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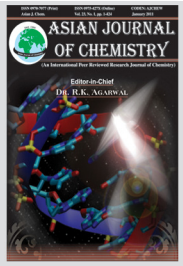

Vermicompost and FYM Effects on Biogeochemical Performances of *Andrographis paniculata* Nees

ALOKA KUMARI

Plant Systematics Research Centre, University Department of Botany, T.M. Bhagalpur University, Bhagalpur-812 007, India

*Corresponding author: Tel: +91 641 2429840; 2500063; E-mail: aloka.psrc@gmail.com; aloka_kumari04@yahoo.com

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Since time immemorial, village and ethnic communities have been using a medicinal plant, Kalmegh (*Andrographis paniculata* Nees.), mainly for liver tonic useful in hyperdispsia, buring sensation, wounds, ulcers, chronic fever, malarial and intermittent fevers, inflammations, cough, common cold, bronchitis, skin diseases, snake bite, leprosy, colic, flatulence, diarrhoea, dysentery, haemorrhoids etc. While the demand of kalmegh is increasing, it is mandatory to standardize the cultivation practices. The experiment was laid out in a randomized block design (RBD) with two parameters replicated thrice. As a result, comparative study FYM @ 15 t/hac and vermidose 5t/hac (cow dung + vegetable wastes + *Eisenia foetida*) recorded double yields. Significantly higher protein was observed under treatment of organic manure *viz.*, 10 tonne/hectare with spacing 30 cm × 45 cm and its morphological study and its biogeochemical study have been done at different stages of plants. Present paper deals with the vermicompost treated and FYM effect on morphological, chlorophyll, sugar, reducing sugar, protein as well as alkaloids.

Key Words: *Andrographis paniculata*, Biogeochemical, FYM, Vermicompost.

INTRODUCTION

The global market of medicinal plant is over 60 billion US $ per year. India, at present export herbal materials and medicines to the tune of Rs. 446.3 crores, as against Rs. 20,000 crores from China. The export potential of the country can be raised to about Rs. 3000 crores by the end of the year 2005. An estimated survey indicated[1] that the use of herbal medicine will reach to the tune of three trillion US $ during 2050. Currently, WHO encourages, recommends and promotes the inclusion of herbal drugs in national health care programmes, because such drugs are easily available at a reasonable price within the reach of common man and as such are time tested and thus considered to be much safer than the modern synthetic drugs. *Andrographis paniculata* Nees. King of bitter, a plant belonging to the acanthaceae family is one of the medicinal plants recommended for cultivation in India, as there is great demand for the plant by the pharmaceutical industries mainly for export[2]. The theurapeutic benefit of this herb has been attributed to adographolide (alkaloid) and its related diterpenoid compound, *i.e.*, deoxandographoloide and neonandrographolide[3,4]. The pharmaceutical studies suggest antiinflammatory[5,6], antipyretic[7], antiviral[8], immunostimulaory[9], potential cancer therapeutic agent[10], antihyperglycemic[11], antioxidant[12] properties.

Significantly higher protein was observed under treatment of organic manure *viz.*, 5 tonne/hectare with spacing 30 cm × 45 cm and its morphological study and its biogeochemical study have been done. Difference between treated and untreated plants has been studied.

EXPERIMENTAL

Plant collection: Wild variety seeds of *Andrographis paniculata* were collected from Banka district 40 km away from the study area and planted in University Department of Botany, T.M. Bhagalpur University dried for a week at room temperature (25 ± 2 °C) and stored in screw capped bottles under ambient condition before experiment during the following April, 2010. Best quality of seeds have been selected by germination test[13] and tetrazolium test[14]. Plants were transplanted after three weeks in 30 cm × 45 cm spacing in field. Experiment was conducted in Botany Department, T.M, Bhagalpur University, Bhagalpur during 2009-2010. At the initial stage of flowering and fruiting when active constituents present in high level plants collected from field for morphological and biogeochemical analysis have been experimented.

Morphological and physical analysis of plants: On the basis of best quality physical and chemical profiles of FYM and vermicompost (cow dung + vegetable wastes + *Eisenia foetida*) have been selected for field treatment. Following data were taken 15 plant were taken for each study.

T_1 = FYM @15 t/hac.

T_2 = Vermicompost @ 5 t/hac (cow dung + vegetable wastes + *Eisenia foetida*).

Root length: The experimental plants were up rooted and washed and washed in running water properly. The root lengths were estimated before root samples were stained.

