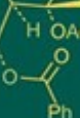
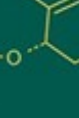
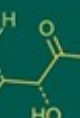
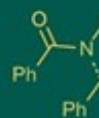
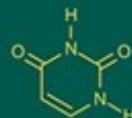
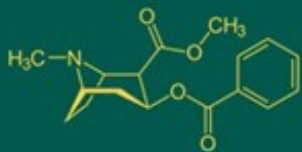


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Effect of foliar application of organic substances on flowering, fruiting and yield attributes of ber (*Zizyphus Mauritiana* Lamk.) cv Apple Ber

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ABSTRACT

The present investigation entitled “Effect of Foliar Application of Organic Substances on Flowering and Yield attributes of ber (*Zizyphus mauritiana* Lamk.) cv. Apple Ber” was conducted at the Dry land Horticultural Farm, SKS College of Agriculture and Research Station, Rajnandgaon, Chhattisgarh, during 2025–26. The experiment was conducted in Randomized Block Design (RBD) with 13 treatments and three replications to evaluate the effect of different organic substances on flowering, fruiting, physical parameters and yield of Apple Ber. The treatments comprised Panchagavya, Jeevamrit, Amrit Pani, *Moringa* leaf extract, Seaweed extract and Humic acid at different concentrations along with control. Among the treatments, Panchagavya @ 3% (T_1) recorded the earliest initiation of flowering (38.56 days) and 50% flowering (45.00 days), along with the highest number of flowers per shoot (14,820.0). It also recorded the highest fruit set (45.00%) and fruit retention (26.50%), with the lowest fruit drop (73.50%). Regarding physical parameters, Panchagavya @ 3% recorded the maximum fruit volume (61.46 cc) and fruit weight (56.55 g), while the pulp:stone ratio was 11.34. The highest yield was also recorded under Panchagavya @ 3% (22.24 t ha⁻¹). Thus, foliar application of Panchagavya @ 3% was found effective in improving flowering, fruiting, physical fruit parameters and yield of Apple Ber under the agro-climatic conditions of Chhattisgarh.

Keywords: Apple Ber, Panchagavya, Organic formulations, Flowering, Fruit set, Fruit retention, Yield, Fruit quality

Introduction

Ber (*Zizyphus mauritiana* Lamk.), belonging to the family Rhamnaceae, is an important fruit crop of arid and semi-arid regions due to its hardiness, wide adaptability, low input requirement and ability to perform under marginal soil conditions. In India, ber is cultivated in several subtropical and tropical regions, including Maharashtra, West Bengal, Andhra Pradesh and Chhattisgarh. The crop is valued for its sweet-sour fruits, which are rich in sugars, organic acids, vitamin C and minerals and are consumed fresh as well as processed into squash, juice, jam, murabba and dehydrated products. Apple Ber is a promising cultivar characterized by large, attractive and crispy fruits, with individual fruits generally weighing about 50–100 g. However, profuse flowering and considerable fruit drop are major constraints affecting fruit retention, yield and marketable production. Therefore, improvement of flowering, fruit set, fruit retention, yield and fruit quality is essential for increasing the productivity and profitability of Apple Ber.

The excessive or imbalanced use of chemical fertilizers and growth regulators may cause environmental and soil-related concerns. Hence, the use of organic substances and biostimulants has gained importance in sustainable horticultural production. Biostimulants can improve nutrient uptake, physiological processes, flowering, fruit set, stress tolerance and fruit quality. Panchagavya and Jeevamrit are traditional cow-based formulations containing beneficial microorganisms and biologically active substances, while Amritpani may improve microbial activity and nutrient availability. *Moringa* leaf extract contains cytokinins, antioxidants, vitamins and minerals that can promote plant growth and productivity (Fuglie, 2000; Yasmeen *et al.*, 2014) [1]. Seaweed extracts contain bioactive compounds, polysaccharides and micronutrients that enhance plant metabolism and stress tolerance (Khan *et al.*, 2009) [2]. Humic acid improves root development, nutrient uptake and physiological efficiency, thereby supporting plant productivity (Nardi *et al.*, 2002) [3].

