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Short communication

Biological activity of red wriggler earthworm using puncture wine weed with cow dung as substrate

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About 2,350 years ago Aristotle has said, "Earthworms are intestines of the earth." Vermicomposting is the process of producing organic fertilizer or the vermicompost from bio-degradable materials with earthworms.

A huge amount of plant biomass is available in the form of weeds. Proper utilization of these weeds can improve soil physical condition and environmental quality as well as provide nutrients for plant (Bhardwaj 1995). The recycling, reuse and resource recovery has been considered as one of the best options for waste management programme. It is well documented that earthworm excreta has higher amounts of nutrients than that of the substrates or soil on which the earthworms feed. Moreover, the nutrients are changed to assimilable forms in the gut, that are more rapidly taken up by plants (Gunadi and Edwards 2003)

Carbon and nitrogen content of the organic matter determine the abundance and diversity of earthworm species (Kale and Krishnanmoorthy 1981). By using different weeds as raw material for vermicomposting their order of preference by earthworms can be determined.

There is not much published report available regarding the vermicomposting of weeds. It is in view of this lacuna and for better understanding of the process of vermicomposting, work on the present problem has been selected. This work presents the dynamics of *E. foetida* earthworm populations during vermicomposting of puncture wine weed (*Tribulus terristris*).

Experiment was carried out to study growth and fecundity of earthworm *Eisenia foetida* using puncture wine (*Tribulus terristris*) weed mixed with cowdung as substrate in different weed and cow dung proportions (Table 1). Three hundred gram of feed mixture was taken in plastic containers of 500 g capacity. All the treatments were kept in triplicate and same setup without earthworm were also maintained which served as control. All the treatment containers were left for 15 days prior to experimentation for thermal stabilization and softening of wastes for easy ingestion by the earthworm. The water was sprinkled over the feed mixture on alternate day to hold moisture content of about 60 to 80%. After 15 days, 10 healthy non-clitellated earthworm weighing 150 to 300 mg were selected form stock culture and introduced in each container. To prevent moisture loss the containers were covered with wet gunny begs. All containers were placed in darkness at room temperature. No additional food was added at any stage during the study period.

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Eisenia foetida specimens of the earthworm commonly known as red wrigglers were used in this study. Young, healthy clitellated earthworms or hatchlings (as per requirements) were randomly picked from several different cultures (each containing 500-2000 earthworms) maintained in the department of botany, Sri Guru Nanak PG Khalsa College, Sri Ganganagar, Rajasthan using cow dung as the culturing material

Fresh cow dung (CD) cow dung was procured from 4Z village, Sri Ganganagar, Rajasthan. The main characteristics of CD were: pH :7.73, organic carbon (OC): 362.3 g/kg, total kjeldhal nitrogen (TKN): 6.5 g/kg, total phosphorus (TP): 4.2 g/kg, total potassium (TP): 5.11 g/kg, C:N ratio: 55.65, calcium (Ca): 3.2 g/kg, and C:P ratio: 84.65.

Table 1. Content of weed with cow dung in initial feed mixture

Feed composition	Weed %	Cow dung %
C_1	0	100
C_2	20	80
C_3	40	60
C_4	60	40
C_5	80	20

Growth and fecundity study

Growth and cocoon production in each mixture was recorded weekly for 18 weeks. The feed in the containers was turned out and earthworms and cocoons were separated from the feed by hand sorting, after which they were counted and weighed after washing with water and drying them by paper towels. The worms were weighed without first voiding them, since it has been reported that the gut content would lie around 10% of live weight, where as larger differences are expected in relation to feed (Neuhauser *et al*. 1980). Corrections for gut content were not applied to any of the data in the study. Then all measured earthworm and feed (but not cocoons) were returned to the containers.

At the end of vermicomposting period, earthworms and cocoons were separated and final compost from each container was air dried at room temperature. Homogenized samples of final compost were ground in a stainless steel blend, stored in airtight plastic vials for further chemical analysis.

No mortality was observed in any of the feed mixture in the present experiment. Gunadi and Edwards (2003) have reported the death of *Eisenia foetida* after 2 weeks in fresh cattle solids, although physiochemical properties were suitable for the growth of the earthworms. They attributed the deaths of earthworms to the anaerobic conditions which developed after 2 weeks in fresh cattle solids. In our experiments, all the weed feed mixture was pre-composted for 2 weeks and during this period all the toxic gases produced might have been eliminated. It is established that pre composting is essential to avoid the deaths of the worms.

The change in biomass and cocoon production differed depending on the substrates. The changes in worm biomass for all the feed mixtures over the observation period illustrated (Table 2). The maximum biomass (1146 ± 3.12 mg) after 120 days was observed in 20:80 (weed : cow dung) treatment and minimum biomass (993 ± 5.19 mg) in 100% cow dung. All the compositions showed increase in biomass at all the time periods with respect to control. The increase was linear up to 12 months but after that it showed a decline trend (Fig. 1).

The maximum growth rate of *Eisenia foetida* was registered between the range of 8 ± 0.04/ earthworm/day (in 80:20 treatment) to 10 ± 0.08/ earthworm/day (in 20:80 treatment). The net weight gain by worm was highest in 20:80 treatment (937 ± 7.65 mg/worm) and lowest in 0:100 treatment (777 ± 7.21 mg/worm).

The maximum weight by earthworm was attained in 12th - 14th week in all the treatments. The fastest growth rate was observed in C_2 treatment (10 ± 0.08 mg/worm/day) whereas C_5 treatment supported the least growth (8 ± 0.04 mg/worm/day). Increasing proportion of weed in the feed mixture promoted a decrease in biomass of *Eisenia foetida.* The loss in worm biomass can be attributed to the exhaustion of food. When *Eisenia foetida* received food below a maintained level, it lost weight at a rate which depended upon quantity and nature of ingestible substrates (Neuhauser *et al.* 1980).