Procedure: The washed roots were cut into 1 cm bits in a petri dish containing water. Aliquots of root bits were then taken in a square grid (1 cm) petri dish and the number of intersects *i.e.*, points where root bits intersect the grids were counted. The same process was used for the entire root sample.

The total root length was estimated by Tennants[15] formula:

$$\text{Total root length (cm)} = N/14 \times \text{Grid size}$$

where, N= Number of intersects; 11/14 = Tennant's factor

Radius of root: The root radius was estimated by slide caliper. The diameter was measured, five readings were taken which include the minimum as well as maximum diameter region.

Surface area of root: The surface area of root was derived by using the general formula:

$$\text{Surface area of root} = 2\pi rl$$

where, (π = 3.14, r = radius of root, l = length of root)

Root volume: Plants are uprooted and roots of the sample plants were washed properly in running tap water without loss of any branch. The washed roots were placed properly on the blotting paper to remove water molecules of surface. The volume of root was taken by immersing the entire root in measuring cylinder full with water. Root volume was represented by cm^3.

Shoot length: The shoot length of plant was measured by ruler scale. Length of the branches and basal stem length which showed highest length were taken into account. It was derived by following formula:

$$\text{Mean shoot length} = \frac{\text{Length of basal stem + Total length of all branches of plant}}{\text{Total number of branches taken}}$$

Radius of stem: The surface area of shoot was derived by using general formula:

$$\text{Surface area of shoot} = 2\pi rl$$

where, (π = 3.14, r = radius of root, l = length of root).

Area of leaf: Leaf was measured by using Graph paper method. The leaves were clipped and marked on graph paper (10 mm × 10 mm).

$$\text{Mean leaf area} = \frac{\text{Sum of total area of total no. of leaf sample of a plant}}{\text{Total no. of leaf of plat}}$$

Number of leaves: The total no. of leaves of an individual plant was derived by using general formula:

$$\text{Mean no. of leaves} = \frac{\text{Sum total no. of leaves of al the replicates}}{\text{Number of replicates}}$$

Estimation of chlorophyll a and chlorophyll b, chlorophyll: The estimation of total chlorophyll content was done by colorimetric method[16].

Estimation of total sugar and reducing sugar: However, for LPO estimation, the tissues were centrifuged in ice-cold potassium chloride (0.15 M) solution. Estimation of total soluble sugar and estimation of reducing sugar was done by the method of Dubois *et al.*[17].

Estimation of protein: The method of Lowry *et al.*[18] was used for protein estimation. After weighing, the brain tissue were homogenized in 2 mL of ice-cold triple distilled water and sonicated for 15 s. The homogenate was then centrifuged and the supernatant used for the biochemical estimations.

Estimation of phosphorus: Total phosphorus of different parts of plants samples were estimated by Banik and Dey[19].

Estimation of alkaloid: Quantitative analysis of alkaloid was conducted by the Mukherjee[20].

RESULTS AND DISCUSSION

After the test plants, soil sample showed improved level of organic carbon, total N, total P and total K in the range of 148.76-625.81, 151.83-454.93 and 268.26-1998.92 %, respectively over control sample. Following are the landmarks of the present investigation that high drug yielding plants species opening new possibilities of their cultivation.

In present status it is found that vermicompost (5 t/hac) enhances the rate of alkaloid percentage doubles than FYM doses (15 t/hac) data furnishes morphological effects (Tables 1-4) also supports chlorophyll content (Table-5), the rate of total sugar (Table-6), reducing sugar (Table-7), proteins

TABLE-1
EFFECT OF VERMICOMPOST ON ROOT GROWTH

Days	Root length (cm)		Radius of root (cm/plant)		Volume of root (cm^3)		Surface area of root (cm)	
	T_1	T_2	T_1	T_2	T_1	T_2	T_1	T_2
30	12.12±0.22	12.95^{NS}±0.69	0.09±0.02	0.10^{NS}±0.03	0.67±0.18	0.92^{NS}±0.05	3.43±0.13	4.07±0.23
45	13.24±0.32	16.21±0.72	0.11±0.02	0.13^{NS}±0.03	0.98±0.12	1.83^{**}±0.12	4.57±0.19	6.62^{***}±0.16
60	18.07±0.98	28.16^{***}±0.07	0.14±0.01	0.19^{**}±0.02	1.09±0.17	2.70^{***}±0.03	7.92±0.17	16.80^{***}±0.21

(Value of Mean ± SE of 10 samples; **p < 0.01; ***p < 0.001; NS = Not significant).

