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Lantana camara L.: An emerging threat to native flora and livestock: A review

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Abstract

The plant *Lantana camara* (L.) or common lantana is a well-known flowering plant and weed in Indian subcontinent. The plant was formerly imported for the purpose of hedge but later transformed into pests for the agricultural crops, native flora as well as for livestock. The weed can be found growing at many places from agricultural fields to roadside and even inside the urban locality. It causes major problems for native flora by covering most of area that result in their suppression and destruction. In rainy season, almost all the roads of rural areas got to be covered by common lantana and parthenium grasses causing a huge disturbance in transportation. *Lantana camara*, is a weed of national significance to India and threatens livestock through its toxicity. Red flowered races are thought to be the most toxic but some white and pink flowered varieties can also be highly toxic. Significant lantana toxins are the triterpene acids, lantadene A (rehmannic acid), lantadene B, and their reduced forms which have significant negative impact on health of livestock.

Keywords: Lantana, pest, weed, grass, flora, cattle, beetle, biological control

Introduction

Common lantana, *Lantana camara* (L.) is a flowering plant belonging to the family Verbenaceae (Jean Henri Jaume Saint-Hilaire). The family is represented by many flowering plants with a cosmopolitan distribution. The family is characterized by having a total number of 37 widely distributed genera including *Lantana*. *Lantana* is a well-known genus of this family used as hedge and decorating gardens and having a total number of 150 species. They are native to tropical regions of the Americas and Africa but exist as an introduced species in numerous areas, especially in the Australian-Pacific region, South and Northeastern part of India. The genus includes both herbaceous plants and shrubs growing to 0.5–2 m (1.6–6.6 ft) tall. Their common names are shrub verbenas or lantanas. The generic name originated in late Latin, where it refers to the unrelated *Viburnum lantana* (Nanjappa *et al.* 2005) [8].

Lantana is a semi woody or woody plant, can be grown all types of soil and climate from temperate to tropical regions. Formerly it was introduced to India for the purpose of hedge in gardens. The plant is perfect for hedge making as its growth is very fast and branches are spiny. The plant is also grown for its multicolor beautiful flowers from red pink to white. These plants can be found to be growing throughout the year in all type of topographies. Lantana's aromatic flower clusters (called umbels) are a mix of red, orange, yellow, or blue and white florets. Other colors exist as new varieties are being selected. The flowers typically change color as they mature, resulting in inflorescences that are two- or three-colored. Plant produce seeds in bunches of 20 to 30 seed which are green in color but turns black in prior to maturity.

The plants can grow as taller as a tree in some conditions but mostly it depends on availability of water in off seasons. Lantana grows very fast and can cover a large area within a few months by suppressing other native flora. Although lantanas are generally hardy and, being somewhat toxic, usually rejected by herbivores, they may still become infested with pests. The edibility of Lantana berries is contested. Some experts claim Lantana berries are edible when ripe though like many fruit are mildly poisonous if eaten while still green. Other experts claim that experimental research indicates that both unripe and ripe Lantana berries are potentially lethal, despite claims by others that ripe berries are not poisonous. As an ornamental, *L. camara* is often cultivated indoors, or in a conservatory, but can also thrive in a garden with sufficient shelter. It has spread from its native Central and South America to around 50 countries, where it has become an invasive species. It first spread out of the Americas when it was brought to Europe by Dutch explorers and cultivated widely, soon spreading further into Asia and Oceania where it has established itself as a notorious weed, and in Goa it was introduced by the Portuguese.

It is an artificial hybrid species that has been subject to intense horticultural improvement in Europe since the sixteenth century and now exists in many different forms or varieties throughout the world. Flower colour has been the primary feature for distinguishing between different forms. In Australia, these are Red, Pink, White/Pale Pink and Orange. (Scott (1998) ^[9] has proved with RAPD analysis that there is great genetic diversity within *L. camara* and challenged the assertion that flower colour is the primary determining factor in describing varieties. Inflorescences are produced in pairs in the axils of opposite leaves. In almost all colour forms, the flower opens yellow and changes to pink, white or red depending on the variety. In the forms where this does not occur, a yellow ring is present around the opening to the corollary tube (Day *et al.* 2003) ^[3]. The yellow coloration is known to be a visual cue to pollinating insects, and the act of pollination may stimulate colour change.

