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Development of biodegradable film for packaging application vis-à-vis eradication of an invasive plant species *Lantana camara*

Pawan Kumar Bharti*, R.S. Haldar and Ajay K. Tyagi

R & D Division,

Shriram Institute for Industrial Research, 19, University Road, Delhi-110 007, India

*E-mail: gurupawanbharti@gmail.com,

Tel.: +91 11 27667267, Fax: +91 11 27667676

ABSTRACT

The aim of this paper is to determine the feasibility of Lantana camara in the development of biodegradable cellulose film. This perennial weed has not been used in any beneficial activity for many years worldwide. A few of interests have been shown for this plant in last few years in India and aboard. At the same time Lantana camara is one of the most notorious weeds in India. When introduced to terrestrial ecosystem it spreads very quickly due to its high growth potential. Therefore lantana tends to eliminate all other living organisms in surrounding. A development approach is given about potential usage of Lantana camara for cellulosic film preparation.

Keywords: *Lantana camara, invasive weed, Cellulose, Biodegradable packaging film, cellophane*

Citation of this article

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Introduction:

Lantana camara is a low, erect or subscandent, vigorous shrub which can grow to 2 - 4 meters in height. The leaf is ovate or ovate oblong, 2 - 10 cm long and 2 - 6 cm wide, arranged in opposite pairs. Leaves are bright green, rough, finely hairy, with serrate margins and emit a pungent odour when crushed. The stem in cultivated varieties is often non- thorny and in weedy varieties with

recurved prickles. It is woody, square in cross section, hairy when young, cylindrical and up to 15 cm thick as it grows older. Lantana is able to climb to 15 m with the support of other vegetation. Flower heads contain 20 - 40 flowers, usually 2.5 cm across; the colour varies from white, cream or yellow to orange pink, purple and red. Flowering occurs between August and March, or all year round if adequate moisture and light are available. Pollinators include lepidopteran species and thrips. The fruit is a greenish blue-black colour, 5 - 7 mm in diameter, drupaceous, shining, with two nutlets; seed setting takes place between September to May with 1 - 20 seeds on each flower head. Mature plants produce up to 12,000 seeds annually. Seed germination occurs when sufficient moisture is present; germination is reduced by low light conditions. The root system is very strong with a main taproot and a mat of many shallow side roots.

The diverse and broad geographic distribution of lantana is a reflection of its wide ecological tolerance. It occurs in diverse habitats and on a variety of soil types. Lantana generally grows best in open, un-shaded conditions such as wastelands, the edges of rain forests, on beachfronts, in agricultural areas, grasslands, riparian zones, scrub/shrub lands, urban areas, wetlands and forests recovering from fire or logging.

Major composition of Lantana plant is as follow:

Holocellulose – 71.34%

α-Cellulose – 64.91%

Pentosans – 13.0%

Lignin – 27.25%

Ash – 1.8%

Lantana camara (Verbenaceae family), a fast-growing weed with encroached large areas worldwide, is rich in lignocellulosic material. Lantana camera is a rugged evergreen shrub growing to 1.8 m high. Stems are square in profile, with small prickles. The leaves are arranged in opposite pairs .They are broadly oval, rough with short hairs, with finely toothed edges. When crushed they have a strong smell. Flowers are a mixture of cream, pink or orange numerous small rounded heads, often in two colours, yellow and red. Fruits are fleshy berries in clusters, green ripening to black.

Distribution of Lantana:

Lantana camara has been ranked as the highest impacting invasive species and is among the 100 worlds worst invasive alien species, because it posses great potential to escape cultivation and have

deleterious effect on species richness. In India it was introduced in early nineteenth century as an ornamental plant, but now it is growing densely throughout India (Sharma et al., 2005).

