



P-ISSN: 2349-8528

E-ISSN: 2321-4902

[www.chemijournal.com](http://www.chemijournal.com)

IJCS 2020; 8(4): 2304-2307

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Received: 25-05-2020

Accepted: 27-06-2020

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## Influence of bio-stimulants on growth and rhizome yield of black turmeric (*Curcuma caesia*)

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DOI: <https://doi.org/10.22271/chemi.2020.v8.i4z.9980>

**Abstract**

The field experiment was conducted at Horticultural College and Research Institute, Tamil Nadu Agricultural University, Periyakulam to study the effect of bio-stimulants on growth and yield of Black turmeric during 2019 – 2020. The experimental design was RBD (Randomized Block Design) consisting of five treatments replicated four times. In this study, different organic substances viz., humic acid, panchagavya, vermiwash and neem cake extract were used. Water spray was considered as control. The present study envisages that spraying of 3% Panchakavya resulted in higher plant height, number of leaves, number of tillers, leaf length and leaf breadth. The estimated fresh rhizome yield of 21.83 t ha<sup>-1</sup> was recorded from the treatment of 3% Panchagavya and was significantly differed from other treatments.

**Keywords:** Bio-stimulants, growth, rhizome yield, black turmeric, *Curcuma caesia*

**Introduction**

*Curcuma* is a large genus belonging to the family Zingiberaceae, which comprises over 70 species of rhizomatous herbs. *Curcuma caesia* (Roxb.) popularly known as Kali Haldi (Black turmeric) is an uncommon endemic and perennial herb with bluish-black rhizome. It is native to North-East, and Central India, relatively unexplored medicinal plant valued all over Asia for its therapeutic efficacy. It flourishes well in moist deciduous forest areas with rich humid and clayey soils. In India, it is found in Chhattisgarh, Madhya Pradesh, Odisha, Uttar Pradesh and West Bengal (Nadkarni, 1976) [1]. It is also sparsely found in Papi Hills of East Godavari, West Godavari and Khammam district of Andhra Pradesh. *C. caesia* (Roxb.) possess immense ethnomedicinal importance and has been used by various tribal communities in the amelioration of several dreadful diseases such as asthma, leucoderma, tumors, piles, and bronchitis. It also possesses anti-oxidant, anti-tumor, anti-asthmatic, anti-inflammatory, hepatoprotective, blood purifier, stomachic and carminative properties (Gantait *et al.*, 2011) [4]. The plant of *Curcuma caesia* is used in India for tantric sadhana and medication by tribal people, due to which it is over exploited and depleting faster. The National Medicinal Plant Board of India has listed 112 plants as crucially vulnerable species circulated by Ministry of Environment in 1997 and according to this, export of these species is not permitted without the permission of the legal competent authorities and this notification includes *Curcuma caesia* as well. This plant is in great demand in Central India and, due to indiscriminate exploitation the plant has been categorized as an endangered species (Kumar *et al.*, 1998) [6].

The cultivation and harvest practices are similar to that of *Curcuma longa*. The propagating part of the plant is underground short and thick rhizome. The crop is grown in warm and moist regions. The soil should be sandy or clay loam and rich in humus. It can be grown in up to an altitude of 4000 feet above sea level. Small pieces of rhizome with a bud are sown 3 inches deep into soil in the months between April to August. The turning yellow of leaves and their fall in December to January indicate maturity of the crop. The rhizomes are then dug out leaving a few which serve as a seed for the next cropping season (Bendre and Kumar, 1990) [3]. The present harvesting practices of *Curcuma caesia* is very deteriorating because of high price of product in the national and international markets, immature collection by locals, poor regeneration. This may be the reason for the present status of the plant (Mishra, 2000) [7]. This crop is highly used for medicinal purpose, hence there is need to standardize the organic production techniques. In organic production, bio-stimulant play a major role in growth and

