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Effect of organic formulations on propagation of black pepper (*Piper nigrum* L.) cuttings under polyhouse conditions

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ABSTRACT

The present investigation entitled “Effect of organics on propagation of black pepper (*Piper nigrum* L.) cuttings under polyhouse conditions” was conducted during 2025–26 at the Main Agricultural and Horticultural Research Station (MAHRS), Iruvakk, Shivamogga, Karnataka. The experiment was laid out in a Completely Randomized Design (CRD) with nine treatments, viz., T_1 (Microbial Consortia (AMC) @ 0.5%), T_2 (Microbial Consortia (AMC) @ 1.0%), T_3 (Humic Acid @ 0.1%), T_4 (Humic Acid @ 0.2%), T_5 (Seaweed Extract @ 0.5%), T_6 (Seaweed Extract @ 1.0%), T_7 (Vermiwash @ 10%), T_8 (Vermiwash @ 20%) and T_9 (Control), with three replications. The results revealed that Humic Acid @ 0.2% (T_4) recorded the earliest first sprouting (17.00 days) and minimum days taken for 50 per cent sprouting (23.67 days). The same treatment also recorded the highest shoot length (17.66 cm), maximum number of leaves (5.11), maximum leaf length and width (10.45 cm and 9.25 cm, respectively) at 120 days after planting (DAP). With respect to root growth, Humic Acid @ 0.2% produced the maximum length of the longest root (15.89 cm), highest number of roots (10.37) and root volume (8.10 cc). Among the remaining treatments, Vermiwash @ 20% and Microbial Consortia (AMC) @ 1.0% showed comparatively better performance for sprouting, shoot growth and root development, whereas the control recorded the lowest values for all the growth parameters. The results indicated that application of Humic Acid @ 0.2% is effective in promoting early sprouting, vigorous shoot growth and superior root development in black pepper cuttings under polyhouse conditions and can be recommended for the production of healthy planting material.

Keywords: Black pepper, *Piper nigrum* L., Humic acid, Microbial consortia (AMC), Seaweed extract, Vermiwash, Sprouting, Root growth, Polyhouse propagation

Introduction

Black pepper (*Piper nigrum* L.), popularly known as the “King of Spices”, is one of the oldest and most economically important spice crops cultivated in tropical regions. It originated in the Western Ghats of India, which is recognized as its centre of origin and diversity. The crop is highly valued for its characteristic pungency and aroma, mainly due to the presence of piperine and essential oils and finds extensive applications in the food, pharmaceutical, cosmetic and nutraceutical industries. Black pepper also contributes significantly to the economy of several tropical countries through domestic consumption and export earnings (Ravindran, 2000; Nair, 2011) [2, 1].

Commercial propagation of black pepper is carried out predominantly through stem cuttings to maintain genetic uniformity and produce true-to-type planting material. However, rooting success and establishment of cuttings are often influenced by physiological factors, environmental conditions and the quality of propagules. Poor rooting and low survival rates remain major constraints in the large scale production of healthy planting material, necessitating the development of efficient and sustainable propagation techniques under protected cultivation (Ravindran, 2000; Thangaselvabal et al., 2008) [2, 3].

Organic biostimulants such as microbial consortia, humic acid, seaweed extract and vermiwash have gained considerable attention as eco-friendly alternatives for enhancing plant growth and propagation. These organic inputs improve nutrient availability, stimulate root initiation, enhance microbial activity and promote overall plant vigour through the production of growth promoting substances and improved nutrient uptake. Despite their documented benefits in several horticultural crops, information on their comparative effectiveness in black pepper propagation under polyhouse conditions is limited. Therefore, the present investigation was undertaken to evaluate the influence of different organic formulations on the rooting, sprouting, growth and survival of black pepper (*Piper nigrum* L.) cuttings under protected conditions (Canellas et al., 2014; du Jardin, 2015; Calvo et al., 2014) [5, 6, 4].

