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VERMICOMPOSTING OF INVASIVE SPECIES *AZOLLA PINNATA* WITH *EISENIA FETIDA*

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ABSTRACT

The menace of *Azolla pinnata* - the invasive weed in the water bodies of Kashmir Valley, India could be converted to resource through vermicomposting by using earthworm species *Eisenia foetida*. Conversion rate was 17.91 ± 0.30%, 43.46 ± 0.67%, 83.15 ± 0.53% and 100% for first, second, third and fourth fortnight respectively. The number of earthworms increased by 68.66 ± 1.45 and biomass (g) by 10.75 ± 0.47. The percent conversion rate showed a significant correlation ($p<0.05$) with initial number, final number of earthworms and number of vermicomposting days. The vermicast showed increased trend for organic nitrogen (0.84 ± 0.01 to 1.23 ± 0.09), total phosphorous (510 ± 2.9 to 661 ± 7.8), calcium (2040 ± 12 to 2500 ± 30), magnesium (564 ± 67 to 787 ± 20), sodium (20.30 ± 0.21 to 33.12 ± 0.51) and potassium (25.43 ± 1.40 to 40.30 ± 1.60) after every fortnight, except for the total organic carbon which indicated a decreased trend (41.43 ± 0.09 to 23.90 ± 0.35).

INTRODUCTION

Azolla pinnata an aquatic fern grows on water surface and covers it quickly under conducive environmental conditions. *A. pinnata* multiplies at temperature range of 15- 30ºC, with optimum temperature being 25ºC. Under nutrient deficient and strong light conditions, *A. pinnata* turns red. During hot summer or cold winter, it also turns red or brownish red. Its invasion into the water bodies of Kashmir Valley dates back only less than a decade. Its dense infestation, invading the large surface area of water bodies especially Dal Lake (Fig.1) and its connected lakes, is resulting in varied ecological problems besides aesthetic loss. Present study aims to control the menace of *A. Pinnata* in the lake through vermicomposting.

MATERIALS AND METHODS

A. pinnata collected from Dal Lake of Kashmir valley were allowed to drain out excess water for 2 days under sunshine and dried in an oven at 70 ºC for 24 hrs.

Earthworms

Eisenia fetida collected locally were cultured in the laboratory using cow dung as feed. Earthworm biomass both initial and final reported as live weight, is taken after rinsing adhered material and then blotting them dry.

Vermireactors

Twelve circular plastic tubs (43cmx30cm) were used as reactors. 50 g of weed and 20 g of cow dung (w/w dry weight) were added in each reactor and then 20 adult earthworms were introduced into each reactor. Triplicates of reactors were maintained for 15, 30, 45 and 60 days interval. To determine the composibility of weed by *E. fetida* in relation to time, reactors were terminated at the end of 15, 30, 45 and 60 days interval. At the termination of each experiment, observations were noted in terms of conversion of *A. pinnata*, besides increase in number and biomass of earthworms. Earthworms were separated from reactors by hand sorting method. The conversion rate was determined by separating left over weed from vermicast.

Vermicast

Vermicast samples collected at the end of 15, 30, 45 and 60 days were air dried separately at room temperature. They were analyzed for pH, EC and total organic nitrogen (Jackson, 1973), sodium and potassium (Simard, 1993), total organic carbon (Walkley and Black, 1934) and total phosphorous (Anderson and Ingram, 1993).

Statistical analysis

The data in this study were analyzed using the SPSS 16 package and all the values are presented as mean ± SE. Pearson correlation coefficient (r) was employed to examine the relationship between initial, final number and biomass of earthworms; conversion rate and number of vermicomposting days.

RESULTS AND DISCUSSION

During first fortnight only 17.19 ± 0.30 % of the initial weed was recycled by *E. fetida* (Table 1). During second and third fortnight 43.46 ± 0.67 % and 83.15 ± 0.53 % of the initial weed was recycled respectively. Conversion was complete with no remaining feed after fourth fortnight. The average conversion rate of the weed was low during the first fortnight,

Table 1: Multiplication of earthworms (number and weight) with conversion rates (mean ±S.E)

No. of days	No. of Earthworms		Earthworm number gained	Weight of earthworms (g)		Earthworm weight (g) gained	Rate of conversion (%)
	Initial	Final		Initial	Final		
Day 15	20	20	0	11.23 ± 0.08	14.80 ± 0.27	2.95 ± 0.19	17.19 ± 0.30
Day 30	20	38.66 ± 0.66	18.66 ± 0.66	12.10 ± 0.11	19.87 ± 0.13	7.77 ± 0.21	43.46 ± 0.67
Day 45	20	63.66 ± 0.88	43.66 ± 0.88	11.73 ± 0.29	20.41 ± 0.48	8.65 ± 0.17	83.15 ± 0.5
Day 60	20	88.66 ± 1.45	68.66 ± 1.45	10.90 ± 0.43	21.67 ± 0.92	10.75 ± 0.47	100.00

