



Effect of pruning time and intensity on growth, yield and fruit quality of phalsa (*Grewia subinaequalis* D.C.)

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ABSTRACT

The present investigation was conducted at the Main Experimental Station, Department of Fruit Science, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya (U.P) during the year 2023-24. In this study, plants were pruned at six different intensities (5, 15, 25, 35, 45, and 55 cm above ground level) on three different dates (27 January, 4 February, and 14 February), and each treatment combination was replicated three times. The results revealed that minimum number of days taken to sprouting (19), highest number of shoots per plant (70.34), number of nodes per shoot (19.02) and number of buds per node (9.25) along with minimum days taken to flowering (51.5 days) and maximum yield per plant (2.76 kg) were recorded in treatment D₁T₅ (27 Jan + 45cm). Quality attributes viz. maximum fruit length (0.93cm), fruit width (0.98cm), fruit weight (84.29g), TSS (31.51 °B), reducing sugars (18.99%) and total sugars (23.67%) were found in treatment D₁T₅ (27 Jan + 45cm) except for non-reducing sugars (4.78%) which was found highest in treatment D₁T₃ (27 Jan + 25cm) whereas lowest acidity (2.03 was observed in treatment D₃T₆ (14 Feb + 5cm). Further, it was found that the treatment D₁T₅ (27 Jan + 45cm) proved to be the most effective treatment to improve the growth, yield and fruit quality traits of phalsa.

Key words: Growth, phalsa, pruning intensity, quality attributes, yield.

INTRODUCTION

Phalsa (*Grewia subinaequalis* D.C.) is a subtropical minor fruit crop of Indian origin. It is considered unique for its tolerance to harsh climatic and soil conditions, nutritional value, and medicinal and economic importance. Generally, phalsa is grown under subsistence farming and mostly consumed fresh or as juice during the summer season. The ripe fruits are also used to prepare refreshing drinks. Major areas ideal for its commercial cultivation include Punjab, Haryana, and Uttar Pradesh. Here, the crop is grown as a filler crop and as an intercropping border due to its low input requirement (Warang *et al.*, 20).

The plant is a large deciduous shrub and has the potential to grow above 4.5 meters in height. It possesses narrow, elongated branches with a drooping habit and carrying ovate leaves. Small yellow flowers are produced in an axillary cymes arrangement on this shrub during spring. The fruits develop on new season growth in clusters and change color from green to dark purple, maturing irregularly during the middle of May to mid-June. This makes it necessary to conduct multiple harvests for optimum yield and quality. Fruits of Phalsa exhibit a sub-acidic

profile and offer a tart taste similar to grapes. Its fruits are nutritionally significant, as every 100g part contains 16.1 mg of vitamin A and 22 mg of vitamin C, besides essential minerals that increase their dietary value (Singh and Nautiyal, 17)

Apart from nutritional value, phalsa fruits offer significant medicinal benefits. These include cooling effects that help prevent heat stroke, reduction of inflammation and fever, and properties reported to be antimicrobial, anti-anaemic, and potentially anti-cancerous. Different parts of the plant are commonly used for fodder, rope making, and medicinal purposes, while its dense foliage helps conserve soil moisture. Phalsa exhibit the ability to perform well on a wide range of soils, including moderately alkaline and poorly drained saline soils. Its temperature tolerance is as high as 44°C, marking it a potential crop for harsh agro-climatic conditions. Production barriers still exist, particularly with respect to irregular fruit ripening, smaller fruit size, and higher perishability. Technological interventions, specifically pruning time and severity, have an overriding influence on productive efficiency. Pruning has a direct impact on the main yield attributes like plant height, branching, and number of fruiting nodes (Ali *et al.*, 4). It enhances the exposure of plants to light and encourages the development of new shoots, which has a direct positive effect on fruit yield

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and quality. The literature reports that pruning at 3.5 to 4 feet height brings about a remarkable enhancement in yield and number of shoots compared to pruning at ground level. Furthermore, studies also report that the last week of December is the best time for pruning if fruit clusters and yield per plant are to be improved (Ghaffoor *et al.*, 9).

Keeping in view the perishable nature of phalsa and its dire need for systematic marketing with enhanced farmer income, optimization of pruning protocols becomes a pivotal imperative. Abid *et al.* (1) studied the effects of pruning intensity and time on vegetative growth, yield, and fruit quality in phalsa. It addresses major gaps that could help improve cultivation efficiency and augment economic returns for the growers.