TABLE-2
EFFECT OF VERMICOMPOST ON SHOOT GROWTH

Days	Shoot length (cm)		Radius of shoot (cm/plant)		Surface area of root (cm)	
	T_1	T_2	T_1	T_2	T_1	T_2
30	14.17±0.71	17.53±0.27	0.07±0.10	0.09^{NS}±0.32	6.24±0.42	9.92^{**}±0.63
45	21.13±0.20	27.64±0.71	0.085±0.18	0.105^{NS}±0.39	11.27±0.08	18.2^{**}±0.19
60	31.76±1.39	52.07±0.23	0.096±0.01	0.10±0.02	18.97±0.18	32.73^{***}±0.63

(Value of Mean ± SE of 10 samples; **p < 0.01; ***p < 0.001; NS = Not significant).

TABLE-3
EFFECT OF VERMICOMPOST ON LEAF GROWTH

Days	No. of leaves/plant		% Increase over control	Leaf area (cm^2)		% Increase over control
	T_1	T_2		T_1	T_2	
30	20.33±1.49	23.00^{NS}±0.58	13.11	118.70±27.69	202.56^{*}±6.58	70.65
45	26.67±1.88	31.67^{*}±0.88	18.75	268.51±18.91	514.31^{***}±10.52	91.54
60	30.60±3.50	38.00±2.31	26.67	377.08±12.20	759.93^{***}±18.75	101.53

(Value of Mean ± SE of 10 samples; *p < 0.05; ***p < 0.001; NS = Not significant).

TABLE-4
DRY MATTER OF *Andrographis paniculata* AT DIFFERENT HARVESTING PERIOD

Days	Leaf (g)		Stem (g)		Root (g)		Total dry matter (g)	
	T_1	T_2	T_1	T_2	T_1	T_2	T_1	T_2
30	12.12±0.22	12.95^{NS}±0.69	0.09±0.02	0.10^{NS}±0.03	0.67±0.18	0.92^{NS}±0.05	3.43±0.13	4.07±0.23
45	13.24±0.32	16.21±0.72	0.11±0.02	0.13^{NS}±0.03	0.98±0.12	1.83^{**}±0.12	4.57±0.19	6.62^{***}±0.16
60	18.07±0.98	28.16^{***}±0.07	0.14±0.01	0.19^{**}±0.02	1.09±0.17	2.70^{***}±0.03	7.92±0.17	16.80^{***}±0.21

(Value of Mean ± SE of 10 samples; **p < 0.01; ***p < 0.001; NS = Not significant).

TABLE-5
CHLOROPHYLL CONTENT AT DIFFERENT HARVESTING PERIOD

Days	Chlorophyll a (µg/mg)		Chlorophyll b (µg/mg)		Total chlorophyll (µg/mg)		Chi a:Chl b (µg/mg)	
	T_1	T_2	T_1	T_2	T_1	T_2	T_1	T_2
30	3.78±0.150	4.128^{*}±0.066	1.357±0.182	1.293^{NS}±1.550	5.156±0.156	5.417^{NS}±0.095	2.88±0.450	3.338^{NS}±0.513
45	2.727±0.177	3.873^{**}±0.137	1.056±0.038	1.267^{NS}±0.160	3.793±0.236	5.13^{**}±0.280	2.57±0.990	3.117^{NS}±0.282
60	2.83±0.065	5.043^{***}±0.030	1.35±0.125	1.635^{NS}±0.128	4.191±0.188	6.143^{**}±0.520	2.12±0.144	3.513^{*}±0.550

(Value of Mean ± SE of 10 samples; *p < 0.05; **p < 0.01; ***p < 0.001; NS = Not significant).

TABLE-6
FREE SUGAR CONTENT AT DIFFERENT HARVESTING PERIOD

Days	Leaf (µg/mg)		Stem (µg/mg)		Root (µg/mg)		While plant (mg/plant)	
	T_1	T_2	T_1	T_2	T_1	T_2	T_1	T_2
30	2.142±0.04	6.98^{***}±0.19	2.011±0.131	2.37^{NS}±0.320	5.28±0.271	7.84^{**}±0.270	0.844±0.027	5.584^{***}±0.030
45	4.74±0.26	6.645^{**}±0.38	3.721±0.216	4.21^{NS}±0.250	7.983±0.128	11.40^{**}±0.130	1.851±0.032	4.74^{***}±0.201
60	5.065±0.12	9.311^{***}±0.18	4.074±0.305	6.23^{**}±0.231	8.838±0.505	12.02^{**}±0.118	3.471±0.121	13.832^{***}±0.420

(Value of Mean ± SE of 10 samples; **p < 0.01; ***p < 0.001; NS = Not significant).

