

A REVIEW ON BIOLOGY OF *CHROMOLAENA ODORATA*Jyotirmoy Mondal<sup>1\*</sup> and Anindya Sundar Ray<sup>2</sup><sup>1</sup>Department of Agronomy, Palli-Siksha Bhavana (Institute of Agriculture), Visva-Bharati, Sriniketan<sup>2</sup>Department of Botany, Siksha Bhavana (Institute of Science), Visva-Bharati, Santiniketan\*Corresponding author: [jyotirmoymondals@gmail.com](mailto:jyotirmoymondals@gmail.com)

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## ABSTRACT

*Chromolaena odorata* (L.) King and Robinson (Asteraceae), formerly known as *Eupatorium odoratum* L. It is a perennial weed. *Chromolaena* now includes more than 165 species, all from South and Central America and the West Indies. The two main invasive forms of *C. odorata* that occurring in Asia and West Africa and that occurring in southern Africa, differ from one another in morphology, biology, and ecology, and there is little variation within each. *Chromolaena odorata* appeared in West Africa much later than in Asia. It was probably accidentally introduced into Nigeria in 1937, through imported seeds of *Gmelina arborea* Roxb. (Verbenaceae) from Sri Lanka.

**Keywords :** *Chromolaena odorata*, Biology, morphology, propagation.

## INTRODUCTION

*Chromolaena odorata* (L.) King and Robinson (Asteraceae), formerly known as *Eupatorium odoratum* L., is a weedy pioneering shrub native to the Americas from southern USA to northern Argentina (Gautier 1992). It is a perennial weed in many parts of the world from sea level to over 1,000m in elevation (Binggeli, 1999). *Chromolaena odorata* has become one of the worst terrestrial invasive plants in the humid tropics and subtropics of the Old World over the past century (Holm *et al.*, 1977; Gautier, 1992). From its original point of introduction as an ornamental plant in north eastern India in the mid nineteenth century, it has spread throughout Southeast Asia, into parts of Oceania (Muniappan and Marutani, 1988; McFadyen, 1989; Waterhouse, 1994a), and into West and Central Africa (Gautier, 1992; Prasad *et al.*, 1996).

## TAXONOMY

*Chromolaena odorata* belongs to the Asteraceae (Compositae), a large, well-defined and highly evolved family (Toelken, 1983; Bremer, 1994; APG II, 2003). *Chromolaena odorata* is a member of the Eupatorieae, a well-defined, largely New World tribe within the subfamily Asteroideae (King and Robinson, 1987). *Eupatorium* included over 1200 species before it was split by King and Robinson (1970), following which *Chromolaena* now includes more than 165 species, all from South and Central America and the West Indies (King and Robinson, 1987). Within the genus, *C. odorata*, *C. ivaefolia* (L.) King & Robinson and *C. laevigata* (Lam.) King & Robinson are widespread and occasionally weedy in the Americas, but only *C. odorata* has become a serious weed in the Old World (McFadyen, 1989).

The two main invasive forms of *C. odorata* that occurring in Asia and West Africa and that occurring in southern Africa, differ from one another in morphology, biology, and ecology, and there is little variation within each form (Kluge, 1990; Lanaud *et al.*, 1991; Scott *et al.*, 1998; von Senger *et al.*, 2002; Ye *et al.*, 2004). Thus, they are functionally distinct entities, and have been characterized as biotypes (Zachariades *et al.*, 2004). It is important that these differences be considered when comparing studies on one invasive biotype with the other.

**Taxonomic Hierarchy**

Kingdom	Plantae
Sub kingdom	Viridiplantae
Infra kingdom	Streptophyta
Super division	Embryophyta
Division	Tracheophyta
Subdivision	Spermatophytina
Class	Magnoliopsida
Superorder	Asteranae
Order	Asterales
Family	Asteraceae
Genus	Chromolaena
Species	odorata

(Source: www.itis.gov)

**DISTRIBUTION****i. *Chromolaena odorata* in the neotropics**

In the Americas, *C. odorata* occurs from USA (southern Florida and Texas) (30°N) to north-western Argentina (about 30°S) (Gautier, 1992; Kriticos et al., 2005), almost continuously wherever the habitat and climate are suitable. It is present on all the islands of the Caribbean. To the west of the Andes, its range extends as far south as northern Peru (Gautier, 1992). Plants that are similar to the southern African biotype have only been found on the northern Caribbean islands, particularly Jamaica and Cuba (Zachariades et al., 2004).

