



Biopesticidal properties and composting efficiency of *Parthenium*

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Parthenium hysterophorous L. of family Asteraceae is an exotic species commonly known as “Congress Grass” which has invaded about 35 billion hectares of land in India (Sushilkumar and Varshney 2010) and is responsible for loss in crop productivity and biodiversity besides causing health problems in man and animals. It has allelopathic effect and inhibits the germination and growth of neighbouring plants by releasing various allelochemicals such as water soluble phenolics and sesquiterpene lactones including parthenin and coronopilin. *Parthenium* extract has been reported to cause insect mortality, antifeedant activity (Sushilkumar and Singh 2004) and inhibit pathogens.

Composting of organic waste is gaining interest as a suitable option for manures with economic and environment profit. Since the economic use of *Parthenium* is impaired by its toxic property, therefore, its composting can be a useful alternative and it can be used as a soil conditioner. The compost prepared from *Parthenium* has high level of macro and micronutrient. The present investigation was carried out to study the biopesticidal properties and composting efficiency of this weed.

Biopesticidal studies

Leaves of *Parthenium* were collected during the months of March-April 2014, shade dried under laboratory conditions, grinded and powdered. The plant material was extracted in solvents according to the method used by Singh (1996) and working concentrations prepared. The extracts were tested for ovicidal and larvicidal properties against two phytophagous insects, viz. cabbage butterfly (*Pieris brassicae*) and tobacco caterpillar (*Spodoptera litura*) common on vegetable crops and against phytopathogens (*Alternaria alternate*, *Sclerotium rolfsii*, *Fusarium oxysporum*, *Penicillium expansum*, *Rhizopus stolonifer*, *Aspergillus niger*).

For phytopathogens, effect on colony diameter

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in each treatment was measured on the fifth day after inoculation and the per cent inhibition of each phytopathogen was calculated (Vincent 1947).

$$\text{Growth inhibition (\%)} = \frac{\text{Colony diameter in control} - \text{colony diameter in treatment (mm)}}{\text{Colony diameter in control (mm)}} \times 100$$

The data was recorded in triplicates and subjected to statistical analysis.

Compositing studies

P. hysterophorous before flowering was collected during April 2014. The collected plants were chopped into small pieces for composting. The experiment was done in cardboard boxes of 50 x 35 x 30 cm (length x breadth x height) in completely randomized design in four replications with five treatments. The boxes were placed in a shed and moisture content was maintained to about 60% by sprinkling water at alternate days. Turning of the compost was made after 15 days to improve aeration. The composting period was recorded. Samples from each treatment were collected from the centre of each compost box for physico-chemical analysis using standard methods. Total number of earthworm from the treatment *Parthenium* + cow dung (3:1) + earthworms 200 g per replication and *Parthenium* + cow dung + agriculture waste + earthworm [3(1.5+1.5):1+200 g earthworm] were counted and weighed. Recovery percentage (compost prepared in each treatment was weighed at the end of the experiment and total composting period noted) was also calculated.

Effect on insect

At concentration of 5.0% of petroleum ether and aqueous extracts, egg hatching was not observed in *P. brassicae* after 48 hrs (Table 1). Maximum per cent egg hatching 83.1% and 84.8% was recorded in control. At 2.5% concentration of petroleum ether extract, 4.2% egg hatching for *P. brassicae* was recorded. The egg hatching in petroleum ether and aqueous extract for *S. litura* ranged from 21.4-92.1%

Table 1. Ovicidal effect of *Parthenium* extract on *Pieris brassicae* and *Spodoptera litura*