Sustainable cultivation of black pepper depends on the availability of healthy and vigorous planting material produced through efficient propagation techniques. Vegetative propagation through stem cuttings is the most

widely adopted method for commercial multiplication; however, rooting and establishment of cuttings are often influenced by the physiological status of the propagules and the nursery environment. Organic biostimulants such as microbial consortia, humic acid, seaweed extract and vermiwash have been reported to improve root initiation, nutrient uptake, microbial activity and overall plant vigour, thereby enhancing the quality of rooted cuttings. Identification of an effective organic treatment is therefore essential for producing quality planting material and improving nursery success. Hence, the present investigation entitled “Effect of organics on the propagation of black pepper (*Piper nigrum* L.) cuttings under polyhouse conditions” was undertaken with the following objective to evaluate the effect of Microbial Consortia (AMC), Humic Acid, Seaweed Extract and Vermiwash on days to first sprouting, days to 50 per cent sprouting, shoot length, number of leaves, leaf length, leaf width, length of longest root, number of roots and root volume in black pepper (*Piper nigrum* L.) cuttings under polyhouse conditions.

Material and Methods

The present investigation entitled “Effect of organics on the propagation of black pepper (*Piper nigrum* L.) cuttings under polyhouse conditions” was conducted during February to June 2026 at the Main Agricultural and Horticultural Research Station (MAHRS), Keladi Shivappa Nayaka University of Agricultural and Horticultural Sciences (KSNUAHS), Iruvakk, Shivamogga, Karnataka, India. The experimental site is situated at 14.12° N latitude and 75.18° E longitude, with an elevation of 612 m above mean sea level. The region experiences a humid tropical climate with an average annual rainfall of about 2000 mm, making it suitable for the propagation of black pepper under protected conditions.

The experiment was carried out in a naturally ventilated polyhouse using healthy cuttings of the black pepper variety Panniyur-1, an F₁ hybrid of Uthirankotta × Cheriyanakiyakadan. The variety is widely cultivated owing to its high yield potential and superior quality attributes, including higher oleoresin, piperine and essential oil content. The controlled polyhouse environment provided favourable conditions of temperature, humidity and diffused light for successful rooting and establishment of black pepper cuttings.

The experiment was laid out in a Completely Randomized Design (CRD) with nine treatments and three replications. The treatments comprised Microbial Consortia (AMC) at 0.5% (T₁) and 1.0% (T₂), Humic Acid at 0.1% (T₃) and 0.2% (T₄), Sea Weed Extract at 0.5% (T₅) and 1.0% (T₆), Vermiwash at 10% (T₇) and 20% (T₈), and an untreated control (T₉). The influence of these organic formulations on rooting, sprouting, growth and survival of black pepper cuttings was assessed under protected cultivation.

Results and Discussion

The effect of Microbial Consortia (AMC), Humic Acid, Seaweed Extract and Vermiwash on days to first sprouting, days to 50 per cent sprouting in black pepper (*Piper nigrum* L.) cuttings under polyhouse conditions.

Days taken for first sprouting

The number of days taken for first sprouting differed significantly among the organic treatments (Table 1). Humic Acid @ 0.2% (T₄) recorded the earliest first sprouting (17.00 Days), which was significantly superior to all other treatments. This was followed by Vermiwash @ 20% (T₈) (18.00 Days), Vermiwash @ 10% (T₇) (18.60 Days), Microbial Consortia (AMC) @ 1.0% (T₂) and Seaweed Extract @ 1.0% (T₆) (both 18.67 Days). The treatments Microbial Consortia @ 0.5% (T₁) and Seaweed Extract @ 0.5% (T₅) recorded 19.33 Days, while Humic Acid @ 0.1% (T₃) required 19.67 Days. The control (T₉) took the maximum number of days for first sprouting (19.73 Days).

The earliest first sprouting observed with Humic Acid @ 0.2% may be attributed to its ability to stimulate metabolic activity, improve nutrient uptake and enhance cell division through its hormone-like activity. Humic substances are known to promote root initiation and facilitate the mobilization of stored carbohydrates, leading to rapid bud break and sprout emergence. The delayed sprouting in the control may be due to the absence of growth-promoting compounds. Similar findings have been reported by Ahmad *et al.* (2013) in gladiolus and Nakasha *et al.* (2014) [7] in safed musli.