The diverse and broad geographic distribution of lantana is a reflection of its wide ecological tolerances. It occurs in diverse habitats and on a variety of soil types. It generally grows best in open unshaded situations such as wastelands, rainforest edges, beachfronts, and forests recovering from fire or logging. Disturbed areas such as beside roads, railway tracks and canals are also favorable for the species (Day *et al.* 2003) ^[3]. Lantana does not invade intact rainforests, but is found on its margins. Where wet sclerophyll forests and rainforests have been disturbed through logging, gaps are created; this allows lantana to encroach on the forests. Further logging aggravates the condition and allows the lantana to spread or become thicker (Waterhouse and Norris 1970).

Lantana benefits from the destructive foraging activities of introduced vertebrates such as pigs, cattle, goats, horses, sheep and deer and grows well on rich volcanic soils. It can grow at altitudes from sea-level to 2000m (Sharma *et al.*, 1988) ^[10, 11]. It can tolerate some shade, growing in plantations and open eucalypt forests in Australia, but it does not flower readily under these conditions (Humphries and Stanton 1992) ^[6]. In Brazil, lantana rarely grows in secondary forest and commercial plantations (Winder *et al.*, 1984) ^[18]. Wapshere (1974) ^[16] suggested that when there is reduced herbivory by natural enemies, original habitat restrictions, such as climate and soil type, may become less significant and lantana can expand into previously marginal habitats.

Lantana grows under a wide range of climatic conditions. In Australia, the inland limit of its geographical range coincides with the 750mm isohyet in southern Queensland and the 1250mm isohyet in the north (Day *et al.* 2003) ^[3], with infestations being restricted to creek lines in drier areas (Day *et al.* 2003) ^[3]. It does not appear to have an upper temperature or rainfall limit and is often found in tropical areas receiving 3000mm of rainfall per year, provided that soils are sufficiently well drained. Lantana seldom occurs where temperatures frequently fall below 5 °C (Day *et al.* 2003) ^[3], and in South Africa it is found in areas with a mean annual surface temperature greater than 12.5 °C (Stirton 1977) ^[13]. Some varieties can withstand minor frosts, provided these are infrequent. Prolonged freezing temperatures kill aerial woody branches and cause defoliation. In most of the high volcanic island groups in the Pacific, the distribution of lantana is limited by: its inability to survive under dense, intact canopies of taller native forest species; its susceptibility to frosts and low temperatures; its low tolerance to saline soils; its tendency to rot in boggy or hydromorphic soils; its having never been introduced to some islands; insufficient water, due to low rainfall and/or coralline soils

with poor water-holding capacities; and high incidence of tropical hurricanes (Thaman 1974) ^[4].

Lantana camara is a well-known flower plant and loved by bees and many butterflies for its beautiful flowers. The plant leaves are usually thick, dark green and distasteful to cattle and its mostly not preferred to be consumed. In few reported cases, it can cause mild to heigh symptoms of poisoning. In case of native flora, it was found in many cases that the common lantana has more vigorous growth and ability to spread. It was studied in many studies that *Lantana* suppressing to most of the native plants and their spread. The present review will cover all the negative aspects of introduction of *Lantana camara* to India, impact on cattle and also the insects that may help in biological control of this genera.

Impact of *Lantana camara* on Native Flora

There are a lot of plants we can see in our surroundings including native as well as alien spp of plants. The plants probably introduced before the Destructive Insect Pest Act and the regulation governed by the governments after the introduction of many invasive species. The problem lies with introduced species is, they are not fit anywhere in the food chain of introduced locality. New areas only have the introduced species but not the enemies or their controlling agents. In many cases it was observed that plant species with not native origin are not preferred by animals for breed feed shelter.

