PARTHENIUM HysteroPhorus- An Economical Tool To Increase The Agricultural Productivity

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INTRODUCTION

Parthenium hysterophorus is a well known weed that is a serious problem in agriculture. It also produces a toxin called parthenin. However, in this paper we have utilized the leachate of different plant parts of Parthenium plant and observed the effect on several aspects such as seed germination of Phaseolus mungo, metal tolerating capacity of the seeds against iron, lead, mercury and nickel of seeds during germination, antimicrobial activity against fungal pathogens and effect on brinjal fruit borer. We observed that there was a 48.8 % increase in the seeds germination of the seeds treated with flower leachate. The metal tolerating capacity was highest in leaf extract against iron, in stem extract against lead, in flower extract against mercury and leaf extract against nickel. The flower extract exhibited 100% mortality on brinjal fruit borer. This study demonstrated that the weeds can be used to obtain growth factors easily in aqueous medium and that can be utilized for enhanced plant growth of desired plants.

Keywords: Parthenium, Seed germination, Metal tolerance, Plant growth enhancer

Parthenium hysterophorus, commonly known as Peterson’s Curse or Santa-Maria Feverfew, is an obnoxious weed which can cause a total habitat change in native grasslands, the under storey of open woodlands and along rivers and flood plains (Chippendale and Panetta, 1994). Owing to its fast spread Parthenium hysterophorus L. has become a problematic issue to humans all around the world. It can tolerate drought condition also to a certain extent under favorable conditions (Mahedavapa et al., 1999). Parthenium hysterophorus L. completes about three generation in a year. It is also reported that congress grass has remarkable power of regeneration (Dhawan and Dhawan, 1996).

Parthenium hysterophorus L. (Asteraceae), an annual asteraceous herb, is native to Central and South America and is considered to have originated from the Gulf of México (Rollins,
Parthenium hysterophorus has spread rapidly and extensively throughout the world since the 1970s (Evans, 1997) and is considered a major threat in many regions (Adkins & Navie, 2006). Parthenium hysterophorus is capable of growing on a wide range of soil types ranging from sandy to heavy clays, but favors the latter (Dale, 1981). Parthenium hysterophorus occurs in areas with summer rainfall greater than 500 mm per annum (Chamberlain & Gittens, 2004). Germination can occur at temperatures between 10°C and 25°C, it has high germination ability throughout the year (Tamado et al., 2002).

Due to the invasive capacity and allelopathic effects of P. hysterophorus (Mersie and Singh, 1987), natural ecosystems are disrupted (Evans, 1997). Allelopathy is achieved primarily via the two groups of allelochemicals, phenolics and sesquiterpene lactones, mainly parthenin (Belz et al., 2007), which inhibit the germination and growth of plants that include pasture grasses, cereals, vegetables and other plant species (Navie et al., 1996; and Evans, 1997)

Parthenium hysterophorus also causes human health problems such as asthma, bronchitis, dermatitis and hay fever (Evans, 1997). Parthenium hysterophorus taints the milk and meat of animals, thereby reducing the value of animal products (Tudor et al., 1982). Parthenium hysterophorus in animal feed causes dermatitis with pronounced skin lesions (Ahmed et al., 1988) and a significant amount (10–50%) of P. hysterophorus in the diet can kill cattle and buffalo (Narasimhan et al., 1977). The antimicrobial activity of leaf leachates of plants and weeds depends on the phytochemicals present in it (N.B. Barsagade and G.N. Wagh, 2010). It has been reported that the antimicrobial activity depends on the bioactive agents present in the leaves of plants or weed leachate has been reported to be associated with phytochemical constituents and botanical properties. (N.B. Barsagade and G.N. Wagh, 2010). The results obtained in their study confirmed the antimicrobial potential of methanol and acetone leachates of congress grass. The leaf leachates of plants and weeds have great potential as antimicrobial compounds against microorganisms. Thus, they can be used in the treatment of infectious diseases. The allelochemicals released from parthenium affecting many plant species...
are sesquiterpene lactones and phenolics (Swaminathan et al., 1990).

