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Impact of varied pruning schedules on quality attributes of mango cultivars under high-density planting

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Abstract
The present study entitled “Impact of Varied Pruning Schedules on Quality Attributes of Mango Cultivars under High-Density Planting” was carried at Department of Fruit Science, PDKV, Akola, Maharashtra during the year 2024-2025. The experiment was laid out in Factorial Randomized Block design with twelve treatment combination and three replications. Among the varieties, Maximum Total soluble solids (TSS), TSS: Acid ratio, Ascorbic acid content, minimum Titratable acidity, were recorded in Kesar (V_1). Whereas maximum Non- Reducing sugars was recorded in Ratna (V_2) and minimum reducing sugars was recorded in Pairi (V_3). In respect to pruning times, Second Fortnight of July (P_4) was recorded maximum Total soluble solids (TSS), TSS: Acid ratio, Non-reducing sugars, Ascorbic acid content, minimum Titratable acidity, Reducing sugars which was followed by P_3, P_2 and P_1. Additionally, the treatment combination Kesar pruned in the Second Fortnight of July (V_1P_4) recorded significantly the Maximum Total soluble solids (TSS), TSS: Acid ratio, Ascorbic acid content, minimum Titratable acidity, Reducing sugars. Whereas maximum Non- reducing sugars was recorded in V_2P_4.

Keywords: Kesar, Ratna, Pairi, Pruning times

Introduction
Mango (*Mangifera indica* L.), often referred to as the "King of Fruits," is one of the most economically significant and widely cultivated tropical fruit crops in the world. Belonging to the family Anacardiaceae, mango is native to South Asia and has been cultivated for over 4,000 years. It holds immense commercial, nutritional, and cultural importance in many tropical and subtropical regions, particularly in countries like India, which is the largest producer, consumer, and exporter of mango globally. The fruit is highly valued for its rich flavour, aroma, and nutritional content, including vitamins A, C, and E, dietary fibre, and antioxidants. Over 1,000 mango cultivars are grown worldwide, each with distinct characteristics in terms of fruit size, flavour, yield potential, and climatic adaptability.

With increasing demand and shrinking landholdings, high-density planting (HDP**)** systems have emerged as a promising strategy to maximize yield per unit area, enhance orchard management, and improve fruit quality. However, HDP requires intensive canopy and crop management practices, among which pruning plays a vital role. Proper and timely pruning can regulate canopy structure, improve light penetration, enhance photosynthetic efficiency, and ultimately influence the flowering, fruit set, and quality parameters of the fruit. Pruning at the correct time typically during dormancy or specific growth stages helps stimulate healthy new growth and minimizes the risk of diseases and environmental stress. Different mango varieties may respond differently to pruning practices, particularly when pruning is performed at different times of the year.

Material & Methods
The investigation was carried out during June 2024 - May 2025 at Department of Fruit Science, PDKV, Akola district, Maharashtra. Akola is situated under a sub-tropical region between 22" 42" North latitude and 77° 02' East longitude. The altitude of the place is 307.42 meters above from MSL. The experiment was laid out in Factorial Randomized Block Design (FRBD) with two factors, Different mango varieties *viz.*, Kesar (V_1), Ratna (V_2), and

Pairi (V_3); Pruning times *viz.*, First Fortnight of June (P_1), Second Fortnight of June (P_2), First Fortnight of July(P_3) and Second Fortnight of July(P_4), which were replicated three times to study the effect of different mango varieties and pruning times.

Results and Discussion

The Total soluble solids (TSS) was significantly influenced by different mango varieties, pruning times but found to be non-significant for their interaction (Table 1).

The Maximum TSS (20.08 °Brix) was observed in V1- Kesar followed by V2- Ratna (19.47 °Brix) which was statistically at par with V3- Pairi (19.28 °Brix). The maximum TSS was recorded under treatment P4 (Second Fortnight of July) was 20.89 °Brix. This was followed by treatment P3 (First Fortnight of July), P2 (Second Fortnight of June), and P1 (First Fortnight of June), which was recorded 19.77, 18.98, and 18.80 °Brix respectively. An interaction between different mango varieties and pruning times were found to be non significant for total soluble solids. The variability in total soluble solids of different varieties attributed to the altered structure during ripening processes as various hydrolytic processes by enzymes instigated the breakdown of complex carbohydrates to smaller ones like sucrose, glucose and fructose Sayeed *et al.* (2009) [15] and Rathore *et al.* (2007) [10]. The results were similar to the findings of Anila and Radha (2006) [3]. The variation in TSS could be due to varietal nature which was earlier reported by Rajwana *et al.* (2010) [9], Rymbai *et al.* (2015) [12], Ahmed *et al.* (2016) [2], Sampath (2017) [14] and Mandal and Thokchom (2018) [7] in mango. Jha *et al.* reported that there might be effect of harvesting stages on TSS content in mango fruits.

