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

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ABSTRACT

Earthworm species Eisenia foetida might be used in vermicomposting to turn the invasive weed Azolla pinnata into a resource in the water bodies of Kashmir Valley, India. The conversion rate for the first, second, third, and fourth fortnights was 17.91 ± 0.30%, 43.46 ± 0.67%, 83.15 ± 0.53%, and 100% correspondingly. Both the number of earthworms and biomass (g) rose by 68.66 ± 1.45 and 10.75 ± 0.47, respectively. There was a substantial association ($p<0.05$) between the beginning, final, and vermicomposting day counts of earthworms and the percent conversion rate. 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 ±) were all found to be increasing in the vermicast.
with the exception of total organic carbon, which showed a declining trend (41.43 ± 0.09 to 23.90 ± 0.35), every two weeks, from 1.40 to 40.30 ± 1.60.

INTRODUCTION

As soon as the circumstances are right, the aquatic fern Azolla pinnata will spread over the water's surface. Temperatures between 15 to 30 °C are optimal for A. pinnata multiplication, with 25 °C being the sweet spot. A. pinnata becomes crimson when nutrients are scarce and when light is intense. Also, it gets reddish-brown in the winter and heated in the summer. Less than a decade has passed since it invaded the Kashmir Valley's water bodies. In addition to causing aesthetic damage, its dense infestation is causing a host of ecological problems as it spreads over vast quantities of water, most notably Dal Lake (Fig.1) and the lakes that link to it. This research is an attempt to use vermicomposting as a tool to reduce the A. Pinnata population in the lake.

MATERIALS AND METHODS

The A. pinnata harvested from Dal Lake in the Kashmir valley was sun-dried for two days to remove excess water, and then dried for another day at 70 ºC in an oven.
We produced earthworms (Eisenia fetida) in the lab using cow manure as feed after collecting them locally. After washing and blotting the earthworms dry, their biomass, which is expressed as live weight, is measured.Plant aerators
There were twelve reactors made of round plastic tubs that were 43 cm by 30 cm. Each reactor was seeded with 20 mature earthworms after 50 g of weed and 20 g of cow dung were put to it, according to the weight/dry weight ratio. At15,30,45, and 60-day intervals, triplicates of the reactors were maintained. In order to ascertain

the rate at which E. fetida decomposed weed over time, reactors were turned off at15,30,45, and 60 day intervals. Results regarding A. pinnata conversion, as well as increases in earthworm biomass and population, were recorded at the end of each trial. A manual sorting approach was used to extract earthworms from reactors. By isolating the vermicast from the leftover weed, the conversion rate was found.
Using vermicast
At the end of15,30,45, and 60 days, vermicast samples were air dried at room temperature independently. The following parameters were measured: total phosphorus (Anderson and Ingram, 1993), total organic carbon (Walkley and Black, 1934), total organic nitrogen (Jackson, 1973), sodium, and potassium (Simard, 1993).
Data analysis using statistical methods
All results are shown as mean ± SE, and the SPSS 16 software was used to analyse the data in this research. To investigate the connection between starting, ending, and biomass of earthworms; conversion rate; and number of vermicomposting days, the Pearson correlation coefficient (r) was used.

RESULTS AND DISCUSSION

Table 1 shows that during the first two weeks, E. fetida recycled only 17.19 ± 0.30% of the original weed. In the second and third two weeks, the amount of original weed that was recycled was 43.46% ± 0.67% and 83.15% ± 0.53%, respectively. After the fourth fortnight, the conversion was complete and there was no more feed. During the first two weeks, the weed's average conversion rate was poor.

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

it took some time for the earthworms that had been cultivated with cow dung as their main meal to adjust to the switch to A. pinnata. An rise in the conversion rate after first acclimatisation was seen by Gajalakshmi et al. (2001), who also reported a similar finding. Possible other causes include the gradual softening of the weed (feed) and subsequent increases in earthworm biomass. By the end of 60 days, the number of injected earthworms had tripled from 20 to 88.66±1.45, and the biomass had doubled from its original weight to 21.67±0.92, according to Table 1. One possible explanation for the rise in biomass at the end of 60 days is the earthworms' enhanced reproductive capabilities, brought about by their greater ingestion of weed, which gives nutrients. Both Adi and Noor (2009) and Garg et al. (2009) found that earthworm biomass and population size increased in response to time-dependent feeding actions. The percent conversion rate showed a strong relationship ($p<0.05$) with the starting and ending counts of earthworms, as well as the number of days spent vermicomposting.

Nutrient value of the vermicast at different intervals is presentedin 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 proportionof nitrogenous matter excreted by earthworms (Muthukumaravel *et al*., 2008). The increase in EC with timeinterval is attributed to the loss of organic matter and release of

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

several mineral salts in their readily accessible forms, including potassium, ammonia, and phosphate (Wong et al., 1997). The findings of Nath et al. (2009), Suthar (2007), Garg and Kaushik (2005), and Elvira et al. (1998) are supported by the fact that organic carbon dropped as the vermicomposting time intervals increased. Because earthworms facilitate the nitrogen mineralization of weed, nitrogen levels rose over the first four weeks. By incorporating their waste, mucus, bodily fluids, and enzymes into the vermicompost, earthworms may potentially increase the substrate's nitrogen levels (Suthar, 2007). The vermicomposting process causes the feed to mineralize, which increases the phosphorus levels in the compost. According to Lee (1992), when organic materials go through an earthworm's digestive system, the phosphorus is converted to a form that plants may easily absorb. The mineralization of earthworm feed, particularly calcium secreted by the calciferous gland, is responsible for the observed trend of rising levels of calcium, magnesium, sodium, and potassium. Suthar (2007) and Manna et al. (2003) found that the potassium content of vermicompost increased with increasing time intervals.

CONCLUSION

The results show that earthworms E. fetida successfully develop and reproduce when fed A. pinnata. Additionally, research suggests that A. pinnata vermicomposting might be a useful technique for transforming this pest into a valuable byproduct, such as vermicompost, which is rich in nutrients and can be used in local agriculture and floristry. So, farmers and gardeners in the Lake area may collect the weeds, grind them into vermicast, and utilise the compost as a fertiliser. Since previous mechanical and chemical methods of controlling the weed (Azolla pinnata) have been unsuccessful and have posed a significant long-term danger to the Dal Lake ecology, this also helps to keep the plant under control.

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