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Rapid disposal of the weed lantana (*Lantana camara*) in the environment with controlled use of termites

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ABSTRACT

Lantana (*Lantana camara*), a rapid-growing perennial woody shrub, is one of world's most invasive species. Due to its aggressive colonization of landmass, aided by its allelopathic effort, the weed causes great harm to soil health and biodiversity. Due to its prolific growth and wide adaptability it has overrun large areas in the tropics and sub-tropics, and has developed into a serious nuisance. Despite persistent attempts to destroy it by chemical and biological means, it has not been possible to retard its spread, let alone prevent it. The present paper reports a new process based on controlled use of termites for the disposal of lantana - in other words disposal in a way that enables full assimilation of the weed into the environment in an ecologically benign manner. For it, the process of 'termigradation' (termite-mediated biodegradation), and the associated reactors ('termireactors'), developed recently by us, were utilized. In the *in-situ* termireactors of upto 50 Kg capacity; more than 50% of lantana waste termigraded within 60 days which is a much faster rate than achieved by composting or vermicomposting. Use of trails further speeded up the process as also provided a means of process control.

Key words : *Termite, Lantana camara, Weed, Termireactor, Termigradation*

Introduction

Lantana (*Lantana camara*) belongs family Verbenaceae of which more common and abundant species include *L. camara, L.crenulata*, *L. trifolia* and *L.indica.* Of these *L. camara*, which is commonly referred as lantana is a highly aggressive invader of natural ecosystems (Kumar *et al.*, 2011). Due to its tendency to elbow out other species of plants, and the way it monopolizes the use of soil, water, and nutrients in any area, lantana plays havoc with the area's biodiversity (Holm *et al.*, 1977; Prasad and Jamaluddin, 1986; Saxena, 1991).

In an endeavour to find a means of assimilating large quantities of lantana in an ecologically compatible and inexpensive manner we have explored the possibility of getting the weed biodegraded by termites. The premise is that if the weed can be worked upon by termites - a process which we have termed 'termigradation' -it would basically mean converting the weed into termite zoomass and termicast. As has been detailed elsewhere (Abbasi *et al.*, 2007) termites play a crucial role- alongside earthworm and ants - in the turn-over and rejuvenation of soils. After extensive proof-of-concept studies, which have all met with success, we have developed a process of which a patent claim has been granted (Abbasi and Gajalakshmi *et al.*, 2014). The present paper describes the use of the process in the termigradation of lantana.

Materials and Method

Three sets of experiments were conducted with dif-

ferent quantities of lantana. All the reactors were charged with its twigs and placed near active termite mounds in the wooded parts of the Pondicherry University campus. The first set comprised of six reactors with 5 Kg feed.

In the second set of experiments, a total of six termireactors were operated. All were charged with 20 Kg lantana. The first three reactors were placed near active termite mounds in the wooded parts of the Pondicherry University campus. To enhance the rate of substrate degradation, by attracting more number of termites to the reactor than coming naturally to the reactor, three of the termireactors were supported by trails of paper waste and saw dust. These trails, 8 in number, were laid alternatively and equidistance from each other going radially outward upto 5 metres from each termireactor in all directions (Figure 1).

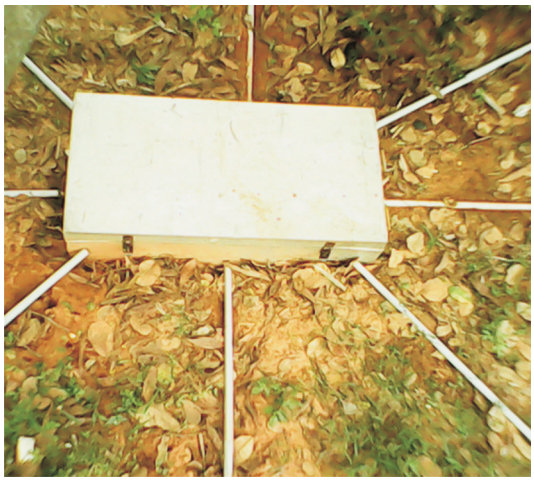

Fig. 1. Termireactor with trails placed in field

In the third set of experiments the termireactors were loaded with 50 Kg of the substrate: triplicates were used with and without trails. The extent of substrate consumption by termites was quantified once in every fifteen days in all the other reactors. The reactors were observed daily and the species present each time were identified (Figure 2).