TABLE-7
REDUCING SUGAR CONTENT AT DIFFERENT HARVESTING PERIOD

Days	Leaf (µg/mg)		Stem (µg/mg)		Root (µg/mg)		While plant (mg/plant)	
	T_1	T_2	T_1	T_2	T_1	T_2	T_1	T_2
30	0.25±0.009	0.58^{***}±0.004	0.43±0.545	0.65^{**}±0.040	0.35^{**}±0.028	0.54^{**}±0.02	0.26±0.009	0.27^{NS}±0.020
45	0.29±0.014	0.72^{***}±0.008	0.58±0.942	1.028^{**}±0.085	0.55^{**}±0.022	0.85^{**}±0.06	0.281±0.070	0.561^{**}±0.040
60	0.51±0.031	0.765^{**}±0.040	0.931±0.230	1.569^{**}±0.290	0.929±0.027	1.43^{**}±0.14	0.46±0.029	1.901^{***}±0.159

(Value of Mean ± SE of 10 samples; **p < 0.01; ***p < 0.001; NS = Not significant).

TABLE-8
CHANGES IN PROTEIN CONTENT AT DIFFERENT HARVESTING PERIOD

Days	Stem (µg/mg)		Root (µg/mg)		Whole plant (mg/plant)	
	T_1	T_2	T_1	T_2	T_1	T_2
30	21.351±0.058	26.143^{***}±0.251	13.55±1.034	13.79^{NS}±0.082	9.641±0.261	19.325^{***}±0.57
45	23.81±0.181	31.23^{***}±0.349	16.714±0.038	19.13^{***}±0.067	18.121±0.682	45.43^{***}±1.07
60	25.26±0.230	34.18^{***}±0.180	19.43±0.260	23.54^{***}±0.540	23.62±0.390	76.94^{***}±0.93

(Value of Mean ± SE of 10 samples; ***p < 0.001; NS = Not significant).

TABLE-9
PHOSPHATE CONTENT AT DIFFERENT HARVESTING PERIOD

Days	Leaf (µg/mg)		Stem (µg/mg)		Root (µg/mg)		Whole plant (mg/plant)	
	T_1	T_2	T_1	T_2	T_1	T_2	T_1	T_2
30	0.021±0.014	0.043^{***}±0.01	0.018±0.002	0.046^{***}±0.001	0.007±0.020	0.016^{**}±0.002	0.012±0.002	0.046^{***}±0.001
45	0.024±0.017	0.067^{***}±0.02	0.031±0.001	0.071^{***}±0.002	0.011±0.001	0.022^{***}±0.002	0.021±0.011	0.099^{***}±0.008
60	0.049±0.040	0.144^{***}±0.08	0.035±0.005	0.134^{***}±0.027	0.014±0.001	0.039^{***}±0.020	0.058±0.010	0.476^{**}±0.064

(Value of Mean ± SE of 10 samples; **p < 0.01; ***p < 0.001; NS = Not significant).

content (Table-8), phosphate (Table-9) and alkaloid contents (Table-10). However, the presence of alkaloid in *Andrographis Cpaniculata* was found to be high amount in stem while negligible in root. This might be due the better availability of nutrients from organic and foliar source of nutrients and effective conservation of nutrients such as Fe, Mg and Zn at site of photosynthesis into pigments. The present study has created an interesting data with respect to plant growth, yield characters and biochemical analysis. As evidenced from the work of Xu and Xu[21] and Hartwingon and Evan[22], this may be due to effective micro-organism enhances the production of phytohormones like auxins and gibberellins that might have stimulated the growth by increasing the plant height, number of branches Humic acid influences plant growth through modifying the physiology of plants and by improving the physical, chemical and biological properties of soil[23]. Humic acid provides carbon as an energy source to nitrogen fixing bacteria and thus proves its biological function[24]. The natural bioregulator in moringa leaf extract also increased the dry matter production registered increased yield compared to control.