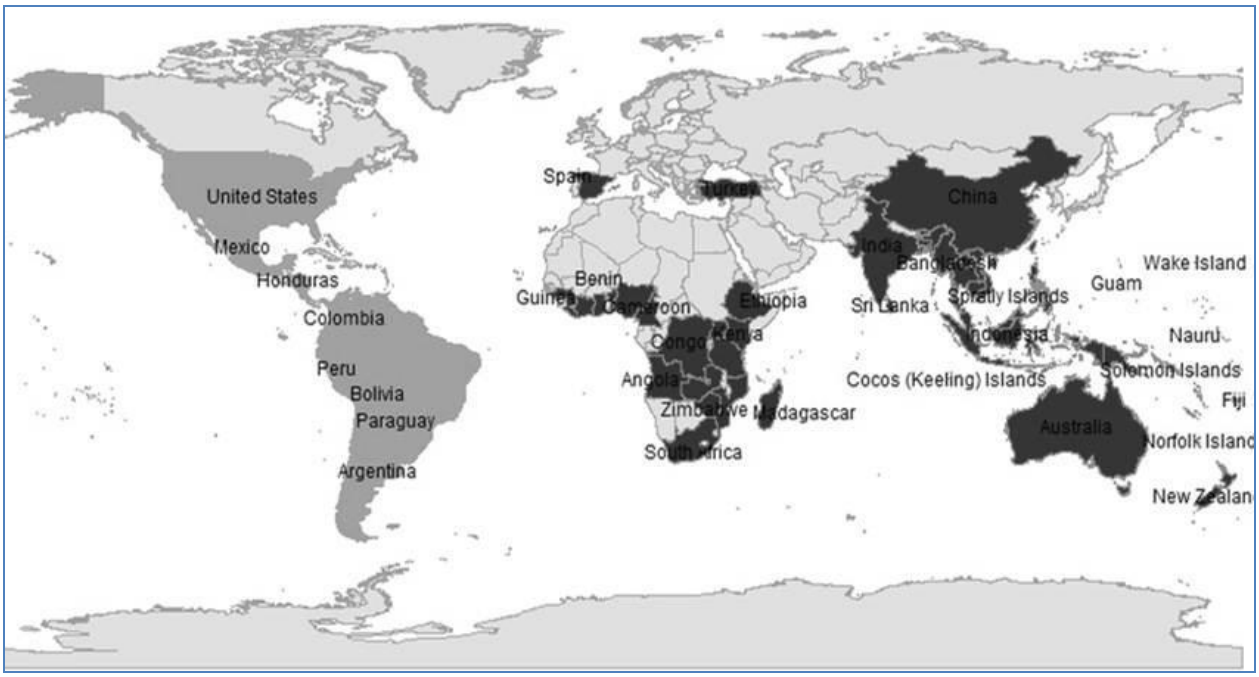


Fig.1: *Lantana camara* native (light grey) and introduced (dark grey) regions(Day et al., 2003)

The species has made itself indispensable in most parts of India. It was introduced in 1809 as an ornamental plant by the British in Calcutta Botanical Garden. Voyaging two centuries of its establishment in India, at present it is considered to be extremely adaptable and prolific. Thus, it has its indiscriminate spread and presence in almost all regions of India including farm, pasture, fallow land and forest except the Thar Desert and its surroundings (Dobhal et al., 2011). Not only is the geographic range of *Lantana camara* still expanding in many regions of India, but the density of infestations within its range is increasing and has been recognized as a future threat to ecosystems.

Lantana has become the most problematic weed in many tropical and subtropical terrestrial habitats worldwide. Lantana forms thick shrub like colonies and caused problems for Horticulture, agriculture, biodiversity, shelter for dangerous wild animals like leopards. Hence, its proper utilization and eradication is immediately required.

Lantana species are widely spread weeds in warm climates. Lantana camara is poisonous to stocks and humans. In India, it is a weed of national significance and must continuously be suppressed and destroyed.

Lantana camara becomes a threat to environment, agriculture soil and other flora and fauna due to its phenomenal growth rate. There are various technologies that have already been adopted to eradication of lantana but the benefits are temporary and sometimes costly too.

Historical resume:

International status

As attempts to control the weed have caused high costs and labour requirements, leading to nothing but temporary removal of the Lantana, considerable research effort has been directed towards exploration of various ways of unlocking value in the otherwise troublesome weed. A number of possible uses of the plant, some of which have been developed and others are still in their infancy have been suggested.

In many parts of the world the plant has been used to treat a wide variety of disorders, in the folk medicine especially for tumors and cancer. A tea prepared from the leaves and flowers is taken against fever, influenza and stomach ache. With other preparations of the plant fever, cold, rheumatism, asthma and high blood pressure are treated. In Central and South America the leaves were made into a poultice to treat sores, chicken pox and measles. In Ghana infusions of the whole plant are used against bronchitis. The powdered root in milk was given to children for stomach ache.