**ii. *Chromolaena odorata* in the Old World**

*Chromolaena odorata* is present in the majority of countries in the humid tropics and subtropics of the Old World. Gautier (1992) and McFadyen (1989, 1996b) have discussed the invasive pathways of *C. odorata* in the Old World. The first record of naturalization was in the 1870s in Dacca and the Ganges flood plain (present day Indian and Bangladesh). However, the plant was probably introduced into Asia as an ornamental plant in the early 1840s, through the Botanical Gardens in Kolkata. By the early twentieth century, it was widespread in Assam, Bengal (India and Bangladesh), Myanmar (Burma) (Rao, 1920) and present in Thailand (Gautier, 1992). The plant was recorded in Vietnam and Laos in the 1930s (Gautier, 1992).

It was introduced as an ornamental to Peradeniya, Sri Lanka, in 1884 and it had naturalized in Sri Lanka by the 1930s (Grierson 1980). *Chromolaena odorata* spread eastwards into China and south into Indonesia, especially during World War II (McFadyen, 2002), although it was present in both of these countries in the 1930s. Within Indonesia, *C. odorata* spread was aided by the transmigration program in the 1960s (McFadyen, 2002). The weed was first recorded in Nepal in the 1950s, the Philippines and Papua New Guinea in the 1960s (Henty and Pritchard, 1973) and in Timor and

Taiwan in the 1980s (Wu et al., 2004; Lai et al., 2006). It was introduced to Guam in the 1960s (Stone, 1966) and it had spread to most of the Micronesian islands by 2000 (Muniappan et al., 2004).

In Australia, *C. odorata* was found along the Tully River and at Bingil Bay in northern Queensland in 1994 (Waterhouse, 1994a) and at several other localities subsequently (McFadyen, 2004a). Two morphological forms were found in Australia. The more widespread form matched genetically with the Asian–West African biotype, whereas the more localized form matched with material from southern Brazil (Scott et al., 1998). Another species, *C. squalida* (Waterhouse, 2003) was also found in the vicinity, implying that all three taxa may have been imported with fodder seed from Brazil (Waterhouse and Zeimer, 2002).

*Chromolaena odorata* appeared in West Africa much later than in Asia. It was probably accidentally introduced into Nigeria in 1937, through imported seeds of *Gmelina arborea* Roxb. (Verbenaceae) from Sri Lanka (Ivens, 1974). By the mid 1990s, *C. odorata* had been recorded from Guinea in the west, south into northern Angola, and east into the central parts of the Democratic Republic of the Congo (Hoevers and M’Boob, 1996). Recent records include Chad (Timbilla, 1998), Burkina Faso and The Gambia (CAB International 2004) and most recently, it has been reported to be common in western Kenya and present in Tanzania (B. le Ru, and Q. Mann, personal communications).

In the mid nineteenth century, *C. odorata* from Jamaica appeared in a list of plants growing in the Cape Town Botanic Gardens, South Africa, and it was found naturalized around Durban in the late 1940s (Hilliard, 1977; Zachariades et al., 2004). From there, it spread rapidly along the coast and is now present from Port St. Johns in the south, where it has probably reached its ecological limit, up into southern Mozambique, and inland through Swaziland into northern South Africa (Goodall and Erasmus, 1996; Macdonald et al., 2003).

## MORPHOLOGY

*Chromolaena odorata* is a scrambling perennial shrub, with straight, pithy, brittle stems which branch readily, bear three-veined, ovate-triangular leaves placed oppositely, and with a shallow, fibrous root system (Holm et al., 1977; Henderson, 2001). Capitula are borne in panicles at the ends of the branches and are devoid of ray florets. The corollas of the florets vary between plants from white to pale blue or lilac. Achenes are black with a pale pappus (Holm et al., 1977; McFadyen, 1989). In open-land situations, *C. odorata* grows to 2–3 m in height, but it can reach up to 5–10 m when supported by other vegetation.

Within its native range, *C. odorata* shows marked morphological variability in terms of flower colour, leaf shape and hairiness, smell of the crushed leaves, and plant architecture. In some regions, several forms and their intermediates co-occur, while in others, the population appears homogeneous; the basis for this variability presently remains unexplained (Zachariades et al., 2004).

