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Assessment of vermicompost and inorganic fertilizers response on growth, yield and Phyllanthin content in Bhumyamalaki (*Phyllanthus amarus* Schum and Thonn.)

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Abstract
Bhumyamalaki is an annual small herb belongs to the family Euphorbiaceae, mainly known in Indian ayurvedic system for its medicinal properties. During 2018-19 in *kharif*, the field experiment was conducted with an objective of increasing yield in *Phyllanthus amarus* with different combinations of vermicompost and inorganic fertilizers under Northern Dry Zone of Karnataka at Main Horticultural Research and Extension Centre (MHREC), UHS, Bagalkot. Among different treatment combinations, application of V_1F_3 (2 tonnes vermicompost and fertilizer combination of 150: 60: 60 kg NPK per hectare) has recorded significantly maximum plant height (64.9 cm), number of leaves per plant (218.78), number of branches per plant (50.46), plant spread (57.07 cm^2), leaf area (446.33 cm^2), leaf area index (2.98), Cumulative growth rate (5.96 $g/m^2/day$), Absolute growth rate (0.12 g/day), total dry matter accumulation (11.97 g/plant), fresh herbage yield (10.75 t/ha) and dry herbage yield (5.25 t/ha), the maximum nutrient uptake (N-121.52, P_2O_5-24.96, K_2O-107.73 kg/ha) by the plants, the highest net returns (132226) and B:C ratio (2.95). Whereas, the maximum Phyllanthin content (0.87%) was recorded with the application of V_1F_1 (2 tonnes of vermicompost and fertilizer combination of 50: 30: 30 kg NPK per hectare) and the maximum phosphorous availability in soil (39.21 kg/ha) was recorded with V_1F_0 (2 tonnes vermicompost and fertilizer combination of 0: 0: 0 kg NPK per hectare).

Keywords: Bhumyamalaki, vermicompost, inorganic fertilizers, growth, yield, Phyllanthin content

Introduction
Phyllanthus amarus Schum and Thonn. belongs to the family Euphorbiaceae known popularly in the Indian Systems of Medicine as Bhumyamalaki. This plant may be indigenous to the tropical Americas (Cabieses, 1993; Morton, 1981; Tirimanna, 1987) [1, 10, 25] and the Philippines or India (Cabieses, 1993 & Chevallier, 2000) [1, 2]. It is a common pantropical weed that grows well in moist, shady and sunny places (Cabieses, 1993) [1]. The plant has been reported to exhibit a marked antihepatitis B virus antigen activity, antibacterial, anticrustacean, antifungal and antiviral activity. The lignans particularly phyllanthin and hypophyllanthin are present in the plant and the whole plant is used in herbal drug preparation. In a number of countries, the aerial part of *P. amarus* is highly valued in traditional medicine for its healing properties (Foo and Wong, 1992) [4]. This species is also used in the most popular Ayurvedic formulations, Chyawanprash, which is consumed at large scale, not only in India but also throughout the world**.** Hence, there is ample scope for large-scale cultivation of *P. amarus* as a pure crop as every part of this plant has been investigated as a source of valuable compounds used as such in drug preparation. So, there is need to increase the production of the crop to meet its demand. The present study was carried out to assess the role of vermicompost and inorganic fertilizers and their interaction effects on the growth, yield and Phyllanthin content of *P. amarus.*

Material and Methods
The experiment was carried out during *Kharif* 2018-19 with mutant variety CIM Jeevan at University of Horticultural Sciences, Bagalkot, which is situated in Northern Dry Zone of Karnataka (Zone-3) located at 542.0 m above the mean sea level. The investigation was conducted on sandy loam soil with pH 8.14, available nitrogen (238 kg/ha), phosphorus (34.36 kg/ ha) and potassium (821.76 kg/ha).

The experiment was laid out in Factorial randomized block design with three replications and there were 8 treatments consisting of different levels. The two levels of vermicompost *viz*., V_0 & V_1 (0 & 2 t/ha) and four levels of chemical fertilizers, *viz*., F_0, F_1, F_2 & F_3 (0: 0: 0, 50: 30: 30, 100: 45: 45 and 150: 60: 60 kg NPK/ha respectively). Full dose of vermicompost were applied one week before sowing and mixed well, Phosphorus in the form of single super phosphate (P_2O_5) and potash in the form of muriate of potash (K_2O) and 50 per cent nitrogen in the form of urea (N) as per the treatments were applied just before sowing of seeds and remaining 50 per cent of nitrogen was top dressed at 35 days after sowing (DAS). Seeds were line sown at a depth of 1-2 cm using 1-kilogram seeds per hectare with row to row spacing of 15 cm and intra-row spacing of 10 cm. Immediately after sowing light irrigation was provided. The observations were recorded on five randomly selected plants from three replications at harvest (100 DAS).