The Titratable acidity was significantly influenced by different mango varieties, pruning times and their interaction (Table 1).

The Minimum acid content (0.27%) was found to be observed in V1 – Kesar followed by V2 - Ratna (0.35%) which was statistically at par with V3- Pairi (0.38%). The titratable acidity was observed to be minimum under the treatment P4 (Second Fortnight of July) was 0.29%. This was followed by P3 (First Fortnight of July), P2(Second Fortnight of June) i.e. 0.32% which was statistically at par with P2(Second Fortnight of June) and P1(First Fortnight of June) was recorded 0.35% and 0.37% respectively. Among the various treatment combinations, V1P4 (Kesar pruning in the Second Fortnight of July) was recorded minimum titratable acidity (0.25%) which was statistically at par with V1P3 (Kesar pruning in the First Fortnight of July) and V1P2 (Kesar pruning in the Second Fortnight of June) was recorded 0.26% and 0.27% respectively. However, maximum titratable acidity was recorded in V3P1(Pairi pruning in the First Fortnight of June) was 0.43%. These results are in accordance with the results of Das (2013) [5]. Varietal nature, time of harvest and prevailing agroclimatic conditions affect the acidity of the fruit. The varied acidity content could be due to varietal behaviour which was supported by Rymbai *et al.* (2015) [12], Ahmed *et al.* (2016) [2], Reda (2016) [11], Sampath (2017) [14] and Mandal and Thokchom (2018) [7] in mango.

The TSS: Acid ratio was significantly influenced by different mango varieties and their interaction. But found to be non-significant for pruning times (Table 1).

Among the different mango varieties studied, V1- Kesar exhibited maximum TSS: Acid ratio (75.45) followed by V2- Ratna (57.48). The minimum TSS: Acid ratio was observed in V3- Pairi (51.33). Variation in sugar acid ratio may be due to varietal nature and the degree of ripeness of the fruit. The pruning times were found to be non significant for TSS: Acid ratio. The maximum TSS:acid ratio was recorded in the treatment combination V1P4 (Kesar pruning in Second Fortnight of July) was 87.08. This was followed by V1P3 (Kesar pruning in the First Fortnight of July) i.e. 78.00 which was statistically at par with V2P4 (Ratna pruning in the First Fortnight of July) and V1P2 (Kesar pruning in the Second Fortnight of June) was recorded 73.60 and 71.00 respectively. However, minimum TSS: Acid ratio was recorded in V3P1(Pairi pruning in the First Fortnight of June) was 43.00. This might be due to competition is minimized, allowing more sugars to accumulate in fruit, and less in shoots or leaves. Consequently, fruit quality improves, particularly in sugar-acid balance.

Table 1: Effect of different mango varieties and pruning times on Total soluble Solids (TSS), Titratable Acidity and TSS: Acid Ratio

Treatment	**Total soluble Solids (°Brix)**					**Titratable Acidity (%)**					**TSS: Acid Ratio**				
Varieties	**Pruning times**														
	P1 (I Fortnight of June)	**P2 (II Fortnight of June)**	**P3 (I Fortnight of July)**	**P4 (II Fortnight of July)**	**Mean**	**P1 (I Fortnight of June)**	**P2 (II Fortnight of June)**	**P3 (I Fortnight of July)**	**P4 (II Fortnight of July)**	**Mean**	**P1 (I Fortnight of June)**	**P2 (II Fortnight of June)**	**P3 (I Fortnight of July)**	**P4 (II Fortnight of July**	**Mean**
V1: Kesar	19.08	19.17	20.30	21.77	20.08	0.29	0.27	0.26	0.25	0.27	65.70	71.00	78.00	87.08	75.45
V2: Ratna	18.82	18.97	19.49	20.62	19.47	0.38	0.37	0.35	0.28	0.35	49.50	51.20	55.60	73.60	57.48
V3: Pairi	18.51	18.79	19.52	20.30	19.28	0.43	0.40	0.35	0.34	0.38	43.00	46.90	55.70	59.70	51.33
Mean	18.80	18.98	19.77	20.89		0.37	0.35	0.32	0.29		52.73	56.37	63.10	73.46	
Interaction effect (VXP)															
	V		P		VXP	V		P		VXP	V		P		VXP
'F' test	Sig		Sig		NS	Sig		Sig		Sig	Sig		NS		Sig
SE(m)±	0.14		0.16		0.27	0.01		0.01		0.02	1.72		1.99		3.45
CD at 5%	0.40		0.46		-	0.03		0.03		0.05	5.06		-		10.11