development of black turmeric. A plant bio-stimulant is any substance or microorganism applied to plants with the aim to enhance nutrition efficiency, abiotic stress tolerance and/or crop quality traits, regardless of its nutrients content (Patrick, 2015) [12]. Specifically, they decrease the application of mineral fertilizers by increasing the amount of micro and macronutrients taken up by plants, positively affecting root morphology and plant growth (Ziosi *et al.*, 2013) [22]. They also show hormone-like activity and impact plant metabolism by interacting with biochemical processes and physiological mechanisms, such as glycolysis and nitrogen assimilation (Azcona *et al.*, 2011) [1]. Recent consideration has been given to decrease contamination sources in present agriculture. One of the procedures to reduce soil pollution is the application of biostimulants, which has turned out to be as a safety nature of plant growth regulators, polyamines and vitamins (Kowalczyk and Zielony, 2008) [5]. Plant biostimulant products are novel in agronomy. However they are more efficient in medicinal plants due to possibility of genetic manipulation in synthesis pathways of secondary metabolites (Rafiee *et al.*, 2016) [16]. Hence the attempt has been made by employing four different organic substances such as panchakavya, humic acid, vermiwash and neem cake extract at different concentrations and to study the influence of bio-stimulants on growth and yield of black turmeric.

### Materials and Methods

The experiment was conducted at the College Orchard, Department of Spices and Plantation Crops, Horticultural College and Research Institute, Tamil Nadu Agricultural University, Periyakulam during 2019 – 20. The field is located at 10°N latitude and 78°E longitude, with an elevation of 300 m above mean sea level. The soil of the experimental field was red sandy loam in texture. The mean annual rainfall was 869 mm and mean temperature was 27.2°C. The single bud rhizome derived transplant of black turmeric was planted under coconut ecosystem at spacing of 45 cm between rows and 25 cm between the plants. The experiment was laid out in a Randomized Block Design with five treatments and replicated at four times. The details of the treatments are as follows,

T1	Humic acid 0.2 per cent
T2	Panchagavya spray 3 per cent
T3	Vermiwash 3 per cent
T4	3% Neem cake Extract
T5	Control (water spray)

The humic acid 0.2 per cent, panchagavya 3 per cent, vermiwash 3 per cent and neem cake extract 3 per cent were sprayed at 90 and 120 days after transplanting. In control, water was sprayed and weeding was done twice over the period of crop. The drip irrigation system was installed and operated daily to provide the sufficient moisture to the plants. Organic manures were applied in all the treatments and similar cultural practices of turmeric were adopted for all treatments. Growth parameters *viz.*, plant height, number of leaves, number of tillers, leaf length and leaf breadth were recorded in the first week of January. The crop was harvested in the first week of February and yield per hectare was estimated. Observations on growth and yield parameters were recorded from ten plants in each replication and the mean values were used for statistical analysis (Panse and Sukhatme, 1957) [11].

### Results and Discussion

The effect of bio-stimulants on growth and yield was assessed on black turmeric and the results of the experiments are presented in Table 1 and 2. In the present experiment, the plant height was significantly influenced by foliar spraying of different organic substances in black turmeric. The treatment consisting of T<sub>2</sub> (Panchagavya spray 3 per cent) resulted in higher plant height (53.50 cm) and was significantly different from rest of the treatments. Number of leaves per plant differed significantly among the treatments. The number of leaves was found to be progressively increasing during the growth stages. The highest number of leaves (15.60) was recorded in the treatment T<sub>2</sub> (Panchagavya spray 3 per cent) whereas the least number (10.20) was registered in T<sub>5</sub> (control). Among the treatments, spraying of panchagavya at 3% (T<sub>2</sub>) produced higher number of tillers (4.30). The least number of tillers (2.00) was recorded in the treatment T<sub>5</sub> (Control). The leaf length and leaf width were significantly higher in spraying of panchagavya at 3% (31.90 cm and 9.10 cm respectively) and followed by spraying of neem cake extract at 3% (27.30 cm and 8.20 cm respectively). While the results obtained the spraying of water (control) was 21.40 cm and 7.00 cm respectively.

Similarly, results in Table 2 showed that number of rhizomes per plant and length of rhizome was significantly increased in panchagavya spraying at 3% (15.10 and 9.14 cm respectively) followed by 3% neem cake extract spraying (14.34 and 8.56 cm respectively), whereas the yield component characters was decreased in control (10.45 and 6.93 cm respectively). Among various treatments, the highest fresh rhizome yield (21.83 t ha<sup>-1</sup>) was recorded under treatment T<sub>2</sub>, which increased by 18 per cent over control. The low yield was recorded under control *i.e.*, water spraying (12.83 t ha<sup>-1</sup>).

