (B) of this leaf was measured and multiplied by a k-coefficient for okra (0.62) (Musa *et al.*, 2016) [22]. This single leaf area was then multiplied by the total number of leaves (n) on the plant to calculate the total leaf area per plant using the formula: Leaf area per plant = L × B × k × n. The Leaf Area Index (LAI) was calculated by dividing the leaf area per plant by the land area occupied by the plant. For dry matter per plant, plants were harvested at ground level, shade dried, and then oven dried to a constant weight. The LAI and dry matter per plant were recorded at 60 DAS. Data were subjected to analysis of variance (ANOVA) and statistically analysed using Grapes Agri 1, an opensource R package for agricultural research data analysis (Gopinath *et al.*, 2020) [10]. When treatment effects were found significant, mean comparisons were done using the critical difference at a 5% significance level. Pearson correlation analysis was performed to determine the relationships between GDD, yield components, and yield at a 5% significance level.

Results and Discussion

The results revealed that five different sowing dates (D), and three okra varieties (V), and their interaction (D x V) had a significant influence on growth and yield of okra.

Table 1: Effect of sowing date and varieties on growing degree day (GDD), growth, and yield of okra

Treatment	Crop duration (d)	Sowing to final harvest GDD (°C d)	Leaf area index	Dry matter per plant (g)	Fruits per plant (No.)	Fruit weight (g)	Fruit yield per plant (g)
Sowing dates (D)							
D_1 October	104^{a}	1783^{a}	1.62^{c}	49.28^{cd}	17.04^{c}	17.02^{c}	300.63^{c}
D_2 November	102^{ab}	1754^{ab}	1.84^{b}	51.89^{c}	18.22^{b}	18.89^{b}	353.00^{b}
D_3 December	94^{c}	1620^{c}	1.49^{c}	46.44^{d}	16.55^{c}	15.31^{d}	264.14^{d}
D_4 January	98^{b}	1708^{b}	2.11^{a}	57.38^{b}	18.94^{ab}	20.01^{a}	389.21^{a}
D_5 February	101^{ab}	1782^{a}	2.28^{a}	63.58^{a}	19.80^{a}	20.48^{a}	404.85^{a}
SEm	1.2	20.1	0.06	0.93	0.28	0.26	9.46
CD (0.05)	3.8	65.6	0.18	3.04	0.92	0.86	30.85
Varieties (V)							
V_1 Anjitha	98^{b}	1704^{b}	1.89^{b}	52.92^{b}	17.94^{b}	18.32^{b}	329.73^{b}
V_2 Aruna	99^{b}	1722^{b}	1.56^{c}	50.26^{c}	17.11^{c}	16.97^{c}	302.87^{c}
V_3 Arka Anamika	102^{a}	1762^{a}	2.15^{a}	57.96^{a}	19.29^{a}	19.74^{a}	394.49^{a}
SEm	0.4	7.0	0.05	0.75	0.20	0.18	4.85
CD (0.05)	1.1	20.6	0.13	2.23	0.6	0.53	14.31

D x V interaction							
d_1v_1	102^{bcd}	1755^{bcde}	1.39^{hi}	49.28^{def}	16.80^{cde}	17.56^{ef}	305.22^{e}
d_1v_2	104^{ab}	1794^{ab}	1.41^{hi}	47.38^{ef}	16.67^{de}	15.28^{h}	264.77^{f}
d_1v_3	105^{a}	1800^{ab}	2.05^{cde}	51.20^{de}	17.67^{bcd}	18.22^{de}	331.88^{de}
d_2v_1	101^{cdef}	1732^{def}	1.85^{ef}	51.38^{de}	18.37^{b}	18.62^{cde}	349.67^{cd}
d_2v_2	102^{abcd}	1759^{bcd}	1.52^{ghi}	50.24^{de}	17.77^{bcd}	16.78^{f}	311.40^{e}
d_2v_3	103^{abc}	1770^{abcd}	2.16^{bcd}	54.06^{cd}	18.53^{b}	21.27^{a}	397.94^{b}
d_3v_1	92^{h}	1575^{h}	1.43^{hi}	47.15^{ef}	15.93^{e}	15.44^{gh}	256.20^{f}
d_3v_2	92^{h}	1592^{h}	1.26^{i}	44.48^{f}	16.00^{e}	14.00^{i}	234.13^{f}
d_3v_3	98^{fg}	1692^{fg}	1.77^{efg}	47.71^{ef}	17.73^{bcd}	16.49^{fg}	302.09^{e}
d_4v_1	99^{fg}	1710^{efg}	2.35^{abc}	54.07^{cd}	18.04^{bc}	19.47^{bc}	357.96^{cd}
d_4v_2	96^{g}	1674^{g}	1.65^{fgh}	52.70^{cd}	17.44^{bcd}	19.30^{bcd}	348.61^{cd}
d_4v_3	100^{def}	1739^{de}	2.33^{abc}	65.36^{b}	21.33^{a}	21.27^{a}	461.07^{a}
d_5v_1	99^{efg}	1748^{cde}	2.46^{a}	62.73^{b}	20.57^{a}	20.48^{ab}	379.61^{bc}
d_5v_2	101^{cde}	1789^{abc}	1.94^{def}	56.51^{c}	17.67^{bcd}	19.51^{bc}	355.44^{cd}
d_5v_3	102^{abcd}	1808^{a}	2.45^{ab}	71.49^{a}	21.17^{a}	21.43^{a}	479.49^{a}
SEm [D(V)]	0.9	15.6	0.10	1.69	0.44	0.40	10.84
CD (0.05) [D(V)]	2.5	46.1	0.29	4.98	1.31	1.18	31.99

