Chapter 1

INTRODUCTON

INTRODUCTION

Parthenium hysterophorus was accidently introduced in India around 1956 and has since spread over most part of the country. *Parthenium hysterophorus* now occurs throughout the tropical and subtropical America from southern United State of America to southern Brazil and to northern Argentina. *Parthenium hysterophorus* is an herbaceous annual ephemeral member of the family Asteraceae attaining a height of 2 meters in good soil and reach flowering within 4-6 week after germination. In India, it was accidently introduced through PL-480 wheat import and first appeared at Pune (Maharashtra), from where it has spread rapidly in all directions and has successfully colonized vast areas. Its allelopathic effect and high rate of reproduction are the major causes for rapid spread in all types of terrestrial and marshy habitats (Pandey *et al.* 1989).

This plant is found as a weed in many parts of the India. It has longitudinally grooved stem. The leaf is alternate, sessile and irregularly dissected. The florets are white, born on terminal or axillaries, peduncle paniculate and the heads are approximately 0.5 cm in diameter. The plant bears flowers and fruits throughout the year. *P. hysterophorus* aggressively colonizes and disturbs the site. In some areas it has become an extremely serious agricultural and rangeland weed. It is also known to be allergic to some people and consumption by livestock can taint meat. It has major impact on pasture and cropping industries, spreading to and impacting on new areas. Control of *P. hysterophorus* can be managed using a combination of methods depending on the site, including biological control agents, pasture management cultivation and chemicals. Chemical analysis has indicated that all the plant parts including trichome and pollen contain a toxin called sesquiterpene lactones. The major component of this toxin being parthenin and other phenolic acids such as caffeic acid, vanilic acid, anisic acid, chlorogenic acid, parahydroxy benzoic acid and p-anisic acid which are lethal to humans and animals.

Congress grass is most noxious dominant weed of the cultivated fields and fallows lands of India. Beside crop losses, it exhibits allelopathic effects on neighboring crop plants and affects their growth. It is an extremely adaptable weed and can grow on any kind of soil. It has become a menace to crop fields, vegetable and horticultural fields, forest nurseries, causing severe losses to food and fodder crops (Khosla *et al.* 1980).

It is considered as a noxious weed because of its allelopathic effect (Kanchan and Jayachandra, 1980; Swaminathan *et al.,* 1990; Adkins and Sowerby, 1996; Sharma *et al.,* 2005; Kumar and Gautam, 2008), strong competitiveness for soil moisture and nutrients, as well as the hazard it posses to humans and animals i.e. causing dermatitis (Khosla and Sobti, 1979; More *et al.,* 1982; Lakshmi and Srinivas, 2007a; Verma *et al.,* 2006; Srinivas, 2006). Pollens of this weed cause allergenic rhinitis (hey fever) (Lakshmi and Srinivas, 2007b) and may develop finally in bronchitis (asthma). This weed also invades all sorts of crops and herbaceous flora, causing a substantial loss on yield and growth. The major toxicants of *P. hysterophorus* are parthenin and other phenolic acids such as coffeic acid, vanillic acid, ansic acid, chlorogenic acid and parahydroxy benzoic acid, which are lethal to human beings and animals (Mahadevappa, 1997; Oudhia, 1998).

Rajan (1973) and Kanchan and Jayachandra (1979) were the first who reported the presence of plant growth inhibitors in *P. hysterophorus* weed. Jayachandra (1971) reported that this weed can be a serious problem for grassland in India, which can reduce the pasture carrying capacity severely up to 90%. Serious human health risk due to *P. hysterophorus* had been reported in India, about three decades ago (Srinivas, 2005; Handa *et al.,* 2001; Dhileepan *et al.,* 2000; Chippendale and Panetta, 1994; Lonkar *et al.,* 1974).

Kumar *et al.* (2007) made survey of *Parthenium hysterophorus L.,* in and around the campus of Banaras Hindu University (BHU) and observed that few *P.*

hysterophorus plants were diseased, and symptoms were restricted to the flowers, buds, and inflorescences. Khan *et al.* (2008) reported that the *P. hysterophorus* L., being a declared invasive weed is threatening the biodiversity and human health in several areas of Pakistan.