Material and Methods

The present experiment was conducted during 2025–2026 at the Dry Land Horticulture Farm, SKS College of Agriculture and Research Station, Surgi, Rajnandgaon, Chhattisgarh, India, on eight-year-old plants of ber (*Zizyphus mauritiana* Lamk.) cv. Apple Ber planted at a spacing of 5 × 5 m. Thirteen treatments, viz., T_0

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Control (water spray), T₁-Panchagavya (3%), T₂- Panchagavya (5%), T₃-Jeevamrit (5%), T₄-Jeevamrit (10%), T₅-Amrit Pani (3%), T₆-Amrit Pani (5%), T₇-Moringa leaf extract (4%), T₈-Moringa leaf extract (6%), T₉-Seaweed extract (3%), T₁₀-Seaweed extract (5%), T₁₁-Humic acid (1%) and T₁₂-Humic acid (2%), were evaluated in Randomized Block Design (RBD) with three replications. Each treatment consisted of ten plants, making a total of 390 experimental plants. Foliar sprays were applied at pre-flowering, flowering, mustard and marble stages using a hand-operated knapsack sprayer.

The observations were recorded on initiation of flowering, days to 50% flowering, number of flowers per shoot, fruit set, fruit retention, fruit drop, fruit volume, fruit weight, pulp:stone ratio and yield. For

flowering and fruiting observations, three uniform shoots were selected and tagged on each experimental plant. The number of days from treatment application to the appearance of the first flower was recorded and expressed in days. The number of days taken from treatment application to the stage when approximately 50 per cent of flowers had opened was recorded. Flowers on the selected tagged shoots were counted periodically during the flowering period and the average number of flowers per shoot was recorded.

Fruit set (%)

Fruit set was calculated from the number of fruits formed in relation to the total number of flowers on the tagged shoots.

$$\text{Fruit set (\%)} = (\text{Number of fruits set/Number of flowers}) \times 100$$

Fruit retention (%)

Fruits retained up to harvest were recorded and expressed as a percentage of the initial number of fruits set.

$$\text{Fruit retention (\%)} = (\text{Number of fruits retained at harvest/Initial number of fruits set}) \times 100$$

Fruit drop (%)

The number of fruits dropped from fruit setting to harvest was recorded and expressed as a percentage of the initial number of fruits set.

$$\text{Fruit drop (\%)} = (\text{Number of fruits dropped/Initial number of fruits set}) \times 100$$

Fruit volume (cc)

Fruit volume was determined by the water displacement method and expressed in cubic centimetres (cc).

Fruit weight (g)

The weight of individual mature fruits was recorded using a weighing balance and expressed in grams (g).

Pulp : stone ratio

The pulp and stone were separated from representative fruits and weighed separately. The ratio was calculated as:

$$\text{Pulp:stone ratio} = \frac{\text{Weight of pulp}}{\text{Weight of stone}}$$

Yield: The yield in tonnes per hectare (t ha⁻¹) was calculated by multiplying the yield per

plant (kg) by the number of plants per hectare and dividing the result by 1000.

$$\text{Yield (t ha}^{-1}\text{)} = \text{Yield per plant (kg)} \times \text{Number of plants per hectare}/1000$$

The data obtained were subjected to analysis of variance appropriate for RBD, and treatment means were compared using Critical Difference (CD) at 5% level of significance. The SE(m) ± was also calculated for each parameter.

Results and Discussion

Initiation of flowering (days)

Significant differences in flowering initiation were observed among the treatments following the application of different organic substances (Table 1 & Fig 1). The earliest flowering (38.56 days) was recorded in T₁ (Panchagavya @ 3%), followed by T₂ (Panchagavya @ 5%) (39.22 days), whereas the latest flowering (52.11 days) was observed in T₀ (Control). The early initiation of flowering under Panchagavya may be attributed to improved nutrient availability and enhanced physiological activity, which favoured reproductive development. Similar effects were reported by Yadav *et al.* (2018) [4].

Days to 50% flowering

Application of different organic substances at varying concentrations influenced the number of days required to attain 50% flowering (Table 1 & Fig 1). The minimum days to 50% flowering (45.00 days) were recorded in T₁ (Panchagavya @ 3%), whereas T₀ (Control) exhibited the maximum days (60.33 days). The reduction in days to 50% flowering under Panchagavya @ 3% may be attributed to the availability of essential nutrients, beneficial microorganisms and growth-promoting substances, which enhance physiological activity and promote early floral initiation. (Sreenivasa *et al.*, 2010 and Raut *et al.*, 2014) [5].