The ultimate goal to be achieved in any crop management aspect is maximization of yield. In the present study the spraying of panchagavya at 3% produced the highest fresh rhizome yield. The similar spraying significantly promoted the plant height and enhanced the plant growth via higher number of leaves and number of tillers. The possible reason for this acceleration of growth might be due to the increased content of nitrogen, the chief constituent of protein, essential for the formation of protoplasm, which leads to cell division and cell enlargement. Panchagavya carries considerable amounts of nitrogen, which would be utilized for the protein synthesis and eventually resulted in stimulated growth. Moreover nitrogen is an important component of amino acids and coenzymes, which have considerable biological importance (Balkly, 1974) [2]. Another possible reason for highest growth character might be due to the growth of enzymes present in organic substances, which favoured rapid cell division and multiplication. This view was also supported by Mohd *et al.* (2011) [8] in garlic and Sanker *et al.* (2009) [18] in onion. The increase in the number of tillers per plant due to auxins which is present in panchagavya attributed to the activation of cell division and cell elongation in the axillary buds which had a promoting effect in increased number of tillers. The application of panchagavya would have induced the endogenous synthesis of native auxins resulting in an early active growth. Similar results were obtained by Singh *et al.* (2009) [19] in ginger and Singh (2013) [20] in turmeric.

Nitrogen being the essential constituent of protein might have increased the production of leaves associated with the increased leaf area and leaf area index (Prabhu *et al.*, 2010) [14]. Leaf expansion due to the presence of growth regulators such as IAA, GA and cytokinin etc., in Panchakavya might

have enhanced the leaf length and width. Similar results made in turmeric by Natarajan (2002) [10]. Crop yield is the complex function of physiological processes and biochemical activities, which modify plant anatomy and morphology of the growing plants. There are several reasons for increased yield in different crops due to spray of panchagavya. Smaller quantities of IAA and GA present in panchagavya when foliar sprayed could have created stimuli in the plant system which in turn increased the production of growth regulator in cell system and the action of growth regulators in plant system stimulated the necessary growth and development, leading to better yield (Prمود Kumar *et al.*, 2018) [15]. Panchagavya increased synthesis of growth promoting substances which in turn helped in increased growth and yield attributes and

finally rhizome yield. Similarly findings have been reported by Subha *et al.* (2010) [21] in curry leaf, Ramanan *et al.* (2010) [17] in coriander and Perumal *et al.* (2006) [13] in onion. Thus from the discussion made so far it is concluded that spraying of 3% Panchagavya at 90 and 120 days after transplanting was the promoting source of fresh rhizome yield in black turmeric.

#### Acknowledgement

The author is grateful to the Project Regional Director, NMPB-Regional cum Facilitation Centre (Southern Region), Kerala Forest Research Institute, Peechi, Kerala for the financial assistance under GOI-NMPB scheme.

**Table 1:** Effect of Bio-stimulants on growth parameters of Black turmeric

Treatment	Plant height (cm)	No. of leaves / plant	No. of tillers / plant	Leaf length (cm)	Leaf breadth (cm)	Days to maturity
T <sub>1</sub>	47.20	10.80	2.30	26.00	7.10	273.00
T <sub>2</sub>	53.50	15.60	4.30	31.90	9.10	262.00
T <sub>3</sub>	44.60	10.40	2.50	23.20	7.20	270.00
T <sub>4</sub>	47.90	12.10	3.00	27.30	8.20	265.00
T <sub>5</sub>	43.30	10.20	2.00	21.40	7.00	276.00
Mean	47.30	11.82	2.82	25.96	7.72	269.20
SEd	0.91	0.27	0.06	0.53	0.16	-
CD (0.05%)	1.92	0.57	0.12	1.12	0.34	-

**Table 2:** Effect of Bio-stimulants on yield parameters of Black turmeric

Treatment	No. of rhizome / plant	Length of rhizome (cm)	Fresh rhizome yield/plot (g)	Fresh rhizome yield/plot (3 sq. m) (kg)	Estimated fresh rhizome yield/ha (t)
T <sub>1</sub>	11.78	7.52	247.00	4.94	18.28
T <sub>2</sub>	15.01	9.14	295.00	5.90	21.83
T <sub>3</sub>	12.26	7.63	229.00	4.58	16.95
T <sub>4</sub>	14.34	8.56	267.00	5.34	19.76
T <sub>5</sub>	10.45	6.93	173.33	3.47	12.83
Mean	12.76	7.95	242.27	4.85	17.93
SEd	0.35	1.18	1.358	-	-
CD (0.05%)	0.74	2.48	4.557	-	-

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