Concentrations	Percent egg hatching after 48 hrs			
	Petroleum ether extract		Aqueous extract	
	<i>P. brassicae</i>	<i>S. litura</i>	<i>P. brassicae</i>	<i>S. litura</i>
5.0%	0.0 (0.00)	21.4 (27.09)	0.0 (0.00)	22.3 (28.09)
2.5%	4.2 (6.90)	18.2 (24.55)	10.3 (15.43)	27.4 (31.52)
1.0%	19.0 (25.32)	41.9 (40.04)	18.1 (25.18)	43.3 (41.14)
0.5%	15.6 (19.16)	75.1 (60.28)	46. (42.31)	57.3 (45.34)
Control	83.1 (65.76)	92.1 (76.55)	84.8 (55.75)	83.6 (66.42)
LSD (p=0.05)	18.33	16.90	28.91	N/S

Values in parentheses are arc sine transformation

and 22.3 - 83.6%, respectively (**Table 1**). At 0.5% concentration egg hatching for *S. litura* after 48 hrs in petroleum ether and aqueous extracts was 75.1 and 57.3%, respectively. The toxic and ovicidal effect of petroleum ether extract is reported for *Aedes aegypti* (Kumar *et al.* 2011).

The highest mortality of second instar larvae of *P. brassicae* on exposure to petroleum ether extract was 73.3% after 48 hrs at 2.5% concentration which was at par with 5.0% (**Table 2**). The superiority of *Parthenium* for larvicidal effect has been reported by Khan *et al.* (2014).

The highest mortality of 50.0% after 48 hrs of exposure of first instar larvae of *S. litura* was recorded in petroleum ether extract of *Parthenium*. Singh *et al.* (1996) reported 73.23 per cent larval mortality of *S. litura* after 72 hours with ethyl acetate.

Effect of pathogens

Maximum per cent growth inhibition was observed in *Sclerotium rolfsii* (59.5%) followed by *Fusarium oxysporum* (58.6%), *Penicillium expansum* (53.1%) and *Alternaria alternata* (35.6%), while the

Table 2. Toxic effect of *Parthenium* extracts on *Pieris brassicae* and *Spodoptera litura*

Concentrations	% mortality after 48 hours					
	Petroleum ether extract			Aqueous extract		
	<i>P. brassicae</i>		<i>S. litura</i>	<i>P. brassicae</i>		<i>S. litura</i>
	1 st Instar	2 nd Instar	1 st Instar	1 st Instar	2 nd Instar	1 st Instar
5.0%	100.0 (90.00)	50.0 (43.98)	50.0 (49.21)	73.3 (63.83)	70.0 (56.76)	60.0 (51.12)
2.5%	100.0 (90.00)	73.3 (58.98)	26.7 (30.28)	60.0 (50.91)	70.0 (57.26)	53.3 (46.90)
1.0%	76.7 (66.13)	23.3 (28.76)	23.3 (28.06)	53.3 (47.28)	40.0 (39.04)	26.0 (17.06)
0.5%	63.3 (52.83)	16.7 (19.91)	26.7 (30.28)	0.0(0.00)	13.3 (21.13)	26.7 (30.77)
Control	0.0(0.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)
LSD (p=0.05)	19.47	23.71	N/S	23.47	19.90	13.04

Values in parentheses are arc sine transformation

least per cent growth inhibition was recorded in *Rhizopus stolonifer* (26.7%) and *Aspergillus niger* (29.3%) (**Table 3**).

Physicochemical characteristics of compost

The percentage recovery of the compost ranged from 42.2-62.8%. It was highest (62.8%) in treatment *Parthenium* + cow dung + earthworms. The whole process of composting took approximately 18 months for completion which confirmed the study of Yadav and Garg (2011).

In the present study, N and P content was high in the treatments where *E. fetida* was added for composting, similarly K content was also statistically highest in *Parthenium* + cow dung + agriculture waste + earthworms and *Parthenium* + cow dung + earthworms though at par with each other as compared to compost of *Parthenium* alone and other treatments. Bhojar (2013) also reported high composting value of *Parthenium* (1.05, 0.84, 1.11 per cent N,P,K content), as compared to FYM alone (0.5, 0.2, 0.5 per cent N,P,K content). The treatments did not differ statistically from each other with respect to C/N ratio and organic carbon. Though the parameters had high value for *Parthenium* + cow dung (3:1) followed by *Parthenium* alone. Compost mixtures *Parthenium* + cow dung + earthworms and *Parthenium* + cow dung + agriculture waste + earthworms recorded low values for organic carbon and C/N ratio.

