Indian Journal of Weed Science **51**(2): 169–172, 2019

Print ISSN 0253-8040 Online ISSN 0974-8164

Effect of compost extract compost of *Parthenium hysterophorus* on seed germination and growth of mustard, wheat and weeds

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Article information

DOI: 10.5958/0974-8164.2019.00036.4

Type of article: Research article

Received : 21 February 2019
Revised : 29 April 2019
Accepted : 1 May 2019

Key words
Allelopathy
Crop
Inhibition
Invasive
Control

ABSTRACT

This study was conducted at Research laboratory, Botany Department Amrit Campus, Kathmandu, Tribhuvan University, Nepal, in the year 2015-2016 to investigate the allelopathic effects of compost extract and soil amended with compost invasive weed *Parthenium weed* on seed germination and seedling growth of two crops *Triticum aestivum*, *Brassica campestris* and some common weeds (*Ageratum conyzoides*, *Bidens pilosa*, *Galinsoga parviflora* and *Cyperus rotundus*). *Parthenium hysterophorus* was collected before flowering and matured seeds of *Bidens pilosa*, *Ageratum conyzoides*, *Galinsoga parviflora* and *Cyperus rotundus* were collected from different sites around Kathmandu valley like Kirtipur and Bhaktapur areas. The compost extract of *Parthenium* of different concentration (control, 1, 2.5, 5 and 10%) and *Parthenium* compost (control, 10, 20, 40 and 50 g compost/kg soil) were used to determine its effect on seed germination, shoot and root length of *T. aestivum* and *B. campestris* and selected common weed seeds under laboratory condition. The compost extracts of *Parthenium* caused significant reduction in seed germination, seedling length (shoot and root length) of selected crops and weeds. The selected common weeds showed more reduction in germination and vegetative shoot and root length in comparison to crop plants (*B. campestris* and *T. aestivum*) in the soil amended with the compost of *Parthenium*.

INTRODUCTION

Parthenium hysterophorus is an invasive weed, commonly known as carrot grass, bitter weed or star weed and belongs to the family Asteraceae. In rainy season, *P. hysterophorus* completes its life cycle within 16-18 weeks (Maharjan *et al*. 2014). *Parthenium* had been ranked top ten among the list of worst weed in the Global Invasive Species Database (Callaway and Ridenour 2004). Ecological impact and economic loss due to rapid expansion of *Parthenium* has become a regional environmental issue of tropical world (Bhowmik *et al.* 2007, Sushilkumar 2014). In Nepal, this species entered probably in 1950s from India. Herbarium specimens of this plant were collected from Trishuli valley of Nuwakot district, a small city north to Kathmandu, in 1967 (Tiwari *et al.* 2005). In Nepal, this plant has already invaded the maize, sugarcane and mustard fields (Shrestha 2014), while in India, this weed has been reported to infest all type of crops and orchards (Sushilkumar 2014).

Singh *et al.* (2003) explored the allelopathic properties of unburnt (UR) and burnt (BR) residues of *P. hysterophorus* on the growth of winter crops, radish and chickpeas. Soil amended with UR and BR extracts, revealed the phytotoxic effects towards test crops, UR crude extracts being more active showed toxic effects on the growth. These effects were attributed to the presence of phenolics (Singh *et al*. 2003). Parthenin has also been reported as a germination and radical growth inhibitor in a different species of dicot and monocot plants (Patel 2011). The present study attempts to find out the allelopathic influences of compost extract and compost of *P. hysterohorus* on some common weeds and winter crops. It is hypothesized that both the compost extract and compost will have inhibitory effects on winter weeds and crops affecting its germination and growth as well.

MATERIALS AND METHODS

Preparation of extract

Parthenium hysterophorus was collected from different selected sites around Kathmandu valley, Nepal, before flowering in May-June, to prepare compost. Mature seeds of *Bidens pilosa*, *Ageratum conyzoides*, *Galinsoga parviflora* and *Cyperus rotundus* were collected from different sites around Kathmandu valley like Kirtipur and Bhaktapur areas in the month of March and April in 2015 for seed germination experiments.