The observations like plant height, number of leaves per plant, number of branches per plant were recorded, the plant spread was measured along the East-West and North-South direction with the help of meter scale, leaf area was determined with digital leaf area meter (LI-3100 Area Meter) and LAI was calculated by applying the formula as suggested by Sestak *et al*. (1971) [19]. The total dry matter production was recorded and calculated Cumulative growth rate (CGR) and Absolute growth rate (AGR) using the formula suggested by Watson (1952) [26] for CGR and for AGR by Radford (1967) [17].

The harvesting was done using sickel by cutting whole herb at crown region and weighed for fresh herbage yield. They were dried in the shade to retain the color and weighed for dry herbage yield.

After drying, the plants were analyzed for N, P, and K content and total uptake of each was calculated. Plant nutrient content were determined; total nitrogen by Kjeldhal method suggested by Piper (1966) [13], total phosphorus by vanadomolybdate method and the total potassium content in the plant samples was estimated by flame photometer method outlined by Jackson (1973) [7] and expressed as percentage on dry weight basis and calculated for kg/ha (nutrient uptake).

The soil samples were collected before and after cropping at a depth of 0-30 cm from each plot and a composite soil sample was drawn and analyzed for N, P, and K content. Where, available nitrogen by using alkaline potassium permanganate method given by Subbiah and Asija, (1956) [22], available phosphorus by chlorostannus reduced molybdo-phosphoric blue colour method and available potassium by flame photometer method as suggested by Jackson (1973) [7] were determined.

Phyllanthin content in the whole herb was estimated by RP-UFLC method (Kshringhar *et al.* 2016) [8]. For estimating the economics of *Phyllanthus amarus* cultivation, the prices of all the inputs and prevailing labour costs were taken into account. The gross income was worked out based on the prevailing market rate for the shade dried produce (Rs 50 kg^{-1}). The benefit cost ratio was also worked out. The data recorded during the crop period were statistically analyzed using the Fischer's method of analysis of variance technique as outlined by Panse and Sukhatme (1967) [12] and the results have been discussed at 5% probability level.

Results and Discussion

The results of the experiment on response of vermicompost and inorganic nutrients fertilization had showed significant effect on growth, yield and phyllanthin content in Bhumyamalaki. Among different nutrients combinations, V_1F_3 (2 t vermicompost/ha + 150: 60: 60 kg NPK/ha) showed significantly maximum plant height (64.9 cm), number of leaves per plant (218.77), number of branches per plant (50.45) which was followed by V_1F_2 and V_1F_1 and plant spread (57.06 cm^2) was recorded maximum with application of V_1F_3 (2 t vermicompost/ha + 150: 60: 60 kg NPK/ha) which was on par with V_0F_3 (0 t vermicompost/ha + 150: 60: 60 kg NPK/ha) and V_1F_2 (2 t vermicompost/ha + 100: 45: 45 kg NPK/ha) represented in Table 1.

The leaf area and leaf area index were not significantly differed (Table 2). Where, the increase in leaf area (446.33 cm^2) and LAI (2.98) were recorded with V_1F_3 (2 t vermicompost/ha + 150: 60: 60 kg NPK/ha) followed by V_0F_3 (0 t vermicompost/ha + 150: 60: 60 kg NPK/ ha). This increase in growth parameters might be due to higher nutrient released from both vermicompost and inorganic fertilizers would have resulted in the increased nutrient availability of both macro and micro nutrients, along with improvement in soil health where it enhanced the translocation of photosynthates from source to sink and improved vegetative growth parameters. The results are in conformity with Singh and Ramesh (2002)[20] in sweet basil, Deivasigamani *et al.* (2011) [3] in Glorylilly, Raina *et al.* (2013) [15] in *Ocimum sanctum*, Priyadarshini *et al.* (2016) [14] in *Phyllanthus niruri*, Gamar *et al.* (2017) [5] in fennel and Gupta *et al.* (2011) [6] in black henbane, Sadhashiv (2010) [18] in ashwagandha and Nadukeri (2006) [11] in coleus.