All quantities have been reported on 'dry weight basis'; it is the equivalent of fresh weight of the sub-

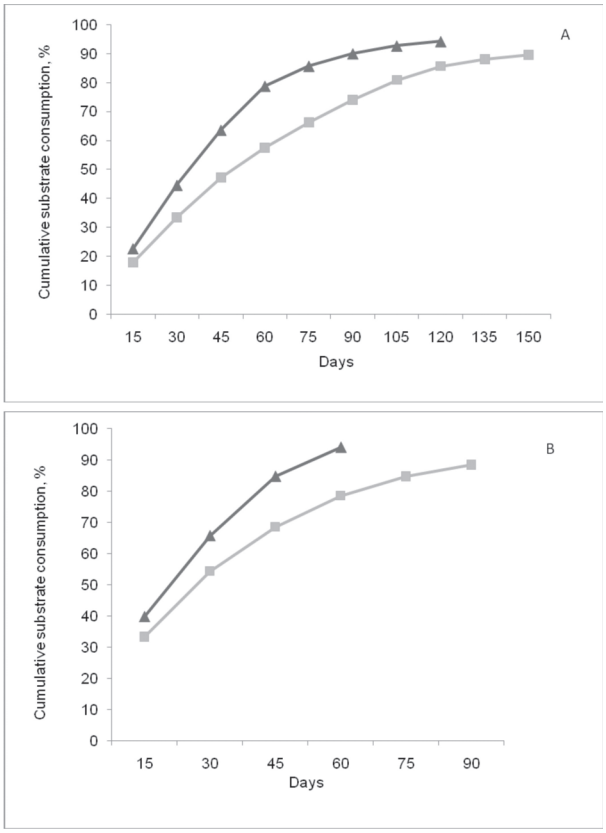

Fig. 2. Cumulative of lantana consumption, %, in termireactors of different capacities not supported (A) and supported by trails (B): Reactor 20 kg Reactor 50 kg

Table 1. Extent of termigradation (%) of *Lantana camara* (5 Kg) at 15-day intervals

Days	Reactor						Termigradation	
	A	B	C	D	E	F	During each run	Cumulative
0-15	13.0	16.7	14.2	15.8	13.5	17.1	15.1±1.7	17.0±0.6
15-30	15.1	14.1	15.7	11.9	14.6	16.0	14.7±1.5	29.8±2.5
31-45	10.2	12.6	10.8	11.5	10.7	13.2	11.5±1.2	41.3±0.9
46-60	10.5	8.5	9.4	8.0	9.9	7.9	9.0±1.1	50.3±3.6
61-75	6.4	8.1	7.4	7.8	7.0	6.6	7.2±0.6	57.5±3.0
76-90	6.2	7.5	6.1	6.7	6.3	5.9	6.5±0.6	64.0±3.8
91-105	5.6	6.1	4.4	3.8	5.6	4.2	5.0±0.9	69.0±3.5
106-120	5.2	4.4	4.0	3.3	5.4	3.8	4.4±0.8	73.4±3.2
121-135	2.3	3.9	3.2	2.9	2.1	1.5	2.7±0.8	76.1±2.3
136-150	1.0	2.4	1.3	2.0	1.3	1.4	1.6±0.5	77.1±1.6

strate oven dried at 105° C to constant weight.

Results and Discussion

The results are summarized in Tables 1 to 3. It is seen that the rate of the 'termigradation' % or the rate of consumption of the substrate by termites - is the highest during the initial 10-15 days. By the 60th day, half of feed was termigraded in all reactors without trails and more than 75% in reactors with trails. The rate then fell as the quantity of the substrate was reduced. The rate falls as the quantity of the substrate reduced. In general there is a precipiteous fall in termigradation after about half of the substrate is utilized. This trend is seen to be independent of the initial quantity of the substrate - similar trend is seen whether a reactor was started with 5 Kg of substrate (Table 1) or 20-50 (Figure 3). The mass of unconsumed substrate tended to approach zero within an identical duration of time even when the starting mass differed by a factor of 5 with the weeds *I. carnea* and *E. crassipes* (Kaur *et al.*, 2014a,b, unpublished data, 2016) (Figure 4). Supporting the reactors with trails attracted more number of termites than coming naturally to the reactors, hence more substrate consumed when these reactors were with trails.

After assimilation of the *L. camara*, only a small residue of particulates was found in the reactors. *Hypotermesobscuriceps* was the species present.

In all the reactors, > 50% (50.3 % for 5 Kg, 78.8% and 94.0% for 20 Kg and 57.4% and 78.5% for 50 Kg) of the feed was consumed with and without trail within 60 days. This time-span can be considered very quick because conventional forms of

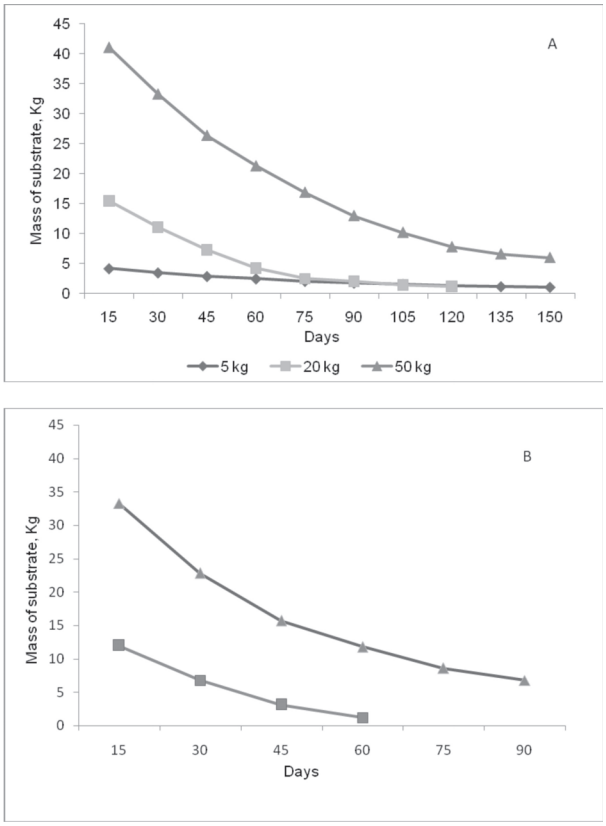

Fig. 3. Mass of lantana left at different intervals in reactors without (A) and with (B) trails: Reactor 5 kg Reactor 20 kg Reactor 50 kg

