Effect and Management of Various Terrestrial Weeds—Review

Biswanath Saha, Heena Kauser, Meena Khwairakpam and Ajay S. Kalamdhad

Abstract Terrestrial weeds affect ecosystems like forest, agriculture, and urban areas seriously, which demand proper management of these invasive plants. Due to their fast adaption and morphological advancement, controlling it's expand is challenging. Globally found are the species *Parthenium hysterophorus*, *Lantena camara*, *Saccharam spontaneum, and Azeratum conyzoides.* Though many attempts were made to control the terrestrial weeds either environmental and/or economical drawbacks occurred. This paper presents an alternative way for treatment of terrestrial weeds. Anaerobic digestion and composting are feasible and low-cost options. Anaerobic digestion is the process which breaks down organic compounds in presence of microorganism and in absence of oxygen and at the same time it obtains renewal energy. Methane and carbon dioxide are the products. Composting is also a biological process that breaks down organic compounds in presence of oxygen, fertilizer is the end product. Few studies were conducted on anaerobic digestion and composting of weed.

Keywords Terrestrial weeds · Anaerobic digestion · Composting · Biogas · Fertilizer

Highlights

- Negative effect of terrestrial weed has become a matter of concern globally.
- The terrestrial weeds increase the productivity of cropland.
- Utilization of this weed for anaerobic digestion and composting as a way of control.
- The regarded weeds contain a high amount of lignin.
- Pretreatment is required for efficient degradation.

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1 Introduction

According to various definitions, weed is considered as a plant growing in not desired localities, within competing with native and/or agricultural plants. Features that are responsible for invasive nature of terrestrial weed are (1) prolonged seed life, (2) fast mergence, (3) vigorous early growth, (4) capacity to grow in harsh environment, and (5) ability to survive and prosper under unfavorable condition [10]. Actually, the daily speedy spread of terrestrial weeds is a worldwide dilemma because of its harmful effect toward the soil and the ecosystem it is introduced to as well as to human health. The dominant nature of terrestrial weeds threatens the agricultural sector; once it grows in the farming sector, it does allow the other crops to grow. Environmental factors influence the growth of terrestrial weeds significantly [4]. Terrestrial weeds in India cause heavy destruction in agricultural field, for example, *Parthenium hysterophorus* covers vast area of plantation in urban and rural areas, *Lantana camara* in forestlands, and *Ageratum conyzoides* in rice fields. All these three weeds are native in America, later on it spread all over the world. In recent scenarios, these weeds spread almost all over the world, i.e., Australia, Western Africa, Asia, and Caribbean countries. It can grow anywhere like wastelands, roadsides, railway sides, watercourses, and cultivated crops. In India, 40% damages were found in yield of agricultural crops due to *P. hysterophorous* [12]. In Australia, yearly damage of around $16.8 million in the cattle industry was found [5]. Vivek et al. [23] reported that black gram (*P. mungo*) causes significant yield losses after 30–45 days after crop planting.

The adverse effects on ecological, agricultural, environmental, health of cattle, and man demand for a sustainable solution to control terrestrial weed [1]. Utilizing it for methane production and composting are favorable techniques to control weeds within obtaining renewable energy and biofertilizer. Currently, anaerobic digestion has become an established technology which is used for biogas production from the sewage sludge, animal manure, agricultural residue, industrial sludge, and energy crops in various countries [14]. Several researchers all over the world are focusing on renewable sources of energy production regarding the depletion of the oil reserves [3]. The application of chemical fertilization in modern agriculture has a major impact on the environment. The utilization of chemicals over a long period of time may reduce the efficiency of the soil, it continuously increases the productivity of land and cultivation. Biofertilizers produced from the biomass can be mixed with chemical fertilizers and applied on the field. Conversion of terrestrial weed to biogas or compost is one of the sustainable way to control invasive weed in low cost and energy.

2 Allelopathy

Allelopathy is a significant characteristic of terrestrial weeds. It produces phytotoxin that interferes the growth of the other plants. Germination and growth of other plants get affected due to the presence of the phytotoxic that is found in plant tissue or soil; the released phytotoxins are known as allelochemics or allelochemicals. Allelopathy is another harmful mechanism of these weeds. After understanding the biochemical and molecular structure, complex mechanism is used to overcome these challenges [24].