In Asian countries leaves are used for cuts, rheumatism, ulcers, and as a vermifuge. Decoctions are applied externally against leprosy and scabies (Ghisberti, 2000). Pass and Steward (1984) highlighted the administration of activated charcoal for the treatment of lantana poisoning of sheep and cattle. Fourie et al. (1987) demonstrated the acute toxicity of Lantana camara in cattle. Ganai and Iha (1991) explained the immunsuppression due to chronic toxicity of Lantana camara in sheep. Pan et al. (1992) and Pan et al. (1993) studied on the chemical constituents of the roots and leaves of Lantana camara. Deena and Thoppil (2000) also highlighted the antimicrobial activity of the essential oil of Lantana camara. Bouda et al. (2001) highlighted the effects of essential oils from leaves of Ageratum conyzoides, Lantana camara and Chromolaena odorata onthe mortality of Sitophilus zea mais (Coleoptera, Curculionidae). Ali-Emmanuel et al. (2003) performed the treatment of bovine dermatophilosis with Senna alata, Lantana camara and Mitracarpus scaber leaf extracts. De Mello et al. (2003) explained the effects of Lantana camara on rat fertility. Abdel-Hadyet al. (2005) analysed the chemical composition and insecticidal activity of the volatile oils of leaves and flowers of Lantana camara L. cultivated in Egypt.

National status

Possible utilization of the Lantana is being performed in antibacterial and toxicological studies in India. In India, the leaves of the plant are boiled for tea and the decoction is a remedy against cough. The decoction of the whole plant is given as treatment against tetanus, rheumatism, malaria and ataxia of abdominal viscera. It is used as a lotion for wounds, too. Pounded leaves are applied to cuts, ulcers and swellings (Verma and Verma, 2006). Sharma (1984) made a review on the biochemical effects of Lantana camara toxicity. Akhter et al. (1990) showed the skin and liver toxicity in experimental Lantana camara poisoning in albino rats. Dua et al. (1996) highlighted the repellency of Lantana camara (Verbenaceae) flowers against Aedes mosquitoes. Garg et al. (1997) explained the antilymphocytic and immunosuppressive effects of Lantana camara leaves in rats. Misra and Laatsch (2000) analysed some triterpenoids, essential oil and photooxidative lactonization of oleanolic acid from Lantana camara. Sagar et al. (2005) evaluated the antimotility effect of Lantana camara L.var aculeate constituents on neostigmine induced gastrointestinal transit in mice.

Objectives:

- To find strategies for turning the invasive weed into worthy resources.
- To separate the lignin and find out cellulose from Lantana plants.
- To produce biodegradable packaging film.
- To develop a strategy to convert the problem into useful resources with the help of proper technology and management.

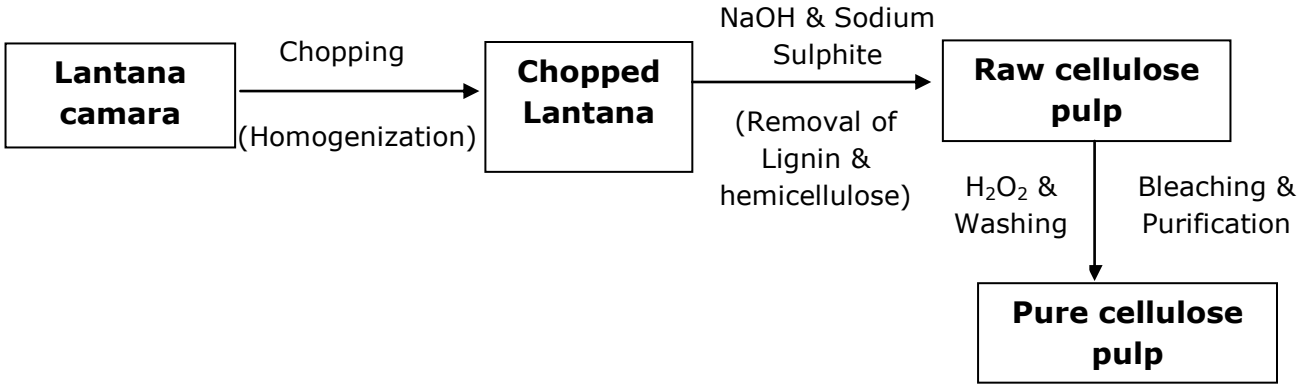
Methodology:

The strategy for the present work includes the following specific work elements as described in the following points:

