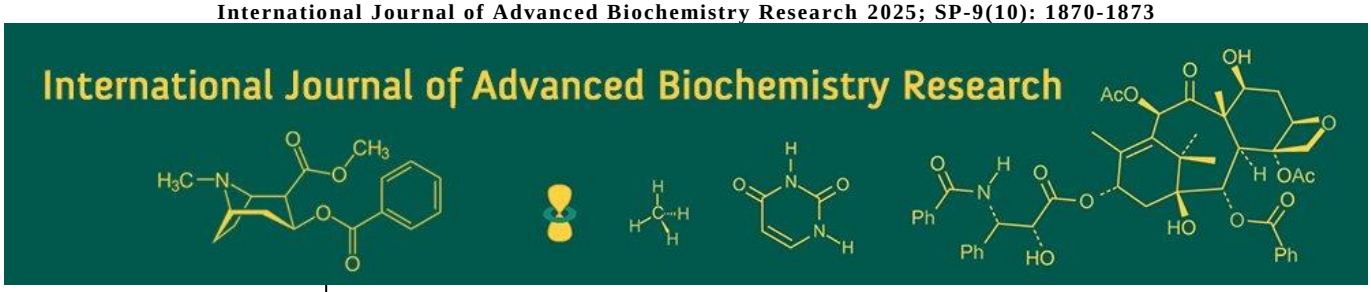

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Effect of pruning levels and months on growth and yield performance of rambutan (*Nephelium lappaceum* L.) in coastal Karnataka

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Abstract
The study investigated the effect of pruning levels and months on growth and yield performance of rambutan (*Nephelium lappaceum* L.) under coastal Karnataka conditions using a Factorial Randomized Block Design comprising two factors: pruning levels and pruning months. The experiment included four pruning levels-0 cm (P_0), 30 cm (P_1), 45 cm (P_2), and 60 cm (P_3) from the shoot tip and two pruning months-July 4th week (M_1) and August 4th week (M_2). Results showed that 30 cm pruning (P_1) accelerated sprouting (18.80 days), increased the number of new shoots (56.65/m²), promoted early flowering (135.00 days) and fruit yield per tree (26.30 kg/tree). Whereas pruning in the 4th week of August (M_2) enhanced sprouting (24.70 days), flowering (140.00 days) and yield (21.60 kg/tree) compared to July pruning. Interaction effects showed that P_1M_2 (30 cm pruning in the 4th week of August) was most effective for early flowering (124.00 days), while P_2M_2 (45 cm pruning in the 4th week of August) gave the highest overall yield (27.10 kg/tree). Overall light to moderate pruning (30-45 cm) in late August optimizes growth and productivity of rambutan in coastal Karnataka.

Keywords: Rambutan, pruning, growth, yield

Introduction
Rambutan (*Nephelium lappaceum* L.), commonly known as "hairy litchi," is a tropical fruit crop belonging to the family *Sapindaceae* (2n = 22). Native to the Malay Archipelago, it has spread across tropical regions owing to its adaptability and commercial appeal. The fruit's distinctive hairy rind and juicy, sweet aril make it highly desirable in fresh markets. In India, although exact statistics are unavailable, the area under rambutan is estimated to be less than 1000 acres. However, its cultivation is steadily expanding, particularly in the humid coastal belts of southern states, where climatic conditions are favourable. Increasing consumer demand in domestic and international markets underscores its potential as a promising tropical fruit crop.

Pruning is an important horticultural practice influencing both vegetative and reproductive growth by regulating canopy structure, light interception, and resource allocation (Zivdar *et al.*, 2016) [26]. It promotes new shoot emergence, removes diseased or over crowded branches, and enhances fruit quality by improving photosynthetic efficiency (Dubey *et al.*, 2001). Appropriate pruning intensity and timing can help maintain vigour, balance shoot-root growth, and direct assimilates towards fruit development (Nair *et al.*, 2024) [15]. Since rambutan exhibits tendencies of irregular bearing, optimizing pruning levels and months are crucial to improve yield, fruit quality, and regularity in production. Hence, the present study was undertaken to evaluate the effect of different pruning levels and months on the growth and yield performance of rambutan under coastal Karnataka conditions.

Materials and Methods
The experiment was carried out in an experimental orchard of Kedoor village in Udupi district during the year, 2024-25 on four years old rambutan (*Nephelium lappaceum* L.) trees, spaced at 5m x 5m. The experiment was laid out in 4 × 2 Factorial RCBD with 2 factors viz., pruning levels and pruning months.