2.1 Terrestrial Weeds

The growth of the terrestrial weeds *Mikania micrantha* kunth, *Parthenium hysterophorus, Lantana camara, and Ageratum conyzoides* is problematic in India and various other countries. These weeds initiate economically and environmentally threats.

2.1.1 Lantana camara

Lantana camara is one of the most harmful terrestrial weed. It comes under the family of Verbenaceae. *L. camara* grows scrambling and horizontal for which reason it is mostly found on the floor of forests and plantations. Its bushy nature obstructs the function and balance of the ecosystem forest [11]. It is native to Central and South America, defined as an evergreen aromatic shrub [18] and now it is spread all over the world (shown in Fig. 1). In India, this weed was used as an ornamental plant in Calcutta [13] and now it is found all over the country. *L. camara* is found to be cytotoxic in nature. Lantadene A and lantadene B which are present in the leaves are responsible for the harmful effect of the plant [15]. Due to the allelopathy nature of *L. camara*, the growth of the other species in the forest started to decline [27, 6]. Ability of high regeneration potential and sexual reproduction it spread in a huge area within a short period of time [1]. To stop the expansion of this weed forest and cultivable lands, the management of this weed is required.

2.1.2 Ageratum conyzoides

Ageratum conyzoides is commonly named as “billy goat weed” or “goat weed”. It is mostly found in tropical and subtropical zones and it grows mainly in cultivated areas. The plant has a harmful effect on almost 36 crops (including plantations) and is found in 46 several countries [10]. It has been considered as 19 worst weeds of

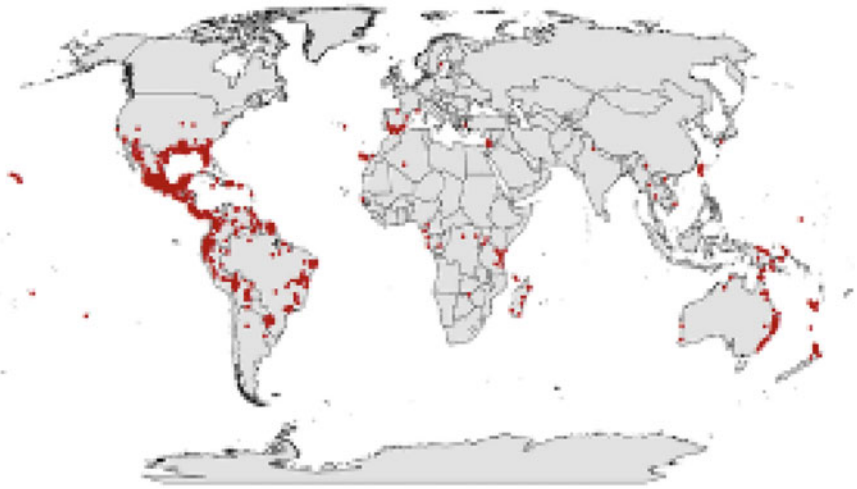

Fig. 1 Redmark represents presence of Lantana camara all over the world [19]

the world [10]. The origin of *A. conyzoides* is in Central America and the Caribbean, now it spread throughout the world [26]. This weed can be easily spread by air, water, and animals. The growth of crops like rice, wheat, corn, etc. has been declined due to the invasion of *A. conyzoides* [19]. The morphological features of this weed facilitate its dispersion as well as its high reproductive capability leading to a successful invasion in absence of natural predators. *A. conyzoides* shows allelopathic effects to a number of cultivated crops, which spread to soil due to volatilizing and leaching. Efforts in maintenence of crops are required to hinder the spread in fieldwork like ploughing. This comes along with increasing maintenence and operation costs.

2.1.3 Parthenium hysterophorus

Parthenium hysterophorus is found among the worst weed worldwide. This weed comes under the family of Asteraceae and it carries the name "Congress Grass". This weed's origin is in the southern United States, Mexico, Central and South America. Within the increase of global export and import it spread all over the world. Now, it is found all over the world (shown in Fig. 2). The growth of this weed became a serious issue over agricultural land and rangeland in Australia, Asia, Africa, and the Pacific Islands. The allelopathic nature of this weed reduces the crops production drastically. This weed has some harmful effects on humans that includes allergic reaction, respiratory problems, contact dermatitis, mutagenicity in human, and livestock [17]. *P. hysterophorous* interferes the early growth of surrounding plants [2]. *P. hysterophorous* is a global species [16], it spread in over 20