Table 2: Nutrient elements in vermicast during different intervals (mean ±S.E)

No of days	pH	EC (mS/cm)	Organic carbon (%)	Organic nitrogen (%)	Total phosphorous (ppm)	Calcium (ppm)	Magnesium (ppm)	Sodium (ppm)	Potassium (ppm)
15	7.13 ± 0.01	0.49 ± 0.02	41.43 ± 0.09	0.84 ± 0.01	510 ± 2.9	2040 ± 12	564 ± 67	20.30 ± 0.21	25.43 ± 1.40
30	7.21 ± 0.01	0.55 ± 0.01	35.10 ± 0.01	0.90 ± 0.01	551 ± 4.1	2180 ± 42	612 ± 12	21.95 ± 0.15	29.56 ± 1.05
45	7.32 ± 0.01	0.62 ± 0.02	30.66 ± 0.91	1.00 ± 0.05	594 ± 6.4	2332 ± 28	688 ± 11	25.72 ± 0.85	34.26 ± 1.31
60	7.41 ± 0.04	0.69 ± 0.02	23.90 ± 0.35	1.23 ± 0.09	661 ± 7.8	2500 ± 30	787 ± 20	33.12 ± 0.51	40.30 ± 1.60

indicating that earthworms which had been cultured initially with cow dung as principal feed, took some time to acclimatize with the change over to *A. pinnata*. Similar observation was reported by Gajalakshmi *et al*., (2001), where increase in conversion rate after initial acclimatization was reported. Another reason could be the softening of the weed (feed) with passage of time in addition to increased earthworm biomass at subsequent intervals. Number of earthworms (inoculated) increased from 20 to more than 3 times (88.66±1.45) and biomass increased from the initial weight to double (21.67±0.92) at the end of 60 days (Table 1). Increase in biomass might be due increased consumption of weed with time that provides nutrients resulting in earthworm reproductive capability enhancement leading to increase in number (including juveniles) by the end of 60 days. Adi and Noor, (2009) and Garg *et al*., (2009) also reported increase in biomass and number of earthworm with time dependent feeding activity. Percent conversion rate indicated a significant correlation ($p<0.05$) with initial number and final number of earthworms and with number of vermicomposting days.

Nutrient value of the vermicast at different intervals is presented in Table 2. There is a marginal increase in pH with time interval and this overall increase in pH could be due to the decomposition of ammonia, which forms a large proportion of nitrogenous matter excreted by earthworms (Muthukumaravel *et al*., 2008). The increase in EC with time interval is attributed to the loss of organic matter and release of different mineral salts in available forms such as phosphate, ammonia and potassium (Wong *et al*., 1997). Organic carbon decreased with increase in time intervals of vermicomposting and thus corroborating the reports of Nath *et al*., 2009; Suthar, 2007; Garg and Kaushik, 2005; Elvira *et al*., 1998. Nitrogen increased from first to forth fortnight as the earthworms mediate nitrogen mineralization of weed. It is also suggested that the earthworms also enhance the nitrogen levels of the substrate by adding their excretory products, mucus, body fluids, enzymes to the vermicompost (Suthar, 2007). Increase in phosphorous levels of vermicompost is attributed to mineralization of feed during vermicomposting process. Lee (1992) suggested that the passage of organic matter through the gut of earthworm results in conversion of phosphorous to forms that are of easy uptake by the plants. Calcium, magnesium, sodium and potassium also indicated increased trend which is attributed to the mineralization of feed by earthworms especially secretion from calciferous gland in case of calcium. Work of Manna *et al*., (2003) and Suthar (2007) also reported increase in potassium content of vermicompost with increase in time interval.

Figure 1: Overview of Dal Lake with *A. pinnata* infestation

CONCLUSION

The study reveals that the earthworm *E. fetida* feeds on *A. pinnata,* with successful growth and reproduction. It further indicates that vermicomposting of *A. pinnata* could be an effective technology to convert the menace of *A. pinnata* into value-added product like vermicompost which being rich in nutrients can be used in agriculture/floriculture locally itself. Thus the people having agriculture fields and vegetable gardens around and within the Lake can harvest the weed, converting it into vermicast and use as manure. This additionally help to keep the weed (*Azolla pinnata*) under control as the other chemical and mechanical means of control have been ineffective besides causing enormous long term threat to Dal Lake ecosystem.

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