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ASSESSMENT OF IMPACT OF *PARTHENIUM HYSTEROPHORUS* L. ON *EISENIA FOETIDA* THROUGH VERMICOMPOSTING

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ABSTRACT
The paper deals with the impact of *Parthenium hyterophorus* on the eartheworm *Eisenia foetida* during vermicomposting. Various combinations of Parthenium and cow dung as well as long gress were used. Different parameters earthworm population like increase in population, population growth rate, biomass, age class were analysed following standard methods. The combination with parthenium always showed adverse impact .

INTRODUCTION

Parthenium hysterophorus L. (Heliantheae: Asteraceae; 2n = 34), an exotic species said to be originated in Mexico/ Argentina and commonly known as congress grass has spread to Africa, Australia and Asia during last 100 years where it has got the status of "worst weed". The species is a nuisance weed and causes harm to the system it invades. Its success of spreading lies in its enormous proliferating capability. *Parthenium hysterophorus*, an r-selection species with huge biotic potential and having capability to overcome environmental resistance has well spread in different habitats. Moist, shady habitats particularly rich in organic matter are most vulnerable to the infestation of this invasive weed. Parthenium is a real problem in orchards short structure crops grown with spacing (Joshi, 1991). The weed drastically reduces (up to 90%) the yield of pasture grass of fodder value (Vartak, 1968). The growth of *Parthenium* starts with onset of monsoon in a particular habitat. The seeds of the weed remain viable up to two years while in soil and germinate with the begning of monsoon and reaches the flowering stage within a month (Dhawan and Dhawan, 1994; Navie, 1998; Tamado *et al.,* 2002).

The enormous capability of reproduction of the weed is reflected by production of nearly 100,000 seeds per plant. Even more than four successive generations of the weed may emerge in suitable environmental conditions. In comparison to the number of 120,000 native grass weeds nearly 340 million seeds of the weed can be present in one hectare area which narrates the success story and the invasive capability of the weed.

Chemically parthenin is the toxic substance present in the weed and is the causative factor for many problems. Analysis has indicated that all the plant parts including trichomes and pollen contain toxins called sesquiterpene lactones. The major component of these toxins being parthenin another phenolic acid such as caffic acid, vanillic acid, anisic acid, chlorogenic, parahydroxy benzoic acid and P-anisic acid are lethal to human and animal.

The weed after its luxuriant growth dies and the biomass with the harmful chemicals is mixed in the supporting soil or near by area. The toxicity caused by these chemicals affect the beneficial organism of soil. The toxic and harmful impacts of *Parthenium* have been studied by namy workers. Krishnamurthy *et al.,* (1975) Ahmed *et al.,* (1988); Kadhare *et al.,* (1992) Prakash *et al.,* (2002) have studied the impact of the weed on different species of mammals while impact on seed germination has been reported by Nath (1981) and on forest biodiversity by Pandey and Saini (2002). The review of literature reveals that no attempt has been made to investigate the toxic impact of the weed on soil fauna. The present paper communicates the impact of *Parthenium hysterophorus* on the earthworm, the most dominant soil macro fauna (by weight) through experimentation by vermicomposting.

MATERIALS AND METHODS

The experiment was carried out in pucca (brick walled) or masonary over ground beds of equal size. The fresh green plants of congress grass were collected and chopped on a mechanical shredder. The dry biomass was calculated following oven-drying method. On the basis of its dry weight, *Parthenium* in combination with cow dung in different ratios were subjected to vermicomposting by adding 100 mature of earthworms to each combination. Similar process was carried out for long grass. Two beds were kept at control.

The materials of the beds were tilled upside down fortnightly without disturbing the basal layer.

After 45 days black granular crumbly powder on top of the vermibeds was obtained. This was the vermicompost ready to be harvested. For harvesting 3-5 mm pore sized iron mesh

was used to separate the vermicompost from the non degraded material. In each vermibed the numbers of adult and young earthworms were counted and data were recorded. Also their size and biomass were determined. The data were analysed to see the effect of *Parthenium* on growth, reproduction size and biomass of earthworms. It was compared with the data obtained for long grass and control.