Number of flowers per shoot

Different organic substances significantly influenced the number of flowers per shoot. The maximum number was recorded in T₁ (Panchagavya @ 3%) (14820.0), followed by T₂ (Panchagavya @ 5%) (14495.0), while the minimum was recorded in T₁₁ (Humic acid @ 1%) (12410.0). The higher flower production with Panchagavya may be attributed to its nutrients, beneficial microorganisms and growth-promoting substances (Table 1 & Fig 2).

Fruit set (%)

The fruit set percentage varied considerably among the treatments receiving different organic substances and their concentrations. The maximum fruit set (45.00%) was recorded in T₁ (Panchagavya @ 3%), followed by T₂ (Panchagavya @ 5%) with 44.50%, whereas the minimum fruit set (12.20%) was observed in T₀ (Control). The higher fruit set under Panchagavya may be attributed to improved nutrient uptake, enhanced pollen viability, fertilization and carbohydrate accumulation, resulting in better reproductive efficiency (Table 2 & Fig 3).

Fruit retention (%)

A noticeable variation in fruit retention was observed due to the application of different organic substances at various concentrations (Table 2 & Fig 3). The maximum fruit retention (26.50%) was recorded in T₁ (Panchagavya @ 3%), followed by T₂ (25.00%), whereas the minimum fruit retention (9.50%) was observed in T₀ (Control). The improvement in fruit retention may be attributed to better nutritional status, enhanced photosynthetic activity and efficient translocation of assimilates towards developing fruits, which may reduce premature fruit abscission. (Yadav *et al.*, 2018) [4] and Meena *et al.*, 2018).

Fruit drop (%)

Distinct variation in fruit drop was recorded in response to the application of different organic substances (Table 2 & Fig 3). The minimum fruit drop (73.50%) was recorded in T₁ (Panchagavya @ 3%), followed by T₂ (Panchagavya @ 5%) (75.00%) and T₄ (Jeevamrit @ 10%) (75.10%), whereas the maximum fruit drop (90.50%) was observed in T₀ (Control). The reduction in fruit drop under Panchagavya may be attributed to improved nutrient uptake and enhanced physiological activity, resulting in better fruit retention. Similar effects of organic nutrient management on fruit retention were reported by Panna *et al.* (2024) [6] in ber.

Fruit volume (cc)

Significant differences in fruit volume were observed among the treatments following the application of different organic substances (Table 3 & Fig 4). The maximum fruit volume (61.46 cc) was recorded in T₁ (Panchagavya @ 3%), followed by T₂ (Panchagavya @ 5%) (59.34 cc) and T₄ (Jeevamrit @ 10%) (55.02 cc), whereas the minimum fruit volume (31.82 cc) was recorded in T₀ (Control). The increase in fruit volume under Panchagavya may be attributed to improved nutrient availability and efficient translocation of assimilates towards developing fruits. Similar improvement in fruit growth under organic nutrient application was reported by Meena *et al.* (2025) [7] in ber.

Fruit weight (g)

Significant differences in fruit weight were observed among the treatments following the application of various organic substances (Table 3 & Fig 4). The maximum fruit weight (56.55 g) was recorded in T₁ (Panchagavya @ 3%), followed by T₂ (55.52 g), whereas the minimum fruit weight (31.51 g) was observed in T₀ (Control). The in-

crease in fruit weight may be attributed to enhanced nutrient availability, photosynthetic activity and efficient translocation of assimilates towards developing fruits.

Pulp: stone ratio

It is evident from the results obtained under the present investigation that the application of different organic substances significantly influenced the pulp:stone ratio (Table 3 & Fig 4). Among the evaluated treatments, the highest pulp:stone ratio (11.34) was observed in T₁ (Panchagavya @ 3%), whereas T₀ (Control) exhibited the lowest pulp:stone ratio (8.08). The increase in pulp:stone ratio may be attributed to enhanced nutrient availability, photosynthetic activity and efficient translocation of assimilates towards developing fruits, resulting in greater pulp development relative to stone formation.

Yield (tonnes/ha)

The obtained data in respect of fruit yield revealed significant differences among the treatments (Table 3 & Fig 4). The maximum yield (22.24 t ha⁻¹) was recorded in T₁ (Panchagavya @ 3%), followed by T₂ (Panchagavya @ 5%) (20.36 t ha⁻¹) and T₄ (Jeevamrit @ 10%) (18.57 t ha⁻¹), whereas the minimum yield (3.55 t ha⁻¹) was observed in T₀ (Control). The higher yield under Panchagavya may be attributed to its favourable influence on flowering, fruit set, fruit retention and fruit development, along with improved nutrient availability and assimilate translocation. Similar enhancement in yield under organic nutrient management was reported by Bohane *et al.* (2016) [8].

