Measurement of ecological parameters of *Parthenium hysterophorus* weed and its socio-economic impacts in India.

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Abstract

Measurement of ecological parameters of *Parthenium hysterophorus* weed is done, in open (grazing) grasslands and protected grasslands in the forest of Ambikapur (India). Ecological parameters *i.e.* abundance, density , Relative density, frequency index , basal area and dominance , are measured and compared with the same parameters of both grasslands , and the difference is described as an effect of inter specific competition between *Parthenium hysterophorus* and other accompanied grasses. The possibility of biological control of *Parthenium hysterophorus* inter specific competition is studied. Hazardous effects due to its spread e.g. village's farmers face a socio-economic loss while entire grassland and forest ecosystems face a threat to be disturbance of food chain, ultimately, it is effecting to the village's farmers nearer to the forests is discussed .

Key words: *Parthenium weed*, Dangerous weeds, Inter – specific - competition, Biological control of weed. Congress weed.

Introduction:

Parthenium hysterophorus L. is a genus in the family Asteraceae (Compositae), native to tropical Americas, *Parthenium hysterophorus*, is an aggressive weed invading all disturbed land, including farms, pastures, and roadsides. Contact with this plant causes dermatitis and respiratory malfunction in humans, dermatitis in cattle and domestic animals, due to the presence of toxin *Parthenium hysterophorus.* (1)

The species *Parthenium hysterophorus*, also known as congress weed or congress grass, has become a common weed in Australia Taiwan, Southern China, the Pacific Islands, India and has recently spread to East and South Africa ,India, Australia and parts of Africa. In some areas, outbreaks have been of almost epidemic proportions, impacting crop production, live stock and human health. It's also called Congress weed in India, Parthenium weed. (2)

Parthenium is a fast maturing plant with a deep tap roof that can grow to a height of 1.5 to 2 meters having branched leaves covered with fine hairs. It grows a large number of small white flowers and seeds of light weight that are easily dispersed to distant places causing allergy in human beings. Each plant can produce up to 10,000 seeds. It has the capacity to re-grow from the cut or broken parts. It has no natural enemies such as insects and diseases because of which it spreads rapidly in India. (3)

Lakshmi Chembolli and C. Srinivas studied *Parthenium hysterophorus L*. (congress grass, congress weed, carrot weed, wild feverfew, the "Scourge of India") is an exotic weed that was accidentally introduced in India in 1956 through imported food grains. (4)

Chippendale, J.F. and Panetta, F.D. (1994) studied the cost of *Parthenium hysterophorus*, weed to the Queensland cattle industry .He stated that *Parthenium hysterophorus* weed commonly dominates cultivated and other disturbed areas, in addition to flood-prone pastures. (5)

Navie, S.C., McFadyen, R.E., Panetta, F.D., Adkins, S.W., 1996. Introduced biotypes of *Parthenium Hysterophorus* .Two biotypes of *Parthenium hysterophorus L*. have established in Australia as a result of two separate introductions from the USA. The first introduction occurred in south-east Queensland and the second in central Queensland. Nine plants from each of the biotypes were grown under a day/night temperature regime of 2313°C /13°C and 14 hour photoperiod in a plant growth cabinet for a period of five months. (6)

Adkins, S.W., Navie S.C., McFadyen R.E, 1996, studied the harmful effect and control of *Parthenium* Weed (*Parthenium Hysterophorus* L.) in southern Asia , and found that It causes direct losses to the grazing industry (about $A 14-18 million per annum) and is a human health hazard, causing allergic rhinitis and contact dermatitis. (7)

Adane Kebede Gebeyehu (2008) studied the distributions of *Parthenium* weed and explained that the weed is widely distributed in north-eastern parts of the Woreda. Results also showed that from all the sample species *Parthenium hysterophorus* was found to be the most abundant in road sides. (8)

Mc Fadyen, R.E. (1995).studied *Parthenium* weeds its effects on human health in Queensland. Allergic reactions to the pollen and plant dust of the *Parthenium* weed are causing major health problems, which can be expected to increase, especially as the pasture weed is rapidly spreading south. This paper reviews published information on health aspects of this weed and calls attention to its spread into areas with much greater population. (9)

The objective of this paper is to study the ecological and Socio-economic impacts of *Parthenium* in India and to discuss it biological control by inter specific competition ,Since *Parthenium* weed has a strong and thick root, named also as a carrot

grass, a manual uprooting , application of chemical herbicides , insects ,and pathogen is not successful yet. So that, a new idea is applied in this paper.

The ecological parameters of *Parthenium hysterophorus* studied at present in open grassland are compared with the same parameters of the ecology practical records of previous year 1999 and 2004, studied in this dept. The population growth *i.e.* spread of *Parthenium hysterophorus* weed is described, based on these comparative parameters .