Crop duration

Crop duration was significantly influenced by the different sowing dates and okra varieties (Table 1). The longest crop duration was observed in the October sowing (104 days), closely comparable by November (102 days) and February (101 days). The January sowing recorded a slightly shorter duration (98 days). The shortest crop duration was observed in the December sowing (94 days), indicating that lower temperatures during early winter accelerated maturity and shortened the overall growth period. Among the varieties, Arka Anamika (V_3) recorded the maximum crop duration (102 days. The shortest duration was observed in Aruna (99 days) and Anjitha (98 days), suggesting that Aruna and Anjitha completed their life cycle slightly earlier than Arka Anamika under the same conditions. Similar varietal differences in duration was recorded by Sood and Kaur (2019) [27], and Kunwar *et al.*, (2024) [13] in okra. The interaction effect of sowing dates and varieties revealed that the October sowing of Arka Anamika recorded the longest crop duration (105 days), which was comparable with February sowing of Arka Anamika (102 days). For the variety Aruna, the longest duration was noted in October (104 days) which was comparable with November (102 days). In contrast, the December sowing consistently resulted in the shortest crop duration across all varieties, with the December sowing of Anjitha recording the minimum duration (92 days). This clearly indicates that both sowing time and genotype jointly determine the length of the growth period. Overall, the results show that crop duration is maximized when sowing is done in the October, November, and February. while December sowing significantly reduces the duration due to restricted heat accumulation and faster crop maturity. This indicates that crop sown in December grew slowly during the cool winter. However, as temperatures rose in their later growth stages, they matured more quickly, shortening their life cycle. The results are in agreement with findings of Dhankar and Singh (2013), and Budania *et al.*, (2018) [5].

Growing degree days

Growing degree days accumulated until the final harvest was significantly influenced by the different sowing dates and okra varieties (Table 1). The highest GDD accumulation was recorded in the October sown crop (1783°C days), which was comparable to February (1782°C days) and November (1754°C days). The lowest GDD was observed in the December sowing (1620°C days), indicating reduced thermal availability during early winter, which in turn restricted crop growth and development. Among the varieties, Arka Anamika accumulated the highest GDD (1762°C days), followed by Aruna (1722°C days). The lowest thermal accumulation was observed in Anjitha (1704°C days), suggesting relatively lower heat unit accumulation in this variety. The interaction effect of sowing dates and varieties showed that the February sowing of Arka Anamika recorded the maximum GDD accumulation (1808°C days), which was comparable with October sowing (1800°C days). For the variety Aruna, the highest GDD was accumulated during October (1794°C days) which was comparable with GDD in February (1789°C days). In contrast, December sowing consistently resulted in the lowest GDD values across all varieties, with December sowing of Anjitha recording the minimum GDD (1575°C days). This confirms the strong influence of cooler December temperatures on reducing heat unit accumulation. The results demonstrate that the maximum GDD accumulation occurs when Arka Anamika is sown in February, providing the optimum thermal environment. Conversely, December sowing markedly reduced GDD across all varieties, consequently slowing growth and delaying developmental processes. Dhankhar and Singh (2013) [8] reported that okra required approximately 762 °C·day to reach 50% flowering and 1600 °C·day for total fruit yield. Budania *et al.* (2018) [5], in another study at Hisar, found that okra sown in the third week of March accumulated the highest GDD (706.8 °C·day), resulting in delayed flowering and maturity, but yielding greater biomass and fruit yield due to extended growth duration. Moula *et al.* (2018) [20] observed distinct phenological responses in okra to varying GDD accumulation across planting dates. The crop sown on 15 April accumulated the highest GDD (1,884-1,979 °C·day), exhibiting rapid vegetative growth, early flowering, and higher yields.

