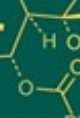
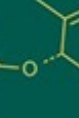
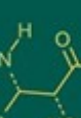
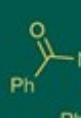
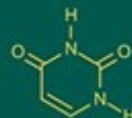


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Tusha Gavel

Research Scholar, Department of Fruit Science, Indira Gandhi Krishi Vishwavidyalaya, Raipur (Chhattisgarh) India.

Ghanshyam Das Sahu
Shalini Ogarey

Professor, Department of Fruit Science, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

Shalini Ogarey

Department of Fruit Science, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

Pallavi Deshlahare

Department of Fruit Science, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

Effect of growing media on branching, leaf dimensions and pH–EC dynamics of fruit and substrate in hydroponically grown blueberry (*Vaccinium corymbosum* L.) cv. Biloxi under protected cultivation

Tusha Gavel¹, Ghanshyam Das Sahu Shalini Ogarey², Shalini Ogarey³, Pallavi Deshlahare⁴

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ABSTRACT

Blueberry (*Vaccinium corymbosum* L.) cv. Biloxi requires an acidic, well-aerated root zone, making growing-medium properties critical for successful soilless cultivation. A hydroponic pot experiment was conducted at Indira Gandhi Krishi Vishwavidyalaya, Raipur, during 2025–26 to evaluate eleven coco peat-based media in a Completely Randomized Design with three replications. Treatments included 100% coco peat (T_0) and coco peat mixed (60:40, v/v) with ten different substrate materials. T_1 (coco peat + peanut shell) recorded the highest number of branches (30.00), leaf length (7.97 cm), and leaf breadth (4.40 cm), followed by T_5 (coco peat + vermicompost). Fruit pH ranged from 3.18 to 3.33. Growing-medium pH ranged from 3.50 to 8.10, with T_1 (4.70) and T_8 (4.55) closest to the optimum range for blueberry. Electrical conductivity was highest in T_2 (1.45 dS m^{-1}), followed by T_5 (1.32 dS m^{-1}). Overall, coco peat amended with peanut shell or vermicompost provided favourable conditions for vegetative growth and root-zone characteristics of ‘Biloxi’ blueberry under protected cultivation.

Keywords: Blueberry, Substrate, PH, Electrical Conductivity, Growth

1. Introduction

Blueberry (*Vaccinium corymbosum* L.) is a high-value ericaceous fruit crop increasingly explored for protected and soilless cultivation in non-traditional subtropical regions of India (Savvas *et al.*, 2018) [1]. Its shallow, fibrous and root-hairless root system makes the crop particularly sensitive to root-zone conditions, especially substrate acidity, aeration and salinity (Korcak, 1988) [2]. Blueberry performs best under acidic conditions, generally at a substrate pH of 4.5–5.5, which favours nutrient availability, vegetative development and fruit quality (Jiang *et al.*, 2019) [3].

The suitability of a growing medium can be assessed through vegetative traits such as branching and leaf dimensions, which reflect canopy development and plant response to the root-zone environment (Xie *et al.*, 2009) [4]. Likewise, substrate pH and electrical conductivity (EC) are important indicators of nutrient availability and root-zone stability during cultivation (Gohardoust *et al.*, 2020) [5], while fruit pH contributes to the assessment of berry acidity and quality (Hera *et al.*, 2023) [6]. However, information on suitable coco peat-based substrate combinations for hydroponically grown ‘Biloxi’ blueberry under Chhattisgarh conditions remains limited.

Therefore, the present study evaluated ten coco peat-based growing media against 100% coco peat to determine their effects on branch number, leaf length and breadth, fruit pH, and changes in substrate pH and EC under protected cultivation.

2. Materials and methods

The experiment was conducted during the academic year 2025-26 at the Horticulture Farm, College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.) under subtropical protected conditions. Uniform, healthy, two-year-old plants of blueberry (*Vaccinium corymbosum* L.) cv. Biloxi were grown in 18 × 30-inch grow bags under hydroponic conditions. The experiment was laid out in a Completely Randomized Design (CRD) with 11 treatments and three replications. The treatments included 100% coco peat as control (T_0) and coco peat mixed at 60:40 (v/v) with peanut shell (T_1), spent mushroom compost (T_2), zeolite (T_3), rice husk (T_4), vermicompost (T_5), peat moss (T_6), perlite (T_7), wood bark (T_8), coco chips (T_9) and rockwool (T_{10}). The growing media were filled into grow bags on 1 August 2025, and uniform irrigation and nutrients were supplied through drip fertigation. At the final observation in March 2026, the number of branches, leaf length and leaf breadth were recorded, while fruit pH was determined from ripe

Corresponding Author:

Ghanshyam Das Sahu
Shalini Ogarey

Professor, Department of Fruit Science, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

fruit juice using a digital pH meter. Growing-medium pH and electrical conductivity (EC) were measured before planting and after completion of the crop cycle using a 1:2.5 (w/v) media–water suspension with digital pH and conductivity meters, respectively. The data were subjected to analysis of variance (ANOVA) for CRD, and treatment means were compared using the Critical Difference (CD) at the 5% probability level wherever the *F*-test was significant (Fisher, 1973) [7].