A pit of 2x3x3 feet was prepared at shady place and was filled with layers of *Parthenium* plants altering with soil. It was left for seven months (from March to September, 2015) to become compost. Experiment on compost extract at laboratory was conducted from this compost. To prepare compost extract, compost was air dried then 2 g of compost were soaked in 20 ml distilled water for 24 hours. The extract was filtered using Whatman No.1 filter paper and thus 10% stock solution was prepared. From this stock solution, 1.0, 2.5, 5.0 and 10.0% concentration was prepared. The *Parthenium* compost was also tested by amending 10, 20, 40 and 50 g compost in 1.0 kg soil of Kirtipur and Bhaktapur, separately, in polybag (size 14"x7)

Seed germination

The dominant weed seeds (*A. conyzoides*, *B. pilosa*, *C. rotundus* and *G. parviflora*) and the crop seeds of *B. campestris* and *T. aestivum* were soaked in 2% sodium hypochlorite for 2 minutes separately. The seeds were then washed with distilled water thoroughly. Ten seeds of each species were kept in sterilized Petri-dishes containing control, 1.0, 2.5, 5.0 and 10.0% concentrations of compost extracts for 10 days. For control, seeds were grown in filter paper soaked with 5 ml distilled water. All these experiments were conducted under normal room temperature with five replications. The moisture level in the Petri-dish was maintained by adding distilled water as required.

The seed germination experiment was conducted in polybag by using different concentration of *P. hysterophorus* compost (10, 20, 40 and 50 g/kg soil) in the month of November 2015. The soil for this experiment was sandy loam type having 6.2 pH and humus 0.88%. The nutrients NPK of the soil was recorded 0.14,0, 0028, 0.018% respectively.There were five replications of each treatment (10 seeds of selected seeds of weed and crops were sown separately). The germination and seedling growth was recorded after 40 days. The soil without compost was taken as control.

Statistical analyses were done by using SPSS statistical version 20. The data were subjected to one way ANOVA followed by Duncan's Multiple Range Test

RESULTS AND DISCUSSION

Seed germination, shoot and root length decreased more in the tested weed seeds (*Ageratum conyzoides*, *Bidens pilosa*, *Cyperus rotundus* and *Galinsoga parviflora*) than in selected crops (*Brassica campestris* and *Triticum aestivum*) with an increase in concentration of *Parthenium* compost extract (**Table 1**). *Parthenium* compost extract showed insignificant reduction on seed germination of *B. campestris* with 1.0 and 2.5% , but it was reduced significantly with 5.0%. Seed germination was completely inhibited at 10% *Parthenium* compost extract. Seed germination of *T. aestivum* was enhanced significantly (P=0.05) at 1.0 and 2.5% compost extract treatment, but at higher concentrations (5 and 10%), it reduced significantly. Seed germination of weeds *A. conyzoides* and *G. parviflora* reduced insignificantly up to 5%, but seeds of *Bidens pilosa* showed significant reduction with 2.5 and 5% treatments. Total inhibition of weed was observed at 10%. No seed germination of *Cyperus rotundus* was observed even at lower concentrations of *Parthenium* compost extract (**Table 1**).

The shoot and root length of *B. campestris* reduced significantly with increase in concentration of *Parthenium* compost extract. In *T. aestivum*, the shoot and root length increased significantly at 1% concentration, but reduced significantly at higher concentration (5 and 10%). Shoot and root length of weed seedlings reduced significantly with increasing concentrations of compost extracts (**Table 1**).

Seed germination of crops *B. campestris* and *T. aestivum* increased insignificantly with 10 and 20 g/kg soil treatment with compost of Parthenium, but it reduced significantly with high concentrations in compost amended with soil. Seed germination of *B. campestris* was totally inhibited at 50 g/kg soil treatment (**Table 2**).

Seed germination of weeds *A. conyzoides*, *B. Pilosa* and *G. parviflora* reduced at 10 and 20 g/kg soil treatment. Seed germination of *Cyperus rotundus* was completely inhibited at all treatments of (**Table 2**).

