Leachate from Earthworm Castings Breaks Seed Dormancy and Preferentially Promotes Radicle Growth in Jute

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Abstract. Seeds of jute (*Corchorus olitorius* L.) undergo a period of dormancy, which hitherto has been broken with the conventional method of steeping in boiling water. Another seed treatment procedure, which involves soaking seeds in earthworm cast leachate, was found superior to the conventional method of breaking dormancy. Furthermore, radicle growth was enhanced when seeds were irrigated with water that contained earthworm cast leachate instead of water without earthworm cast leachate. This possibly suggests that earthworms excrete substances that contain hormones or biochemically active ingredients that are capable of stimulating root growth.

Jute (*Corchorus olitorius* L.) is one of the vitamin-rich leafy vegetables used in cooking draw-soups with which the hard and starchy staple foods of the tropical countries are eaten (Dinakin and Ayanlaja 1996). The seeds of jute undergo a lengthy period of dormancy that necessitates the steeping in hot (100 °C) water to break dormancy before the seeds can germinate (Akoroda, 1985). An alternative approach is to use a natural substance, earthworm castings, that can break dormancy and improve germination and seedling growth. Tropical rain forest and savanna soils are usually covered with earthworm castings and therefore this material is abundant (Dangerfield, 1990; Mulongoy and Bedoret, 1989; Owa, 1992). Compounds present in earthworm castings may be biologically active on jute seeds.

The first study describes the ability of the leachate from earthworm [*Hyperiodrilus africanus* (Beddad)] and *Eudrilus eugeniae* (Kinsberg) castings to enhance germination in comparison with conventional steeping in hot water. The second study describes the effect of earthworm extracts in preferentially promoting radicle growth in comparison to shoot growth.

Materials and Methods

The first experiment was conducted on a seed lot of jute (cultivar NH87-C07). There were three treatments: 1) seeds steeped in hot water for 10 s, and air-dried; 2) seeds soaked for 1 h in the leachates of earthworm cast

Hyperiodrilus africanus; and 3) seeds soaked for 1 h in the leachates of earthworm cast *Eudrilus eugeniae*. Leachates were prepared by placing 250 g of earthworm castings into a beaker and adding 300 mL of water. The mixture was stirred to dissolve any compound excreted with the worm cast into solution. The soil/water mixture was allowed to stand ≈10 min to allow soil particles to settle. The clear supernatant was then decanted and this is referred to as earthworm cast leachate. Seeds were soaked in this supernatant for 1 h, after which the seed lots were removed, air-dried, and 20 seeds were planted 1 cm deep in 2-kg soil in pots. The soil used in this study was collected from a forest at Ago-Iwoye (lat. 6°56'N, long. 4°0'E), and classified as Ferric luvisol and Oxic paleustalf (Smyth and Montgomery, 1962). The surface soil (0–15 cm) is well drained and contains 70% sand, 21% silt, and 9% clay, with a moisture retention of 16% at 30 kPa (Lal, 1978). The soil had 2.0% organic C, with a CEC of 12 me/100 g. The soil pH is 6.0 at a 1 soil : 2 water ratio.

Seedling emergence counts were made on 3, 5, and 7 d after sowing and recorded as percentages of numbers of seed planted. There were three replications for each treatment, and analysis of variance with Duncan's multiple range test at the 5% level was used for mean comparisons.

The second experiment was performed in petri dishes. Seed lots of jute were steeped in hot water for 10 s, and air-dried to break dormancy. A 200-mL aliquot of water was added to 100 g of soil and incubated for 24 h. Water decanted from two soil jars, one containing 10 earthworms (*Hyperiodrilus africanus*) and the other containing no earthworms, was used to moisten the cotton wool in the petri dishes. Twenty seeds were placed in each petri dish, and seedling growth (radicle, hypocotyl, and leaf length) was recorded after 3 d. There were seven replications per treatment.

Nontreated seeds did not germinate, while hot water steeping resulted in 65% germination after 7 d, indicating that dormancy was present (Table 1). Soaking seeds in earthworm cast leachate of *Hyperiodrilus africanus* enhanced the rate and percentage of germination in comparison with conventional hot water steeping. Earthworm cast leachate of *Eudrilus eugeniae* resulted in similar a response to the hot water treatment. This method is very simple and could be adopted by farmers. The earthworm cast leachate may contain enzymes or other compounds that weaken the woody seedcoat of jute, making them more permeable to water.

In the second experiment, water decanted from soil with and without worms was used to irrigate seeds. The radicle length was significantly higher for worm-water-irrigated seedlings (2.7 cm) than for soil-water-irrigated seedlings (1.0 cm) (Table 2). There were no differences in hypocotyl and leaf length or leaf width because of earthworm extracts.

Worm-water extract may contain hormones or other compounds that stimulate the root growth. Consistent with our results, Spain et al. (1992) also observed the stimulating effect of earthworms on plant growth. Lavelle et al. (1983) and Hauser (1993) found that geophagous earthworms feeding on low-quality organic matter do digest and assimilate between 10% to 20% of the ingested matter, and that even the undigested organic matter was transformed during the passage through the intestine of the worm. Martin (1991) also demonstrated that there was a 25% decrease in coarse (>50 µm) organic fraction after transmission through the worm and that 60% of the material ingested was actually assimilated. *Eudrilus eugeniae* has the ability to digest woody material, and has been used in the disposal of woody cassava (*Manihot esculenta*) peels (Mba, 1983). The earthworm cast leachate in this study may be capable of weakening the seedcoat, making it more permeable to water,

Table 1. Germination percentage of jute seeds with different dormancy breaking treatments.

Seed Treatment	Percentage of germination at day		
	3	5	7
Control	0 a	0 a	0 a
Hot water steeping (conventional)	35 b	55 b	65 b
Leachates of <i>H. africanus</i>	50 c	73 c	100 c
Leachates of <i>E. eugeniae</i>	28 b	63 b	71 b

Means separation within columns by Duncan's multiple range test, $P < 0.05$.

Table 2. Seedling growth of jute seeds as influenced by *H. africanus* leachate.

Response	Growth (cm)	
	Control	<i>H. africanus</i> leachate
Length of hypocotyl	2.65 ± 0.53	2.70 ± 0.54
Length of leaf	0.33 ± 0.06	0.37 ± 0.07
Width of leaf	0.34 ± 0.06	0.33 ± 0.07
Length of radicle	2.74 ± 0.72	0.97 ± 0.40

Means with SE.

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and resulting in enhanced germination. Furthermore, earthworm exudates appear to contain compounds that are preferentially capable of promoting radicle growth.

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