Days taken for 50 per cent sprouting

The number of days taken for 50 per cent sprouting varied significantly among the treatments (Table 1). Humic Acid @ 0.2% (T₄) recorded the minimum number of days for 50 per cent sprouting (23.67 Days) and was significantly superior to all other treatments. It was followed by Vermiwash @ 20% (T₈) (25.00 Days) and Microbial Consortia (AMC) @ 1.0% (T₂) (25.33 Days). Humic Acid @ 0.1% (T₃) and Seaweed Extract @ 1.0% (T₆) recorded 26.00 Days and 26.33 Days, respectively, whereas Vermiwash @ 10% (T₇) and Seaweed Extract @ 0.5% (T₅) required 27.00 Days and 27.33 Days, respectively. The control (T₉) recorded the maximum duration (28.00 Days) for attaining 50 per cent sprouting.

The reduction in the number of days required for 50 per cent sprouting under Humic Acid @ 0.2% may be due to enhanced physiological processes, including increased enzymatic activity, improved nutrient absorption and stimulation of endogenous growth regulators, resulting in faster and more uniform sprouting. The auxin-like properties of humic substances facilitate rapid root development and shoot emergence, thereby accelerating sprouting in a greater proportion of cuttings. These findings are in agreement with those of Ahmad *et al.* (2013) in gladiolus and Nakasha *et al.* (2014) [7] in safed musli.

Table 1. Effect of different organic formulations on sprouting behaviour of black pepper (*Piper nigrum* L.) cuttings under polyhouse conditions

Treatment No.	Treatments	Days taken for first sprouting	Days taken for 50% sprouting
T ₁	Microbial Consortia (AMC) @ 0.5%	19.33	27.67
T ₂	Microbial Consortia (AMC) @ 1.0%	18.67	25.33
T ₃	Humic Acid @ 0.1%	19.67	26.00
T ₄	Humic Acid @ 0.2%	17.00	23.67
T ₅	Seaweed Extract @ 0.5%	19.33	27.33
T ₆	Seaweed Extract @ 1.0%	18.67	26.33
T ₇	Vermiwash @ 10%	18.60	27.00
T ₈	Vermiwash @ 20%	18.00	25.00
T ₉	Control	19.73	28.00
	S.E.m. ±	0.23	0.31
	CD (P = 0.05)	0.68	0.93

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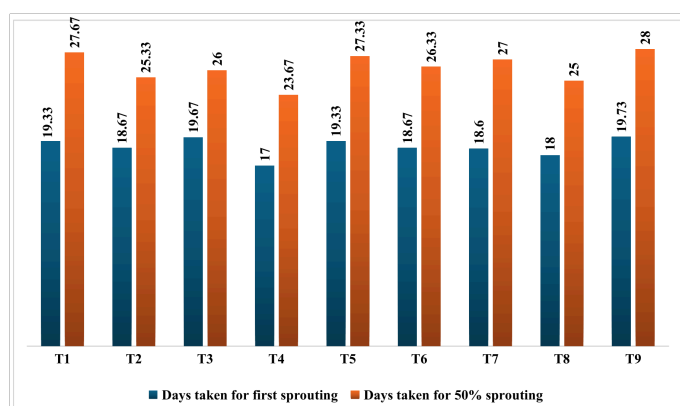


Figure 1. Effect of different organic formulations on sprouting behaviour of black pepper (*Piper nigrum* L.) cuttings under polyhouse conditions

The effect of Microbial Consortia (AMC), Humic Acid, Seaweed Extract and Vermiwash on shoot length, number of leaves, leaf length and leaf width at 120 DAP in black pepper (*Piper nigrum* L.) cuttings under polyhouse conditions.

Shoot length at 120 DAP

The shoot length of black pepper cuttings at 120 days after planting (DAP) differed significantly among the different organic treatments (Table 2). Humic Acid @ 0.2% (T₄) recorded the maximum shoot length (17.66 cm), which was significantly superior to all other treatments. This was followed by Vermiwash @ 20% (T₈) (14.72 cm), Microbial Consortia (AMC) @ 1.0% (T₂) (13.12 cm) and Humic Acid @ 0.1% (T₃) (12.46 cm). The treatments Microbial Consortia @ 0.5% (T₁), Seaweed Extract @ 1.0% (T₆), Vermiwash @ 10% (T₇) and Seaweed Extract @ 0.5% (T₅) recorded intermediate shoot lengths of 11.10, 10.78, 10.94 and 10.26 cm, respectively. The control (T₉) recorded the minimum shoot length (9.12 cm).