The shoot and root length of *B. campestris* and *T. aestivum* significantly increased with 10 and 20 g/kg compost, but it reduced significantly with high concentrations (40 g/kg and above) in both crops. The shoot and root length of weed *A. conyzoides* reduced significantly with 10 and 20 g/kg soil treatment, but in case of *B. pilosa* and *G. parviflora* it reduced significantly with 20 g/kg soil treatment only (**Table 2**).

The reduction in seed germination and seedling growth in *B. campestris* was possibly due to presence of significant amount of phenolics the largest group of secondary metabolites in *P. hysterophorus* plant (Singh *et al.* 2005, Safdar *et al.* 2014). Altogether about 47 phytocomponents; 3 terpenoids, 14 fatty acids, 4 hydrocarbons, 7 alcohols, 5 phytosterols, and 14 other metabolites are reported in leaf of *Parthenium* (Ahmed *et al.* 2018).

Lesser detrimental effect of *Parthenium* compost extract was observed in *T. aestivum* than in *B. campestries*. Afridi *et al.* (2015) reported that the effect of allelochemicals on seed germination tested were unfavorable on the seed germination of *T. aestivum* and other species. The insignificant changes in *Triticum* seed germination shoot and root length with lower concentrations may be due to secondary metabolites cysteine rich proteins- defensins present in endosperm of *Triticum* (Freeman and Beattie 2008).

Seed germination of *Brassica* was more or less remained same up to 2.5% compost extract treatment but it was enhanced up to 5% in *T. aestivum*. Similarly, soil amended with *Parthenium* compost also showed insignificantly different seed germination of *Brassica* up to 20 g/kg soil treatment and up to 40 g/kg soil treatment in case of *Triticum*. Seed germination of *T. aestivum* increased slightly at 10 and 20 g/kg treatments. Presence of plenty of micronutrients such as Fe, Zn, Mn and Cu and macro nutrients including NPK in *Parthenium* compost makes it two times richer than farmyard manure (Krishna Murthy *et al.* 2010, Sushilkumar *et al.* 2005), and this possibly might have acted as the promoter for seed germination and seedling growth in low concentrations. But at high concentrations, the allelochemicals found in *Parthenium* might be responsible for the inhibition of cell division, gibberelline and indolacetic acid functions (Tomaszewski and Thimann 1966).

Various types of terpenoids, (9 in roots, 3 in stem and 3 in leaf) are also found in *Parthenium* (Ahmed *et al.* 2018). The noxious behavior of this weed was thought to be due to the sesquiterpene lactone parthenin, which is synthesized by this plant and play a role of allelopathic interference with surrounding plants (Belz 2007). Possibly these terpenoids interfere with enzymatic activity and reduces seed germination of crops as well as weeds at higher concentrations.

Allelochemicals of *P. hysterophorus* severely affected the seed germination, shoot and root length of all tested weeds and crops at higher concentration. The *C. rotundus* was totally inhibited in all tested concentration of *Parthenium* compost extract and compost amended soil. The seed germination of *Brassica* and weeds *A. conyzoides* and *G. parviflora* were fully suppressed at higher concentrations, but the crop *Triticum* could germinate and can survive at higher concentration. The enhancement of seed germination and seedling growth of *Triticum* (up to 40 g compost/kg soil) and *Brassica* (up to 20 g compost/ kg soil) indicate that there is a possibility of using the compost of *Parthenium hysterophorus* to reduce the associated weeds in wheat and mustard fields.

Table 1. Seed germination (% ±SD), shoot and root length (cm ±SD) of selected crop and weed seeds growth on *Parthenium* compost extract (control, 1, 2.5, 5, 10% concentration)