Conclusion

It can be concluded that Panchagavya @ 3% (T₁) was the most effective treatment for improving flowering, fruiting, physical fruit parameters and yield of ber cv. Apple Ber. It recorded the earliest flowering (38.56 days), minimum days to 50% flowering (45.00 days), highest flowers per shoot (14,820.0), fruit set (45.00%), fruit retention (26.50%), fruit volume (61.46 cc), fruit weight (56.55 g) and yield (22.24 t ha⁻¹). Thus, Panchagavya @ 3% may be considered a promising organic treatment for improving productivity of Apple Ber under the agro-climatic conditions of Chhattisgarh.

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Competing interests

Authors have declared that they have no known competing financial interests or non-financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Table 1. Effect of foliar application of organic substances on flowering attributes of ber cv. Apple Ber

Notations	Treatments	Initiation of flowering (days)	50% flowering (days)	No. of flowers per shoot
T ₀	Control	52.11 ^l	60.33 ^m	12428.3
T ₁	Panchagavya(3%)	38.56 ^a	45.00 ^a	14820.0
T ₂	Panchagavya(5%)	39.22 ^b	46.23 ^b	14495.0
T ₃	Jeevamrit (5%)	47.44 ^h	55.00 ⁱ	13651.7
T ₄	Jeevamrit (10%)	45.25 ^g	52.35 ^g	14080.0
T ₅	Amrit Pani (3%)	45.35 ^{gh}	52.67 ^h	13210.0
T ₆	Amrit Pani (5%)	48.56 ⁱ	55.77 ^j	13580.0
T ₇	Moringa leaf extract (4%)	41.48 ^d	48.42 ^d	12621.7
T ₈	Moringa leaf extract (6%)	43.43 ^f	51.00 ^f	13140.0

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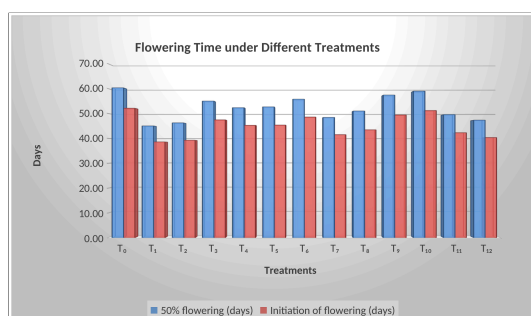
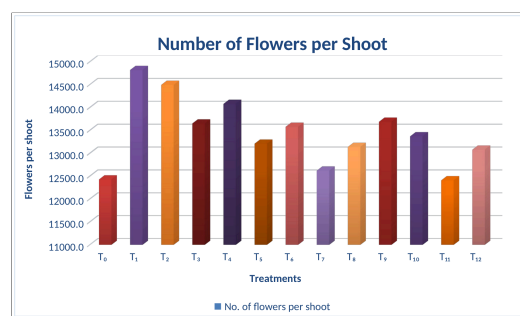
Notations	Treatments	Initiation of flowering (days)	50% flowering (days)	No. of flowers per shoot
T ₉	Seaweed extract (3%)	49.42 ^j	57.43 ^k	13690.0
T ₁₀	Seaweed extract (5%)	51.20 ^k	59.00 ^l	13371.7
T ₁₁	Humic acid (1%)	42.27 ^e	49.53 ^e	12410.0
T ₁₂	Humic acid (2%)	40.33 ^c	47.33 ^c	13080.0
	SE(m) ±	0.11	0.19	376.42
	CD (5%)	0.33	0.56	128.96

Table 2. Effect of foliar application of organic substances on fruiting attributes of ber cv. Apple Ber