Methodology

A protected grassland and a grazing grassland of forest of Ambikapur India is chosen .The measurement of ecological parameters *i. e.* abundance, density , Relative density, frequency index , basal area and dominance is done in present situation in the open (grazing) and protected grasslands in the forest of Ambikapur (India).

The ecological parameters of *Parthenium hysterophorus* studied at present (October 2022) in open grassland , are compared with the same parameters of the previous year 2012 and 2017 for the calculation of population growth. The method described by E. P. Odum (10) is followed for the measurements and calculations of all the ecological parameters.

A visit has been done to the farmers and workers of villages at remote tribal forest area. A reality of the hazardous effects of *Parthenium hysterophorus* on their socio-economics is known by conversations .

Result and discussion

Table 1 represents ecological parameters of *Parthenium hysterophorus* in the open and protected grassland of forest of Ambikapur India .this study was done in the month of Oct.2022. Ecological parameters of a grassland are dynamic with the months and season ,in India , having winter ,summer and rainy seasons periodically varying temperature 10^0C to 40^0C and the floristic of the grassland structure is composed of mainly by annual herbs *i.e.* grasses .

Table 1 Ecological parameters of *Parthenium hysterophorus* in the open and protected grassland of forest of Ambikapur India in the year 2022

Sr.No.	Ecological parameter	Open grassland	Protected Grassland
1	Population Abundance	5.46	3.29
2	Population Density	6.20	4.88
3	Relative Density	10.20	9.66
4	Frequency index	42.96 %	56.25 %
5	Basal Area	6.31 mm	6.46m
6	Dominance	9.07	8.43

Table 2 is a comparative representation of the ecological parameters of *Parthenium hysterophorus* in a particular grazing grassland observed in each Oct. of the year 2012, 2017 and 2022 at an average precipitation 15mm. and 22^0C atmospheric temp. . The data of the year 2012 and 2017 is matched with the results of 2022.

Table 2 .Comparative values of ecological parameters of *Parthenium hysterophorus* in a grazing grassland after five years each .

Sr.N0.	Ecological parameters	In Oct.2012	In Oct.2017	In Oct.2022
1	Population Abundance	4.56	4.87	5.46
2	Population Density	6.00	6.12	6.20
3	Relative Density	8.68	9.87	10.20
4	Frequency index	40.52%	41.85%	42.96 %
5	Basal Area	6,33mm	6.28mm	6.31 mm
6	Dominance	9.23	9.64	9.07

i. Population abundance

Population abundance is the relative distribution of the species in any community. Abundance is qualitative character of any species rather than quantitative, although abundance

A= Total number of individuals / Total number of sample area having individuals

Population Abundance of *Parthenium hysterophorus* is 5.46 and 3.29 in grazing and protected grass land respectively. While it was 4.56 in the year 2017 and 4.87 in the year 2022.

ii. Population Density

Population density of any species is the total number of individuals per sample area. Thus

Density, d= Total number of individuals / Total number of sample area

Unlike in abundance, here, sample area may have or may not have the individuals. Density of *Parthenium hysterophorus* was 6.00 in 2012 , 6.12 in 2017 and 6.20 in 2022 in open grassland , while it is 4.88 in protected grassland **.**The increase of the density per five year 0.08 to 0.20 . It indicates that *Parthenium hysterophorus* is spreading fast.

iii. Relative density

Relative density is in inter-specific relation of any species in any community, where all type of species is accompanied. Relative density is calculated by the formula:

$$d_r = \frac{\text{Density of individual species}}{\text{Density of all species}} \times 100$$

iv. Frequency index

Raunkiaer (1941) presented the concept of frequency index .Frequency index is the degree of dispersal of a species, may be said it is uniformity of occurrence of particular species in any ecosystem.

It is represented also by relative frequency, i.e.

$$F_r = \frac{\text{Number of sample area, in which individual species is}}{\text{Total number of sample area studied}} \times 100$$

v. Basal Area

Basal area is the area covered by stem at the bottom (soil surface), calculated calculate by $Ba = \pi r^2$. Where *Ba* is Basal area and *r* = radius *i. e.* half diameter of stem for basal area. an average basal area of *Parthenium ysterophorus* ,in grazing field is 6.51 mm and in protected field it is 6.46mm. It indicates that in protected grassland, this plant has thin stem due to high density of other grass species.

vi. Dominance

Dominance is a relative basal area of individual plant species. It is represented by formula

$$D = \frac{\textbf{Ba of individual plant species}}{\textbf{Ba of all plant species}} \times 100$$

Dominance is a significant value for any species. It represents the status of vigor to dominate other accompanied species. Table 2 represents a gradual increase of dominance of *Parthenium hysterophorus* per five years *i.e.* 9.23, 9.64 and 9.07 in grazing grassland. It indicates that it is dominating to other grasses and would be a serious problem for ecologists.