Species		*Parthenium* compost extract (%)				
		0	1	2.5	5	10
Brassica campestris	SG	75±10.00 b	75±5.77 b	70±5.67 b	67.5±5.00 a	NG
	SL	3.25±1.93 d	2.63±1.53 c	1.96±1.22 b	1.46±1.03 a	NG
	RL	3.34±1.96 d	2.68±1.59 c	1.74±1.09 b	1.13±0.84 a	NG
Triticum aestivum	SG	67.5±5.00 b	85±5.77 cd	80.5±0.00 cd	70± 11.54 b	50±21.60 a
	SL	3.92±2.61 b	5.63±2.40 c	4.36±2.38 b	3.65±1.92 b	1.03±1.01 a
	RL	3.76±2.50 b	5.54±2.38 c	4.1±2.24 b	3.46±1.85 b	0.93±0.92 a
Ageratum conyzoides	SG	57.5±5.00 a	52.50±9.57 a	50.00±12.58 a	48±11.57 a	NG
	SL	1.95±1.72 c	0.69±0.68 b	0.69±0.67 b	0.51±0.50 a	NG
	RL	1.27±1.18 c	0.60±0.55 b	0.58±0.57 b	0.44±0.43 a	NG
Bidens pilosa	SG	62.5±5.00 b	65± 12.90 b	52.5±16.32 a	50±14.14.00 a	NG
	SL	2.81±2.09 c	1.69±1.30 b	1.107±1.104 b	0.94±0.86 a	NG
	RL	2.59±1.94 b	1.32±1.13 a	1.04±1.03 a	0.89±0.81 a	NG
Cyperus rotundus	SG	55±5.77	NG	NG	NG	NG
	SL	1.06±1.03	NG	NG	NG	NG
	RL	0.89±0.88	NG	NG	NG	NG
Galinsoga parviflora	SG	55±5.77 a	52.5±5.00 a	50±8.16 a	47.5±9.57 a	NG
	SL	1.90±1.77 b	0.82±0.79 a	0.70±0.68 a	0.43±0.41 a	NG
	RL	1.78±1.66 a	0.73±0.70 b	0.61±0.59 b	0.34±0.33 a	NG

SG-seed germination; SL-Shoot length; RL-Root length; NG- No Germination; Same letters in the same column after Mean ±SD does not differ significantly according to ANOVA followed by Duncan's Multiple Range Test atP=0.05

Table 2. Seed germination (% ±SD), shoot and root length (cm ±SD) of selected crop and weed seeds growth on soil amended with *Parthenium* compost at (0,10,20,40 and 50g compost/kg soil concentration)

Species		Soil amended with Parthenium compost (g/kg)				
		0	10	20	40	50
Brassica campestris	SG	60±14.14 b	65±12.50 b	70±8.16 ab	60±0.00 a	NG
	SL	8.16±7.21 b	12.31±8.84 b	19.9±10.19 b	6.25±5.10 a	NG
	RL	6.44±5.92 b	10.92±7.93 b	10.33±5.87 b	5.14±4.11 a	NG
Triticum aestivum	SG	57.5±5.00 ab	70±11.54 bc	68±14.14 bc	65±5.77 ab	52.5±12.58 a
	SL	9.26±7.73 b	14.64±9.83 c	17.23±11.48 c	9.86±7.72 b	3.68±3.56 a
	RL	7.66±6.47 b	11.71±7.83 c	12.31±9.03 c	8.24±6.42 ab	3.30±3.20 a
Ageratum conyzoides	SG	55±5.77 a	52.5±5.00 a	45±5.00 a	NG	NG
	SL	2.25±2.14 b	1.05±1.02 a	0.90±0.86 a	NG	NG
	RL	1.90±1.76 b	0.96±0.92 a	0.82±0.79 a	NG	NG
Bidens pilosa	SG	55±12.90 b	50±8.16 ab	47.5±9.57 a	NG	NG
	SL	2.27±2.19 b	2.01±1.94 b	1.26±1.21 a	NG	NG
	RL	2.00±1.94 b	1.84±1.79 b	1.04±1.02 a	NG	NG
Cyperus rotundus	SG	52.5±9.57 a	NG	NG	NG	NG
	SL	1.21±1.16 a	NG	NG	NG	NG
	RL	1.09±1.05 a	NG	NG	NG	NG
Galinsog parviflora	SG	55±5.77 a	52.5 ±5.00 a	50±8.16 a	NG	NG
	SL	1.69±1.62 b	1.32±1.27 b	0.71±0.68 a	NG	NG
	RL	1.63±1.54 b	1.24±1.19 b	0.61±0.59 a	NG	NG

SG-seed germination; SL-Shoot length; RL-Root length; NG- No Germination; Same letters in the same column after Mean±SD does not differ significantly according to ANOVA followed byDuncan's Multiple Range Test at P=0.05

ACKNOWLEDGEMENT

The first author is thankful to research grant provided by Professor Emeritus Williams Styan Richards Foundation (PEWSTRIF), Maiduguri, Nigeria for this work and Amrit campus, TU, Nepal for providing laboratory facilities.