Taye and Gossmann (2007) reported that the *Parthenium hysterophorus* L. is an exotic invasive annual weed causing severe infestation in Ethiopia. Exploratory surveys revealed that parasitic fungi associated with *P. hysterophorus* in Ethiopia comprised of *Helminthosporium sp.*, *Phoma sp.*, *Curvularia sp.*, *Chaetomium sp.*, *Alternaria sp.* and *Fusarium sp.* It was, therefore, concluded that though these fungal isolates constituted new records they have no significant potential for biological control of *P. hysterophorus* due to their opportunistic behaviour.

The pathogens which cause powdery mildew belongs to the family Erysiphaceae. They form white powdery appearance due to the production of enormous number of hyaline conidia on the surface of host and haustoria in the epidermal cells of hosts. Powdery mildew is an obligate parasite ascomycetous fungus which grows principally on foliage of Angiosperms and cause damage to a wide variety of crops. The fungus shows very mild infection producing small patches on the host, later it becomes chlorotic and may kill the plant as a result of severe infections. Powdery mildew fungi have wide host range. Blumer (1967) observed powdery mildew on 1928 plant species belonging to different families of Angiosperms.

In the absence of perfect stage the identification is mostly done on the basis of conidial characters (Clare, 1958, Kable and Bllantyne, 1963). Zaracovitis (1965), Goster (1966), Blumer (1967), and Mathur *et al.* (1967) suggested that the two can be differentiated on the basis of production of forked germ tube in *Sphaerotheca fuliginea* and appressoria like bodies in *Erysiphe cichoracearum*. The causative agent of powdery mildew of majority of members of Asteraceae has been identified

as *E. cichoracearum*. Mc Keen *et al.* (1966) studied the pathogenicity of *Erysiphe cichoracearum* on *Helianthus annuus* and found that houstoria of the fungus were elongated, ellipsoidal with twisted branches and host cell wall surrounded the infection peg of powdery mildew fungi.

The effect of different environmental factors on powdery mildew has been extensively studied by Graf and Martin (1934), Yarwood (1957) and Schnathorst (1965). Different environmental factors also influence the production of perithecia (Yarwood, 1957). Blumer (1948) reported that low relative humidity favored the formation of perithecia. Bessey (1943) and Yarwood (1957) reported that amongst the different climatic factors, temperature appeared to be the most important for perithecia formation. Size and shape of conidia is influenced by temperature, relative humidity and host nutritional value.

Mycelium is usually well developed, evanescent but some time persistent and effused. Conidia in long chains, ellipsoid or barrel shaped, highly variable in size, 25-45×14-26 µm. Cleistothecia are formed in autumn, gregarious or scattered, globose becoming depressed or irregular, 90-135 µm in size, wall of the cell usually indistinct, 10-20 µm wide. Appendages numerous, basally inserted mycelioid, interwoven with mycelium, hyaline to dark brown, 1-4 time as long as the diameter of the ascocarp, rarely branched. Ascus 10-25, ovate to broadly ovate, rarely subglobose, more or less stalked, 60-90 × 25 - 50 µm. Ascospores 3 very rarely 5, 20 – 30 × 12 - 18 µm in size.

Gorter and Eicker (1983) reported the teleomorphic stage of the *E. cichoracearum* from South Africa on *Zinnia spp.* In India the Sunflower has been recorded as the host of *S. fuliginea* by Jhooty (1965) from Chandigarh. The perfect stage of this pathogen was reported on *H. annuus* by Patil (1964) from Maharastra.

Dugan and Glawe (2007) reported *Erysiphe polygony* in *Rumex cripus*, from California, in the Pacific Northwest. *Podosphaera* (*Sphaerotheca*) *fusca* is

reported in the Pacific Northwest for the first time on *Taraxacum laevigatum*, a host record documented previously in Europe. New hosts such as *Golovinomyces sordidus* on *Plantago major*, *Erysiphe convolvuli* on *Convolulus arvensus*, and *Podosphaera* (*Sphaerotheca*) *aphanis* on *Geum macrophyllum*. *Golovinomymyces* (*Erysiphe*) *cichoracearum* on *Circium arvense* are reported for the first time in Washington.