RESULTS AND DISCUSSION

In order to test feasibility of adding environmental value to congress grass (*Parthenium hysterophorus*) and long grass through vermitechnology, the present project was carried out for 45days. Different share of *Parthenium hysterophorus* like 25%, 50% and 75% was mixed with cow dung for vermicomposting using the earthwarm *Eisenia foetida*. The earthworm showed 85% mortality after 45days of inoculation in 25% *Parthenium hysterophorus* and 75% cow dung mixture used for vermicomposting. The rate of mortality of earthworm was recorded to be 95% when 50% *Parthenium hysterophorus* was used. The mortality reached as high as 99% when 75% *Parthenium hysterophorus* and 25% cow dung was used. The high mortality with only 25% of *Parthenium hysterophorus* suggests that the congress grass is imparting adverse impact on earthworm population (Fig. 1). When long grass was used in place of congress grass in the similar percentage with cow dung the result was totally different. This combination resulted into appreciable growth in the earthworm population in place of high mortality due to *Parthenium hysterophorus*. As shown in (Fig. 2) 25% share of long grass in vermicomposting resultant into 219% growth of earthworm population after 45 days of inoculation. 50% share of long grass showed 132.50% growth of earthworm while 75% share of the grass restricted the growth to 133% only. The population growth of earthworm during the same period in control condition (only cow dung) was recorded to be 343%. A similar impact on earthworm has been reported by Van-Gestel *et al.,* (1992);Tomlin and Gore(2005); Yasmin and D'Souza (2010) in context of various chemicals.

In control condition on an average the weight (wet weight) gained by the earthworm during the 45 days period was found to be 154.55%. But in case of vermicomposting using different percentage of *Parthenium hysterophorus* the earthworms lost their weight (Table 1). In case of 25% of *Parthenium hysterophorus* the weight loss was recorded to be 81.15% which increased to be 92.91% in case of 50% *of Parthenium hysterophorus*. Weight loss of 97.83% was recorded when 75% *Parthenium hysterophorus* was used in vermicomposting. This result clearly reflects that *Parthenium hysterophorus* not only adversely affects the population growth of earthworms but also decreases their biomass. When long grass was used in place of *Parthenium hysterophorus* the result on weight gain by earthworms was totally different. In 25% combination of long grass weight gained by earthworms was 68.65% while in 50% combination it was 63.715%. In 75% combination of long grass in vermicomposting the weight gained by the earthworms was 63.51% (Table 2). This result gives reflection of suitability of long grass in vermicomposting and unsuitability of *Parthenium hysterophorus*. Tomlin and Gore (2005) reported weight loss of similar trend in *E.foetida* as an effect of insecticides and funficides.

Age group is one of the important characteristics of any population which determines the future prospect of the population in terms of growth and expansion. The age group

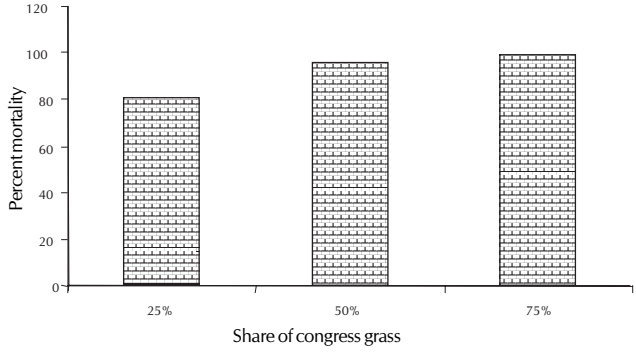

Figure 1: Percentage mortality of earthworm during vermicomposting with different percentage of *Parthenium hysterophorus*