Leaf area index

The highest LAI was recorded in the February sown crop (2.28), which was at par with January (2.11) (Table 1). These values were markedly superior to the LAI recorded in November (1.84). The lowest LAI was observed in the December sowing (1.49), indicating that suboptimal early winter temperatures limited canopy expansion and photosynthetic surface development. Among the varieties, Arka Anamika recorded the highest LAI (2.15), significantly surpassing Anjitha (1.89) and Aruna (1.56). The reduced LAI in Aruna indicates comparatively lower vegetative vigour and lesser leaf area development. The interaction effect of sowing dates and varieties showed that February sowing of Anjitha recorded the maximum LAI (2.46), comparable with January sowing (2.35). For the variety Arka Anamika, the highest LAI was also recorded under favourable sowing windows, particularly February (2.45) which was on par with January (2.33 g). In contrast, December sowing consistently resulted in lower LAI across all varieties, with the December sowing of Aruna registering the lowest LAI (1.26). The results demonstrate that Anjitha and Arka Anamika sown in January or February produces the highest leaf area index, reflecting superior canopy development under favourable thermal conditions. Conversely, December sowing markedly reduced LAI across all varieties, restricting leaf expansion and potential photosynthetic capacity. Budania *et al.*, (2018) [5], observed that maximum LAI is attained when optimum temperature and radiation coincide with the vegetative phase. Maduwanthi and Karunarathna (2019) [16] showed that LAI of okra varies between 1.6 and 2.8 depending on planting pattern and environmental conditions. Morwal and Patel (2017) [19] reported that early sowing in 15 August had significantly higher LAI compared to later sowings.

Dry matter

Dry matter accumulated per plant was significantly influenced by sowing dates and okra varieties (Table 1). The highest dry matter production was recorded in the February sown crop (63.58 g), followed by dry matter obtained in January (57.38 g). These values were significantly superior to the dry matter recorded in November (51.89 g). The lowest dry matter per plant was observed in the December sowing (46.44 g), indicating that suboptimal early-winter temperatures reduced vegetative growth and biomass accumulation. Among the varieties, Arka Anamika recorded the maximum dry matter (57.96 g), which was considerably higher than Anjitha (52.92 g) and Aruna (50.26 g). The lower dry matter accumulation in Aruna suggests relatively reduced vegetative vigour compared to the other two varieties. The interaction effect of sowing dates and varieties revealed that the February sowing of Arka Anamika resulted in the highest dry matter accumulation (71.49 g), followed by January sowing (65.36 g). For the variety Anjitha, the highest dry matter was also obtained in the favourable sowing period, particularly February (62.73 g). In contrast, December sowing consistently resulted in reduced dry matter accumulation across all varieties, with the December sowing of Aruna recording the lowest biomass accumulation (44.48 g). The results indicate that maximum dry matter accumulation was achieved when Arka Anamika was sown in February, highlighting the importance of favourable thermal conditions for vigorous growth. Conversely, December sowing markedly suppressed vegetative biomass in all varieties, reflecting the adverse effect of suboptimal temperatures on biomass accumulation. Moustakas *et al.*, (2011) [21], reported that dry matter accumulation in okra increases steadily when plants receive optimal heat units and light during early growth stages. Similarly, Maduwanthi and Karunarathna (2019) [16] observed significantly higher dry matter production in okra varieties with a larger canopy structure, owing to their greater light interception. In addition, Budania *et al.* (2018) [5] demonstrated that sowing date significantly affects LAI and dry matter accumulation, with crops sown at the optimal mid-March date recording higher LAI and dry matter.