Table 3. Growth inhibition of phytopathogens by aqueous extract of *Parthenium* at 10%

Phytopathogens	Per cent growth inhibition
<i>Alternaria alternata</i>	35.6 (6.05)
<i>Sclerotium rolfsii</i>	59.5 (7.77)
<i>Fusarium oxysporum</i>	58.6 (7.72)
<i>Aspergillus niger</i>	29.3 (5.50)
<i>Penicillium expansum</i>	53.1 (7.35)
<i>Rhizopus stolonifer</i>	26.7 (5.36)
LSD (p=0.05)	1.39

Values in parentheses are arc sine transformation

Table 4. Physico-chemical characteristics of *Parthenium* compost

Treatment	N (%)	P (%)	K (%)	Organic carbon (%)	pH	EC (dS/m)	C/N ratio	Recovery (%)
<i>Parthenium</i> alone	1.6 (1.60)	0.4 (1.16)	1.2 (1.48)	49.5 (44.6)	7.9	2.7	33.7	47.5
<i>Parthenium</i> + cow dung 3:1	1.5 (1.54)	0.4 (1.18)	2.0 (1.72)	54.9 (47.8)	7.6	2.7	36.5	52.2
<i>Parthenium</i> + cow dung + earthworms	1.8 (1.67)	1.3 (0.72)	3.0 (2.00)	26.0 (30.3)	8.1	2.9	16.7	62.8
<i>Parthenium</i> + cow dung + agriculture waste	1.6 (1.62)	0.4 (1.18)	2.4 (1.83)	29.8 (31.7)	7.0	1.8	16.9	42.2
<i>Parthenium</i> + cow dung + agriculture waste + earthworms	1.9 (1.71)	0.80 (1.34)	3.1 (2.01)	21.3 (26.8)	7.5	2.0	11.0	51.4
LSD (p=0.05)	N/S	N/S	0.29	N/S	N/S	N/S	N/S	N/S

Values in parentheses are square root and are arcsine transformation

The pH and EC of the compost prepared at all the treatments ranged from 7.04-8.11 and 1.82-2.94, dS/m, respectively. Sangwan *et al.* (2011) reported decrease in pH of *Parthenium* compost prepared along with sugar mill sludge and biogas plant slurry by employing *E. fetida* as compared to compost prepared from *Parthenium* alone. In the present study pH values were more *i.e.* 8.11 when *Parthenium* and cow dung was composted with earthworm, but did not differ statistically from other treatments. Yadav and Garg (2011) also reported decrease in pH for compost of *Parthenium* mixed with cow dung using *E. fetida*. In the present investigation, though there was no significant difference in EC value of different compost but highest value of 2.94 dS/m was recorded for compost prepared from *Parthenium* and cow dung by earthworms. The results find support from the findings of Yadav and Garg (2011) who also reported increase in EC value in the compost prepared from *Parthenium* using *E. fetida*.

SUMMARY

No egg hatching of *P. brassicae* was recorded at the highest concentration (5.0%) of petroleum ether and aqueous extracts of *Parthenium*. After 48 hrs of exposure of first instar of *P. brassicae*, 100% mortality was recorded at 2.5% and 5.0 concentration. Aqueous extract of *Parthenium* provided good control with 70.0% mortality of second instar of *P. brassicae* after 48 hrs of exposure. The petroleum ether extract and aqueous extract of *Parthenium* provided 50% and 60% mortality of first instar of *S. litura*, whereas 10% aqueous extract of *P. hysterophorus* recorded maximum % growth inhibition of *Sclerotium rolfsii* (59.5%). The compost prepared with *E. fetida* inoculum had high N, P, K

content and low organic carbon and C/N ratio. Maximum (62.8%) recovery was recorded in *Parthenium* + cow dung + earthworm treatment.

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