The pruning was carried out in four different intensities i.e. no pruning (P_0), 30 cm (P_1), 45 cm (P_2) and 60 cm (P_3) pruning from the shoot tip during July 4th week (M_1) and August 4th week (M_2).

The observations recorded includes days required for sprouting, number of sprouted shoots per square meter, days required for first flowering, number of panicles per square meter and fruit yield per tree (kg). The collected data were subjected to statistical analysis using R Studio (2024) following the methodology outlined by Fisher and Yates (1963) [4].

Results and Discussion

Days required for sprouting

Significant variations were observed in the number of days taken for sprouting among pruning levels, months and interaction (Table 1). The minimum days for sprouting (18.80) was recorded in P_1 which was on par with P_3 (21.20), while the maximum days (45.70) were observed in P_0. Among pruning months, M_2 recorded the minimum days for sprouting (24.70), whereas M_1 showed the maximum (29.30). The interaction effect was also significant, with the early sprouting (15.70 days) recorded in P_3M_2 closely followed by P_1M_2 (17.10 days) while the maximum days (45.97) were recorded in P_0M_1. Early sprouting in pruned treatments may be due to enhanced carbohydrate accumulation and activation of growth hormones such as gibberellins and cytokinins near pruning sites, promoting rapid bud emergence (Zivdar *et al.*, 2016) [26].

Number of sprouted shoots per square meter

The number of new shoots produced per square meter varied significantly with different pruning levels and pruning months in rambutan (Table 1). Among pruning levels, the maximum sprout density (56.65 m^{-2}) was recorded in P_1 followed by P_3 (44.39 m^{-2}), while the minimum (9.28 m^{-2}) was observed in the P_0. Considering the pruning months, the greater number of sprout density (47.30 m^{-2}) was recorded in M_1 whereas lesser number (29.60 m^{-2}) was observed in M_2. The interaction effect was also significant, with the highest sprout density (69.11 m^{-2}) obtained in P_1M_1 followed by P_2M_1 (57.47 m^{-2}) whereas the lowest sprout density (8.91 m^{-2}) occurred in P_0M_2. This might be attributed to the removal of old shoots, which promotes carbohydrate accumulation and growth hormones near the pruning site, stimulating bud emergence and vegetative growth under favourable environmental conditions as suggested by Zivdar *et al.* (2016) [26] and Bagchi *et al.* (2008) [1]. Similar trends were reported by Pawan *et al.* (2017) [17], Lakpathi and Rajkumar (2018) [11], Kumar *et al.* (2021) [9], Raj *et al.* (2021) [18], Singh *et al.* (2023) [23], Sonika *et al.* (2023) [25], and Gomasta *et al.* (2024) [6].

Days required for first flowering

Pruning at 30 cm (P_1) recorded the minimum days taken for flowering (135.00), which was statistically on par with P_2 (136.00), while the maximum days taken for flowering (156.00) was observed in P_0. Months also showed significant variation, with the lesser number of days days for flowering (140.00) recorded in M_2 and the maximum (148.00) in M_1. Their interaction effect was also significant, with the early flowering (124.00) observed in P_1M_2, followed by P_2M_2 (130.00 days) whereas the maximum (163.00) was recorded in P_0M_2. Early flowering in pruned treatments might be due to enhanced new shoot development and increased light penetration to the canopy, which influence IAA activity and promote floral induction (Lal and Shukla, 2008) [12]. Similar results have been reported by Singh *et al.* (2010) [24] in mango, Kumar (2015) [8] in litchi, Pawan *et al.* (2017) [17] in mulberry, Choudhary and Dhakare (2018) [2] in custard apple, Kumar *et al.* (2023) [10] in guava, Relhan *et al.* (2023) [19] in guava, and Gomasta *et al.* (2024) [6] in guava.

Number of panicles per square meter

The data on number of panicles per square meter as influenced by different pruning levels and pruning months are presented in Table 1. The maximum number of panicles (14.60 m^{-2}) was recorded in P_2 which was statistically on par with P_1 (14.10 m^{-2}) while the lesser number of panicle count (10.50 m^{-2}) was observed in P_0. Pruning months has no significant effect on the number of panicles per square meter. However, the interaction effect between pruning levels and months was notable, with the maximum panicle density (16.74 m^{-2}) recorded in P_2M_2 followed by P_1M_1 (14.91 m^{-2}) whereas the lowest (9.77 m^{-2}) was observed in P_0M_1. The maximum panicle growth under moderate pruning may be attributed to the stimulation of new fruiting shoots and the improved canopy structure which has contributed for resource allocation for flowering as per studies of Pandey *et al.* (2020) [16] in guava, Singh *et al.* (2020) [16] in guava, Kumar *et al.* (2021) [9] in guava, and Meenakshi *et al.* (2022) [14] in phalsa.