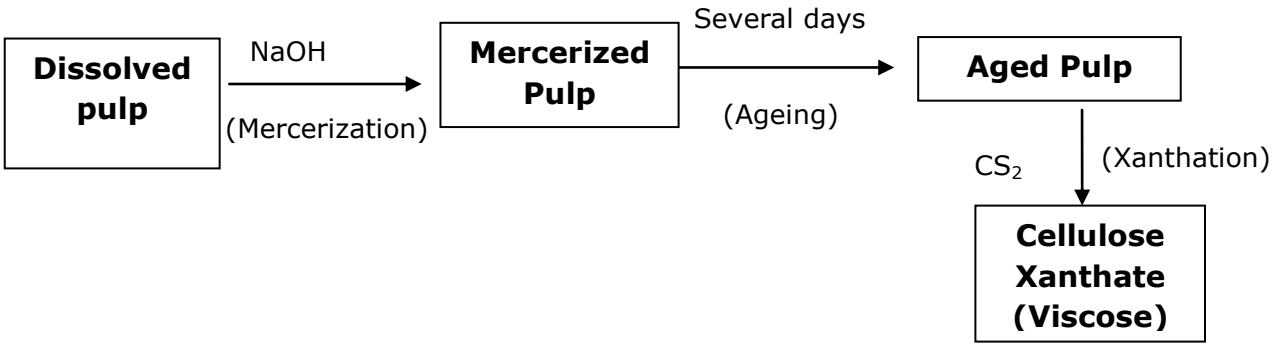
1) Invasive weed Lantana will be collected from its natural habitats.
2) Lantana plants will be chopped and homogenized in order to achieve a well mix material.
3) Performing delignifications, Cellulose will be extracted from Lantana grass
4) Xanthation will be performed for making cellulose Xanthate.
5) Casting and coating of biodegradable film will be executed.

Schematic representation of methodology is given below:

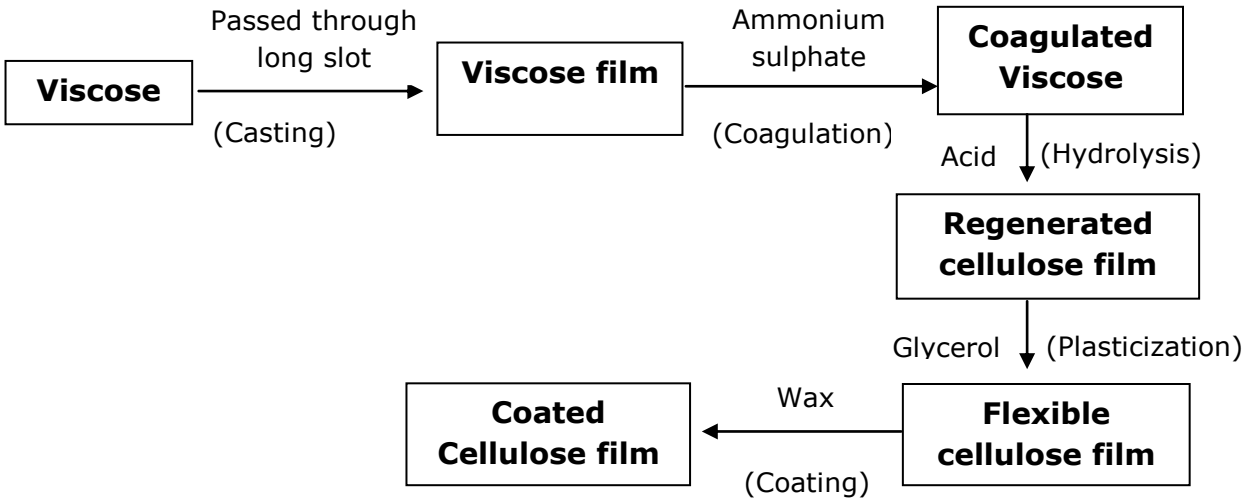
Step 1: Delignification



Step 2: Viscose Formation



Step 3: Casting of cellulose film



Significance of the work:

All plastic and polythene films like polythene, PPE, PTFE, PVC, etc. are petrochemical oriented and due to the increasing demand of petroleum products, it will not be available in near future. On the other hand, petrochemical based films are not degradable and the all types of existing films pollute the environment in several ways. It is necessary to find out the alternative of petroleum based packaging film. In this context, a biodegradable film derived from natural material will be appreciated. Furthermore, Lantana grass has no use to mankind rather it is detrimental as a useless weed to degrade the terrestrial ecosystem. Hence, it will be the best solution to degenerate the weeds and in lieu to develop some useful product from it like biodegradable packaging film.

Conclusion:

Industries working in the field of biodegradable films can utilize the results of the proposed work. Proposed product biodegradable cellulosic film will be eco-friendly and will not create pollution and hence, conserve the environment. As raw material is Lantana grass, so it will help to save the trees. People can use this biodegradable sheet and can throw it anywhere. This biodegradable film will be beneficial for current consumers of recent and advanced market.

Raw material used for the development of biodegradable sheets, will be a useless invasive plant species, which is available in plenty. Therefore the developed material would be cheaper. The developed technology will be scaled-up before commercialization. Initially the development process will be executed at laboratory scale.

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