Notations	Treatments	Fruit set (%)	Fruit retention (%)	Fruit drop (%)
T ₀	Control	12.20 ⁱ	9.50 ^m	90.50 ^a
T ₁	Panchagavya (3%)	45.00 ^a	26.50 ^a	73.50 ^l
T ₂	Panchagavya (5%)	44.50 ^{ab}	25.00 ^{ab}	75.00 ^{jk}
T ₃	Jeevamrit (5%)	38.14 ^{cd}	23.50 ^d	76.50 ^{hi}
T ₄	Jeevamrit (10%)	43.25 ^{abc}	24.90 ^{bc}	75.10 ^j
T ₅	Amrit Pani (3%)	32.21 ^e	22.62 ^{def}	77.38 ^h
T ₆	Amrit Pani (5%)	37.66 ^d	23.00 ^{de}	77.00 ^{hi}
T ₇	Moringa leaf extract (4%)	27.50 ^f	18.00 ^{gh}	82.00 ^f
T ₈	Moringa leaf extract (6%)	32.00 ^{ef}	19.50 ^g	80.50 ^g
T ₉	Seaweed extract (3%)	20.20 ^g	13.00 ^j	87.00 ^{bcd}
T ₁₀	Seaweed extract (5%)	25.40 ^f	14.80 ⁱ	85.20 ^e
T ₁₁	Humic acid (1%)	20.10 ^g	12.46 ^{jk}	87.50 ^{bc}
T ₁₂	Humic acid (2%)	15.00 ^h	12.20 ^{kl}	87.80 ^b
	SE(m) ±	1.68	0.2	0.32
	CD (5%)	4.95	0.62	0.94

Table 3. Effect of foliar application of organic substances on quantitative attributes of ber cv. Apple Ber

Notations	Treatments	Fruit volume (cc)	Fruit weight (g)	Pulp : Stone ratio	Yield (t/ha)
T ₀	Control	31.82 ^m	31.51 ^l	8.08	3.55 ^m
T ₁	Panchagavya (3%)	61.46 ^a	56.55 ^a	11.34	22.24 ^a
T ₂	Panchagavya (5%)	59.34 ^b	55.52 ^{ab}	11.20	20.36 ^b
T ₃	Jeevamrit (5%)	52.91 ^d	49.74 ^d	10.25	16.13 ^d
T ₄	Jeevamrit (10%)	55.02 ^c	52.27 ^c	10.69	18.57 ^c
T ₅	Amrit Pani (3%)	49.77 ^f	47.78 ^e	10.26	14.47 ^f
T ₆	Amrit Pani (5%)	51.27 ^e	49.74 ^d	10.43	15.66 ^{de}
T ₇	Moringa leaf extract (4%)	46.31 ^h	45.39 ^{fg}	10.49	10.34 ^h
T ₈	Moringa leaf extract (6%)	47.67 ^g	46.72 ^{ef}	10.73	11.99 ^g
T ₉	Seaweed extract (3%)	37.98 ^l	36.47 ^{hijk}	9.30	6.33 ^{ij}
T ₁₀	Seaweed extract (5%)	38.91 ^{ij}	37.36 ^{hij}	9.68	7.46 ⁱ
T ₁₁	Humic acid (1%)	38.62 ^{ijk}	37.85 ^{hi}	9.48	5.82 ^{jkl}
T ₁₂	Humic acid (2%)	38.92 ⁱ	38.15 ^h	9.39	5.94 ^{jk}
	SE(m) ±	0.05	0.58	0.07	0.24
	CD (5%)	0.16	1.71	N/S	0.50

**Figure 1.** Effect of foliar application of organic substances on initiation of flowering and 50 % flowering of ber**Figure 2.** Effect of foliar application of organic substances on number of flowers per shoot of ber

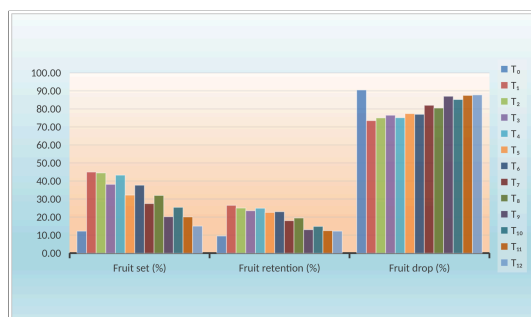


Figure 3. Effect of foliar application of organic substances on fruit set, fruit retention and fruit drop of ber

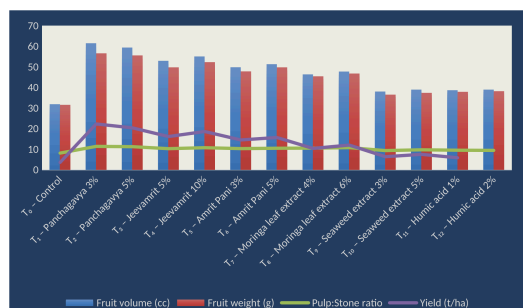


Figure 4. Effect of foliar application of organic substances on quantitative attributes of ber

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