MATERIALS AND METHODS

The experiment was undertaken during 2023–2024 at the Main Experimental Station, Department of Fruit Science, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya (U.P.). The experimental site is situated in the saline-alkaline belt of the eastern Uttar Pradesh plains at latitude 26.47° N, longitude 82.12° E, and 113 meters above sea level.

The experimentation utilized uniformly grown phalsa plants arranged with 3×2.5 m² spacing. Treatments were organized in a factorial randomized block design (FRBD) comprising six levels of pruning intensities (5 cm, 15 cm, 25 cm, 35 cm, 45 cm, and 55 cm above ground) and three pruning dates (27 Jan, 4 Feb and 14 Feb), each replicated three times. Pruning was performed with sharp secateurs, cutting branches to the designated heights per the treatment schedule to optimise shoot induction.

Routine agronomic practices were applied across all experimental plots. Key variables were measured, including growth and yield attributes like days taken

to sprouting, number of shoots per plant, number of nodes per shoot, number of buds per node, days taken to flowering and yield per plant. Fruit quality assessments comprised measurements of fruit length and breadth using a digital Vernier calliper, average fruit weight, total soluble solids (TSS) with a digital hand refractometer (expressed in Brix), titratable acidity, and proportions of reducing, non-reducing, and total sugars, all determined using standardized laboratory procedures. The recorded data were analyzed using the analysis of variance (ANOVA) technique. The least significance test was employed to analyze the impact of treatments at a 5% significance level.

RESULTS AND DISCUSSION

The number of days taken to sprout was significantly affected by the various combinations of pruning intensity and time of pruning (Table 1). The minimum number of days taken to sprouting (19) was recorded in treatment D₁T₅ (27 Jan + 45cm), while the maximum number of days taken to sprouting (33.99) was observed in treatment D₃T₁ (14 Feb + 5cm). This might be due to environmental conditions, as the drop in temperature from January to early February may have activated the buds, which might have sprouted early due to severe pruning (Fig 1). These results are in accordance with findings reported by Saini *et al.* (16) and Suzuki (19) in mulberry. The early sprouting might also be due to pruning, as it resulted in better light interception and lesser apical dominance, leading to early sprouting. These results are supported by the findings of Adhikari and Kandel (2) in guava plants Gola *et al.* (10) in ber plants.

The number of shoots per plant, the number of nodes per shoot and the number of buds per node were also significantly influenced by the tested treatment combinations (Table 1). The highest number of shoots per plant (70.34), number of nodes

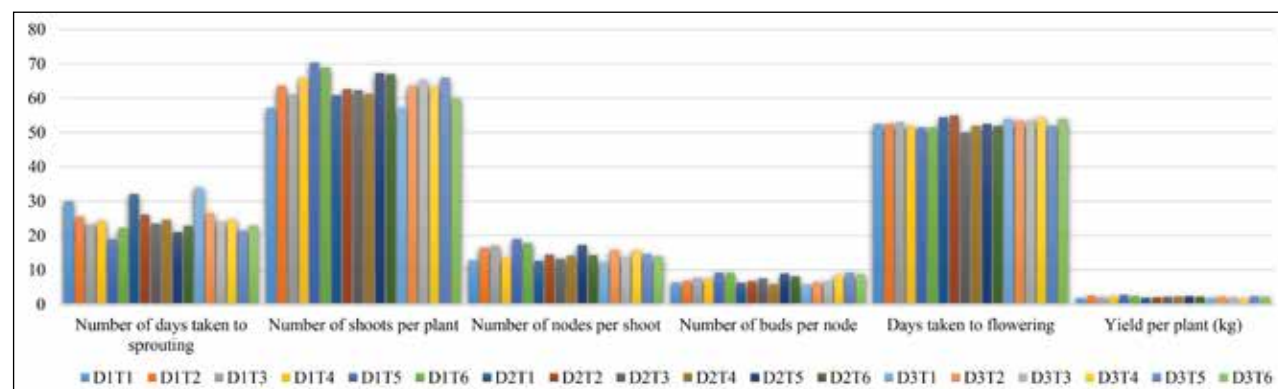


Fig. 1. Effect of different pruning intensities on growth attributes of phalsa.

Table 1: Effect of different pruning intensities on growth attributes of phalsa.