Table 1 represents that dominance of open (grazing) grassland is 9.07 while it is 8.43 in protected grasslands that is due to the high competition with other grasses in open grassland gasses are grazed by herbivores and the *Parthenium hysterophorus* faces less competition comparatively and dominates to grasses. While in protected grassland grasses grow freely and give high competition to Parthenium *hysterophorus* . So that, the dominance value is less in protected grassland. This result indicates that *Parthenium hysterophorus* might be suppressed or somewhat controlled by growing more grasses.

Socio-economic impact of *Parthenium hysterophorus* :

There is Hazardous effects due to its spread e. *g.* village-s farmer face a socio-economic loss while entire grassland and forest ecosystems face a threat to be disturbance of food chain, ultimately, how it is effecting to the village's farmers nearer to the forests.

Fig 1 (a) *Parthenium* plant **Fig 1(b) Skin disease caused by *Parthenium***

i. Human disease

Fig 1(a) represents well grown *Parthenium hysterophorus* plant and Fig (b) **Represents** causing dermatitis to the workers on its contact. Despite looking beautiful and smelling sweet, congress weed is among the world's 10 most dangerous weeds. On contact with the human body, it causes a burning effect that can peel off the skin. Human beings who inhale pollen from the flowers can get an asthma-like illness or persistent flu-like symptoms. This fast growing weed is a nuisance in public parks, residential colonies and orchards. Not only that, it causes health hazards such as skin allergy, hay fever and asthma in human beings and is toxic to livestock. It squeezes grasslands and pastures, reducing the fodder supply. Scientists describe it as a "poisonous, allergic and aggressive weed posing a serious threat to human beings and livestock."

V. Parasar *et,al.* described **Parthenium** *hysterophorus* causing contact dermatitis in livestock and is reported to be poisonous to sheep. Humans are also affected by this weed with respiratory malfunction and dermatitis. *Parthenium hysterophorus* is also reported as promising remedy against hepatic amoebiasis, neuralgia and certain types of rheumatism Main toxin responsible for the effect is Parthenin .They used Parthenium in synthesizing silver nanoparticles, from Parthenium *hysterophorus* leaf extract suggesting a good antimicrobial agent. (11)

ii. Inhibitory effects to other crops

The presence of *Parthenium hysterophorus* in cropped lands results in yield reduction up to 40 per cent. The pollen grains inhibit fruit set in tomato, brinjal, beans, etc. It is also responsible for bitter milk disease in livestock fed on grass mixed with *Parthenium hysterophorus*, Cattle that eat it produce foul-smelling milk or even die. *Parthenium hysterophorus* weed can reduce maize yield by 40-60%. It can also reduce the amount of pasture in a grazing area.

iii. Ecological loss

This weed can grow to the height of an adult and produce tens of thousands of seeds in one to two months. The seeds germinate easily but if the ground is not moist, it can remain viable (able to germinate) for up to 20 years. Covering to the grassland ,it reduces the grazing area for the wild and domestic animal and an ecological crisis may be due to the disturbance of the food chain .When herbivores will suffer with food *i.e.* grasses they will come to eat agricultural crops . the problem of wild elephants coming to human residence and farm area has been started in Ambikapur India . some grass feeding animal are not so strong to come to agricultural fields to feed and grass will be lost by *Parthenium hysterophorus* spread , their population would be reduced then they may attack to human population.

Integrated weed management

Hand pulling is recommended once the weed emerges from the soil. If, area of spread is high a serious hand pulling campaign is needed to control. The uprooted *Parthenium* might be used in synthesis of silver nano-particles, and compost production. (11, 12) Crop rotation might be infested in a cultivated land; normal crop is rotated with marigold during rains. Allelopathic effect of some other weed might be applied, as it is suppressed by *Cassia sericea*.

Social impact of *Parthenium*

Parthenium hysterophorus is very harm full to the environment and socio economics. It is progressively spreading in India and all over globe by a fast rate. The chemical control is not successful due to its thick roots and capable to produce new stem also, due to this property of roots, pest control is not successful yet. One cannot do a manual uprooting in all the forest land for the entire forest it is impossible ,also due to high number and of minute seed's dispersal . The biological control is also an option. But it might be controlled by further researches in a joint effort of the all methods and all scientists from all over the globe.

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year2012, 2017 and 2022 at an average precipitation 15mm. and 22^{0}C atmospheric temp.

Conclusion

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