Utkhede *et al.* (2000) reported a powdery mildew disease of greenhouse tomato that first appeared in the Fraser Valley of British Columbia in 1995. The causal agent was identified as *Erysiphe orontii.* Lebeda *et al.* (2001) reported that the symptoms of powdery mildew infections were recorded on a group of 15 *Utricularia* species cultivated in a glasshouse. A white superficial mycelium formed rings around the peduncles and also occurred on both sides of the leaves of several species. . This is the first report of a powdery mildew on *Utricularia* spp. and the family Lentibulariaceae. Moyer *et al.* (2004) reported that the powdery mildew caused by *Erysiphe cichoracearum* or *Podosphaera fusca*, is a common disease of gerbera daisy (*Gerbera jamesonii*) grown in Florida. Khodaparast and Abbasi (2004) reported the species, host ranges and geographical distribution of powdery mildew fungi in Iran. Lebeda *et al.* (2009) reported that the two ectoparasite powdery mildew species *Golovinomyces cichoracearum* (*Gc*) and *Podosphaera xanthii* (*Px*) occurring on cucurbits differ, besides other characteristics, by specific ecologic requirements.

Glawe *et al.* (2003) first time recorded the powdery mildew of *Convolvulus arvensis* (field bindweed) caused by *Erysiphe convolvuli* var. *convolvuli* in North America. Field bindweed (*Convolvulus arvensis* L.) is widespread in the Pacific Northwest where it is considered a noxious weed. Similarly, the powdery mildew on potato caused by *Leveillula taurica* in North America and powdery mildew of *Coreopsis* species caused by *Golovinomyces cichoracearum* in the Pacific Northwest were also for the first time reported by Glawe *et al.*, (2004, 2006). Frank

and Glawe (2006) for the first time reported the powdery mildew on *Dipsacus sylvestris* caused by *Sphaerotheca dipsacearum* in North America. Dugan and Glawe (2006) reported *Erysiphe flexusa* first time in Western North America. Pacific North West Fungi. Lebeda *et al.* (2002) were first to observe the symptoms of powdery mildew disease on *Pachypodium lamerei* in the Czech Republic.

Jancovits *et al.* (2006) observed the symptoms of powdery mildew infection on striped sedum (*Sedum alboroseum* CV. Mediovariegatum, syn. *Sedum erythrostichum* f. *variegatum*), sold as potted ornamental plants in Budapest. Reis *et al.* (2007) reported *Oidiopsis haplophylli* (syn. *Oidiopsis sicula*) and identified it as the causal agent of powdery mildew diseases occurring on five ornamental species in Brazil. Sudha and Lakshamanan (2007) reported that the powdery mildew disease incited by *Leveillula taurica* was found on *Capsicum annuum* (chilli). Moyer *et al.* (2008) reported that the powdery mildew caused by the fungus *Erysiphe cichoracearum* DC. or *Podosphaera fusca* is a common disease on gerbera daisies (*Gerbera jamesonii* Bolus ex. Hook f.) grown in Florida.

Takamatsu *et al.*, (2009) reported that the powdery mildew fungus *Erysiphe* (*Uncinula*) *kenjiana* (Erysiphales, Ascomycota) has been found in Ukraine. This is the first record of this fungus in Europe. Choi *et al.* (2009) found that powdery mildew symptoms were observed on leaves of *Arabidopsis thaliana* caused by *Erysiphe cruciferarum* in Korea University, Seoul. Bacigalova and Markova (2006) reported a new species of powdery mildew *Erysiphe azalea* (Erysiphales) for Slovakia and further records from the Czech Republic. Hartman *et al.* (2007) showed the powdery mildew (*Erysiphe cichoracearum*) produced on the surface of leaves of *Phlox paniculata* leaves in summer. Voytyuk (2004) gave information about *Neoerysiphe galii* (Erysiphales), a powdery mildew fungus new for Israel, is provided. Nagraja and Deshmukh (2009) reported that the powdered leaves, stem and roots of *Andrographis paniculata* (Nees) adversely affected the metabolism of *Parthenium hysterophorus* L.

Because of its high reproductive capacity and wide dispersal means, it is difficult to eradicate this weed. The control measures include:

1-Uprooting the plants, preferably before flowering, either manually or mechanically and thereafter burning them. This method is particularly easy during rainy season when the soil is wet.

