Journal for Nature Conservation 31 (2016) 16–21

Contents lists available at ScienceDirect

Journal for Nature Conservation

journal homepage: www.elsevier.de/jnc

Short communication

The other sides of invasive alien plants of India—With special reference to medicinal values

S. Sandilyan*, Charlotte I.E.A. van't Klooster

Centre for Biodiversity Policy and Law (CEBPOL), National Biodiversity Authority, Taramani, Chennai, India

ARTICLE INFO

Article history:
Received 13 November 2015
Received in revised form 23 February 2016
Accepted 23 February 2016

Keywords:
Invasive alien species
IAS
Medicinal plants
India
Ecological services

ABSTRACT

Invasive Alien Species (IAS) have been emerging as the second biggest threat to global biodiversity after habitat destruction. They intervene in environmental services offered by ecosystems and negatively impact flood control, water supply, water assimilation, nutrient recycling, conservation and regeneration of soils. Due to these threats better IAS management is needed for a biodiversity rich nation like India. To date very few examples of successful eradications of IAS exist. However, some studies have pointed out several economic benefits rendered by IAS which include fodder, food, manure, bio-fuels and medication values which make them interesting from a commercial point of view which could led to an increase in demand for these IAS species by certain industries (pharmaceutical, botanical sectors) in the future driving IAS to the verge of extinction in the wild this way. This review presents an overview of IAS existing in India and their possible medicinal potential which could, if proven useful, lead to an alternative way of controlling the proliferation of IAS and to conserve nature diversity.

1. Introduction

An alien species is a species, subspecies or lower taxon, introduced outside its natural past or present distribution, which includes any part, gametes, seeds, eggs, or propagules of such species that might survive and subsequently reproduce. Whereas an invasive alien species refers an alien species whose introduction and/or spread threaten biological diversity of the region/habitat (CBD, 2002). Recently, these Invasive Alien Species (IAS) have been emerging as the second biggest threat to global biodiversity after habitat destruction and it is expected to soon surpass the damage caused by habit destruction and fragmentation (De Milliano, Woolnough, Reeves, & Shepherd, 2010; Zhang & Chen, 2011; Surendra, Muhammed, & Raju, 2013). Internationally, knowledge on controlling IAS is still limited which has resulted in numerous problems (Surendra et al., 2013), including the extinction of some indigenous, endemic and threatened species (*e.g.* Armstrong, 1995; Gurevitch & Padilla, 2004). It has also been reported that IAS may cause changes in environmental services, such as flood control, water supply/level, water assimilation, nutrient recycling, conservation and regeneration of soils (*e.g.* Armstrong, 1995; GISP, 2004; MA, 2006). It is therefore vital to find an effective management strategy of IAS.

Globally there are very few examples of successful eradications of IAS, especially once the given IAS spans an area of tens of square kilometers or more (Mack & Lonsdale, 2002; Moore, Runge, Webber, & Wislon, 2011). It is widely accepted now that the control of IAS is not a short-term or isolated effort, but it requires a long-term application of efforts aided by constant monitoring and investigation (Bibhuti, Talukdar, & Sarma, 2011). Strenuous efforts are needed to control/manage invasive species and a better understanding of the causes of their spread can help to implement pre-emptive measures (Bibhuti et al., 2011). In India, various control methods (manual, mechanical, application of pesticides, and introduction of biological control agents) have been applied to eradicate IAS but have unfortunately failed so far. For instance attempts to curb the weed *Lantana camara* L. have been unsuccessful (Priyanka, Shiju, & Joshi, 2013) and have been described as a lost battle (Bhagwat, Breman, Thekaekara ,Thornton, & Willis, 2012). Not only *L. camara,* but control of other weeds such as *Prosopis juliflora* (SW.) DC. (Kathiresan, 2006), *Parthenium hysterophorus* L. (Kaur, Aggarwal, Kumar, & Dhiman, 2014), *Eichhornia crassipes* (Mart.) Solms (Shaha & Rajemahcdik, 2008) and *Mimosa diplotricha* Sauvalle (Bibhuti et al., 2011) have been futile as well. It is therefore essential to find alternative ways for better management or eradication of these weeds.

* Corresponding author.
E-mail address: ssandilyan@gmail.com (S. Sandilyan).

http://dx.doi.org/10.1016/j.jnc.2016.02.005
1617-1381/

Table 1
Beneficial sides of Indian IAS plants.

Sl no.	Kind of use	Species name
Edibles		
1	Food	*Sonchus oleraceus* L.
2	Medicine	*Echinops echinatus* Roxb
Domestic use		
3	Tying the thatch of hut roofs	*Triumfetta rhomboidea Jacq*
4	Furniture	*Lantana camara* L.
5	Fan	*Borassus flabellifer* L.
6	Cloths	*Asclepias curassavica* L.
7	Rope Making	*Saccharum spontaneum* L.
8	Bio fuel	*Xanthium indicum* L.
Agriculture use		
9	Pollutant remover	*Eichhornia crassipes*
10	Bio fertilizer	*Lantana camara* L.
11	Manure	*Eichhornia crassipes* (Mart.)
12	Fodder	*Leucaena leucocephala* (Lam.)
13	Compost	*Eichhornia crassipes* (Mart.)
14	Waste water treatment,	*Eichhornia crassipes* (Mart.)
15	Insecticide	*Ocimum americanum* L.

Source: Prasad & Freitas, 2003; Bergier et al., 2012; Sekar, 2012; Aravindhan and Rajendran, 2014; Kumar and Bihari, 2015.