Fruits per plant

The highest number of fruits per plant was recorded in the February sown crop (19.80), which was at par with January (18.94) (Table 1). These values were significantly superior to the number of fruits recorded in November (18.22). The lowest number of fruits per plant was observed in the December sowing (16.55), indicating that early-winter sowing adversely affected the flowering and fruiting potential of okra. Among the varieties, Arka Anamika recorded the maximum number of fruits per plant (19.29), which was significantly superior to Anjitha (17.94) and Aruna (17.11). The minimum fruit number observed in Aruna indicates comparatively lower reproductive efficiency relative to the other two varieties. The interaction effect of sowing dates and varieties revealed that January sowing of Arka Anamika produced the highest number of fruits (21.33), which was comparable with February sowing of Arka Anamika (21.17). For the variety Anjitha, the highest number of fruits was also obtained in the favourable sowing period, specifically February (20.50). In contrast, December sowing consistently resulted in reduced fruit numbers across varieties, with December sowing of Anjitha recording the lowest fruit count (15.93). The results indicate that sowing Arka Anamika in either January or February maximizes the number of fruits per plant. At the same time, December sowing significantly reduced fruit production in all varieties due to suboptimal growing conditions. The maximum number of fruits and the best fruit yield was found in the seeds sown in March (Sohel, 2018) [26]. The maximum number of fruits was recorded from the 10 March sowing, due to increased node formation and an extended harvest period (Sood and Kaur, 2019) [27]. Meena *et al.* (2021) [17] reported maximum number of fruits and fruit yield per plant for the variety Arka Anamika sown during August-November, whereas Upadhyay *et al.* (2020) [30] reported higher number of fruits per plant for Arka Anamika when sown during the first week of March.

Fruit weight

The highest fruit weight was recorded in the February sown crop (20.48 g), which was comparable with the fruit weight obtained in January (20.01 g) (Table 1). These values were significantly superior to the fruit weight recorded in November (18.89 g). The October sowing date recorded a comparatively moderate fruit weight (17.02 g), whereas the lowest fruit weight per fruit was observed in the December sowing (15.31 g), indicating a marked reduction in fruit development under unfavourable early-winter conditions. Among the varieties, Arka Anamika recorded the highest fruit weight (19.74 g), which was significantly superior to both Aruna (18.32 g) and Anjitha (16.97 g). The minimum fruit weight noted in the variety Aruna indicates relatively reduced sink strength and fruit development potential when compared to Arka Anamika and Anjitha. The interaction effect of sowing dates and varieties showed that February sowing of Arka Anamika resulted in the maximum fruit weight (21.43 g), which was statistically on par with January (21.27 g) and November (21.27 g) sowing of Arka Anamika. For the variety Anjitha, maximum fruit weight (20.48 g) was likewise obtained when the crop was sown within the favourable February sowing window. In contrast, the December sowing consistently resulted in reduced fruit weight across varieties, with December sowing of Aruna registering the lowest fruit weight (14 g). The results indicate that fruit weight is maximized when Arka Anamika is sown in February or January, highlighting the importance of favourable thermal regimes for optimum fruit development. Conversely, December sowing significantly suppressed fruit weight across all varieties. Dash *et al.* (2013) [7] emphasized that okra variety Annie Oakley sown on 15 February yielded the highest due to greater fruit size and weight. Another study reported that Arka Anamika sown during the first week of March exhibited high fruit weight (Upadhyay *et al.*, 2020) [30]. Similarly, in a varietal evaluation of okra, Thapa *et al.* (2012) [29] documented the highest fruit weight and fruit yield per plant for Arka Anamika.

Fruit yield

The highest fruit yield per plant was recorded in February sown crop (404.85 g), which was statistically at par with the yield obtained in January (389.21 g) (Table 1). These were significantly superior to the yield recorded in November (353.00 g). The lowest fruit yield per plant was observed in the December sowing date (264.14 g), indicating a significant yield reduction during this specific sowing time. The variety Arka Anamika recorded highest fruit yield (394.49 g) compared to the other varieties under study. This was followed by variety Anjitha (329.73 g), which performed significantly better than the lowest performing variety. The minimum fruit yield per plant was registered in variety Aruna (302.87 g), indicating that Arka Anamika possesses a superior genetic potential for yield compared to Anjitha and Aruna. The interaction effect of sowing dates and varieties showed that February sowing of Arka Anamika resulted in maximum yield (479.49 g), which was on par with January sowing of Arka Anamika (461.07 g). For the variety Anjitha, the highest yield was likewise obtained in the later sowing dates, particularly in February (379.61 g). Conversely, December sowing consistently resulted in lower yields across varieties, with the December sowing of Aruna recording the lowest yield (234.13 g). Results indicate that the variety Arka Anamika sown in either February or January could achieve maximum yield, whereas sowing in December markedly reduced yield across all varieties. Sood and Kaur (2019) [27] reported superior fruit yield per plant for the 01 March × Arka Anamika combination, attributing this advantage to favourable vegetative growth and yield contributing traits. Consistent with these findings, Bake *et al.* (2017) [4] and Sohel (2018) [26] demonstrated that sowing in late June or early March enhanced fruit yield, while Upadhyay *et al.* (2020) [30] observed high yield performance for Arka Anamika sown during the first week of March. Padhiyar *et al.* (2025) [23] further noted that sowing during the second fortnight of March resulted in the maximum number of fruits per plant and the highest marketable yield. Additional evidence from Das *et al.* (2018) [6] showed that sowing on 15 February produced the greatest fruit yield, surpassing later sowing dates due to more favourable temperatures and extended vegetative and reproductive periods. Similarly, Sohel (2018) [26] found that mid-February sowing significantly increased fruit yield compared with March sowing, attributing the improvement to optimal early-season temperatures that enhanced flowering and fruit set.

