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Suppression of Parthenium by botanical agents - standardization of technique

N. Arun kumar, L.K. Akshata , R. Devendra and Louis Linda
Department of crop Physiology, UAS, Bangalore (Karnataka)
E-mail: devendra_cuticle@yahoo.co.in

ABSRACT

Parthenium contact cause skin allergy, pollen leads to breathing problems in sensitive human and if deposited on stigmatic surface fruits gets aborted in brinjal. Parthenium harbors organisms of virus diseases and infect the crop later. Managing the Parthenium is absolutely essential but costly. Non-availability of timely labour force and the awareness of chemical pollution causes dilemma of herbicide usage. Alternative technique to manage Parthenium weed is a welcome challenge.Aqueous extracts of fresh or dry leaves (1%) of *Lantana camara* and *Hyptis sulvelolensis* suppressed germination of Parthenium more than that by *Cassia uniflora* extracts. Mulching of these botanical agents (10 t/ha) suppressed Parthenium till 60 DAS, but stimulated the growth of sunflower and tomato, respectively. Mulching of fresh or 30 days deposited materials suppressed the germination and growth of Parthenium. Soil sterilization enhanced the allelo-chemical efficacy of botanical agent indicating the role of soil microbes in degrading the allelo-chemicals.

Key words: Mulching, *Lantana camara*, *Hyptis sulvelolensis*, Germination, Parthenium.

Aqueous extracts of shoot of sunflower, sorghum and rice suppressed germination and root growth of *Parthenium hysterophorus* L. Sunflower extracts at 25% was most effective than sorghum and rice. (Javaid *et al.* 2006). Apart from leaf extract *Cassia uniflora* seed powder extracts at 6% inhibited germination (48%) and growth (Root 64% and shoot 38%) of Parthenium (Anonymous 2005). Fresh leaf and dry leaf extracts of *Lantana camara* and *Hyptis suaveolens* were more effective than *Cassia uniflora, Sida hyptosa, Tephrosia purpuria, Chromolaena odorata,* and *Corton sparisiflorus* (Anonymous 2006). Spray of *Eucalyptus citridora* oil at 0.5 to 7% to four weeks old Parthenium led to visible reduction in chlorophyll content, respiration and rapid electrolyte leakage (Singh *et al.* 2005). Fodder grass, Bisset blue grass, Floren blue grass and Buffel grass had competitive ability with Parthenium by a factor of 3.16, 1.49 and 1.11, respectively for limited resources, whereas Butterfly pea has factor of 2.89, indicating one plant of Butterfly pea is equal to 2.89 Parthenium plants near its vicinity to have same effect on Parthenium (Donnell and Adkins 2005). Thus presence of extract or spraying of oil or growing together suppresses the germination and growth of Parthenium.

Most of these studies were carried out in petridish condition, but extract application either by soil or foliar failed to produce required suppression in pot culture. Allelo-chemicals present in extracts or released by decomposing mulched material or as root exudation affect the germination, growth and development of Parthenium. Accessibility of allelopathic plant material may not be possible through out the year being annuals. Some of the botanical agents (*Hyptis* and *Lantana*) cannot be grown in Parthenium-infested areas. Thus plant materials have to be collected, stored for long period and optimize the application technique to get desired suppression of Parthenium.

With this background, an attempt was made to evaluate different mulching materials suppressing Parthenium, to know effective period of decomposition on Parthenium suppression, to assess dry leaf extracts of botanical agents on Parthenium suppression under sterilized and non-sterilized soils.

MATERIALS AND METHODS

Three experiments were carried out to assess the effect of mulching, decomposed mulching material for varied period and role to soil microbes on allelochemicals efficacy.

Effect of mulching

Experiment was carried out using botanical agents *H. suaveolens, C. uniflora* and *L. camara*, which suppress the growth of Parthenium and their effect on sunflower and tomato. The pots of size 45 x 20 x 22.5 (L x B x H) cm^3 were filled with 1:4 proportion of sand : soil free from any propagating material. Seeds of Parthenium, sunflower and tomato were sown and fresh shoot materials of three botanical plants were chopped to 1-2 inch were spread on the soil surface (mulching) at 10 t/ha. Control was maintained without mulching. It was watered daily over the mulched material.

Decomposed mulching for varied period

The fresh leaf and shoot material of the three botanical agents were chopped into small pieces of about 2.5 – 5.0 cm and transferred to battery pots and decomposed by watering once in three days for varied period *viz*. 0,10,20,30 and 40 days. Plastic bowls of size 23 cm diameter and 6 cm depth was filled with sand: soil of 1:4 ratio. Seeds of Parthenium were sown, immediately after sowing decomposed material of botanical agents was mulched over the sown area at 3.6 t/ha.

Role of soil microbes on botanical agents' allelopathic efficacy

Twenty grams of soil was transferred to petri-dishes and a set of petri-dishes was sterilized by keeping them in autoclave at 10 PSI for 3 hours. To these sterilized and non-sterilized petriplates, seeds of Parthenium were sown and different concentration of allelochemical extracts *viz* 5% and 10% was added at 10 ml per petri-dish.