In contrast, the biotype invasive in Asia, Oceania, and West Africa is uniform in its morphological features, and has pale blue–lilac flowers, fairly hairy, dull-green leaves and stems, and a lax habit. The southern African biotype of *C. odorata* is distinct from this more widespread biotype, having glabrous stems and leaves, which in consequence are bright yellow-green when young. The plant has a more upright growth habit, white flowers and the smell emitted by the crushed leaves is sharp when compared with that of the Asian–West African biotype.

## BIOLOGY

The tropical and subtropical areas in which *C. odorata* grows as either a native or an invasive species are generally characterized by a dry season with shorter days and a rainy season with longer days. At the start of the wet season, established plants generate new shoots from the crown or from higher, undamaged axillary buds, while seeds in the soil, produced during the previous dry season, germinate (McFadyen, 1988 and 1989). In its invasive range, several thousand *C. odorata* seeds may germinate per square meter, but subsequent high mortality of seedlings (Yadav and Tripathi, 1981; Epp, 1987) and self-thinning of older plants (Witkowski and Wilson, 2001) occurs. Under moist conditions, *C.*

*odorata* branches trailing on the ground may root (Gautier, 1993), but vegetative reproduction does not contribute significantly to its pest status.

Plants grow vigorously throughout the wet season and flowering is initiated by a decrease in both day length and rainfall (Sajise et al., 1974, Gautie, 1993). Flowering peaks in December–January in the northern hemisphere and June–July in the southern hemisphere. The onset of flowering coincides with the cessation of vegetative growth. Flowering is often prolific, and in both the native and invasive ranges, fertile seed is produced without pollination, as the species is apomictic (Coleman, 1989; Rambuda and Johnson, 2004). However, the flowers of *C. odorata* are also visited by insects (Ghazoul, 2004; Ramí´rez, 2004) and *C. odorata* is an important honey plant in Thailand (Thapa and Wongsiri, 1997).

**PROPAGATION**

*Chromolaena odorata* is a perennial species, as it lives for more than one year. Seeds germinate during the wet season. Seedling growth is prolific, and seedlings that have germinated early in the wet season may flower during the following flowering season in June–July. Because flowering is triggered by day length, all plants in an area flower at much the same time of the year. The fruits ripen and drop several months after flowering. Large numbers of seeds (in South Africa, one plant produced over one million seeds in a single season; (Liggitt, 1983) are set in less than two months after flowering (Erasmus, 1985). Seeds are dispersed by wind, as well as via animal fur, clothing, and vehicles (Gautier, 1992 and 1993; Blackmore, 1998). Most seed loses its viability after a year, although a small proportion of the seed persists in the soil for several years, allowing for rapid recolonization after the removal of a parent population (Witkowski and Wilson, 2001). Once plants have flowered and seeded, the terminal, flower-bearing parts of the stems die, and in seasonally drier areas, the leaves wither and fall.

*Growth Calendar*

Months Growth stages	January	February	March	April	May	June	July	August	September	October	November	December
<b>Flowering</b>												
<b>Seed formation</b>												
<b>Seed drop</b>												
<b>Dieback</b>												
<b>Regrowth</b>												
<b>Germination</b>												

## How it spreads?

*Chromolaena odorata* spreads mostly through its numerous seeds – potentially in the millions in larger bushes – being easily transported short distances by wind due to the tufts of hair that catch any breeze. Seeds also readily become lodged in clothing, animal fur or machinery, and in this way it spreads large distances since initially being introduced into India in the 1840s. In particular, much of the spread has been attributed to the movement of people, equipment and materials during World War II. It is now a serious weed throughout the Indian subcontinent and South-East Asia, and central, western and southern Africa. Siam weed is also present in many of Australia's near neighbours, including East Timor, Philippines, Papua New Guinea and several Pacific islands.

## CONCLUSION

One of the worst weeds of the world is *Chromolaena odorata*. It affects agriculture and biodiversity in the Old World. Its original point of introduction was in northeast India in mid nineteenth century as an ornamental plant. After that it spread throughout Southeast Asia, into parts of Oceania and into West and Central Africa. A good number of studies have been conducted on its allelopathic effects, dynamics of population, impact on indigenous vegetation, biology and ecology. However, significant research gaps remain. Significant research work may be conducted on its medicinal value and it may be act as a good medicinal plant for mankind.

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