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Biocontrol of a Toxic Weed, *Argemone mexicana* L. through Vermicomposting and its Effect on the Growth of *Eisenia fetida* Sav.

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Argemone mexicana L. (Mexican prickly poppy) is an herbaceous weed of **rabi** season. Presence of *A. mexicana* not only adversely affects crop yield but also hinders in agricultural operations and its seed adulteration can be a health hazard. One per cent adulteration of mustard oil by *Argemone* oil has been shown to cause a clinical disease, epidemic dropsy in human beings as its seeds are similar with mustard. Although some work has been done on the degradation of various weeds using earthworms (Mudgal *et al*., 2006; Narayana *et al*., 2007; Dasgupta and Singh, 2009) but attempt has not been made to transform this toxic tropical weed into a biomanure. In the present studies, the weed was composted alongwith cattle dung using an epigeic worm, *Eisenia fetida*. Effect of weed on the maturity, biomass and cocoon production of worms was also studied.

The weed was collected from the agricultural lands during winter months (November to February), chopped into small pieces of 2 cm size excluding root system and mixed with cattle dung in three ratios 1 : 3, 1 : 1 and 3 : 1. Four kg of each medium (ratio) was kept in rectangular plastic tubs (size 43 x 17 x 13 cm), in triplicate. After pre-decomposition period of 15 days, 20 g immature healthy worms of the genus, *E. fetida* was inoculated into each tub. Control sets, devoid of worms, were also arranged side by side with their respective ratios. Moisture was maintained by sprinkling tap water as and when required. The experiment was conducted in two consecutive years during winter months and till the transformation of waste into vermicompost. Physico-chemical parameters of different media were analysed before the inoculation of worms and after the completion of the experiment. Per cent organic matter was analysed by Walkley-Black (1947) method, nitrogen content by Kjeldhal method (Jackson, 1967), pH by Systronics digital pH meter (Make MK VI) and per cent water-holding capacity by the method described by Srinivasa Murthy *et al.* (1999) method. Total biomass of worms was taken by using an electronic balance (Afcoset, ER-182A make) after a very quick wash using filter paper to remove extraneous material on the body, if any.

Alterations in physico-chemical parameters of media have been shown in Table 1. It may be noticed that the level of moisture content significantly decreased during the transformation of waste into vermicompost. It was lowered by 1.28 times in 1 : 3; 1.15 times in 1 : 1 and 1.05 times in 3 : 1 experimental media, while 1.35 times in 1 : 3, 1.20 times in 1 : 1 and 1.06 times lowered in 3 : 1 control media than that of their initial values. Similar findings have also been observed by Singh *et al.* (2009) while working on the biomanagement of banana packing waste using epigeic earthworm, *E. fetida.*

It may be interesting to note that the bulk density was reduced after vermicomposting but such reduction was more in the media without earthworms. In contrast, Gupta and Sakal (1967) while working on comparative analysis of physico-chemical composition of earthworm castings of garden and cultivated soils recorded that bulk density was lowered in worm-castings than that of parent soil. Water holding capacity that plays a significant role in plant growth was lowered significantly in the vermicompost than that of their respective control media (Table 1). It was lowered by 1.30 times in 1 : 3, 1.11 times in 1 : 1 and 1.07 times in 3 : 1 of experimental media, while such reduction was more in the media without earthworms. It might probably be due to the formation of a bio-complex between the fluid component of waste material and dung. Contrary to this, Ghosh *et al.* (2005) have mentioned more water holding capacity of vermicompost than the worm's feed.

Earthworms are very sensitive to hydrogen ions concentration. It may be seen that worms lowered the pH during the waste processing. This lowering was 1.04 times in the experimental media and 1.01 times in the media without worms with respect to their initial values. Some workers have found that the pH of worm-castings was higher than that of the soil (Lunt and Jacobson, 1944; Srikhande and Pathak, 1948; Reddy, 1983) as reported in the present studies, while others

Table 1. Physico-chemical parameters of different media (*A. mexicana* : Cattle dung) before and after vermicomposting process