2. Beneficial sides of IAS

Recent studies have showed the beneficial sides of IAS as well, pointing out several economic benefits rendered by IAS. For instance several IAS plants are reported to be used for food (*Portulaca oleracea* L., *Digera muricata* L. Mart., *Solanum nigrum* L., *Alternanthera philoxeroides* (Mart.), *P. oleracea* L.), basket (*L. camara* L.), removal of heavy metal from different habitats *P. hysterophorus* L., *E. crassipes* (Mart.) Solms (Prasad & Freitas, 2003; Bergier et al., 2012; Sekar, 2012; Kumar & Bihari, 2015). The other benefits offered by IAS plants are provided in Table 1. At the moment economic valuations of most of these IAS are due in India (Raghubanshi, Rai, Gaur, & d Singh, 2005). The commercial utilization of all IAS should be encouraged, especially screening their medicinal potential which could be interesting for the development of new drugs.

2.1. Medicinal importance of IAS plants

Approximately 80% of the population in developing countries still depend directly on medicinal plants for their first medication (Mukhopadhyay, 1998). In India, approximately 2,000 different kinds of plant derived drugs are used to treat a wide variety of health problems (Dikshit, 1999). The commonest bioactive constituents obtained from the plants include, alkaloids, tannins, flavonoids and phenolic compounds (Okwu, 2001), which have been proved to cure several diseases (*e.g.* Roy & Munan Shaik, 2013). Although plants have been studied and screened for their potential value as a source of drugs (Singh, 2012), not much attention has been given to the screening of IAS for this purpose yet.

A few studies conducted on IAS in India disclose the medicinal values of a number of IAS plants (*e.g.* Sekar, 2012; Devamma & Gopal, 2013; Aravindhan & Rajendran, 2014; Kumar & Bihari, 2015; Renganathan, Sahu, & Kathiresan, 2015) However, more research on the identification of useful bio-compounds for drugs is needed.

2.2. Medicinal values of some common IAS plants in India

Several IAS plants in India are used to improve health care. A list of such a species is given in Table 2 while the most important species are mentioned below in further detail.

2.2.1. P. juliflora *(Sw)*

P. juliflora is a small shrub or tree, native to Mexico, South America and the Caribbean. This genus forms a major component in dry land ecosystems in America, Africa and Asia as it is fast growing, hardy and drought-resistant tree with remarkable coppicing power (Azhar, 1998). During the mid nineteenth century, *P. juliflora* was introduced into India in order to prevent the further expansion of the Thar Desert in Northwestern states and to help address the fuel wood crisis of peninsular India. Large scale plantation of this species took place between 1934–1984 in Gujarat, Maharashtra and Rajasthan (Pasiecznik et al., 2001). Interestingly, the Rajasthan state declared *P. juliflora* as a Royal Plant in 1940 (Pasiecznik et al., 2001). After the 1980s, most of the Indian states introduced this species in their state provinces in order to overcome the fuel wood demand (Pasiecznik et al., 2001). The plant was even introduced in protected areas like Keoladeo Ghana and Ranthambore (Robbins, 2001; Dayal, 2007; Anoop, 2010). In Keoladeo Ghana National park the negative impact of this species was only recognized later when it had already largely replaced the native vegetation cover through its allelopathic effect and drought tolerance ability (Anoop, 2010). Furthermore, the invasion resulted in a decrease of grass land which affected the already critically endangered bird species known as the Great Indian Bustards (*Ardeotis nigriceps*) (Tiwari, 1999). Likewise, the tiger population declined in the Ranthambore National park due to the poor herbivore prey base which was a direct result of the invasion of *P. juliflora* (Dayal, 2007).

In contrast, *P. juliflora* has been used as remedy for catarrh, cold, diarrhea, dysentery, excrescences, flu, hoarseness, inflammation, measles, sore throat and in healing of wounds (Rastogi & Mehrotra, 1993). Recent phytochemical screening of the *P. juliflora* leaf extract showed the presence of alkaloids, flavonoids, steroids, phenolics and tannins (Renganathan et al., 2015). Moreover, molecular docking analysis revealed the therapeutic importance of *P. juliflora* which have more bio-active compounds including phorbol-12 and 13-dihexanoate used against the anti-apoptic BCL2 protein which plays a pivotal role in the deactivation of the apoptosis process in cancer (Renganathan et al., 2015).

2.2.2. Cuscuta reflexa *Roxb*

C. reflexa is an angiospermic leafless parasitic plant belonging to the family Convolvulaceae which is commonly known as the dodder plant to native of North America (Devamma & Gopal, 2013). Several studies in India highlighted the invasive potential of this species (e.g. Surendra et al., 2013). This plant species has been used for various medication *viz.* as a purgative in the treatment of liver disorders, cough and itching and for its carminative and anthelmintic actions (Udavant, Satyanarayana, & Upasani, 2012). The whole plant and stem are generally used for curing diseases like rheumatoid arthritis, dysentery, loss of appetite, anti-microbial, hair strengthening, urinary disorders and for strengthening the body (Shikha & Amrinder 2013). Furthermore, *C. reflexa* has antibacterial, antiviral and anti-proliferative properties and contains compounds like phenolics and flavonoids (Udavant et al., 2012).

2.2.3. P. hysterophorus *(L.)*

P. hysterophorus, commonly known as carrot weed or congress grass is a small weed plant native to tropical America and was introduced into India in cereal and grass seed shipments from U.S.A. during 1950s. In India, it has been considered as one of the worst weeds responsible for causing health problems in men and animals besides loss to crop productivity and plant biodiversity. The weed has invaded around 35 million hectares of land in India including agricultural lands, community land, forests, road sides and railway track (Mitchell & Calnan, 1978; Sushilkumar & Jay, 2007; Sushilkumar, 2009).

Recent studies on the medicinal property of *P. hysterophorus* revealed that this weed has a number of health benefits to treat *viz.* skin inflammation, rheumatic pain, diarrhea, urinary tract infec-