Table 2. Extent of termigradation (%) of *Lantana camara* (20 Kg) at 15-day intervals, in the reactors without trails and the reactors supported by trails

Days	Reactors without trails			Termigradation		Reactors supported by trails			Termigradation		Increase (I) or decrease (D) in termigradation by use of trails, significant to confidence level
	A	B	C	During each run	Cumulative	A	B	C	During each run	Cumulative	
0-15	22.3	23.1	22.8	22.7±0.4	22.7±0.7	38.8	40.1	40.6	39.8±0.9	39.8±1.1	I 99
16-30	21.5	21.6	22.7	21.9±0.6	44.6±1.2	26.1	25.8	25.7	25.9±0.2	65.7±0.7	I 98
31-45	19.0	19.2	18.6	18.9±0.3	63.6±1.0	18.6	19.4	18.9	19.0±0.4	84.7±0.5	I 60
46-60	14.7	14.5	15.0	14.7±0.3	78.8±0.8	9.7	9.3	8.9	9.3±0.4	94.0±0.3	D 99
61-75	7.7	7.0	6.1	6.9±0.8	85.7±1.3	-	-	-	-	-	-
76-90	4.2	5.1	3.7	4.3±0.7	90.0±1.2	-	-	-	-	-	-
90-105	3.7	2.5	2.0	2.7±0.8	92.7±1.1	-	-	-	-	-	-
106-120	1.1	1.5	1.9	1.5±0.4	94.2±0.8	-	-	-	-	-	-

Table 3. Extent of termigradation (%) of *Lantana camara* (50 Kg) at 15-day intervals, in the reactors without trails and the reactors supported by trails

Days	Reactors without trails					Reactors supported by trails					Increase (I) or decrease (D) in termigradation by use of trails, significant to confidence level
	Reactor			Termigradation		Reactor			Termigradation		
	A	B	C	Duringeach run	Cumulative	A	B	C	Duringeach run	Cumulative	
0-15	19.9	17.5	16.1	17.8±1.9	17.8±1.9	30.5	33.8	35.9	33.4±2.7	33.4±1.6	I 95
16-30	16.5	16.1	14.2	15.6±1.2	33.4±3.1	20.8	24.0	18.1	21.0±2.9	54.4±3.4	I 90
31-45	14.8	12.9	13.5	13.7±0.9	47.1±3.7	14.8	12.2	15.5	14.2±1.7	68.5±0.7	I 20
46-60	11.5	10.3	9.1	10.3±1.2	57.4±4.9	11.1	8.8	9.9	9.9±1.2	78.5±0.5	D 20
61-75	8.1	9.5	8.5	8.7±0.7	66.1±4.7	7.4	5.3	6.1	6.3±1.1	84.7±1.0	D 80
76-90	7.3	8.2	7.9	7.8±0.4	73.9±4.4	3.7	4.8	2.6	3.7±1.1	88.4±0.4	D 95
91-105	5.2	4.9	7.1	6.9±1.2	80.8±3.5	-	-	-	-	-	-
106-120	3.3	5.8	5.1	4.7±1.3	85.5±2.6	-	-	-	-	-	-
121-135	2.2	1.9	3.0	2.4±0.6	87.9±2.2	-	-	-	-	-	-
136-150	1.5	1.1	1.2	1.6±0.2	89.5±2.3	-	-	-	-	-	-

Fig. 4(a). Lantana termireactors with termite tunnels made on the substrate (b) Close up of the substrate with the tunnels (c) Substrate consumed after termite action

composting or vermicomposting of biodegradable waste takes much longer. More significantly, whereas periodic supervision for maintaining moisture, turning of substrates (needed in composting), and resultant energy/material inputs, that are necessary in those processes, are not required in termigradation. Hence this is a much less expensive process with much lesser 'footprint'.

Conclusion

Disposal of notorious weed lantana was accomplished by controlled action of termites using *in-situ* reactors of capacities ranging from 5 to 50 Kg. Multiple reactors were operated with attaching trails to them. The trails constituted lines of paper waste or saw dust, drawn in a manner that led termites to the termireactors from eight uniformly spaced directions.

About half of the initial charge was 'termigraded' in 60 days. The process resembled a zero order reaction in the sense that the rate of termigradation appeared independent of the starting substrate quantities; the termite scouts apparently signal for, and summon, the number of foragers in proportion to the quantity of the food source.

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