TABLE-10
ALKALOIDS CONTENT AT HARVESTING PERIOD IN FRESH AND DRY MATERIAL

Alkaloid content (mg/plant)		Dry matter (mg/plant)	
T_1	T_2	T_1	T_2
1.272±0.068	3.664^{*NS}±0.165	0.22	0.24

(Value of Mean ± SE of 10 samples; *p < 0.05; NS = Not significant).

Conclusion

In present study, after explanting the test plants, soil sample showed improved level of organic carbon, total N, total P and total K in the range over FYM sample. Following are the landmarks of the present investigation that high drug yielding plants species opening new possibilities of their cultivation. As FYM dose 15 t/hac and vermicompost dose needs only 5 t/hac yields doubles registered more effective than FYM dose. Vermicompost treatment better result in protein, phosphate, sugar and alkaloid contents. Thus, it is economic and easily applicable by nursery workers and poor farmers in developing mass planting stock over costly plant growth regulators and associated technical use in rapid multiplication.

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REFERENCES

1. www.kurzweilai.net
2. J. Arpana and D.J. Bhagyaraj, *Am. Eurasia J. Agric. Environ. Sci.*, **2**, 33 (2007).
3. ICH Stering Committees, Stp 4 of the ICH Process, 10,11 (1996).
4. N. Bunyaprapatrasara and V. Chokecharoenporn, Native Herbs Prachachon Co. Ltd. Bangkok, Thailand (1997).
5. Y.C. Shen, C.F. Chen and W.F. Chiou, *Br. J. Pharmocol.*, **135**, 399 (2002).
6. E. Amroyan, E. Gabrielian, A. Panossian, G. Wikman and H. Wagner, *Phytomedicine*, **6**, 27 (1999).
7. S. Madav, H.C. Tripathi, S.K. Tandan and S. Misra, *Indian J. Pharm. Sci.*, **57**, 121 (1995).
8. R.S. Chang, L. Ding, G.Q. Chen, Q.C. Pan, Z.L. Zhao and K.M. Snith, *Proc. Soc. Experim. Biol. Med.*, **197**, 59 (1991).
9. A. Puri, R. Saxena, R.P. Saxena, K.C. Srivastava and J. Tondon, *J. Nat. Prod.*, **56**, 995 (1993).
10. S. Rajgopal, R.A. Kumar, D.S. Devi, C. Satyanarayan and R. Rajgopalan, *J. Experim. Therap. Oncol.*, **3**, 147 (2003).
11. B.C. Yu, C.R. Hung, Chen WC, Cheng JT., *Planta Med.*, **69**, 1075 (2003).
12. X.F. Zhang and B.K. Tan, *Clin. Exp. Pharmocol. Physiol.*, **27**, 358 (2000).
13. P. Peter, Tetrazolium Testing Handbook, Contribution No. 29, The Handbook on Seed Testing. Prepared by the Tetrazolium Subcommittee of the Association of Official Seed Analysts, Part 2. Lincoln, Nebraska (2000).
14. D.F. Grabe, Tetrazoliun Testing Handbook for Agricultural Seeds Association of Official Seed Analysts, Contribution No. 19 to the Hand Book of Seed Testing (1970).
15. D. Tehnants, Barliss, Springer-Verlag, Vol. 2, pp. 20-41 (1975).
16. S. Yoshida, D.A. Forno, J.H. Cock and K.A. Gomez, Laboratory Manual for Physiological Studies of Rice, IRRI, Los Banos, Phillipines, edn. 3 (1976).
17. M. Dubois, K.A. Gills, J.K. Hamilton, P.A. Robess and F. Smith, in eds.: J.R. Norris and D.W. Ribbons, In methods in Microbiology, Academic Press, London, New York, p. 272 (1956).
18. O.H. Lowry, N.J. Rosebrough, A.L. Farr and R.J. Randall, *J. Biol. Chem.*, **193**, 265 (1951).
19. S. Banik and B.K. Dey, *Zbl. Baset II*, **136**, 487 (1981).
20. B. Mukherjee, Pharmaceutical Codes, CSIR, New Delhi, India (1953).
21. H.L. Xu and H.L. Xu, *J. Crop Prod.*, **3**, 235 (2000).
22. J.A. Hartwigson and M.R. Evans, *HortScience*, **35**, 1231 (2000).
23. A. Dursun, I. Guvenc, Y. Tuzel and O. Tuncay, *Acta Horticult.*, **491**, 235 (1999).
24. D. Vaughan, *Planta*, **115**, 135 (1974).