RESULTS AND DISCUSSION

Effect of botanical agent mulching on suppression of Parthenium and crops

Mulching of *Hyptis* and *Lantana* at 10 t/ha significantly suppressed *Parthenium* germination compared to *Cassia* and control. Whereas, *C. uniflora* and *L. camara* mulching significantly suppressed sunflower and tomato germination respectively significantly compared to control (Fig. 1). The in establishment of Parthenium was severely suppressed in 10 t/ha mulching compared to 5 t/ha and such suppression of seedling establishment was not observed in sunflower and tomato. *Lantana* mulching inhibited Parthenium may be due to the presence of triterpenes *viz*. Lantadene A (22*b*- Angeloyloxy-3*b*-hydroxyolean-12-en-28-oic acid) and Lantadene B (22*b*-dimethylacryloyloxy-3*b*-hydroxyolean 12-en-28-oic acid) (Hart *et al*. 1976). These compounds may inhibit Parthenium seedling establishment.

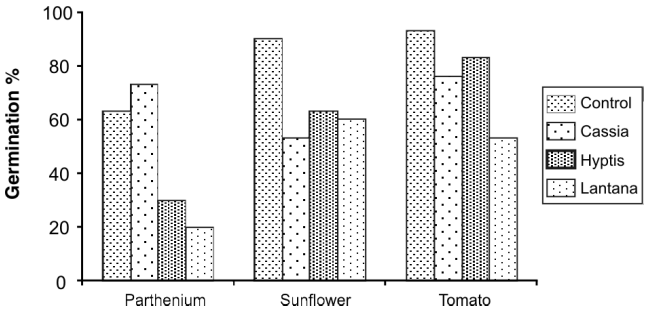

Fig. 1. Effect of mulching of botanical agents (10t/ha) on germination percentage of Parthenium, sunflower and tomato

Effect of decomposed botanical agent mulching on suppression of Parthenium.

Mulching of decomposed material up to 20 days of any botanical agent can be used for suppression of Parthenium seed germination compared to control (Table 1). Thus during rainy days the shoot materials can be collected and spread on the Parthenium infested area during the rain break period. Similar results were reported that alfalfa (*Medicago sativa* L. and kava (*Piper methysticum* L) strongly inhibited *Echinoclov* and *Monochoria* growth by 80-100% up to 10 days and 50% up to 25 days of decomposition, respectively. Varied phenolic acids *viz.* catechin, coumalic acid, ferulic acid, gallic acid, *p*-chlorobenzoic, acid etc. were released and maximum release was observed at 15 days of decomposition. Release of phenolic acids varied between alfalfa and kava, which were related to electrical conductivity (EC)(Xuan *et al.* 2005) decomposed *Vulpia* material up to 60 days was found to be effective as reflected by reduced wheat germination bioassay (An *et al.* 1997).

Table 1. Effect of decomposed material at 3.6 t/ha of botanical agents on germination of Parthenium.

Period (days) of decomposition	*Hyptis*	*Cassia*	*Lantana*
0	10	10	10
10	26	13	10
20	20	16	23
30	10	30	10
40	40	33	16
Control	**77**	**79**	**83**

LSD (P=0.05) = 17.2

Influence of soil microbes and allelopathic botanical agents on suppression of Parthenium.

Sterilization of soil reduced the germination of Parthenium significantly compared to non-sterilized soil.

This may be due to alteration in nutrients availability from soil. Further in the presence of extracts of botanical agents significantly reduced the Parthenium germination. The suppression of germination of Parthenium due to the presence of any botanical extract in sterilized soil was substantial compare to non-sterilized soil. Microbes alter the allelopathic activities by releasing the phenoilc acids. They metabolize the released phenolic acids by addition or deletion of side groups, polymerization or use as carbon source for their growth (Blum 1998 and Blum *et al.* 1999). This data suggests that the microbes present in soil may degrade the allelochemicals added to the soil by *Hyptis*, *Cassia* and *Lantana* dry leaf extracts make them less effective. Thus sterilized soils free from microbes were more effective than non-sterilized soil.

Table 2. Effect of soil sterilization on allelopathy of botanical agents on suppression of Parthenium germination

	Sterilized soil	Non sterilized soil	Mean
Hyptis			
5%	0.0^{e}	33.33^{c}	16.66^{c}
10%	0.0^{e}	20.83^{cd}	10.41^{b}
Control	78.33^{b}	87.5^{ab}	82.91^{a}
Mean	26.111^{b}	47.33^{a}	36.66^{a}
Cassia			
5%	0.0	25.0	12.5
10%	0.0	16.65	8.32
Control	78.33	95.83	87.08
Mean	26.111	45.46	35.97
Lantana			
5%	0.0	20.83	10.41
10%	0.0	16.66	8.33
Control	78.33	95.83	87.08
Mean	26.111	44.44	35.3
CD for species (P=0.05) :			6.605
CD for soil condition and species (P=0.05) :			9.341
CD for soil condition, species and concentration (P=0.05) :			16.18

Mulching of botanical agents *viz. Lantana ,Hyptis and Cassia* above ground portion can be used to the germination and growth of Parthenium . Even material decomposed upto 20 days can be used. Colonization of *Cassia* effectively suppressed Parthenium but being annual after the senescence Parthenium produce few seeds and propagate. Hence mulching of these botanical agents can be used effectively to check Parthenium spread.

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