The significantly higher shoot length observed with Humic Acid @ 0.2% may be attributed to its ability to stimulate cell division and elongation, improve nutrient uptake and enhance photosynthetic efficiency through auxin-like activity, resulting in vigorous shoot growth. Humic substances also improve root development and membrane permeability, facilitating efficient absorption and translocation of water and nutrients required for vegetative growth. The superior performance of Vermiwash @ 20% and Microbial Consortia @ 1.0% may be due to the presence of beneficial microorganisms, enzymes, plant growth-promoting substances and readily available nutrients, which enhance metabolic activity and biomass accumulation. Similar findings have been reported by Aswathy *et al.* (2018) [8] and Bendre *et al.* (2018) in black pepper, Moshtaghi *et al.* (2011) [9] in olive.

Number of leaves at 120 DAP

The number of leaves produced by black pepper cuttings at 120 days after planting (DAP) differed significantly among the organic treatments (Table 2). Humic Acid @ 0.2% (T₄) recorded the maximum number of leaves (5.11), which was significantly superior to all other treatments. This was followed by Vermiwash @ 20% (T₈) (4.44), Microbial Consortia (AMC) @ 1.0% (T₂) (4.33) and Seaweed Extract @ 1.0% (T₆) (4.00). The treatments Vermiwash @ 10% (T₇), Humic Acid @ 0.1% (T₃), Microbial Consortia @ 0.5% (T₁) and Seaweed Extract @ 0.5% (T₅) recorded 3.78, 3.44, 3.22 and 3.00 leaves, respectively. The control (T₉) recorded the minimum number of leaves (2.89).

The production of a greater number of leaves in cuttings treated with Humic Acid @ 0.2% may be attributed to the stimulatory effect of humic substances on cell division, chlorophyll synthesis, photosynthetic activity and nutrient uptake, which collectively promote vigorous vegetative growth. The enhanced root development induced by humic acid facilitates efficient absorption of water and mineral nutrients, resulting in increased leaf production. The superior performance of Vermiwash @ 20% and Microbial Consortia @ 1.0% may be due to the presence of beneficial microorganisms, enzymes, phytohormones and readily available nutrients that improve plant metabolism and leaf development. The lower number of leaves observed in the untreated control could be attributed to the absence of these growth-promoting effects. Similar findings have been reported by Bhai *et al.* (2018) [10] and Pawar (2020) [11] in black pepper and Memon *et al.* (2014) [12] in zinnia.

Leaf length at 120 DAP

At 120 DAP, length of leaf differed significantly among the treatments. The maximum length of leaf was recorded with T₄ (Humic acid @ 0.2 %) (10.45 cm), followed by T₈ (Vermiwash @ 20 %) and T₂ (Microbial Consortia (AMC) @ 1.0 %) (9.33 and 8.91 cm, respectively). The minimum length of leaf was recorded in the T₉ (Control) (7.98 cm).

The maximum leaf length under T₄ (Humic acid @ 0.2%) may be attributed to the ability of humic substances to improve soil structure, cation exchange capacity and nutrient availability, thereby enhancing root activity and nutrient uptake. Humic acid also exhibits auxin-like effects that stimulate cell division and elongation, resulting in greater leaf expansion. Improved uptake of nitrogen, phosphorus and potassium may further enhance chlorophyll synthesis, photosynthetic activity and assimilate production, favouring vegetative growth. The superior performance of T₈ and T₂ may be due to enhanced nutrient mineralization and beneficial microbial activity in the rhizosphere. In contrast, the control recorded minimum leaf length due to relatively limited nutrient availability and reduced physiological activity. Similar findings were reported by Bendre *et al.* (2018) and Bhai *et al.* (2018) [10] in black pepper and Ahmad *et al.* (2013) in gladiolus.