3. Results and discussion

The growing media significantly influenced the vegetative characteristics, fruit pH, and physicochemical properties of ‘Biloxi’ blueberry as mentioned in Data in table 1 and 2.

3.1 Number of branches

Among the evaluated treatments, the maximum number of branches (30.00) was recorded in *T*₁ (Coco Peat + Peanut Shell). The increased branching may be attributed to improved substrate macroporosity, gas exchange and moisture retention, which minimize root hypoxia and promote lateral shoot development. Xie *et al.* (2009) [4] and Ochmian *et al.*, (2009) [8] also reported that substrate composition significantly influences branching and shoot development in blueberries.

3.2 Leaf length (cm)

The maximum leaf length (7.97 cm) was recorded in *T*₁ (Coco Peat + Peanut Shell). The increased leaf length may be attributed to improved porosity, moisture availability and nutrient supply, which maintain a favourable water-air balance and enhance nutrient uptake and cell elongation. Similar improvement in blueberry leaf development under favourable substrate conditions was reported by Cheon *et al.*, (2021) [9] and Caspersen *et al.*, (2013) [10].

3.3 Leaf breadth (cm)

The maximum leaf breadth (4.40 cm) was recorded in *T*₁ (Coco Peat + Peanut Shell). The increased leaf breadth may be attributed to adequate moisture and nutrient availability, which improve plant turgidity, photosynthate translocation and lateral cell expansion. Raviv *et al.*, (2019) [11] reported that balanced substrate porosity and water-holding capacity promote cell expansion and vigorous leaf development.

3.4 Fruit pH

The lowest fruit pH (3.18) was recorded in *T*₅ (Coco Peat + Vermicompost), indicating greater fruit acidity. The lower fruit pH corresponded with higher titratable acidity and may be associated with greater accumulation of organic acids in the fruit. Similar varia-

tions in blueberry fruit acidity in response to substrate conditions were reported by Hera *et al.*, (2023) [6].

3.5 pH of growing medium

Among the evaluated treatments, *T*₁ (Coco Peat + Peanut Shell) recorded a growing-medium pH of 4.70, which was closest to the desirable pH range of 4.5–5.5 for blueberry. This favourable acidic root-zone environment may enhance nutrient availability and support better plant growth. Similar observations regarding the importance of appropriate substrate pH for blueberry growth were reported by Yang *et al.* (2025) [12].

3.6 Electrical conductivity of growing medium (dS m⁻¹)

The highest EC (1.45 dS m⁻¹) was recorded in *T*₂ (Coco Peat + Spent Mushroom Compost). The higher EC may be attributed to the greater concentration of soluble mineral nutrients, including potassium, calcium, magnesium and nitrate ions, in spent mushroom compost. Kingston *et al.*, (2017) [13] similarly reported that nutrient-rich organic amendments may exhibit higher EC because of their greater soluble mineral content.

4. Conclusion

Coco peat amended with Peanut shell (*T*₁) produced the most vigorous vegetative growth, recording the maximum number of branches and the largest leaves, closely followed by Coco peat + Vermicompost (*T*₅), while the unamended control was consistently poorest for these traits. Fruit pH remained within the characteristic acidic range of blueberry across all media, with *T*₅, *T*₁ and *T*₇ producing the most acidic, best-flavoured fruit. Media pH and EC were comparatively more stable under Coco peat + Peanut shell and coco peat + Wood Bark, which remained closest to the 4.5–5.5 pH range optimum for blueberry, whereas coco peat + Spent Mushroom Compost and Coco peat + Peat moss deviated most from this range despite acceptable EC. Coco peat blended with peanut shell or vermicompost is therefore indicated as the more favourable substrate combination for sustaining vegetative growth and root-zone stability in hydroponic Biloxi blueberry under protected cultivation in Chhattisgarh.

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Table 1. Effect of growing media on branch number, leaf length and breadth.