The cocoon production of all the studied feed mixtures over the observation period is illustrated in (Fig. 2). Cocoon production started in 6th week in 100% cow dung; in 5th week in other feed mixtures except C_5 treatment (6th week). After 120 days, maximum cocoons (199 ± 1.52) were counted in C_4 treatment and minimum (143 ± 1.40) in C_1 treatment.

The mean number of cocoon production was between 12.0 ± 0.13 (in C_5 treatment) and 17.0 ± 0.05 (in C_3 treatment) cocoons/earthworm for different feed mixtures tested as shown (Table 3).

Cocoon production fluctuated with time. Initially cocoon production rate was high. The range of mean number of cocoons produced per worm per day was 0.34 ± 0.004 in cow dung to 0.57 ± 0.001 in C_4 treatment. The difference between the rates of cocoon production could be related to the biochemical quality of the feeds, which is an important factor in determining the time taken to reach sex maturity and onset of maturity (Edwards 1988, Edwards *et al.* 1998). Feeds which provide

Table 2. Earthworm growth of *Eisenia foetida* in different feed mixtures of cow dung with *Tribulus terristris* weed (mean ± SEm, n=3)

Feed no.	Mean initial wt./worm (mg)	Maximum wt. achieved/worm (mg)	Maximum wt. achieved in	Net wt. gain/worm (mg)	Growth rate/worm/day (mg)
C_1	216 ± 3.96	993 ± 5.19	12th Week	777 ± 7.21	9 ± 0.08
C_2	209 ± 4.77	1146 ± 3.12	13th Week	937 ± 7.65	10 ± 0.08
C_3	216 ± 4.19	1013 ± 5.06	14th Week	797 ± 6.29	8 ± 0.05
C_4	220 ± 2.51	1022 ± 4.35	13th Week	802 ± 4.81	9 ± 0.04
C_5	199 ± 4.39	999 ± 3.01	14th Week	800 ± 4.65	8 ± 0.04

Fig. 1. Growth pattern of *Eisenia foetida* in feed mixture of *Tribulus terristris*

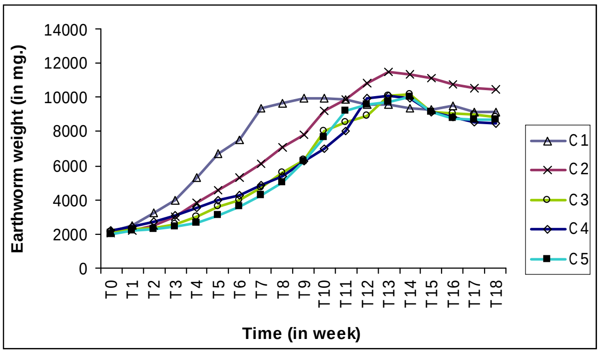

Fig. 2. Cocoon production of *Eisenia foetida* in feed mixture of *Tribulus terristris*

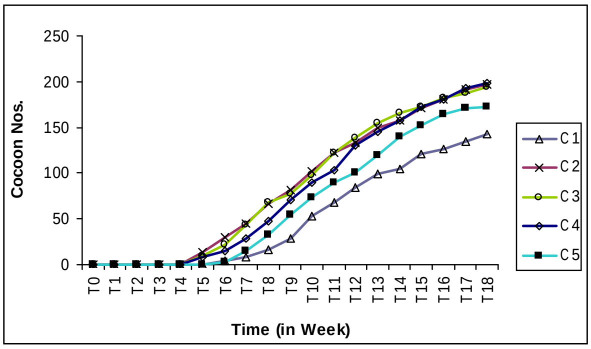

Table 3. Cocoon production by *Eisenia foetida* in different feed mixtures of *Tribulus terristris* weed (mean $\pm$ SEm, n=3)

Feed no.	Cocoon production started in	Total nos. of cocoons after 11 weeks	Nos. of cocoons produced/earthworm	Nos. of cocoons produced/earthworm/day
C_1	6^{th} Week	143 ± 1.40	14.3 ± 0.13	0.34 ± 0.004
C_2	5^{th} Week	197 ± 1.40	19.7 ± 0.13	0.56 ± 0.004
C_3	5^{th} Week	194 ± 1.52	19.4 ± 0.04	0.55 ± 0.001
C_4	5^{th} Week	199 ± 1.52	19.9 ± 0.04	0.57 ± 0.001
C_5	6^{th} Week	172 ± 1.52	17.2 ± 0.04	0.41 ± 0.0006

earthworms with sufficient amount of easily metabolizable organic matter and non-assimilated carbohydrates favour growth and reproduction (Edwards 1988). Verma and Kaur (2015) reported that addition of *Chenopodium murale* weed in cow dung not only enhanced the growth of worm but also increased cocoon production

SUMMARY

Fecundity study of earthworm species *Eisenia foetida* during vermicomposting of puncture wine weed (*Tribulus terristris*) mixed with cowdung in different combinations was carried out. It was observed that both weight gain and cocoon production was more when *Tribulus terristris* weed was mixed with pure cowdung. Net biomass gain by earthworm in different feed mixture was in order of $C_2>C_4>C_3>C_5>C_1$ and that of cocoon production of $C_4>C_2>C_3>C_5>C_1$. It indicated that *Tribulus terristris* weed is a good biomass and reproduction supporting medium which can be used effectively for culturing *Eisenia foetida* as well as recycling of weed material for production of vermicompost when mixed with pure cowdung. Therefore, there is a need to divert research activities to expore the potential of different weeds as a raw material for vermicomposting and their utilization and to design a national level policy for their proper utilization.

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