Treatments	Number of days taken to sprouting	Number of shoots per plant	Number of nodes per shoot	Number of buds per node	Days taken to flowering	Yield per plant (kg)
D ₁ T ₁ (27 Jan + 5cm)	30.1	57.2	12.84	6.35	52.5	1.85
D ₁ T ₂ (27 Jan + 15cm)	25.5	63.67	16.49	6.85	52.5	2.54
D ₁ T ₃ (27 Jan + 25cm)	23.2	61	17.14	7.65	53	2.1
D ₁ T ₄ (27 Jan + 35cm)	24.4	66	13.66	7.45	52	2.3
D ₁ T ₅ (27 Jan + 45cm)	19	70.34	19.02	9.25	51.5	2.76
D ₁ T ₆ (27 Jan + 55cm)	22.29	69	17.85	9.19	51.51	2.49
D ₂ T ₁ (4 Feb + 5cm)	32.09	60.85	12.64	6.28	54.5	1.95
D ₂ T ₂ (4 Feb + 15cm)	26.1	62.67	14.49	6.78	55	2.1
D ₂ T ₃ (4 Feb + 25cm)	23.5	62.33	13.29	7.56	50	2.28
D ₂ T ₄ (4 Feb + 35cm)	24.6	61.33	14.22	5.89	52	2.33
D ₂ T ₅ (4 Feb + 45cm)	20.99	67.33	17.26	8.96	52.5	2.47
D ₂ T ₆ (4 Feb + 55cm)	22.9	67	14.34	8.19	52	2.31
D ₃ T ₁ (14 Feb + 5cm)	33.99	57.34	12.29	5.77	54	1.96
D ₃ T ₂ (14 Feb + 15cm)	26.6	63.68	15.89	6.55	53.5	2.26
D ₃ T ₃ (14 Feb + 25cm)	24.1	65.34	13.75	6.83	53.49	2.09
D ₃ T ₄ (14 Feb + 35cm)	24.8	63.34	15.85	8.69	54.5	1.73
D ₃ T ₅ (14 Feb + 45cm)	21.5	66	14.66	9.24	52	2.43
D ₃ T ₆ (14 Feb + 55cm)	22.95	60.1	14.02	8.76	54	2.31
C.D. at 5%	0.89	2.88	0.74	0.43	2.03	0.08
SE(m)±	0.31	1.00	0.26	0.15	0.71	0.03

per shoot (19.02) and number of buds per node (9.25) were recorded in treatment D₁T₅ (27 Jan + 45cm), whereas lowest number of shoots per plant (57.2) was observed in treatment D₁T₁ (27 Jan + 5cm), however minimum number of nodes per shoot (12.29) and number of buds per node (5.77) was found in treatment D₃T₁ (14 Feb + 5cm) respectively. This might also be due to the availability of more light per unit area, which favourably influences greater photosynthetic activity, thereby producing more photosynthates. Similarly, Awasthi and Misra (5) observed an increase in the number of internodes with the increase in severity of pruning in Ber. The present findings also align with those of Braswell *et al.* (2005), who discovered that spring pruning in 'Climax' blueberry plants enhanced bud initiation. George and Nissen (8) also recorded similar results, noting that summer pruning of custard apple increased the number of sub-petiole buds compared to unpruned trees.

The days to flowering were significantly influenced by various treatment combinations of pruning intensity and time (Table 1). The minimum days taken to

flowering (51.5 days) was recorded in treatment D₁T₅ (27 Jan + 45cm), whereas the maximum days taken to flowering (55 days) was observed in D₂T₂ (4 Feb + 15cm) treatment. This might be due to delayed vegetative sprouting and increased availability of reserve food material per bud due to pruning at 45 cm above ground level. These results are in accordance with those reported by Saini *et al.* (16) and Suzuki (19) in mulberry.

The effect of various combinations of pruning intensity and time was also found to be significant with respect to yield per plant (Table 1). The maximum yield per plant (2.76 kg) was noted in treatment D₁T₅ (27 Jan + 45cm), whereas the minimum yield per plant (1.73 kg) was found in treatment D₃T₄ (14 Feb + 35cm). This may be due to the availability of more metabolites and the retention of sufficient bearing shoot size after pruning at 45 cm intensity. Similar results have been reported by Saini *et al.* (16) and Rangaswami *et al.* (14) in mulberry. Additionally, Pandey *et al.* (12) reported maximum fruit yield with 50% pruning severity, followed by 75% pruning in Ber. According to Bagchi *et al.* (6) a consistent

increase in the concentrations of tryptophan, proline, and peroxidase in leaves, bark and fruits, along with a decreased content of phenols after pruning, can be considered favourable factors for enhanced flowering and fruiting, ultimately leading to higher yields. These findings are in close agreement with earlier studies by Pilania *et al.* (13) and Sah *et al.* (15), who observed significantly higher fruit yield per plant with 50% shoot pruning.