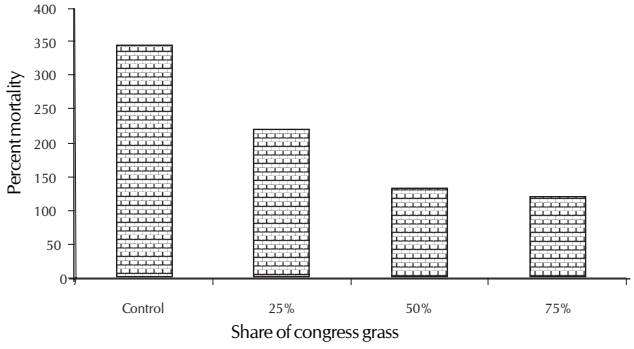

Figure 2: Percentage growth of earthworm during vermicomposting with different percentage of long grass and in control

Table 1: Weight gain (+) and loss (-) (in g) by earthworm during vermicomposting with different percentage of *Parthenium hysterophorus* and in control after 45 days

B. No.	% of *Parthenium hysterophorus*	Weight (g)	Weight (g)	Average weight M ± SD	Weight gain	Average weight gain M ± SD	Average% weight gain
1	25	50	10.8	9.45 ± 1.909	(-) 39.2	(-) 40.7±2.121*	(-) 81.15%
2	25	50.3	8.1		(-) 42.2		
3	50	48.5	3.8	3.45 ± 0.494	(-) 44.7	(-) 45.25±0.777*	(-) 92.91%
4	50	48.9	3.1		(-) 45.8		
5	75	50.2	1.58	1.00 ± 0.820	(-) 48.62	(-) 49.15±0.749*	(-) 97.83%
6	75	50.1	0.42		(-) 49.68		
23	Control	49	138.7	125.75 ± 18.314	(+) 89.7	(+) 76.3±18.950	(+)154.55%
24	Control	49.9	112.8		(+) 62.9		

* = Significant change ($p < 0.01$) with respect to control

Table 2: Weight gain (+) and loss (-) (in g) by earthworm during vermicomposting with different percentage of Long grass and in control after 45 days

B. No.	Long grass%	Weight(g)	Weight(g)	Weight of earthwormM ± SD	Weight gain	Weight gain M ± SD	Averageweight gain%
14	25	48.8	83.5	83.05 ± 0.636	34.7	33.8±1.838*	+68.65%
15	25	49.7	82.6		32.1		
16	50	50.2	83.2	82.00 ± 1.697	33	31.85±1.626*	+63.51%
17	50	50.1	80.8		30.7		
18	75	49.8	81.1	81.45 ± 0.494	31.3	31.7±0.565*	+63.715%
19	75	49.7	81.8		32.1		
23	Control	49	138.7	125.75 ± 18.314	89.7	76.3±18.950	+154.55%
24	Control	49.9	112.8		62.9		

* = Significant change ($p < 0.01$) with respect to control

Table 3: Age group of earthworm during vermicomposting with different percentage of *Parthenium hysterophorus* and in control after 45 days

B.No.	% of Parthenium hysterophrus	Juvenile	Immature	Adult	Length of earthworm M ± SD
1	25	-	3 – 4	10 - 11.8	10.9± 1.272
2	25	-	3.9 – 4.8	9 -10	9.5± 0.707
3	50	-	3.8 – 4.8	9.9 – 10.1	10± 0.141
4	50	-	3 – 4.2	9.5 – 10.4	9.95± 0.636
5	75	-	3.5 – 4.5	9 – 9.8	9.4± 0.565
6	75	-	3.6 – 4.2	9.1 – 9.5	9.3± 0.282
23	Control	1.1 – 1.9	-	12.9 – 13.8	13.35± 0.636
24	Control	1.5 – 2	-	12.8 – 14	13.4± 0.845

Table 4: Age group of earthworm during vermicomposting with different percentage of Long grass and in control after 45 days