Lantana camara have its impact on native flora in the way of consumption of areas for growing and by covering most of lands that do not allow other plants to get sufficient sunlight as well as land to spread. Lantana can be found in almost all the parts of India beside the roads and farms. *Saccharum spontaneum* is a clear-cut example of destruction. Since *Saccharum spontaneum* is a native grass of Poaceae and have been covering the most of lands in native area until the *Lantana camara* started spreading. It has been noted in many places that *Lantana* can grow in adverse climates as well as in dry lands with major phenomena of overlapping on the native vegetations and plants.

Impact of *Lantana camara* on Agriculture

Lantana camara can be found to be growing inside the many agricultural crops like wheat, pulses rice etc causing a major weed problem for farmers. There are many known weedicides reported to be working in weeds of these agricultural crops but have no significant effects against Lantana. Weedicides like Glyphosate can be effective against it but can cause a huge loss to agricultural crops too. The major problem in controlling the *Lantana camara* is that the weeds has woody stem and spines that can't be extracted easily. Beside this, Lantana is not edible for animals and have adverse effects on feeding, so the destruction of this weed is an issue. Lantana can greatly alter fire regimes in natural systems (Humphries and Stanton 1992) ^[6]. A research team from The School for Field Studies (SFS) Center for Rainforest Studies in North Queensland, Australia's Wet Tropics, found that *L. camara* increases fire risk in dry rainforest by altering fuel loads. Through a suite of field and laboratory research methods, the authors concluded that *L. camara* is less ignitable than native rainforest species but creates a more continuous layer of 'ladder' fuels, which may allow fire to reach the forest canopy. They suggest that management of this species in fire susceptible ecosystems should include targeted physical removal to reduce fuel loads. (Berry *et al* 2011) ^[2].

Lantana is now a major weed in many regions of the Palaetropics where it invades natural and agricultural ecosystems (Thomas and Ellison 1999) [15]. The plants can grow individually in clumps or as dense thickets, crowding out more desirable species. In disturbed native forests it can become the dominant understorey species, disrupting succession and decreasing biodiversity. As the density of lantana in forest increases species richness decreases (Fensham *et al.* 1994) [4]. Its allelopathic qualities can reduce vigour of plant species nearby and reduced productivity in orchards. At some sites, lantana infestations have been so persistent that they have completely stalled the regeneration of rainforest for three decades. Such is its impact that, for example, in south-east Queensland lantana was ranked as the most significant weed of non-agricultural areas. Lantana competition may have caused the extinction of the shrub *Linum cratericola* Eliasson (Linaceae), and is a major threat to other endangered plants in the Galapagos Archipelago. The replacement of native pastures by lantana is threatening the habitat of the sable antelope in Kenya (Greathead 1971) [5].

It can affect agriculture in a number of ways. In plantations in south-east Asia and the Pacific Island communities it can reduce productivity and interfere with harvesting. It may affect economic viability of crops such as coffee, oil palm, coconuts and cotton. In Queensland, loss of pasture is the greatest single cost of lantana invasion in grazing areas (A\$3m per year at 1985 values). In dense stands of lantana, the capacity of the soil to absorb rain is lower than under good grass cover. This could potentially increase the amount of run-off and the subsequent risk of soil erosion in areas infested with lantana. Lantana has been implicated in the poisoning of a number of animals including cattle, buffalo, sheep and goats (Sharma *et al.* 1988) [10, 11] (its leaves and seeds contain triterpenoids, which cause poisoning and photosensitivity). Poisoning mainly occurs in newly introduced young animals without access to other fodder (Yadava and Verma 1978) [19].

Lantana has many secondary impacts, especially in many tropical countries where it can harbour several serious pests. Malarial mosquitoes in India and tsetse flies in Rwanda, Tanzania, Uganda and Kenya shelter in bushes and are the cause of serious health problems.