The information presented in Table 2 demonstrates a significant increase in fruit length, width and weight, due to various combinations of pruning intensity and pruning time. The maximum fruit length (0.93cm), fruit width (0.98cm) and fruit weight (84.29g) was noted in treatment D₁T₅ (27 Jan + 45cm) whereas minimum fruit length (0.71cm) and fruit weight (64.31g) was found in treatment D₁T₁ (27 Jan + 5cm) however minimum fruit width (0.82cm) was observed under the effect of treatment D₂T₁ (4 Feb + 5cm). In the present investigation, the date and intensity of pruning significantly affected fruit weight, fruit length and fruit width. This may be attributed to better sunlight penetration in the plant canopy,

leading to increased fruit weight, length, width and volume (Singh *et al.*, 18). Increased fruit weight in severely pruned bushes might be due to reduced competition compared to lightly pruned trees. Similar findings were reported by Ahmad *et al.* (3) in Kinnow and Singh *et al.* (18) in ber.

TSS, reducing sugars, non-reducing sugars and total sugars (Table 2) were also significantly influenced by various treatment combinations of pruning intensity and time. Maximum TSS (31.51 °B), reducing sugars (18.99%) and total sugars (23.67%) were noted in treatment D₁T₅ (27 Jan + 45cm); however, maximum non-reducing sugars (4.78%) were observed in treatment D₁T₃ (27 Jan + 25cm). The minimum TSS (21.02 °B) was observed in treatment D₃T₃ (14 Feb + 5cm), whereas the lowest reducing sugars (12.9%), non-reducing sugars (2.42%) and total sugars (15.32%) were found in treatment D₂T₁ (4 Feb + 5cm) (Fig 2). This might be due to the beneficial role of sunlight on photosynthetic activity, as optimum pruning ultimately leads to the accumulation of large amounts of carbohydrates and an increase in the TSS content of fruits. Saini *et*

Table 2: Effect of different pruning intensities on biochemical attributes of phalsa.

Treatment	Fruit length (cm)	Fruit width (cm)	Fruit weight (g)	TSS (°B)	Reducing sugars (%)	Non-reducing sugars (%)	Total sugars (%)	Acidity (%)
D ₁ T ₁ (27 Jan + 5cm)	0.71	0.86	64.31	23.52	14.16	3.01	17.19	2.6
D ₁ T ₂ (27 Jan + 15cm)	0.79	0.94	81.24	25.85	15.09	4.2	19.29	2.38
D ₁ T ₃ (27 Jan + 25cm)	0.79	0.96	77.66	25.52	16.58	4.78	21.35	2.35
D ₁ T ₄ (27 Jan + 35cm)	0.83	0.95	77.6	25.18	16.53	3.74	20.27	2.09
D ₁ T ₅ (27 Jan + 45cm)	0.93	0.98	84.29	31.51	18.99	4.67	23.67	2.05
D ₁ T ₆ (27 Jan + 55cm)	0.91	0.92	83.87	30.85	17.25	4.31	21.56	2.15
D ₂ T ₁ (4 Feb + 5cm)	0.81	0.82	67.18	23.84	12.9	2.42	15.32	3.05
D ₂ T ₂ (4 Feb + 15cm)	0.77	0.83	75.72	27.85	15.91	3.39	19.3	2.54
D ₂ T ₃ (4 Feb + 25cm)	0.78	0.84	79	27.85	14.85	4.51	19.35	2.51
D ₂ T ₄ (4 Feb + 35cm)	0.8	0.85	70.79	24.85	16.63	4.37	21	2.14
D ₂ T ₅ (4 Feb + 45cm)	0.88	0.97	82.5	27.52	17.96	4.06	22.02	2.13
D ₂ T ₆ (4 Feb + 55cm)	0.89	0.85	81.4	28.52	15.99	3.36	19.36	2.73
D ₃ T ₁ (14 Feb + 5cm)	0.8	0.9	65.7	24.51	13.55	2.75	16.3	3.18
D ₃ T ₂ (14 Feb + 15cm)	0.87	0.92	79.52	22.52	14.88	3.47	18.35	2.21
D ₃ T ₃ (14 Feb + 25cm)	0.84	0.92	76.72	21.02	15.86	4.7	20.55	2.26
D ₃ T ₄ (14 Feb + 35cm)	0.74	0.91	78.8	26.85	15.98	3.42	19.4	2.68
D ₃ T ₅ (14 Feb + 45cm)	0.82	0.94	82.75	28.85	18.17	4.33	22.5	2.11
D ₃ T ₆ (14 Feb + 55cm)	0.75	0.87	82.22	26.52	17.93	3.55	21.48	2.03
C.D. at 5%	0.03	0.04	3.15	1.087	0.67	0.17	0.93	0.10
SE(m)±	0.01	0.02	1.09	0.377	0.23	0.06	0.32	0.03