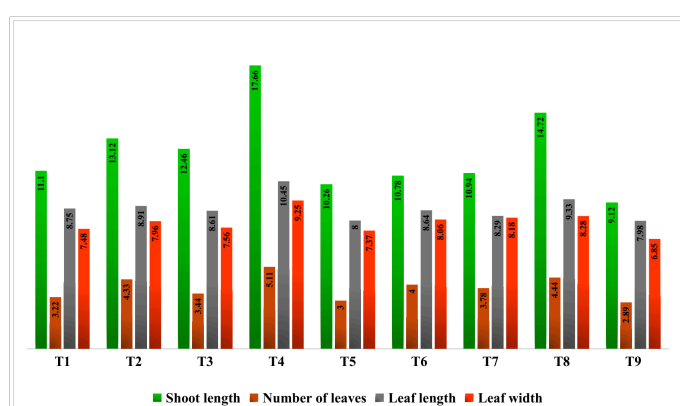
Leaf width at 120 DAP

Significant variation in leaf width was observed among the treatments. T₄ (Humic acid @ 0.2 %) recorded the maximum leaf width of 9.25 cm, indicating a favourable response to humic acid application. This was followed by T₈ (Vermiwash @ 20 %) and T₇ (Vermiwash @ 10 %), which recorded leaf widths of 8.28 and 8.18 cm, respectively. The minimum leaf width of 3.85 cm was recorded in T₉ (Control). These results were observed at 120 DAP.

The maximum leaf width in T₄ (Humic acid @ 0.2%) may be attributed to enhanced cell division and cell enlargement in the leaf lamina, resulting in greater lateral expansion of leaves. Humic substances can improve plant water relations and membrane activity, facilitating efficient movement of water and solutes into developing leaf tissues. The improved physiological activity may enhance photosynthate accumulation and expansion of leaf tissues, leading to broader leaves. The comparatively higher leaf width under T₈ and T₇ may be associated with the organic compounds and micronutrients present in vermicompost, which support active leaf tissue development. The minimum leaf width in the control indicates comparatively restricted leaf lamina expansion and tissue development under the absence of organic amendments. Similar findings were reported by Bendre *et al.* (2018) and Bhai *et al.* (2018) [10] in black pepper and Ahmad *et al.* (2013) in gladiolus.

Table 2. Effect of different organic formulations on shoot length, number of leaf, leaf length and leaf width of black pepper (*Piper nigrum* L.) cuttings under polyhouse conditions

Treatment No.	Treatments	Shoot length at 120 DAP (cm)	Number of leaves at 120 DAP	Leaf length at 120 DAP	Leaf width at 120 DAP
T ₁	Microbial Consortia (AMC) @ 0.5%	11.10	3.22	8.75	7.48
T ₂	Microbial Consortia (AMC) @ 1.0%	13.12	4.33	8.91	7.96
T ₃	Humic Acid @ 0.1%	12.46	3.44	8.61	7.56
T ₄	Humic Acid @ 0.2%	17.66	5.11	10.45	9.25
T ₅	Seaweed Extract @ 0.5%	10.26	3.00	8.00	7.37
T ₆	Seaweed Extract @ 1.0%	10.78	4.00	8.64	8.06
T ₇	Vermiwash @ 10%	10.94	3.78	8.29	8.18
T ₈	Vermiwash @ 20%	14.72	4.44	9.33	8.28
T ₉	Control	9.12	2.89	7.98	6.85
	S.E.m. ±	0.55	0.20	0.36	0.32
	CD (P = 0.05)	1.63	0.60	1.06	0.95

**Figure 2.** Effect of different organic formulations on shoot length, number of leaf, leaf length and leaf width of black pepper (*Piper nigrum* L.) cuttings under polyhouse conditions

The effect of Microbial Consortia (AMC), Humic Acid, Seaweed Extract, and Vermiwash on root growth parameters (length of longest root, number of roots and root volume) of black pepper (*Piper nigrum* L.) cuttings under polyhouse conditions.

Length of longest root

The length of the longest root differed significantly among the organic treatments (Table 3). Humic Acid @ 0.2% (T₄) recorded the maximum root length (15.89 cm), which was significantly superior to all other treatments. This was followed by Seaweed Extract @ 1.0% (T₆) (14.29 cm), Microbial Consortia (AMC) @ 1.0% (T₂) (14.10 cm) and Vermiwash @ 20% (T₈) (13.98 cm). The minimum root length was recorded in the control (T₉) (9.92 cm).

The increased root length in cuttings treated with Humic Acid @ 0.2% may be attributed to its auxin-like activity, which promotes cell division, cell elongation and root initiation. Humic substances also improve nutrient uptake and membrane permeability, thereby enhanc-

ing root elongation and overall root development. Similar findings were reported by Pawar (2020) [11] and Jalgaonkar (2022) [13] in black pepper and Sari *et al.* (2017) [14] in coffee.