Initial physico-chemical parameters of media (before vermicomposting)			Parameters	Final physico-chemical parameters (after vermicomposting)					
				Experimental media			Control media		
1 : 3	1 : 1	3 : 1		1 : 3	1 : 1	3 : 1	1 : 3	1 : 1	3 : 1
61.40±0.71	52.07±0.36	47.89±0.31	% MC	47.60±0.69	45.04±0.72	45.28±0.92	46.94±0.98	43.39±0.39	44.80±0.20
01.18±0.34	0.93±0.16	0.81±0.81	BD (g/cm^3)	01.09±0.45	0.96±0.35	0.79±0.27	01.02±0.82	0.76±0.52	0.63±0.57
58.81±0.39	47.20±0.32	41.36±0.39	% WHC	56.59±0.86	42.38±0.63	38.78±0.47	39.36±0.68	36.38±0.37	34.38±0.36
09.61±0.32	10.02±0.48	10.03±0.92	pH	09.24±0.72	09.52±0.35	09.63±0.37	09.57±0.91	09.76±0.28	09.89±0.69
35.47±0.65	36.90±0.67	40.21±0.49	% OM	25.45±0.92	26.92±0.38	28.30±0.53	34.35±0.81	32.89±0.65	38.78±0.37
01.12±0.17	02.01±0.30	02.10±0.83	% N	02.12±0.39	02.30±0.83	02.54±0.58	01.38±0.73	02.23±0.35	02.35±0.34

MC–Moisture content, BD–Bulk density, WHC–Water holding capacity, OM–Organic matter, N–Nitrogen, Experimental media–Media with worms, Control media–Media without worms.

reported it in the reversed order (Puh, 1941; Stockli, 1949; Nye, 1955) although all these findings reported by different workers were concerned with endogeic species of earthworms.

The per cent organic matter was lowered by 1.39 times in 1 : 3, 1.37 times in 1 : 1 and 1.42 times in 3 : 1 experimental media, while it was only 1.03 in 1 : 3, 1.12 in 1 : 1 and 1.03 times in the media without worms than that of their initial values. Singh *et al.* (2009) have also reported lowering in per cent organic matter in the vermicompost than that of their initial values. Significant increase in per cent nitrogen was recorded in experimental and control media both. It was 1.89 times in 1 : 3, 1.14 times in 1 : 1 and 1.20 times higher in experimental media and 1.23 times in 1 : 3, 1.10 times in 1 : 1 and 1.11 times higher in control media than that of their initial values. Higher values of % N in vermicompost samples have been reported by many workers (Edwards, 1988; Balamurugan, 2002; Mudgal *et al.*, 2006; Singh *et al.*, 2009).

Quality of feed affects the growth and development of worms. It may be noted that the number of clitellates, non-clitellates and juveniles was found maximum in the 1 : 1 experimental media. Clitellates were 1.02 times more in 1 : 3 and 2.52 times in 3 : 1 experimental media, while non-clitellates counted 1.12 times more from 1 : 3 and 1.75 times from 3 : 1 experimental media. In case of juveniles, their number was 1.29 times higher in 1 : 3 and 1.74 times in 3 : 1 experimental media. Interestingly, biomass of worms was also recorded higher in 1 : 1 experimental media than that of 1 : 3 and 3 : 1 media (Table 2). It was 1.06 times more from 1 : 3 and 2.14 times from 3 : 1 experimental media indicating that 1 : 1 ratio of weed and cattle dung makes a good feed material for the worms. Edwards *et al.* (1985) evaluated the productivity of worm's biomass and processed waste in relation to type of waste. However, it is fascinating to note that the maximum number of cocoons is produced in 1 : 3 experimental media. This value was 1.16 times more from 1 : 1 and 1.74 times from 3 : 1 media (Table 2).

These results indicate that the worms lower the bulk density, water holding capacity, moisture content and pH of vermicompost on one side and increase the level of nitrogen on the other. The 1 : 1 ratio of weed : dung was found the best-suited growing medium for *E. fetida* and 1 : 3 for their cocoon production. It may also be concluded that the toxic weed, *A. mexicana* could easily be transformed into vermicompost and be used in improving soil health.