In Table 2 The maximum CGR and AGR (5.96 g/m^2/day and 0.12 g/day, respectively) were observed with V_1F_3 (2 t vermicompost/ha + 150: 60: 60 kg NPK/ ha) followed by V_0F_3 (0 t vermicompost/ha + 150: 60: 60 kg NPK/ ha). This increased CGR and AGR might be due to fact that the vermicompost supply macronutrients, micronutrients and organic acids like humic acids, which enhanced the growth rate and also additional supply of major nutrients by fertilizers resulted in maximum growth rate. Similar trend was found in ashwagandha by Sadhashiv (2010) [18] reported that significantly highest CGR (0.561 g/m2/day) was reported with the application of 0.5 tones vermicompost + 20: 30: 20 kg NPK per hectare.

The combined application of vermicompost and fertilizers had significant effect on total dry matter production, fresh herbage yield and dry herbage yield (Table 3 & Fig. 2). Significantly, maximum dry matter production (11.97 g/pant), fresh herbage yield (10.75 t/ha) and dry herbage yield (5.25 t/ha) was observed with V_1F_3 (2 t vermicompost/ha + 150: 60: 60 kg NPK/ ha) followed by V_0F_3 (0 t vermicompost/ha + 150: 60: 60 kg NPK/ ha). This might be due to fact that the combined application of vermicompost and fertilizers help in keeping up biomass yield through correction of minimal lacks of micronutrients, improving effectiveness of connected supplements and providing favorable soil physical conditions and produce completely balanced out natural soil amendments with low C: N proportion and enhance soil fertility and raise crop productivity. Similarly other findings were reported by Singh (2011) [21] in geranium, Rajamanickam *et al*, (2011) [16] in *Mentha arvensis*, Suresh and Senthinathan (2017) [23] in *Solanum trilobatum* and Raina *et al.* (2013) [15] in *Ocimum sanctum*.

The phyllanthin content (Table 3) though significantly not influenced, but found maximum (0.87%) with V_1F_1 (2 t vermicompost/ha + 50: 30: 30 kg NPK/ ha) followed by V_1F_0 (2 t vermicompost/ha + 0: 0: 0 kg NPK/ ha). This increase in phyllanthin might be due to increased protein synthesis, less starch accumulation and enhancement of enzymatic antioxidant activity by vermicompost localized in mesophyll cells of plant. The present result was similar with other findings of Kumar *et al.* (2013) [10] in case of stevia and Sadashiv (2010) [18] in ashwagandha.

The nutrients of N, P and K in the whole plant after harvest is presented in Table 4. The maximum uptake of nitrogen (N-kg/ha), phosphorous (P_2O_5- kg/ha) and potassium (K_2O-kg/ha) was observed with V_1F_3 (2 t vermcompost/ha + 150: 60: 60 kg NPK/ ha) which was followed by V_1F_2 (2 t vermicompost/ha + 100: 45: 45 kg NPK/ha). This increase in the nutrient uptake by the plants might be due to fact that both the vermicompost and fertilizers are high in nutrient content and application of vermicompost enhanced soil fertility by excreting beneficial soil organisms and secreting polysaccharides, proteins and others which helps in immobilizing the unavailable nutrients to available form in the soil. Hence, increases the uptake and utilization of nutrients by the plants. The results were in line with findings of Singh *et al.* (2012) [21] in geranium and Rajmanickam *et al.* (2011) [16] in *Mentha arvensis*.

Soil available nitrogen and potassium content after harvest did not show any significant difference with the application of different levels of organic manures and inorganic fertilizers. Whereas, it recorded significant impact on soil available P content (Table 5). Highest available P (39.21 kg/ha) was recorded with the application of V_1F_0 (2 tonnes vermicompost along with 0 kg NPK per hectare). The higher P content in V_1F_0 might be due to high fixation and poor uptake by the plants. As a result, more amount of phosphorous was fixed in the soil. Similar results were observed in stevia by Kumar *et al.* (2013) [9] and Sukumal *et al.* (2001) [23] in mint.

The maximum net returns (Rs. 132226 /ha) and B:C ratio (2.95) was observed (Table 6 and Fig.2) in V_1F_3 (2 t vermicompost/ha + 150: 60: 60 kg NPK/ ha) followed by V_0F_3 (0 t vermicompost/ha + 150: 60: 60 kg NPK/ ha). This might be attributed to the enhanced herb yield due to optimum level of nutrients supplied with vermicompost and fertilizers to meet the required nutrient demand of the crop.

Table 1: Influence of vermicompost and inorganic fertilizers on growth and developmental parameters of Bhumyamalaiki (*Phyllanthus amarus* Schum and Thonn.)