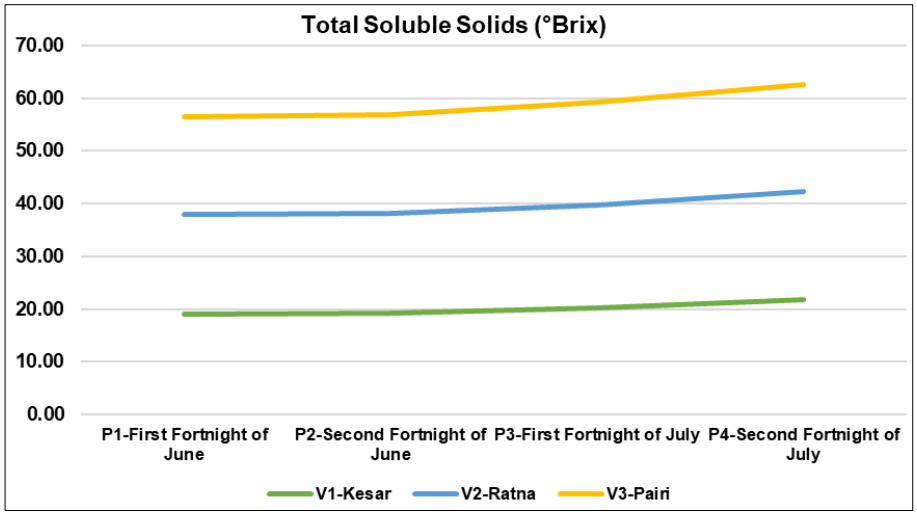

Fig 1: Effect of different mango varieties and pruning times on Total Soluble Solids (°Brix)

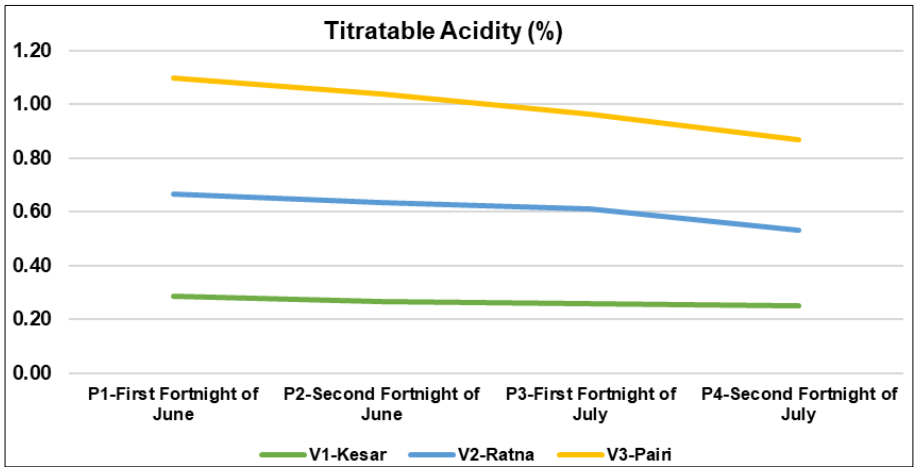

Fig 2: Effect of different mango varieties and pruning times on Titratable Acidity (%)