Notation	Treatment Details	Number of branches		Leaf length (cm)		Leaf length (cm)	
		August	March	August	March	August	March
<i>T</i> ₀	Control (Coco Peat 100%)	5.67 ^{hc}	14.67 ^f	4.36 ^h	6.07 ^h	2.13 ^j	3.23 ^g
<i>T</i> ₁	Coco Peat + Peanut Shell (60:40)	12.33 ^a	30.00 ^a	6.00 ^a	7.97 ^a	3.10 ^a	4.40 ^a
<i>T</i> ₂	Coco Peat + Spent Mushroom Compost (60:40)	9.67 ^{bcde}	25.67 ^{bcd}	5.13 ^{de}	7.33 ^{cd}	2.70 ^{de}	3.90 ^{cd}
<i>T</i> ₃	Coco Peat + Zeolite (60:40)	8.67 ^{efg}	25.33 ^{cd}	5.00 ^{ef}	7.13 ^{de}	2.60 ^{def}	3.80 ^{de}
<i>T</i> ₄	Coco Peat + Rice husk (60:40)	10.33 ^{cd}	10.90 ^{bcd}	5.33 ^{cd}	7.63 ^{bc}	2.80 ^{cd}	4.10 ^{bc}
<i>T</i> ₅	Coco Peat + Vermicompost (60:40)	11.67 ^{ab}	27.67 ^{abc}	5.73 ^{ab}	7.83 ^{ab}	3.00 ^{ab}	4.30 ^{ab}
<i>T</i> ₆	Coco Peat + Peatmoss (60:40)	9.33 ^{def}	25.67 ^{bcd}	5.60 ^{bc}	7.67 ^{ab}	2.90 ^{bc}	4.20 ^{ab}
<i>T</i> ₇	Coco Peat + Perlite (60:40)	10.67 ^{bc}	28.67 ^{ab}	5.03 ^e	7.03 ^{de}	2.60 ^{defg}	3.73 ^{de}
<i>T</i> ₈	Coco Peat + Wood Bark (60:40)	7.67 ^g	24.33 ^d	4.73 ^{fg}	6.57 ^{fg}	2.40 ^{fhi}	3.43 ^{fg}
<i>T</i> ₉	Coco Peat + Cocochips (60:40)	8.33 ^{fg}	24.67 ^{cd}	4.93 ^{ef}	6.87 ^{ef}	2.53 ^{efgh}	3.63 ^{ef}
<i>T</i> ₁₀	Coco Peat + Rockwool (60:40)	6.00 ^h	18.33 ^e	4.53 ^{gh}	6.33 ^{gh}	2.30 ^{ij}	3.40 ^g

(continued on next page)

SEm ±	0.36	0.97	0.09	0.1	0.06	0.07
CD at 5 %	1.06	2.85	0.26	0.30	0.18	0.20

Table 2. Effect of growing media on fruit pH, and changes in substrate pH and EC.

Notation	Treatment Details	fruit pH	substrate pH		substrate EC	
			Before	After	Before	After
T ₀	Control (Coco Peat 100%)	3.33 ^a	6.13 ^f	6.10 ^h	0.80 ^{de}	0.78 ^{gh}
T ₁	Coco Peat + Peanut Shell (60:40)	3.20 ^{ef}	4.72 ^g	4.70 ⁱ	0.94 ^c	0.92 ^c
T ₂	Coco Peat + Spent Mushroom Compost (60:40)	3.32 ^a	8.15 ^a	8.10 ^a	1.48 ^a	1.45 ^a
T ₃	Coco Peat + Zeolite (60:40)	3.30 ^{ab}	7.04 ^{cd}	7.00 ^d	0.86 ^{cde}	0.85 ^{de}
T ₄	Coco Peat + Rice husk (60:40)	3.28 ^{abc}	6.75 ^e	6.70 ^f	0.89 ^{cd}	0.88 ^d
T ₅	Coco Peat + Vermicompost (60:40)	3.18 ^f	6.78 ^{de}	6.80 ^e	1.35 ^b	1.32 ^b
T ₆	Coco Peat + Peatmoss (60:40)	3.24 ^{cde}	3.54 ^h	3.50 ^k	0.81 ^{cde}	0.80 ^{fg}
T ₇	Coco Peat + Perlite (60:40)	3.22 ^{def}	7.24 ^c	7.20 ^c	0.76 ^{de}	0.76 ^{hi}
T ₈	Coco Peat + Wood Bark (60:40)	3.29 ^{abc}	4.56 ^g	4.55 ^j	0.84 ^{cde}	0.82 ^{ef}
T ₉	Coco Peat + Cocochips (60:40)	3.26 ^{bcd}	6.22 ^f	6.15 ^g	0.87 ^{cde}	0.86 ^d
T ₁₀	Coco Peat + Rockwool (60:40)	3.31 ^{ab}	7.8 ^b	7.75 ^b	0.74 ^e	0.74 ⁱ
	SEm ±	0.015	0.08	0.01	0.04	0.01
	CD at 5 %	0.046	0.26	0.04	0.11	0.03

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