The most common effects of allelochemicals may occur through leaching, volatilization, root exudations and decay of the fallen parts either through biotic or abiotic means (Anaya et al. 1990).

Positive and negative allelopathic effects have been reported of Parthenium on many agricultural crops and other plant species (Oudhia et al. 1997, Aggarwal & Kohli 1992) and it inhibits the surrounding herbaceous vegetation (Nath 1988, Srivastava et al. 1985). There are hundreds of secondary metabolites in the plant kingdom and many are known to be phytotoxic (Einhelling 2002). Allelopathic effects of these compounds are often observed to occur early in the life cycle, causing inhibition of seed germination and/or seedling growth.

MATERIALS AND METHODS

Plant Material Collection and Preparation

Parthenium plants were collected from the GITAM University campus. The plant parts were separated viz root, stem, leaves and flowers. The parts were thoroughly washed with sterile distilled water. The parts were blotted dry and used for further experimentation.

Effect of Parthenium Leachate on Seed Germination

Parthenium plant parts (root, stem, leaves and flowers 250 gm each) were soaked separately in 500 ml distilled water for 24 hours. The leachate was then used to treat seeds of Phaseolus mungo. The seeds were purchased from local market. 100 seeds were taken and were treated with 10 ml of leachate for 2 hours. Seeds soaked in distilled water served as control. The seeds were placed in a petridish on a two layered moistened filter paper. The root length was measured after three days.

Effect on Metal tolerance Capacity During Seed Germination

A set of 100 seeds were taken and soaked in a solution of 10 ml of different metals (concentration 1mg/ml) (FeCl₃, HgCl₂, PbSO₄, Ni (SO₄)₂ solutions. Following this, the seeds were treated with leachate of different plant parts. Seeds treated with distilled water served as control. The seeds were observed for germination and the root and shoot length was measured after three days.

Screening of Control Seeds for Infection

The infected seeds in control were separated. The fungal spores on the seeds were taken using inoculating loop and streaked on to Sabouraud’s agar plates. The plates were incubated at 28°C for 48 hours. The fungi were identified by spore morphology and microscopic examination.

Evaluating the Antifungal Activity of Aqueous Leachate

Two fungal cultures (isolated from infected seeds) were spread on to Sabouraud’s agar plates. Well of 4 mm diameter of was made and 0.1ml of the aqueous leachate of each plant part was dispensed. The plates were incubated at 30°C. Following incubation the plates were observed for zones of inhibition.

Evaluating the Activity of Leachate on Larvae of Brinjal Fruit Borer

A total of 100 larvae of brinjal fruit borer were taken and treated with leachate of each plant part (100ml of leachate was used to treat the larvae). Treatment with distilled water served as control. The larvae observed for mortality.
Quantification of Auxins in the Aqueous Leachate

The aqueous leachate of *parthenium* plant parts (roots, stem, leaves and flowers) at a concentration of 1 gm/10ml were separately used for IAA estimation. To 0.2 ml aliquots, 50 µl of 50% ethanol was added and reagents comprising of one part of Salkowski reagent and one part Erhlich’s reagent were added. After heating at 45 °C for 30 minutes colour developed was estimated after making up to 1 ml with 50% ethanol at 615 nm against blank. A graph was plotted taking IAA as standard.

RESULTS

Effect of *Parthenium* Leachate on Seed Germination

The seeds on treatment with the root leachate of *Parthenium* showed 37.8% increase in the root length and 43.24% increase in the shoot length respectively. When the seeds were treated with stem leachate, an increase of 34.8% in the root length and 36.36% increase in shoot length were observed. The treatment with leaf leachate showed a 5.5% increase in root length and 23.8% increase in the shoot length respectively. The treatment with flower leachate showed the highest increase in the root length of 48.81% and 37.31% increase in the shoot length respectively. Figure 1 and 2 shows the effect of leachate on root length and shoot length of *Phaseolus Mungo*.