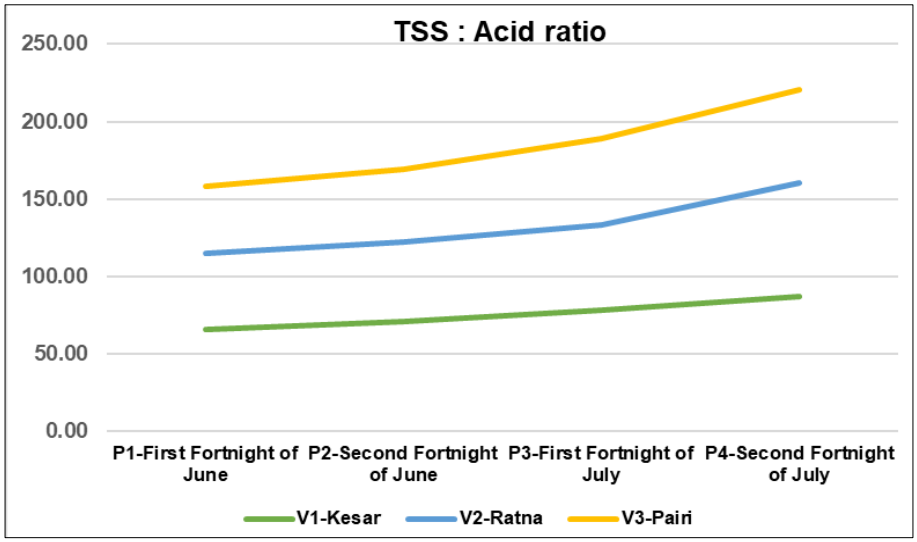

Fig 3: Effect of different mango varieties and pruning times on TSS: Acid ratio

The Reducing sugars was significantly influenced by different mango varieties, pruning times and their interaction (Table 2).

The Minimum reducing sugars content (3.16%) was observed in V3- Pairi which was statistically at par with V1-Kesar and V2-Ratna was recorded 3.30% and 3.52% respectively. The data revealed that the significantly minimum reducing sugars was recorded under treatment P4 (Second Fortnight of July), with an average of 2.13%. This was followed by treatments P3 (First Fortnight of July), P2 (Second Fortnight of June), and P1 (First Fortnight of June), which was recorded reducing sugars of 2.92%, 3.81% and 4.44%, respectively. Among the various treatment combinations, the minimum reducing sugars was observed under the treatment combination V1P4 (Kesar pruning in the Second Fortnight of July) was 1.86%. This was followed by

V3P4(Pairi pruning in the Second Fortnight of Juy) *i.e.* 2.18% which was statistically at par with V2P4(Ratna pruning in the Second Fortnight of July) and V1P3(Kesar pruning in the First Fortnight of July) was recorded 2.35% and 2.50% respectively. However, Maximum reducing sugars was recorded in V2P1(Ratna pruning in the First Fortnight of June) was 4.55%. The varied reducing sugar content in mango fruits were probably due to varietal character which was confirmed by Singh *et al. (*2010) [18], Gopu *et al.* (2014) [6], Ahmed *et al.* (2016) [2], Bora *et al.* (2017) [4] and Sampath (2017) [14] and Mandal and Thokchom (2018) [7]. Cultural practices like spacing and pruning, pruning season and the interaction effects of spacing and fertigation have also influenced the reducing sugar content in the fruits which was found in accordance with the findings of Gopu *et al.* (2014) [6], Sagar *et al.* (2019) [13] and Prakash *et al.* (2011) [8] respectively.

The Non-reducing sugars was significantly influenced by different mango varieties, pruning times but found to be non-significant for their interaction (Table 2). The Maximum value of non-reducing sugar (14.42%) was obtained in V2- Ratna which was followed by V1- Kesar (7.57%). Minimum value of non-reducing sugars (3.36%) was obtained in V3- Pairi. The data revealed that the significantly maximum non-reducing sugars was recorded under treatment P4 (Second Fortnight of July), with an average of 9.38%. This was followed by treatments P3 (First Fortnight of July) i.e. 8.52% which was at par with P2 (Second Fortnight of June) was 8.25%. While minimum non-reducing sugars was recorded in P1 (First Fortnight of June) was 7.65%. An interaction between different mango varieties and pruning times were found to be non-significant for non-reducing sugars. Varieties differed in the non-reducing sugar content which might be due to the genetic makeup of each variety and the same was viewed the study conducted by Ahmed *et al.* (2016) [2] and Bora *et al.* (2017) [14] in mango. This extended and optimized fruit maturation period promotes enhanced synthesis and accumulation of carbohydrates, particularly non-reducing sugars like sucrose, which typically accumulate later in fruit development was supported by Solanki *et al.* (2014) [19].