Treatments	**Growth parameters**			
	Plant height	**No of leaves**	**No of branches**	**Plant spread**
Factor A: Vermicompost (V)				
V_0: Vermicompost 0t/ha	43.39	121.19	34.96	41.66
V_1: Vermicompost 2t/ha	48.80	148.50	39.60	47.03
S.Em±	0.55	2.08	0.41	0.66
C.D at 5%	1.57	5.92	1.16	1.89
Factor B: Inorganic fertilizers(F)				
F_0: Inorganic fertilizers @ 0:0:0 kg NPK/ha	31.65	77.05	26.53	31.40
F_1: Inorganic fertilizers @ 50:30:30 kg NPK/ha	39.70	106.60	33.03	39.19
F_2: Inorganic fertilizers @ 100:45:45 kg NPK/ha	52.29	151.95	41.58	50.34
F_3: Inorganic fertilizers @ 150:60:60 kg NPK/ha	60.75	203.79	47.98	56.45
S.Em±	0.78	2.94	0.57	0.94
C.D at 5%	2.22	8.37	1.64	2.67
Interactions (VxF)				
T_1: V_0F_0- Vermicompost 0t/ha + Inorganic fertilizers @ 0:0:0 kg NPK/ha	31.15	71.34	25.38	27.94
T_2: V_0F_1- Vermicompost 0t/ha + Inorganic fertilizers @ 50:30:30 kg NPK/ha	37.69	96.31	30.78	37.17
T_3: V_0F_2- Vermicompost 0t/ha + Inorganic fertilizers @ 100:45:45 kg NPK/ha	48.11	128.32	38.20	45.70
T_4: V_0F_3- Vermicompost 0t/ha + Inorganic fertilizers @ 150:60:60 kg NPK/ha	56.60	188.80	45.50	55.83
T_5: V_1F_0- Vermicompost 2/ha + Inorganic fertilizers @ 0:0:0 kg NPK/ha	32.14	82.76	27.68	34.86
T_6: V_1F_1 - Vermicompost 2t/ha + Inorganic fertilizers @ 50:30:30 kg NPK/ha	41.71	116.90	35.28	41.21
T_7: V_1F_2- Vermicompost 2t/ha + Inorganic fertilizers @ 100:45:45 kg NPK/ha	56.46	175.58	44.97	54.98
T_8: V_1F_3- Vermicompost 2t/ha + Inorganic fertilizers @ 150:60:60 kg NPK/ha	64.90	218.78	50.46	57.07
S.Em±	1.10	4.16	0.81	1.33
C.D at 5%	3.15	11.84	NS	3.78