B.No.	% Long grass	Juvenile	Immature	Adult	Length of earthwormM ± SD
14	25	1 – 2	-	12 – 13.1	12.55 ± 0.777
15	25	1.5 – 2	-	12.3 – 13.5	12.9 ± 0.848
16	50	1 – 2	-	11.9 – 12.8	24.7 ± 0.636
17	50	1 – 1.8	-	12 – 13.5	12.75 ± 1.060
18	75	0.5 – 1.9	-	12.3 – 13.1	12.7 ± 0.5656
19	75	1.1 – 2	-	11.9 – 13.6	12.75 ± 1.202
23	Control	1.1 – 1.9	-	12.9 – 13.8	13.35 ± 0.636
24	Control	1.5 – 2	-	12.8 – 14	13.4 ± 0.845

of the earthworms from different experimental beds was analysed after 45 days of inoculation. Initially 100 mature worms were inoculated in every bed. After 45 days in the bed with 25% *Parthenium hysterophorus* no juvenile earthworm was found. Only 3-4 immature worms were could be recorded and about ten adult worms were found. In 50% *Parthenium hysterophorus* bed 9 adults 3-4 immature were recorded. This bed was also not having any juvenile worm. A similar trend was noticed in case of 75% *Parthenium hysterophorus* (Table 3). In case of control bed juveniles and adults were recorded. It may be concluded that the absence of juveniles in the beds containing *Parthenium hysterophorus* is due to non-reproduction of the earthworms which is caused by adverse physiological impact by congress grass on earthworms. The presence of immature worms in the beds containing different percentage of *Parthenium hysterophorus* shows that the influence of weed has restricted the process of transformation of the worms from immature to mature. In control beds (with only cow dung) the absence of immature worm's shows that transformation has not been adversely affected form immature to mature. The presence of juvenile worms is an indication of occurrence of reproduction among the worms. The average length of worms after 45 days of vermicomposting with different percentage of *Parthenium hysterophorus*. A similar trend of transformation (delayed in adverse condition) has been repoted by Edwards and Lofty (1972)

Similar to control condition the juvenile worms were recorded in all the beds with different combination of long grass (Table 4). Immature worms were not found in any bed. This age group shows the normal state of transformation from immature to adult and occurrence of reproduction in normal way.

The rate of reproduction was estimated in different beds. In beds containing different percentage of *Parthenium hysterophorus* the rate of reproduction of the worms was found

Table 5: Rate of reproduction of earthworm during vermicomposting with different percentage of Long grass and in control after 45 days

B. No.	% Long grass	Adults	Juvenile	Rate of reproduction	Rate of reproduction M ± SD	% rate of reproduction	% Rate of reproduction M ± SD
14	25	204	60	0.294	0.270±0.033*	29.40	27.0±3.30
15	25	234	58	0.247		24.70	
16	50	128	51	0.398	0.370±0.0388*	39.80	37.0±3.80
17	50	137	47	0.343		34.30	
18	75	136	43	0.316	0.331±0212*	31.60	33.10±2.10
19	75	130	45	0.346		34.60	
23	Control	360	167	0.463	0.474±0162	46.30	47.4±1.62
24	Control	327	159	0.486		48.60	

* = Significant change ($p < 0.01$) with respect to control

nil (Table 5). But in the beds with different combination of long grass an appreciable rate of reproduction was recorded. In control 46.30 to 48.60% of rate of reproduction was found while in bed with 25% long grass it was 24.70% to 29.40% and in 50% long grass bed 34.30 to 38.90%. In the bed with 75% long grass the rate of reproduction varied form 31.60% to 34.60%.

On the basis of experiments carried out it was evident that *Parthenium hysterophorus* in its different combinations with cow dung like 1:3, 1:1, 3:1 is harmful to earthworms. The congress grass in every combination retarded the growth of earthworm by restricting length, by changing usual age group in population and by reducing the wet weight and there by the biomass. The transformation of earthworm form immature to mature, which is greatly influenced by environmental conditions, was highly affected by all the combinations of the weed. The physiological activity like reproduction has been recorded to be adversely influenced by weed during 45 days. The rate of reproduction has been considerably decreased. The weed can not be used for vermicomposting.- as it adversally affects the earthworm.

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