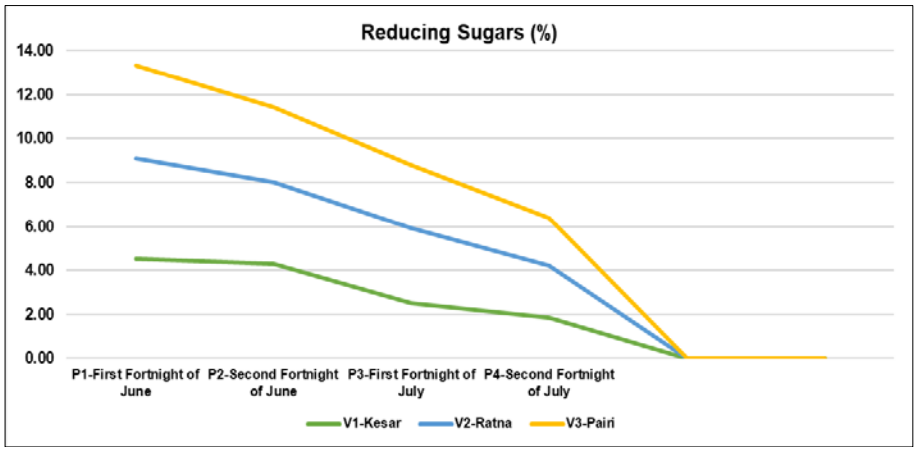

Fig 4: Effect of different mango varieties and pruning times on Reducing Sugars (%)

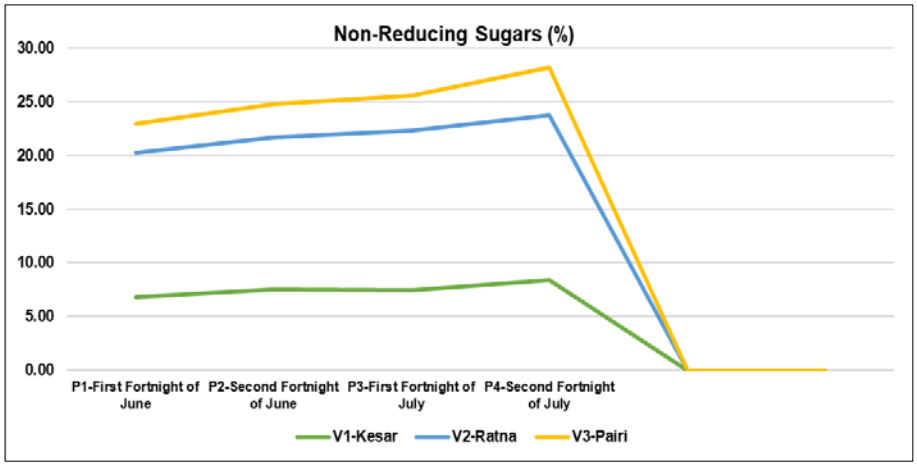

Fig 5: Effect of different mango varieties and pruning times on Non-Reducing Sugars (%)

Table 2: Effect of different mango varieties and pruning times on Reducing sugars and Non – Reducing sugars

Treatment	Reducing sugars (%)					Non - Reducing sugars (%)				
Varieties	Pruning times									
	P1 (I Fortnight of June)	P2 (II Fortnight of June)	P3 (I Fortnight of July)	P4 (II Fortnight of July)	Mean	P1 (I Fortnight of June)	P2 (II Fortnight of June)	P3 (I Fortnight of July)	P4 (II Fortnight of July)	Mean
V1: Kesar	4.54	4.29	2.50	1.86	3.30	6.85	7.53	7.46	8.45	7.57
V2: Ratna	4.55	3.74	3.42	2.35	3.52	13.43	14.10	14.87	15.28	14.42
V3: Pairi	4.22	3.39	2.85	2.18	3.16	2.67	3.10	3.23	4.42	3.36
Mean	4.44	3.81	2.92	2.13		7.65	8.25	8.52	9.38	
Interaction effect (VXP)										
	V		P	VXP		V		P	VXP	
'F' test	Sig		Sig	Sig		Sig		Sig	NS	
SE(m)±	0.08		0.09	0.15		0.14		0.16	0.29	
CD at 5%	0.23		0.26	0.45		0.42		0.48	-	

The Ascorbic acid was significantly influenced by different mango varieties, pruning times and their interaction (Table 3).