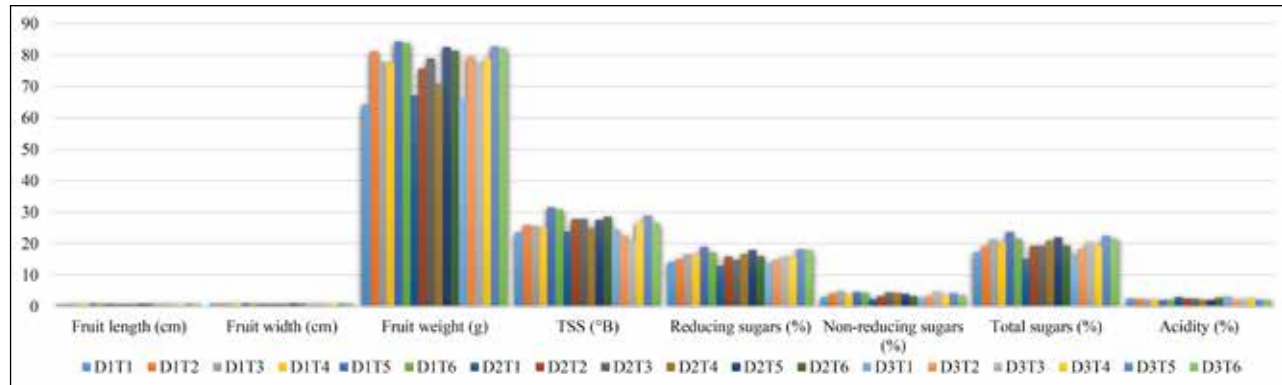


Fig. 2. Effect of different pruning intensities on biochemical attributes of phalsa.

al. (16) also observed the highest total soluble solids in fruits from trees pruned at 75% severity, while the least TSS was found in unpruned mulberry trees. The increased total sugar content, along with reducing and non-reducing sugars in fruits, might also be attributed to the high temperatures during flowering, fruit formation, and ripening, which promote the degradation of polysaccharides into simple sugars through metabolic activities, conversion of organic acids into sugars, and moisture loss, as suggested by Lakpathi and Rajkumar (11). Singh and Nautiyal (17) also observed that reducing sugars, non-reducing sugars, and total sugars showed positive changes in their biochemical composition under different pruning intensities, with the highest values recorded under 75 percent pruning in apple.

The acidity of phalsa fruit was affected significantly by the different intensities and times of pruning, as represented in Table 2. The lowest acidity (2.03%) was found in treatment D_3T_6 (14 Feb + 5cm), whereas the highest acidity (3.18%) was noted in treatment D_3T_1 (14 Feb + 5cm). Similar findings have been reported by Saini *et al.* (16). Rangaswami *et al.* (14) also observed a decrease in acid content in fruits with increasing pruning intensities in mulberry.

Considering the findings outlined above, it is apparent that the combination of 45 cm pruning intensity and pruning carried out on 27th January produced superior results with respect to the growth, yield, and quality of phalsa. Therefore, it is recommended for phalsa growers in the Eastern U.P. region. Pruning time and intensity significantly influenced the growth, yield, and fruit quality of phalsa. The treatment combination D_1T_5 (pruning on 27 January at 45 cm above ground level) proved most effective, recording the earliest sprouting, maximum number of shoots per plant, nodes per shoot, buds per node, earliest flowering, and highest yield per plant.

AUTHOR'S CONTRIBUTION

Conceptualization of research (BS); Designing of the experiments (BS); Contribution of experimental materials (BS, HY, MT); Execution of field/lab experiments and data collection (BS, MT, HY); Analysis of data and interpretation (BS, OP, PP); Preparation of the manuscript (BS, OP, PP).

DECLARATION

The authors declare that there are no conflicts of interest related to this study.

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