Number of roots

The number of roots was significantly influenced by the organic treatments (Table 3). Humic Acid @ 0.2% (T₄) produced the maximum number of roots (10.37), followed by Vermiwash @ 20% (T₈) (9.23) and Microbial Consortia (AMC) @ 1.0% (T₂) (9.20). The control (T₉) recorded the minimum number of roots (7.00).

The higher number of roots observed under Humic Acid @ 0.2% could be due to enhanced cell differentiation and stimulation of lateral root formation through hormone like activity. Improved nutrient availability and increased physiological activity further favoured prolific root development. These results are in agreement with the findings of Pawar (2020) [11] and Jalgaonkar (2022) [13] in black pepper and Sari *et al.* (2017) [14] in coffee.

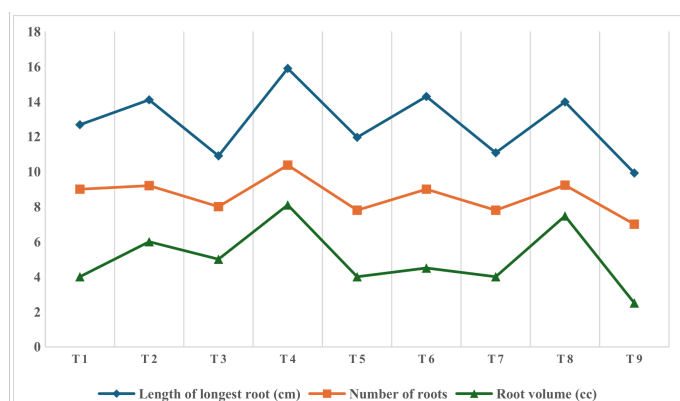
Root volume

The root volume showed significant variation among different organic treatments. The treatment T₄ (Humic acid @ 0.2 %) recorded the maximum root volume (8.10 cc), followed by T₈ (Vermiwash @ 20 %) and T₂ (Microbial Consortia (AMC) @ 1.0 %) (7.47 and 6.00 cc, respectively). The T₉ (Control) recorded the minimum root volume (2.50 cc).

The higher root volume under T₄ (Humic acid @ 0.2%) may be attributed to improved soil structure, aeration and moisture retention, which favoured better root development. Humic acid also enhances nutrient availability and stimulates root growth and proliferation. Vermiwash and microbial consortia may have promoted root growth through improved nutrient mineralization and beneficial microbial activity in the rhizosphere. The control recorded the lowest root volume due to comparatively lower nutrient availability and absence of growth-promoting effects from the organic treatments. These findings are supported by Pawar (2020) [11] and Jalgaonkar (2022) [13] in black pepper and Sari *et al.* (2017) [14] in coffee.

Table 3. Effect of organics on root parameters of black pepper propagation in polyhouse.

Treatment No.	Treatments	Length of longest root (cm)	Number of roots	Root volume (cc)
T ₁	Microbial Consortia (AMC) @ 0.5%	12.68	9.00	4.00
T ₂	Microbial Consortia (AMC) @ 1.0%	14.10	9.20	6.00
T ₃	Humic Acid @ 0.1%	10.90	8.00	5.00
T ₄	Humic Acid @ 0.2%	15.89	10.37	8.10
T ₅	Sea Weed Extract @ 0.5%	11.96	7.80	4.00
T ₆	Sea Weed Extract @ 1.0%	14.29	9.00	4.50
T ₇	Vermi wash @ 10 %	11.08	7.80	4.00
T ₈	Vermi wash @ 20 %	13.98	9.23	7.47
T ₉	Control	9.92	7.00	2.50
	S. Em ±	0.53	0.35	0.21
	CD @ 5%	1.57	1.05	0.61

**Figure 3.** Effect of organics on root parameters of black pepper propagation in polyhouse.

Conclusion

The application of organics significantly influenced the sprouting, shoot growth, leaf development and root growth of black pepper (*Piper nigrum* L.) cuttings under polyhouse conditions. Among the treatments evaluated, Humic Acid @ 0.2% (T₄) proved to be the most effective, recording the earliest first sprouting, minimum days taken for 50 per cent sprouting, maximum shoot length, highest number of leaves, maximum leaf length and width, longest root length, highest number of roots and maximum root volume. Vermiwash @ 20% (T₈) and Microbial Consortia (AMC) @ 1.0% (T₂) were the next best treatments, whereas the untreated control (T₉) recorded comparatively lower values for most of the growth parameters. Therefore, the application of Humic Acid @ 0.2% is recommended for promoting rapid sprouting, vigorous shoot and leaf development and enhanced root growth, thereby producing healthy and quality planting material of black pepper under polyhouse conditions.