Effect on Metal Tolerance Capacity During Seed Germination

Tolerance of Mercury

The seeds treated with mercuric chloride solutions and subsequently treated with different *parthenium* leachates (root, stem, leaf, and flower leachates) showed significant increase in root and shoot length in comparison with control. The seeds showed maximum increase in root length (44.89%) when they were treated with flower leachate followed by an increase of 38.63%, 18.18%, 42.53% when they were treated with leaf, stem and root leachates respectively. Treatment with root and flower leachates increased the shoot length by 8.69% and 16% whereas treatment with stem leachate decreased the shoot length by 10.5% and treatment with leaf showed no effect Figure 3a and 3b shows the root and shoot length respectively of seeds treated with mercury salt.
When the seeds were treated with nickel sulphate solution and a subsequent treatment with different leachates of *parthenium* (root, stem, leaf, and flower leachates) the root length increased by 66.45%, 67.15%, 68.16% and 64.94% respectively. There was an increase in the shoot length by 67.41%, 68.13%, 68.87%, 70.40% on treatment with the root, stem, leaf and flower leachates respectively.

As it is evident from the results there was a maximum increase in the root length in the seeds treated with leaf leachate (68.16%) and maximum increase in the shoot length in the seeds treated with flower leachate (70.40%) Figures 3a and 3b shows the root and shoot length respectively of seeds treated with nickel salt.

Tolerance of Nickel
When the seeds were treated with a solution of lead sulphate and subsequently treated with different leachates of parthenium (root, stem, leaf and flower leachates) the root length enhanced by 41.53%, 40.88%, 39.20%, 41.53% and the shoot length increased by 14.08%, 8.9%, 12.34%, 26.04% respectively. Maximum root length was observed in the seeds treated with root and flower leachates (41.53%) and the highest shoot length was observed in the seeds treated with the flower leachate (26.04%).
When the seeds were treated with solution of ferrous sulphate and subsequently treated with parthenium leachates which include root, stem, leaf and flower leachates, they enhanced the root length by 1.3%, 13.25%, 2.0% and 2.7% respectively. On the other hand, treatment with leaf and flower decreased the shoot length by 48.5% and 21.15% respectively. Figures 5a and 5b show the root and shoot length respectively of seeds treated with ferrous salt.
Screening of Control Seeds for Fungal Infection

The spore morphology and microscopic examination revealed that the control seeds were infected by *Aspergillus niger* and *Aspergillus flavus*

Effect of Leachate on Larvae of Brinjal Fruit Borer

The pesticidal activity was observed in the flower leachate. The flower leachate showed 100% mortality within 10 minutes and in the remaining leachates no effect was observed.
Figure 6: Effect of Iron

b) Effect on Shoot Length

Figure 7: Quantification of IAA-Concentration In Root And Stem Extract Concentration In Leaf Extract 3-Concentration In Flower Extract
Quantification of Auxins
The concentration of IAA was found to be maximum in flower extract (0.06g/ml) Figure 7 shows the amount of auxins in different extracts.

Antifungal Activity of the Aqueous Leachate of Parthenium
The flower leachate exhibited significant antimicrobial activity against *Aspergillus flavus* and the inhibition zone was observed as 7mm. The other leachates showed no effect.

DISCUSSION
Plant extracts have played significant role in the inhibition of seed-borne pathogens and in the improvement of seed quality and field emergence of plant seeds (Nwachukwe, 2001). Patel *et al* have worked on antimicrobial activity of weeds and have reported the efficiency of parthenium weeds against bacteria and fungi. The excessive growth of the weeds is due their high production of growth hormones. From the above experimental results it is clear that *parthenium* flower extract is very effective as a plant growth enhancer. The germination of seeds needs auxins and it has been observed that the concentration of auxins was highest in flower extract. In addition to hormones that are some other factors that have enhance metal tolerance. In our further study we would like to see whether a plant treated with parthenium extract is safe for consumption or not. At present this study can have application in enhancing the growth of flowering plants.

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