REFERENCES

Afridi R and Khan MA. 2015. Comparative effect of water extract of *Parthenium hysterophorus, Datura alba, Phragmites australis* and *Oryza sativa* on weeds and wheat, *Sains Malaysiana* **44**(5): 693–699.

Ahmad J, Bagheri R, Bashir H, Baig MA, Huqail AA, Ibrahim MM and Qureshi MI. 2018. Organ-specific phytochemical profiling and antioxidant analysis of *Parthenium hysterophorus* L., *Hindawi Bio Med Research International* ID 9535232. https://doi.org/10.1155/2018/9535232.

Belz G, Carl F. Reinhard TB, Llewellyn C, Foxcroftc and Karl H. 2007. Residue allelopathy in *Parthenium hysterophorus* L. Does parthenin play a leading role? *Open UP.*

Bhowmik PC, Sarkar D and Yaduraju NT, 2007, The status of *Parthenium hysterophorus* and its potential management, *Ecoprint* **14**: 1–17.

Callaway RM and Ridenour WM. 2004. Novel weapons: Invasive success and the evolution of increased competitive ability. *Frontiers in Ecology and the Environment* **2**(8)*:* 436–443.

Freeman BC and Bettie GA. 2008. An overview of plant defenses against pathogens and herbivores. *The Plant Health Instructor.* DOI*: 10.1094/PHI-I-2008-0226-01*

Krishna Murthy R, Sreenivasa N and Prakash SS. 2010. Chemical and biochemical properties of *Parthenium* and *Choromolaena* compost, *International Journal of Science and Nature,* **1(2)**: 166–171.

Maharjan S, Joshi S, Shrestha BB, Devkota A and Jha PK. 2014. Life history traits and invasion success of *Parthenium hysterophorus* L. in Kathmandu Valley, Nepal. *Journal of Science and Technology* **15**(1): 31–38.

Patel S. 2011. Harmful and beneficial aspects of *Parthenium hysterophorus*: an update, 3 *Biotech* **1**(1): 1–9.

Safdar ME, Tanveer A, Khalique A and Naeem M. 2014. Allelopathic action of *Parthenium* and its rhizospheric soil on maize as influenced by growing conditions, *Planta Daninha, Viçosa-MG* **32**(2): 243–253.

Shreshta BB, ShabbirA and Adkins SW. 2014. *Parthenium hysterophorus* in Nepal: a review of its weed status and possibilities for management. *Weed Research* **55**(2): 1132–1140.

Singh HP, Batish DR, Pandher JK, Kohli RK. 2003. Assessment of allelopathic properties of *Parthenium hysterophorus* residues. *Agriculture, Ecosystems and Environment* **9**: 537–541.

Singh, HP. Batish DR, Pandher JK and Kohli RK. 2005. Phytotoxic effects of *Parthenium hysterophorus* residues on three *Brassica* species. *Weed Biology and Management* **5**: 105–109.

Sushilkumar. 2014. Spread menace and management of Parthenium. *Indian Journal of Weed Science* **46**(3): 205–219.

Sushilkumar, Yaduraju NT, Vishwakarma K and Sondhia S. 2005. Nutrient quality and seed viability of Parthenium compost by NADEP and conventional pit method, pp. 200-203. In: *Proceedings of Second International Conference on Parthenium Management*, December 5-7, 2005, University of Agriculture, Bangalore.

Tiwari S, Adhikari B, Siwakoti M and Subedi K. 2005. *An Inventory And Assessment Of Invasive Alien Plant Species Of Nepal*. IUCN Nepal, Kathmandu.

Tomaszewski M and Thimann KV. 1966, Interactions of phenolic acids metallic ions and chelating agents on auxin induced growth, *Plant Physiology* **41**: 1443–1445.