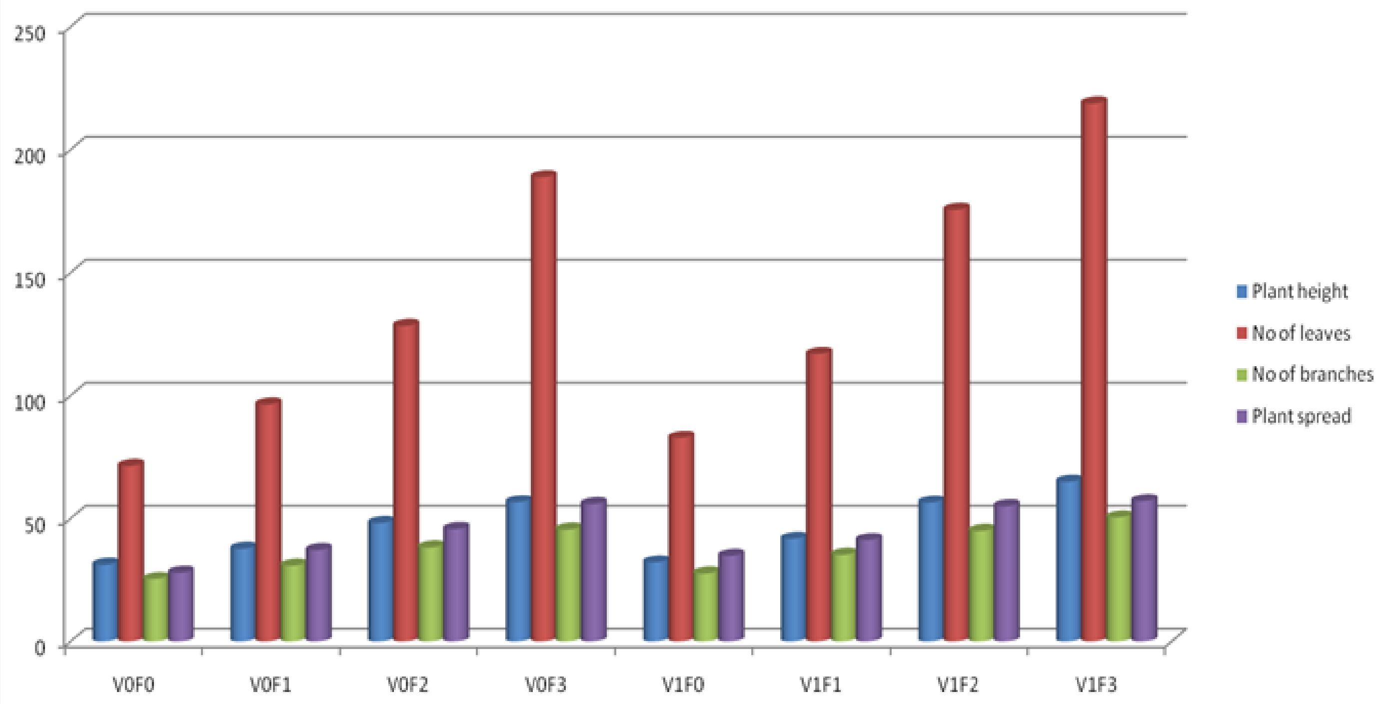

Fig 1: Graphical representation of growth parameters as influenced by interaction of vermicompost and inorganic fertilizers in Bhumyamalaki (*Phyllanthus amarus* Schum and Thonn.)

Vermicompost (V)
V_0= 0 t ha^{-1}
V_1= 2 t ha^{-1}

Fertilizer (F)
F_0= 0:0:0 NPK (kg ha^{-1})
F_1= 50:30:30 NPK (kg ha^{-1})
F_2= 100:45:45 NPK (kg ha^{-1})
F_3= 150:60:60 NPK (kg ha^{-1})

Table 2: Influence of vermicompost and inorganic fertilizers on growth attributing physiological parameters of Bhumyamalaki (*Phyllanthus amarus* Schum and Thonn.)

Treatments	Physiological parameters			
	Leaf area (cm^2)	LAI	CGR (g/m^2/day)	AGR (g/day)
Factor A: Vermicompost (V)				
V_0: Vermicompost 0t/ha	333.22	2.22	4.15	0.08
V_1: Vermicompost 2t/ha	372.81	2.49	5.18	0.10
S.Em±	3.40	0.02	0.08	0.00
C.D at 5%	9.67	0.06	0.24	0.00
Factor B: Inorganic fertilizers(F)				
F_0: Inorganic fertilizers @ 0:0:0 kg NPK/ha	270.00	1.80	2.86	0.06
F_1: Inorganic fertilizers @ 50:30:30 kg NPK/ha	327.28	2.18	4.22	0.08
F_2: Inorganic fertilizers @ 100:45:45 kg NPK/ha	386.67	2.58	5.87	0.12
F_3: Inorganic fertilizers @ 150:60:60 kg NPK/ha	428.11	2.85	5.71	0.11
S.Em±	4.81	0.03	0.12	0.00
C.D at 5%	13.68	0.09	0.33	0.01
Interactions (VxF)				
T_1: V_0F_0- Vermicompost 0t/ha + Inorganic fertilizers @ 0:0:0 kg NPK/ha	248.78	1.66	2.61	0.05
T_2: V_0F_1- Vermicompost 0t/ha + Inorganic fertilizers @ 50:30:30 kg NPK/ha	308.00	2.05	3.69	0.07
T_3: V_0F_2- Vermicompost 0t/ha + Inorganic fertilizers @ 100:45:45 kg NPK/ha	366.22	2.44	4.85	0.10
T_4: V_0F_3- Vermicompost 0t/ha + Inorganic fertilizers @ 150:60:60 kg NPK/ha	409.89	2.73	5.45	0.11
T_5: V_1F_0- Vermicompost 2t/ha + Inorganic fertilizers @ 0:0:0 kg NPK/ha	291.22	1.94	3.11	0.06
T_6: V_1F_1 - Vermicompost 2t/ha + Inorganic fertilizers @ 50:30:30 kg NPK/ha	346.56	2.31	4.75	0.09
T_7: V_1F_2- Vermicompost 2t/ha + Inorganic fertilizers @ 100:45:45 kg NPK/ha	407.11	2.71	6.89	0.14
T_8: V_1F_3- Vermicompost 2t/ha + Inorganic fertilizers @ 150:60:60 kg NPK/ha	446.33	2.98	5.96	0.12
S.Em±	6.80	0.05	0.00	0.00
C.D at 5%	NS	NS	0.01	0.01

Table 3: Influence of vermicompost and inorganic fertilizers on yield and quality attributing parameters of Bhumyamalaki (*Phyllanthus amarus* Schum and Thonn.)