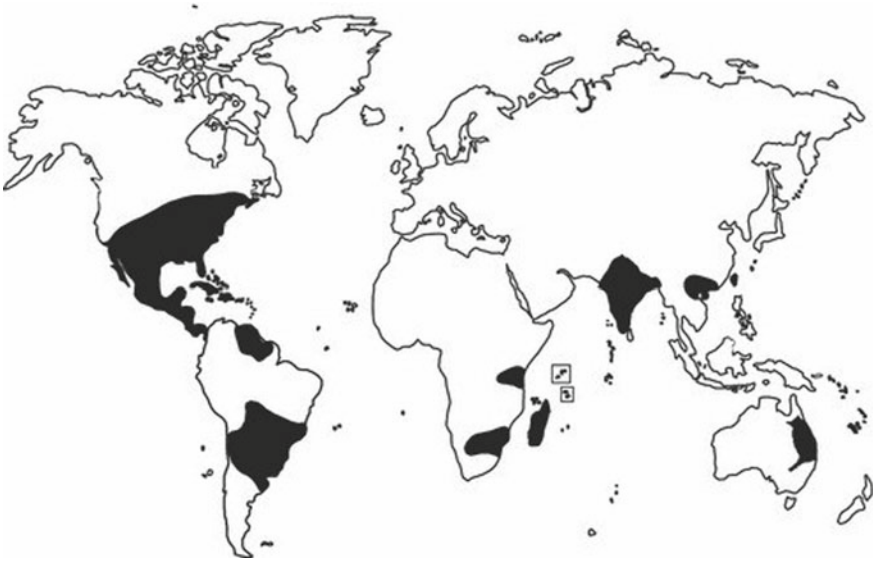

Fig. 2 This figure was reported by [19], 1994. Black color area indicates the distribution of *P. hysterophorous*

countries within Africa, Asia, and Oceania ([7]; Fig. 2). In Africa, this weed arises from South Africa [25, 9]. A Management was installed but an approach is still demanded.

2.1.4 *Mikania micrantha* Kunth

Mikania micrantha is a perennial vine native to subtropical zones of North, Central, and South America (Asia-Pacific Forest Invasive Species Network). The plant is commonly known as "mile a minute" that can grow up to 8–9 cm within 24 h. The main problems associated with *M. micrantha* is that it can smother other plant species inhibiting their photosynthesis process and takes up minerals from the surrounding plants. It has the ability to conquer a vast area once it is established and has huge ability to cope up with the environment. In India, the plant was invaded during 1940s as a ground cover for tea plantation and rubber. But because of its immense growth it has become threat to forest and other ecological system. A number of phytochemicals have been identified in this weed species. A lower level of nitrate and nitrogen was observed in plants grown with *M. micrantha.*

There was prominent reduction in rubber when *M. micrantha* smothers the rubber plant. Various management strategies have been applied to overcome the problems associated with *M. micrantha* but no appropriate outcome was observed because of its rapid growth.

Therefore, biological treatment can be a useful method for the management of this noxious weed.

3 Anaerobic Digestion and Composting, a Possible Way of Control This Weeds

P. hysterophorous is an ideal feedstock for methane production [8]. *P. hysterophorous* shows the potential to produce alcoholic biofuels after pre-treatment [20] Proper study of anaerobic digestion on *P. hysterophorous*, *A. conyzoids, L.camara* has not been done. So systematic anaerobic digestion study is necessary for sustainably control of these weeds. *P.hysterophorous* can be converted into compost [22]. [21] reported that *P. hysterophorous* and neem leaves can utilize for compost. *A.conyzoids and L.camara* can also be converted into compost. Not proper research has been done on compost of these weeds. Few literature review was found that show conversion converts these weeds into biogas and compost. More efficient study is required to convert this weeds into biogas and compost so that it can be utilized for various applications.

4 Conclusion

Although lots of management skills were applied to these noxious weeds that are not sustainable and economically beneficial. Anaerobic digestion and composting are some of the efficient techniques that can be applied for proper utilization of these invasive weeds. This can result in the production of methane gas and compost for agriculture use, respectively. This is one of the sustainable way to control these weeds and at the same time it converts into renewal energy and organic fertilizer, where energy and chemical fertilizer is one of the significant issue. Presence of lignin content in these weeds may cause challenges of anaerobic digestion and composting but pretreatment can overcome these challenges. More research is needful for recovery of biogas and composting technic to increase the efficiency.

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