Fruit yield per tree (kg)

Fruit yield per tree is influenced by pruning levels and months which is are presented in Table 1. Pruning levels showed a highly significant effect on yield, with the maximum yield (26.30 kg/tree) in P_1 followed by P_2 (24.00 kg/tree), while the minimum yield (14.20 kg/tree) was recorded in P_0. Pruning months also had a significant influence, with higher yield (21.60 kg/tree) observed in M_2 than in M_1 (19.90 kg/tree). The interaction effect showed that the highest yield (27.10 kg/tree) was recorded in P_2M_2 which was statistically on par with P_1M_1 (27.00 kg/tree). However, the lowest yield (13.60 kg/tree) was observed in P_0M_2.The increased yield may be attributed to a balanced vegetative and reproductive growth which helps in retaining more fruit bearing shoots thereby reducing intra canopy competition for light and nutrients as documented by Gill *et al.* (2006) [5] and Madhumala *et al.* (2024) [13]. Similar yield improvements with regulated pruning were reported by Senthilkumar *et al.* (2015) [20] in grapes, Choudhary and Dhakare (2018) [2] in guava, Sharma *et al.* (2022) [21] in kinnow, Gomasta *et al.* (2024) [6], and Ingle *et al.* (2024) [7] in guava.

Table 1: Effects of pruning levels and months on vegetative and reproductive performance of rambutan

Treatment	Days required for sprouting	Number of sprouted shoots per square meter	Days required for first flowering	Number of panicles per square meter	Fruit yield per tree (kg)
Pruning levels					
P_0 (No pruning)	45.70	9.28	156.00	10.50	14.20
P_1 (30 cm pruning)	18.80	56.65	135.00	14.10	26.30
P_2 (45 cm pruning)	22.40	43.53	136.00	14.60	24.00
P_3 (60 cm pruning)	21.20	44.39	148.00	13.90	18.40
S.Em (±)	1.34	3.37	3.40	0.629	0.61
CD @ 5%	4.02	10.11	10.20	1.88	1.83
Pruning months					
M_1 (July 4th week)	29.30	47.30	148.00	12.90	19.90
M_2 (August 4th week)	24.70	29.60	140.00	13.70	21.60
S.Em (±)	0.67	2.38	2.40	0.44	0.43
CD @ 5%	2.01	7.15	7.21	NS	1.29
Interaction (P × M)					
P_0M_1 (No pruning during July 4th week)	45.97	9.63	149.00	9.77	14.80
P_1M_1 (30 cm pruning during July 4th week)	19.30	69.11	146.00	14.91	27.00
P_2M_1 (45 cm pruning during July 4th week)	23.20	57.47	143.00	12.39	20.80
P_3M_1 (60 cm pruning during July 4th week)	25.60	53.00	142.00	14.37	16.80
P_0M_2 (No pruning during August 4th week)	45.80	8.91	163.00	11.15	13.60
P_1M_2 (30 cm pruning during August 4th week)	17.10	44.19	124.00	12.89	25.60
P_2M_2 (45 cm pruning during August 4th week)	19.10	29.58	130.00	16.74	27.10
P_3M_2 (60 cm pruning during August 4th week)	15.70	35.77	154.00	13.89	20.00
S.Em (±)	1.34	4.77	4.81	0.89	0.86
CD @ 5%	4.02	14.30	14.42	2.66	2.50

Conclusion

Based on the results it can be concluded that pruning treatments significantly influenced the growth and yield performance of rambutan under coastal Karnataka conditions. Among the pruning levels, 30 cm pruning from the shoot tip (P_1) was superior in terms of lesser number of days taken for sprouting, maximum number of sprouted shoots, early flowering and maximum fruit yield per tree. With respect to pruning months, August 4th week pruning (M_2) recorded better performance than July pruning by promoting early sprouting, flowering and maximum yield. Considering the interaction, P_1M_2 (30 cm pruning during the 4th week of August) proved most effective concerning to early flowering, while P_2M_2 (45 cm pruning during the 4th week of August) was notable for producing maximum number of panicles and fruit yield. These findings suggest that light to moderate pruning (30-45 cm) during the 4th week of August is optimal for enhancing growth and yield performance of rambutan in coastal Karnataka.

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