Treatments	Yield and quality parameters			
	Total dry matter production (g/plant)	**Fresh herbage yield (t/ha)**	**Dry herbage yield (t/ha)**	**Phyllanthin Content (%)**
Factor A: Vermicompost (V)				
V_0: Vermicompost 0t/ha	7.23	7.14	3.24	0.77
V_1: Vermicompost 2t/ha	8.77	8.58	4.04	0.83
S.Em±	0.07	0.07	0.04	0.01
C.D at 5%	0.19	0.19	0.10	0.03
Factor B: Inorganic fertilizers(F)				
F_0: Inorganic fertilizers @ 0:0:0 kg NPK/ha	4.71	5.75	2.35	0.82
F_1: Inorganic fertilizers @ 50:30:30 kg NPK/ha	6.74	6.97	3.24	0.83
F_2: Inorganic fertilizers @ 100:45:45 kg NPK/ha	9.45	8.70	4.18	0.80
F_3: Inorganic fertilizers @ 150:60:60 kg NPK/ha	11.11	10.03	4.82	0.76
S.Em±	0.10	0.10	0.05	0.01
C.D at 5%	0.27	0.28	0.14	0.04
Interactions (VxF)				
T_1: V_0F_0- Vermicompost 0t/ha + Inorganic fertilizers @ 0:0:0 kg NPK/ha	4.38	5.46	2.15	0.78
T_2: V_0F_1- Vermicompost 0t/ha + Inorganic fertilizers @ 50:30:30 kg NPK/ha	6.10	6.30	2.85	0.79
T_3: V_0F_2- Vermicompost 0t/ha + Inorganic fertilizers @ 100:45:45 kg NPK/ha	8.21	7.51	3.59	0.77
T_4: V_0F_3- Vermicompost 0t/ha + Inorganic fertilizers @ 150:60:60 kg NPK/ha	10.25	9.30	4.38	0.74
T_5: V_1F_0- Vermicompost 2t/ha + Inorganic fertilizers @ 0:0:0 kg NPK/ha	5.04	6.03	2.54	0.85
T_6: V_1F_1 - Vermicompost 2t/ha + Inorganic fertilizers @ 50:30:30 kg NPK/ha	7.38	7.65	3.62	0.87
T_7: V_1F_2- Vermicompost 2t/ha + Inorganic fertilizers @ 100:45:45 kg NPK/ha	10.69	9.90	4.76	0.83
T_8: V_1F_3- Vermicompost 2t/ha + Inorganic fertilizers @ 150:60:60 kg NPK/ha	11.97	10.75	5.25	0.77
S.Em±	0.14	0.14	0.07	0.02
C.D at 5%	0.39	0.39	0.20	NS