Impact of *Lantana camara* on Livestock

Studies done by Kumar *et al.*, 2016 stated that Lantana leads to hepatotoxicity, photosensitization and intrahepatic cholestasis almost in all the animals. LA is the main toxic pentacyclic triterpenoid present in this weed. Lantadene toxicity leads to fatty degeneration, bile duct hyperplasia, gall bladder edema, degeneration of parenchymal cells and portal fibrosis observed on histopathological examination. L. camara toxicity causes fluctuation in hematological as well as in biochemical parameters. The management of toxic effects can be achieved by activated charcoal, vaccination and supportive therapy but are not much effective. Besides the harmful effects of this plant, there are some beneficial effects also including anti-inflammatory, hepatoprotective action, antitumor action etc. The control of this weed is difficult because of its allelopathic action. Nowadays this plant is used in many recent advanced techniques like phytoremediation of particulate pollution, phytoextraction of heavy metals and many others. Thereby the use of this plant in the field of research can be an effective way to manage this alien weed. As far as the toxicity is concerned it can be prevented by the

using conventional therapeutic methods along with immunological, nanotechnological and biotechnological approaches. The aim of this article is to discuss the information regarding its progression, mechanism by which it affects animals, pathological alterations, treatment and what strategies we can opt to get rid of this weed.

In general, for the success and impact of any weed many biotic and abiotic environmental factors are responsible. One of the most important factor for the huge prevalence of this weed throughout world is its phytotoxic or allelopathic action which is due to the presence of phenolic compounds (umbelliferone, methylcoumarin, salicylic acid etc.) and lantadenes i.e. LA (lantadene A) and LB (lantadene B). The suppressive allelopathic action of this plant has been seen on certain plant species like *Glycine max* (Linn), *Cyclosorus dentatus* Forsk, *Triticum aestivum* L., *Zea mays* L. and *Lolium multiflorum* Lam (Sharma *et al.*, 2007) [12]. This weed is mainly disseminated by droppings of moving animal flocks/ birds, cutting and pollination (Sharma *et al.*, 2007) [12].

The most important toxic components present in this weed are lantadenes. Lantadenes are pentacyclic triterpenes and often led to hepatotoxicity, photosensitization and jaundice. There are 2 forms isolated from lantana toxin i.e. crystalline and amorphous. The amorphous form is found to be icterogenic to guinea pigs (Sharma *et al.*, 2007) [12]. Among the known compounds present in lantana, LA is the most hepatotoxic component while certain other compounds like naphthoquinones, oil constituents (cital), iridoid glycosides (Theveside) and some of the oligosaccharides are of lesser importance as far as toxicity is concerned (Ajugose). The lantadenes are mainly present in the leaves of this plant (Sharma *et al.*, 2007) [12] having varying toxic effects among different species and strains of mammals/livestock. The toxic effects of this plant are evident both in ruminants as well as in non-ruminants (Sharma *et al.*, 2007) [12].

Biological Control of *Lantana camara*

Natural enemies of *Lantana camara* L. found locally and the species introduced, established and distributed in India. The occurrence of the natural enemies: *Lantanophaga pusillidactyla*, *Ophiomyia lantanae*, *Teleonemia scrupulosa*, *Epinotia lantana*, *Hypena* sp. (near, *abyssinialis*) and *Archips* sp. *micaceana* in India are determined in many surveys. Introduction of other exotic natural enemies that have proven beneficial elsewhere, namely *Calcomyza lantanae*, *Neogalea esula*, *Plagiohammus spinipennis* and *Salbia haemorrhoidalis* are recommended to suppress the weed (Abeygunawardena *et al.*, 1991) [1].

Conclusion

Lantana camara is a well-known threat to the native flora as well as livestock and has been identified to be causing harms to agricultural crops by covering most of lands and decreasing yields. The effects of common lantana on urban areas is well known as it covers empty land very quickly and known to be causing disturbance in transportation of humans. It is not that lantana is only harmful, it has some benefits as a hedge plant and attraction center of many butterflies and bees. All we need is a well management of these plants rapid spread in different areas where they are not locally reported. Lantana camara, is a weed of national significance to India and threatens livestock through its toxicity. Red flowered races are thought to be the most toxic but some white and pink flowered varieties can also be highly toxic. Significant lantana toxins are the triterpene acids, lantadene A (rehmannic acid),

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