The Maximum content of ascorbic acid (46.07 mg $100g^{-1}$) was found in V1 – Kesar followed by V3- Pairi (34.57 mg $100g^{-1}$). However, Minimum value of ascorbic acid content (30.06 mg $100g^{-1}$) was found to be observed in V2- Ratna. The significantly maximum ascorbic acid content was observed under treatment P4 (Second Fortnight of July), with a value of 42.22 mg 100 g^{-1}. This was followed by treatments P3 (First Fortnight of July), P2 (Second Fortnight of June), and P1 (First Fortnight of June), which recorded 38.40, 34.20, 32.79 mg 100 g^{-1} respectively. The maximum ascorbic acid content was recorded in the treatment combination V1P4 (Kesar pruning in the Second Fortnight of July) was 52.55 mg 100 g^{-1}. This was followed by V1P3 (Ratna pruning in the First Fortnight of July) and V3P4 (Pairi pruning in the Second Fortnight of July), which was recorded 48.45 and 42.91 mg 100 g^{-1} respectively. However, minimum ascorbic acid content was recorded in V3P1(Pairi pruning in the First Fortnight of June) was 28.34 mg 100 g^{-1}. The varied ascorbic acid content in the varieties taken for study could be due to varietal behaviour which was upheld by Simi and Rajmohan (2013) [17], Reda (2016) [11] and Bora *et al.* (2017) [4]. Pruning have effect on the ascorbic acid content which was supported by Gopu *et al.* (2014) [6]. Enhanced photosynthate supply to the fruit supports greater synthesis of ascorbic acid, since it is synthesized from sugars and carbohydrate metabolism Sharma *et al.* (2006) [16].

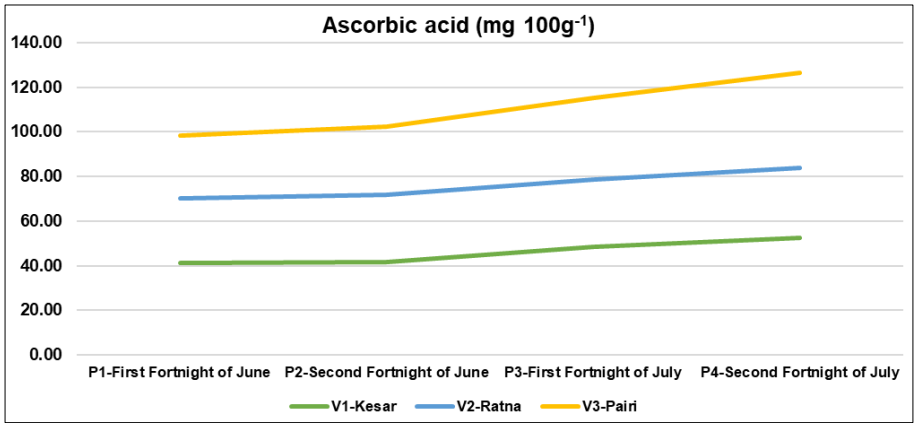

Fig 6: Effect of different mango varieties and pruning times on Ascorbic acid (mg $100g^{-1}$)

Table 3: Effect of different mango varieties and pruning times on Ascorbic Acid

Treatment	Ascorbic Acid (mg 100 g^{-1})				
Varieties	Pruning times				
	P1 (I Fortnight of June)	P2 (II Fortnight of June)	P3 (I Fortnight of July)	P4 (II Fortnight of July)	Mean
V1: Kesar	41.39	41.88	48.45	52.55	46.07
V2: Ratna	28.65	30.05	30.35	31.21	30.06
V3: Pairi	28.34	30.66	36.39	42.91	34.57
Mean	32.79	34.20	38.40	42.22	
Interaction effect (VXP)					
	V		P	VXP	
'F' test	Sig		Sig	Sig	
SE(m)±	0.29		0.34	0.58	
CD at 5%	0.85		0.99	1.71	

Conclusion

Based on the findings, it was evident that among the different mango varieties, the Kesar variety exhibited significantly superior performance. In terms of pruning times, the second fortnight of July proved to be the most effective. The treatment combination of Kesar pruned

during the Second Fortnight of July (V1P4) recorded the most notable results, outperforming all other treatment combinations. This combination consistently demonstrated high yield potential along with the production of superior-quality fruits, which are highly preferred and accepted by consumers.

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