Table. 2. Biomass of earthworms, *E. fetida* (Sav.) before and after vermicomposting in the experimental media

Ratios of Exp. media (*A. m* : c. d.)	Worm's biomass (before vermicomposting)	No. of earthworms (after vermicomposting)			Total number of cocoons	Worm's biomass (after vermicomposting)
		Clitellates	Non-clitellates	Juveniles		
1 : 3	20±0.89	55.32±0.92	38.66±0.38	34.66±0.86	38.20±0.45	49.21±0.97
1 : 1	20±0.62	56.66±0.73	43.32±0.89	44.78±0.27	32.67±0.58	52.58±0.57
3 : 1	20±0.34	22.48±0.78	24.66±0.50	25.60±0.41	21.86±0.78	24.46±0.94

A. m.–Argemone mexicana, c. d.–Cattle dung.

REFERENCES

Balamurugan, V. 2002. Physico-chemical and microbial perspectives of vermicompost produced by *Eisenia fetida* (Sav.), *Eudrilus eugeniae* (Kinb.) and *Lampito mauritii* (Kinb.) with a note on their fecundity and growth studies in 10 different organic wastes. Ph. D thesis, Manonmaniam Sundaranar University, Tirunelveli, India.

Dasgupta, M. and S. M. Singh, 2009. Assessment of rate of vermicomposting of *Eichhornia crassipes*-a notorious aquatic weed using the worm, *Eisenia fetida* in two different conditions. *J. Soil Biol. Ecol*. **29** : 151-157.

Edwards, C. A. 1988. Breakdown of animal, vegetable and industrial organic wastes by earthworms. *Agric. Ecosyst. Environ*. **24** : 21-31.

Edwards, C. A., I. Burrows, K. E. Fletcher and B. A. James, 1985. The use of earthworms for composting food wastes. In : *Composting of Agricultural and Other Wastes,* J. K. R. Gasser (ed.). Elsevier, Amsterdam. pp. 229-242.

Ghosh, B. C., S. Palit and H. Banerjee, 2005. Development of production and processing technology of vermicompost unit at commercial scale. National Seminar on Composting and Vermicomposting. Paper presented at

RSRS, Central Silk Board, Kodathi, Bangalore. pp.36-38.

Gupta, M. L. and R. Sakal, 1967. A comparative study of the physico-chemical composition of earthworm castings of the gardens and cultivated soils. *J. Sci. Res. Banaras Hindu Univ.* **17** : 213-220.

Jackson, M. L. 1967. *Soil Chemical Analysis.* Prentice Hall, New Delhi.

Lunt, H. A. and G. M. Jacobson, 1944. The chemical composition of earthworm casts. *Soil Sci.* **58** : 367.

Mudgal, A. K., V. Sharma and R. K. Tiwari, 2006. *Perionyx excavatus* : A biological tool to convert local weeds into useful vermicompost. *Him. J. Env. Zool.* **20** : 243-245.

Narayana, J., G. C. Pundalik, G. Roopa and Shruthi, 2007. Vermicomposting of aquatic weeds and their toxicity effects on earthworms and microbes. In : Proc 1st National Symposium on Earthworm Ecology and Environment, Barielly. p. 35.

Nye, P. H. 1955. Some soil-farming processes in the humid tropics. IV. The action of soil fauna. *J. Soil Sci.* **6** : 78.

Puh, P. C. 1941. Beneficial influence of earthworms on some chemical properties of the soil control. *Biol. Lab. Sci. Soc., China* **15** : 147-155.

Reddy, M. V. 1983. Effect of fire on the nutrient content and microflora of casts of *Pheretima alexandri*. In : *Earthworm Ecology from Darwin to Vermiculture,* J. E. Satchell (ed.). Chapman & Hall, London. pp. 209-213.

Singh, S. M., G. R. Gangwar and O. Prakash, 2009. Bio-management of banana packing waste using an epigeic earthworm, *Eisenia fetida*. In : *Earthworm Ecology and Environment,* S. M. Singh (ed.). IBDC, Lucknow. pp. 133-140.

Srikhande, J. G. and A. N. Pathak, 1948. Earthworms and insects in relation to soil-fertility. *Curr. Sci.* **17** : 327-328.

Srinivasa Murthy, C. A., H. M. Chidanandappa and M. S. Nagaraja, 1999. Laboratory manual for methods of soil plant analysis (SS and AC 607). The University of Agricultural Sciences, Agriculture College, GKVK, Bangalore. pp. 1-108.

Stockli, A. 1949. Einfluess der Mikroflora und Fauna auf die Beschaffenheit des Bodens. *Z. PflErnahr. Dung.* **45** : 41-53.

Walkley-Black, 1947. Oxidizable matter by chromic acid with sulphuric acid heat of dilution. *Soil Sci.* **63** : 251.