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References

- Nair KP. Agronomy and Economy of Black Pepper and Cardamom: The King and Queen of Spices. Elsevier, Amsterdam, The Netherlands; 2011.
- Ravindran PN, editor. Black Pepper (*Piper nigrum* L.). Harwood Academic Publishers, Amsterdam, The Netherlands; 2000.
- Thangaselvabal T, Justin CGL, Leelamathi M. Black pepper (*Piper nigrum* L.)—The king of spices: A review. Agric. Rev. 2008;29(2):89-98.
- Calvo P, Nelson L, Kloepper JW. Agricultural uses of plant biostimulants. Plant Soil. 2014;383(1-2):3-41.
- Canellas LP, Olivares FL. Physiological responses to humic substances as plant growth promoters. Chem. Biol. Technol. Agric. 2014;1:3.
- du Jardin P. Plant biostimulants: Definition, concept, main categories and regulation. Sci. Hortic. 2015;196:3-14.
- Nakasha JJ, Sinniah UR, Puteh A, Hassan SA. Potential regulatory role of gibberellic and humic acids in sprouting of *Chlorophytum borivilianum* tubers. The Scientific World J. 2014;2014:1-9.
- Aswathy TS, Dhanya MK, Jintu J, Sathyan T, Preethy TT, Murugan M. Effect of biofertilizers and organic supplements on the growth of black pepper rooted cuttings (*Piper nigrum* L.). J. Spices and Aromatic Crops. 2018;27(1):54-58.
- Moshtaghi EA, Jaime A, Silva T, Sahsavar AR. Effects of foliar application of humic acid and gibberellic acid on mist-rooted olive cuttings. Fruit, Veg. Cereal Sci. Biotech. 2011;5(2):76-79.
- Bhai RS, Subila KP, Eapen SJ, Reshma A, Pervez R, Bhat I, Srinivasan V. Effect of biocontrol agents on production of rooted black pepper cuttings by serpentine method. J. Spices and Aromatic Crops. 2018;27(1):59-65.
- Pawar JT. Effect of different plant growth promoters on survival and growth of bush pepper (*piper nigrum* L.) M.Sc. (Horti.) thesis, Dr. Balasaheb Sawant konkan Krishi Vidyapeeth, Dapoli, Maharashtra (India). 2020.
- Memon SA, Bangulzai FM, Keerio MI, Baloch MA, Buriro M. Effect of humic acid and iron sulphate on growth and yield of zinnia. J. Agri. Tech. 2014;10(6):1517-1529.

13. Jalgaonkar MR. Effect of drenching with vermiwash, humic acid and cattle urine on survival and subsequent growth of black Pepper (*Piper nigrum* L.) in nursery. M.Sc. (Horti.) thesis, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Maharashtra (India). 2022.
14. Sari NP, Abdoellah S. Effectiveness of humic acid application on growth of coffee seedlings. *Pelita Perkebunan*. 2017;33(3):188-194.
15. Ahmad I, Saquib RU, Qasim M, Saleem M, Khan AM, Yaseen M. Humic acid and cultivar effects on growth, yield, vase life, and corm characteristics of gladiolus. *Chilean J. Agric. Res.* 2014;73(4):339-344.
16. Bendre PD, Kulkarni MM, Khandekar RG, Pawar CD, Gokhale NB. Effect of different potting media on sprouting, survival and growth performance of bush pepper (*Piper nigrum* L.). *Int. J. Curr. Microbiol. Appl. Sci.* 2020;11(1):598-605.
17. Nardi S, Schiavon M, Francioso O. Chemical structure and biological activity of humic substances define their role as plant growth promoters. *Molecules*. 2021;26(8):2256.

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