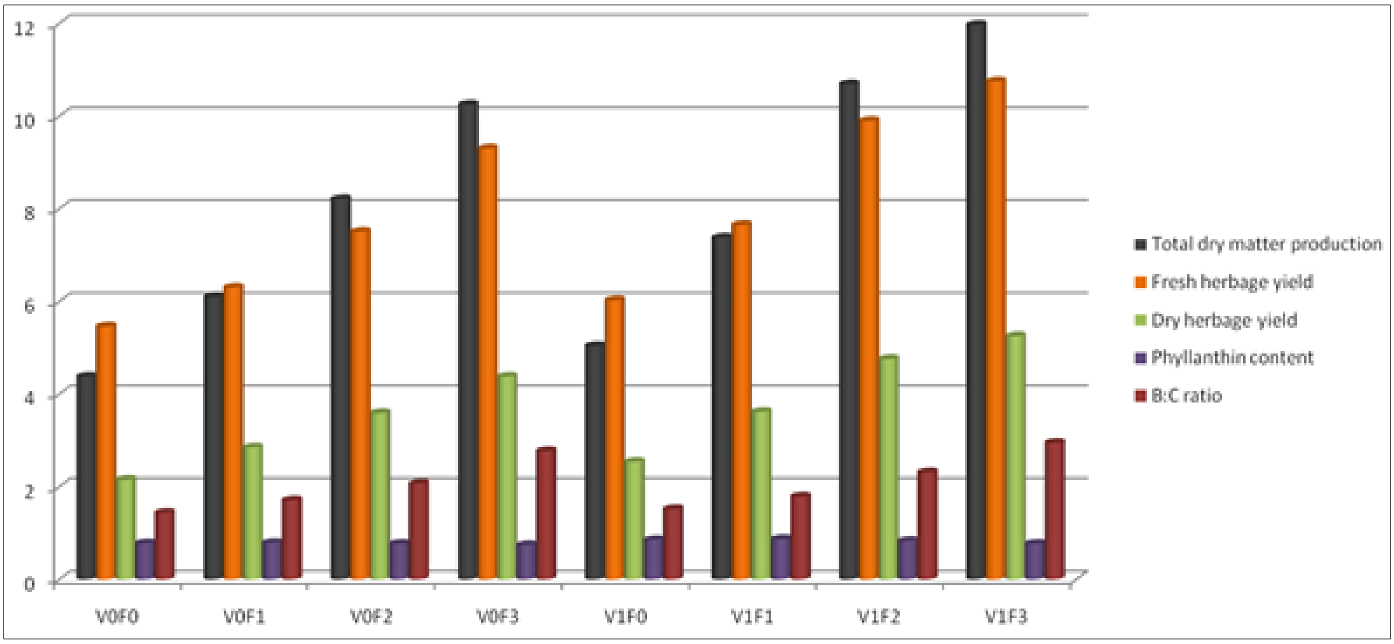

Fig 2: Graphical representation of yield parameters and B:C ratio as influenced by interaction of vermicompost and inorganic fertilizers in Bhumyamalaki (*Phyllanthus amarus* Schum and Thonn.).

Vermicompost (V)
V_0= 0 t ha^{-1}
V_1= 2 t ha^{-1}

Fertilizer (F)
F_0= 0:0:0 NPK (kg ha^{-1})
F_1= 50:30:30 NPK (kg ha^{-1})
F_2= 100:45:45 NPK (kg ha^{-1})
F_3= 150:60:60 NPK (kg ha^{-1})

Table 4: Influence of vermicompost and inorganic fertilizers on nutrient uptake by the plants in Bhumyamalaki (*Phyllanthus amarus* Schum and Thonn.)

Treatments	Nutrient uptake by plants		
	Nitrogen (kg/ha)	Phosphorous (kg/ha)	Potassium (kg/ha)
Factor A: Vermicompost (V)			
V_0: Vermicompost 0t/ha	55.09	13.93	55.21
V_1: Vermicompost 2t/ha	81.04	18.03	76.35
S.Em±	1.51	0.18	1.17
C.D at 5%	4.30	0.52	3.33
Factor B: Inorganic fertilizers(F)			
F_0: Inorganic fertilizers @ 0:0:0 kg NPK/ha	29.13	9.13	33.19
F_1: Inorganic fertilizers @ 50:30:30 kg NPK/ha	51.63	13.27	51.90
F_2: Inorganic fertilizers @ 100:45:45 kg NPK/ha	84.60	18.82	80.23
F_3: Inorganic fertilizers @ 150:60:60 kg NPK/ha	106.90	22.69	97.80
S.Em±	2.13	0.26	1.65
C.D at 5%	7.44	0.74	4.71
Interactions (VxF)			
T_1: V_0F_0- Vermicompost 0t/ha + Inorganic fertilizers @ 0:0:0 kg NPK/ha	23.78	7.96	28.64
T_2: V_0F_1- Vermicompost 0t/ha + Inorganic fertilizers @ 50:30:30 kg NPK/ha	41.01	11.61	43.58
T_3: V_0F_2- Vermicompost 0t/ha + Inorganic fertilizers @ 100:45:45 kg NPK/ha	63.29	15.73	60.73
T_4: V_0F_3- Vermicompost 0t/ha + Inorganic fertilizers @ 150:60:60 kg NPK/ha	92.28	20.41	87.87
T_5: V_1F_0- Vermicompost 2/ha + Inorganic fertilizers @ 0:0:0 kg NPK/ha	34.48	10.30	37.74
T_6: V_1F_1 - Vermicompost 2t/ha + Inorganic fertilizers @ 50:30:30 kg NPK/ha	62.24	14.94	60.21
T_7: V_1F_2- Vermicompost 2t/ha + Inorganic fertilizers @ 100:45:45 kg NPK/ha	105.92	21.92	99.73
T_8: V_1F_3- Vermicompost 2t/ha + Inorganic fertilizers @ 150:60:60 kg NPK/ha	121.52	24.96	107.73
S.Em±	3.02	0.37	2.34
C.D at 5%	8.59	1.05	6.66

Table 5: Influence of vermicompost and inorganic fertilizers on nutrient availability in soil after harvest in Bhumyamalaki (*Phyllanthus amarus* Schum and Thonn.)