2-Several pre- and post-emergence weedicides have been tried for controlling this weed. Chemicals like atrzine, simazine, prometrine, monouron, chloroformuron, 2, 4-D-amine and disodium methane arsenic acid (DSMA) were found effective in controlling this weed. Lasso and sencor (2kg/ha), atrazine (1.5kg/ha), and diuron and boromacil (1.5kg/ha) were found effective in preventing the emergence of this weed. The herbicides, diquat (0.05-0.1%) was found the most effective of the growth stage. Spraying 200 ppm 2, 4-D and garamoxone and 700 ppm stam F-34 during flowering stage completely inhibited the germination of weed pollen grains. Use of combination of 2, 4-D sinbar and reglone as post emergence sprays was most effective in killing the weed within 5-10 days. Post emergence spray with EMD-730 W causes 100% female sterility, thus checking the multiplication of the weed.

3-Several native insects such as mealy bugs and aphids attack congress grass, but these are of little value. It is reported that when aphids were released on this weed, its flowering and fruit setting were affected. *Pseudococcus sp.,* were better adapted to this weed causing wilting of the plants. *Tetranychus* a mite when transfered to fully grown healthy plants caused complete wilting in about two weeks (Towers *et al.*, 1977).

Congress grass possess a serious health hazard as repeated contact with this grass causes allergic contact dermatitis in humans, cattle and other herbivores. The main toxic constituents of the plant responsible for causing dermatitis and other form of allergy are parthenin and coronopilin. Parthenin is present up to 8% in

capitulum and 5% in leaves. Also, inhalation of the weed's air borne pollen causes allergic rhinitis, redenning of eyes with swelling of eyelids, fever and asthma (Khosla *et al.,* 1980).

It exhibits *in vitro* anti-amoebic activity against axenic and polygenic cultures of *Entamoeba histolytica*, comparable to the standard drug for amoebiasis, metronidazole. Parthenin and some of its derivatives exhibited significant antimalarial activity against the multi drug-resistant strain of *Plasmodium falciparum* (Sharma *et al.,* 1988). The grass also possesses antifungal property. The water extracts of leaves showed 50.5% inhibition while hot water extract showed 48.3% inhibition of mycelia growth of *Pythium aphanidermatum*. The plant extract exhibits antiviral activity against *potato virus Y*, which affects the chili crop severely (Suriachandraselvan *et al.,* 1987). *Parthenium hysterophorus* is reported to be responsible for the allelopathic effects produced by the plant. It exhibited an inhibitory effect on wheat seed germination and growth (Patil *et al.,* 1988). The plant can be used as an additive with cattle manure for the production of biogas. The methane content in the biogas is 60-70%. Methanolic extract of the flowers contains the toxic constituents, 2β-hydroxycoronopilin, 8β-hydroxycoronopilin and 11-H, 13-hydroxyparthenin besides parthenin and coronopilin. The 10% cold aqueous extract of the flowers produced hypotensive response in dogs. The flower extracts also produced cardiac depressant effect on perfused frog heart and spasmogenic action in isolated rabbit duodenum. The response was due to released of histamine by the flower extract (Sethi *et al., 1987*).

The leaves and root contain parthenin, caffeic acid, chlorogenic acid, hydroxybenzoic acid, p-anisic acid, vanillic acid, calicylic acid, gentisic acid, p-neochlorogenic acid and protocatechuic acid. These compounds exhibit phytotoxic effects on germination of seeds and seedling growth of the crops (Sinha *et al.,* 1990). A decoction of the leaves possesses fungicidal property against majority of the seed borne fungi of pearl millet, sorghum and maize. Aqueous extract of leaves

and flowers contain phytotoxin which were responsible for lethal effects of the extract on frog tadpoles (Nandakumar *et al.,* 1990). Acetone extract of the leaves yields a crystalline compound with succinate dehydrogenase antagonist property; it exhibits the activity of sheep liver succinate dehydrogenase. The callus extracts contain parthenin, coronopilin, hysterin, tetraneurin A, D, ambrosin, pseudoguaianolide and dihydroparthenin (Talwar *et al.,* 1989).