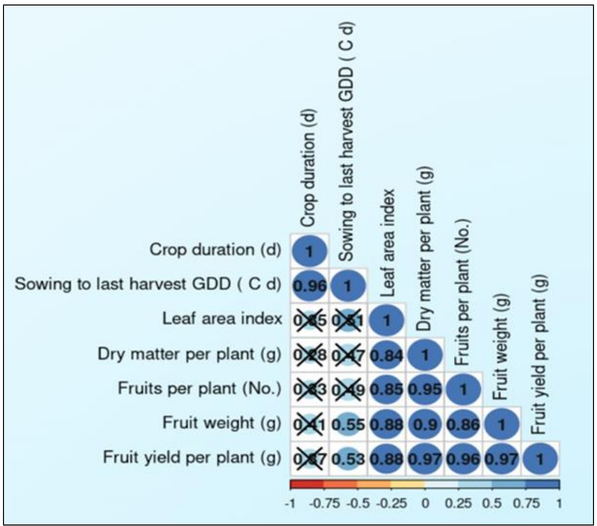

Fig 1: Correlogram of crop duration, growing degree days, growth parameters, yield attributes, and yield in Okra.

Interrelationships among crop duration, growing degree days, growth parameters, yield attributes, and yield in Okra

There was no significant correlation between fruit yield per plant and crop duration (Fig. 1). Fruit yield per plant exhibited a moderate positive correlation (r = 0.53) with total growing degree days (GDD) from sowing to last harvest, implying that greater cumulative heat unit accumulation during total crop duration enhanced yield. As GDD increases, plants experience more favourable thermal conditions that support faster growth, efficient canopy development, and greater biomass accumulation. Dhankhar and Singh (2013) [8] reported a significant positive association between accumulated GDD and fruit yield attainment, indicating that genotypes experiencing higher thermal units produced greater yields.

Fruit yield per plant exhibited a strong positive correlation with leaf area index (LAI) (r = 0.88) (Fig. 1). This suggest that plants with a larger and more functionally efficient canopy intercept greater solar radiation, thereby enhancing photosynthetic activity and assimilate production. Dry matter accumulation per plant also showed an exceptionally strong positive correlation with fruit yield (r = 0.97). This indicate that increased biomass production is closely associated with improved yield. Greater dry matter reflects vigorous vegetative growth and effective translocation of assimilates to reproductive structures, resulting in higher fruit yield. These findings underscore the central role of LAI and dry matter as major determinants of okra productivity, as both parameters directly influence photosynthetic capacity and assimilate partitioning. Similar positive associations between growth attributes and yield have been reported by Abdalla *et al.* (2025) [1], Shinde *et al.* (2023) [25], and Kerure *et al.* (2017) [12], further corroborating the present results.

A highly significant positive correlation was observed between fruit yield and number of fruits per plant (r = 0.96), indicating that yield increased proportionately with the production of marketable fruits (Fig. 1). Fruit weight also showed an equally strong positive association with yield (r = 0.97), demonstrating that heavier fruits contributed substantially to total productivity. These results are consistent with the findings of Shinde *et al.* (2023) [25], who reported strong phenotypic and genotypic correlations of fruit yield with both fruit number and fruit weight. Similar observations by Ashraf *et al.* (2020) [3] and Kerure *et al.* (2017) [12] further corroborate that positive interrelationships among yield components play an important role in enhancing okra productivity. The correlation study indicates that growing degree days, leaf area index, dry matter, fruit number, and fruit weight determine and influence fruit yield in okra.

Conclusion

The study demonstrated that both sowing date and varietal choice exert significant and interactive influence on the growth and yield performance of okra. The findings indicate that sowing okra, particularly the variety Arka Anamika during January or February provides the most favourable thermal environment, thereby maximizing vegetative growth, physiological efficiency, and fruit yield under the agroclimatic conditions in Southern Laterites of Kerala.

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