Treatments	Nutrient availability in soil		
	Nitrogen (kg/ha)	Phosphorous (kg/ha)	Potassium (kg/ha)
Factor A: Vermicompost (V)			
V_0: Vermicompost 0t/ha	202.75	30.41	630.24
V_1: Vermicompost 2t/ha	172.90	27.23	603.46
S.Em±	4.58	0.62	8.78
C.D at 5%	13.05	1.76	24.98
Factor B: Inorganic fertilizers(F)			
F_0: Inorganic fertilizers @ 0:0:0 kg NPK/ha	247.76	38.05	735.43
F_1: Inorganic fertilizers @ 50:30:30 kg NPK/ha	206.11	31.41	657.76
F_2: Inorganic fertilizers @ 100:45:45 kg NPK/ha	165.78	24.45	564.58
F_3: Inorganic fertilizers @ 150:60:60 kg NPK/ha	131.67	21.38	509.64
S.Em±	6.48	0.88	12.41
C.D at 5%	18.45	2.49	35.33
Interactions (VxF)			
T_1: V_0F_0- Vermicompost 0t/ha + Inorganic fertilizers @ 0:0:0 kg NPK/ha	250.46	36.89	729.96
T_2: V_0F_1- Vermicompost 0t/ha + Inorganic fertilizers @ 50:30:30 kg NPK/ha	221.00	34.56	671.58
T_3: V_0F_2- Vermicompost 0t/ha + Inorganic fertilizers @ 100:45:45 kg NPK/ha	191.78	28.00	607.39
T_4: V_0F_3- Vermicompost 0 t/ha + Inorganic fertilizers @ 150:60:60 kg NPK/ha	147.78	22.21	512.06
T_5: V_1F_0- Vermicompost 2t/ha + Inorganic fertilizers @ 0:0:0 kg NPK/ha	245.06	39.21	740.91
T_6: V_1F_1 - Vermicompost 2t/ha + Inorganic fertilizers @ 50:30:30 kg NPK/ha	191.22	28.26	643.93
T_7: V_1F_2- Vermicompost 2t/ha + Inorganic fertilizers @ 100:45:45 kg NPK/ha	139.78	20.90	521.78
T_8: V_1F_3- Vermicompost 2t/ha + Inorganic fertilizers @ 150:60:60 kg NPK/ha	115.56	20.56	507.22
S.Em±	9.17	1.24	17.55
C.D at 5%	NS	3.53	NS

Table 6: Influence of vermicompost and inorganic fertilizers on economics of Bhumyamalaki (*Phyllanthus amarus* Schum and Thonn.)

Treatment	Cost of Cultivation (Rs/ha)	Cost of fertilizers (Rs/ha)	Cost of organics (Rs/ha)		Total cost of cultivation (Rs/ha)	Dry herbage yield (t/ha)	Gross returns (Rs/t)	Net returns (Rs/ha)	Benefit Cost ratio
			FYM	Vermicompost					
V_0F_0	55452	-	-	-	55452	1.60	79835	24383	1.44
V_0F_1	55452	947.6	-	-	56399.6	1.93	96296	39897	1.71
V_0F_2	55452	1566.4	-	-	57018.4	2.37	118313	61294	2.07
V_0F_3	55452	2185.2	-	-	57637.2	3.20	159808	102171	2.77
V_1F_0	55452	-	-	10000	65452	1.99	99314	33862	1.52

V_1F_1	55452	947.6	-	10000	66399.6	2.38	118793	52393	1.79
V_1F_2	55452	1566.4	-	10000	67018.4	3.09	154595	87577	2.31
V_1F_3	55452	2185.2	-	10000	67637.2	4.00	199863	132226	2.95

Conclusion

From this investigation, it can be concluded that the among all the treatment combinations application of 2 tonnes vermicompost + 150: 60: 60 kg NPK per hectare (V_1F_3) recorded the increase in growth parameters, yield parameters, phyllanthin content, maximum uptake of nutrients and higher benefit cost ratio and improvement in soil properties under northern dry zone of Karnataka.

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