Ageratum conyzoides are polymorphic, aromatic and annual herb, native to tropical America, neutralized as a weed throughout the India. The plant is used externally in ague, and internally as a stimulant tonic. The ash of the herb is good source of potash (Kasturi 1973). The leave use along with salt as a vulnerary, they are said to prevent tetanus. The juice of leave use as eye lotion and the leave on steam distillation use an essential oil (Rudolf and Sood 1969).

Cissampelos pareira plants are used as medicine. The dried roots form the drug (Chopra *et al.* 1958). The roots are edible possess astringent, diuretic, antilithic, analgesic, antipyretic properties. They are prescribed for treating cough, dyspepsia, diarrhea, dysentery, dropsy such as cystitis, hymorrhage (Rai *et al.* 1982, Bhatnagar *et al.* 1961). An ethanolic extract of stem and root shows CNS-depressant activity (Chowdhury 1972).

Euphorbia hirta is often used in traditional medicine in many parts of Africa and Asia for treatment of several ailments viz., gastrointestinal disorder (diarrhoia, dysentery), bronchial and respiratory disease (asthma, bronchitis, hay fever) and in conjunctivitis. The aqueous extract of herb exhibits sedative, anxiolytic, analgesic, antipyretic and anti-inflammatory activities (Kapur 1991 and Mohiddin *et al.* 1991). The herb is well known for its anticancer property. The root exudates also exhibited nematicidal activity against juvenile *Meloidogyne incognita* (Das and Misra 1987).

Melilotus indica are vulnerable to fungal diseases like damping off (*Pythium*), crown and stem rot (*Sclerotium*) by Kumar and Joshi (1988). The seed contain moisture, crude protein and gum (Kapoor *et al.* 1988).

Solanum nigrum are diuretic and laxative properties and its decoction is regarded as antispasmodic and narcotic. Decoctions of the plant after transient stimulation, depress the central nervous system and reflexes of spinal cord, reduction in blood pressure (Dhar *et al.* 1968). Leave are use in the treatment of scrophulous dyscrasias and are said to produce diaphoresis (George *et al.* 1947). Berries are considered to possess tonic, diuretic and cathartic properties and are useful in anasarca and heart diseases (Chopra 1958).

Vernonia cineria plant infusion makes a useful combination with quinine against malarial fevers. Fresh juice of the leaves is given in amoebiasis and ringworm. The juice are boiled with oil and used for the treatment of elephantiasis (Dhar *et al.* 1968, Day 1969). The seeds are commonly used as an antihelmintic and alexiformic (effective against roundworms and threadworms). They are also given for coughs, intestinal colic and dysuria and skin disease.

During the survey of fungal disease of weeds growing in and around Aligarh, it has been observed that *P. hysterophorus* showed moderate to severe infection of powdery mildew disease. A preliminary study indicated that the *P. hysterophorus* might be infected with *Erysiphe* sp. and/or *Sphaerotheca* sp. Literature scanned revealed that the powdery mildew disease in *P. hysterophorus* was reported only from Jabalpur M.P. (Patel and Sharma, 1996) and Haydrabad A.P. (Prasad and Rani, 1981). Therefore, keeping in view the occurrence of powdery mildew disease on (*P. hyterophorus*) and its causal agent(s) the following aspects has been carried out in the present study.

1- Survey and identification of causal agent (s) of powdery mildew disease of *P. hysterophorus*.

2- Studies on the anamorphic and teliomorphic characteristic features of *Erysiphe cichoracearum* var. *cichoracearum* and *Sphaerotheca fuliginea* infecting *Parthenium hysterophorus*.

3-Studies on the comparative characters of anamorph state of *Erysiphe cichoracearum* var. *cichoracearum* on some weeds.

4- Disease intensity and frequency of occurrence of powdery mildew diseases of *Parthenium hysterophorus* in different localities at Aligarh.

5- Disease intensity and frequency of occurrence of powdery mildew diseases of weeds in different localities at Aligarh.

6- Impact of powdery mildew disease caused by *Erysiphe cichoracearum* var. *cichoracearum* and *Sphaerotheca fuliginea* on the growth of *Parthenium hysterophorus*.