

MICONIA CALVESENS, A POTENTIALLY INVASIVE PLANT IN AUSTRALIA'S TROPICAL AND SUB-TROPICAL RAINFORESTS
MICONIA CALVESENS, UNE PLANTE POTENTIELLEMENT ENVAHISSANTE DANS LES FORETS TROPICALES ET SUB-TROPICALES HUMIDES D'AUSTRALIE

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Miconia calvenscens, a tree native to tropical America, is highly invasive in the rainforests of French Polynesia and Hawai'i. In 1963, *M.c.* was imported into the Townsville botanic gardens in North Queensland. During the 1970's it became a popular ornamental foliage plant in Australia and was sold by several nurseries in Queensland and New South Wales. Nurserymen have reported naturalised specimens in North Queensland, although the extent of these populations has not been fully assessed. Climatic modelling suggests that *M.c.* has the potential to invade tropical and sub-tropical rainforests of northern and eastern Australia. There appears to be an opportunity to prevent or contain the spread of *M.c.* in Australia. Legislation which prohibits cultivation and sale of *M.c.* and its congeners was put in place in Queensland in May 1997. A program to detect and eradicate cultivated and wild *M.c.* will be launched by the Queensland Government in 1997/98. Unfortunately, there are no legal barriers to sale and cultivation of *M.c.* in other States. Uniform national controls restricting trade in invasive plants such as *M.c.* are urgently required.

Miconia calvenscens, un arbre originaire d'Amérique tropicale, est fortement envahissant dans les forêts humides de Polynésie française et de Hawai'i. En 1963, *M.c.* a été importé dans les jardins botaniques de Townsville dans le Nord Queensland. Durant les années 70, il est devenu une plante ornementale populaire en Australie et a été vendu par plusieurs pépinières dans le Queensland et le New South Wales. Les pépiniéristes ont signalé des spécimens naturalisés dans le Nord Queensland, bien que l'étendue de ses populations n'a pas été totalement évaluée. Une modélisation climatique suggère que *M.c.* a le potentiel pour envahir les forêts humides tropicales et sub-tropicales du Nord et de l'Est de l'Australie. Une réglementation qui interdit la culture et la vente de *M.c.* ainsi que les espèces du même genre a été mise en place au Queensland en mai 1997. Un programme pour détecter et éradiquer les pieds de *M.c.* cultivés ou sauvages sera lancé par le Gouvernement du Queensland en 1997/98. Malheureusement, il n'y a pas de barrières légales à la vente et à la culture de *M.c.* dans les autres États. Des contrôles uniformes nationaux limitant le commerce des plantes envahissantes comme *M.c.* sont nécessaires de toute urgence.

Invasive plant species are usually first studied and reported after they have become extensively naturalized - at a time when eradication of the entire population is no longer feasible. In contrast, this paper draws attention to a potentially invasive plant, *Miconia calvenscens*, which appears to have a very limited distribution in Australia. An assessment of the plant's pest potential is presented together with recommendations for preventive control. Hopefully, this species can be prevented from becoming an intractable problem in Australia.

DESCRIPTION AND BIOLOGY

M.c. is a tree native to Central and Southern America, from southern Mexico to northern Argentina; the bicolorous form is restricted to Central America (southern Mexico, northern Guatemala, Belize and Costa Rica); in its native habitat *M.c.* appears to be a shade-tolerant understory species that behaves as a pioneer tree in forest gaps (Meyer,

1994 ; 1996). It grows in lowland to montane tropical rainforest at altitudes between 300 and 1800 m (Wurdack,1980). Although capable of reaching 15m in height, the majority of specimens in the Society Islands are 6 to 12m tall, with slender, vertical stems (Meyer, 1996). The leaves are opposite, elliptic to obovate, usually 60-70 cm long (sometimes up to 1m long). Perhaps the most characteristic feature of the leaves is the three prominent longitudinal veins. The bicolorous form of the plant has leaves with purple undersides.

Under favorable conditions, juvenile specimens can grow up to 1.5m/year (Meyer and Malet, 1997) and reproduce when four to five years old (Meyer, 1996). The inflorescence is a large panicle comprised of 1000-3000 white or pink flowers. Flowering can occur three times per year and in Hawaii appears to be triggered by weather conditions (Medeiros *et al.*,1997). A young tree with only two panicles can produce ca. 200,000 seeds in its first fruiting season, whereas an older tree, with over 50 panicles, can produce over 5 million seeds per annum (Meyer, *op.cit.*). Berries are 6-7mm in diameter and turn purple or black when ripe. Each berry contains an average of 140-230 seeds, each ca. 0.7 by 0.5mm long (Meyer, *op.cit.*). Soil-seed banks containing more than 50,000 seeds per sq.m have been recorded in heavily infested areas (Gaubert, 1992). Seeds can remain viable for at least four years (Meyer and Malet, 1997). At Limberlost nursery in North Queensland, a seedling emerged five years after the parent tree had died (R. Jones, pers. comm. *in* Edwards, 1996). In a laboratory, some seeds germinate within 15-20 days when exposed to light and moisture, but others remain dormant (Meyer, 1996). Germination and seedling growth can occur under light levels as low as 0.02% of full sun (Meyer, 1994). This attribute facilitates the plant's persistence in deep shade beneath rainforest canopies.

Although most fruit falls beneath the parent tree, the seed is small enough to be moved by wind and water. In Tahiti, berries of *M.c.* are ingested by frugivorous birds, particularly the introduced silver-eye (*Zosterops lateralis*) and the red-vented bulbul (*Pycnonotus cafer*), which transport and defecate the seeds (Gaubert, 1992). Fruit can also be dispersed by frugivorous rodents (Meyer, 1994) and the tiny seed can adhere to mud on vehicles and shoes.

HISTORY AS A WEED ELSEWHERE

Due to the plant's attractive foliage *M.c.*, particularly the bicolorous form, has been grown as a garden ornamental throughout the world (Meyer, 1996). Originally introduced into the Papeari Botanical Garden (Tahiti) in 1937, *M.c.* has naturalized over 65% (ca. 70,000 ha) of the island and has formed dense, monospecific stands over 25% of the island (Meyer, *op.cit.*). It has spread to the surrounding islands of Moorea, Raiatea and Tahaa, and is ranked as the most important plant pest in the Society Islands (Meyer, *op.cit.*). *M.c.* was declared noxious by the French Polynesian Government in 1990.

Dense shade produced by the overlapping foliage of *M.c.* prevents regeneration of local rainforest plants to the extent that 70-100 native plant species, including 40-50 species endemic to French Polynesia, are directly threatened by invasion by *M.c.* (Meyer and Florence, 1996). *M.c.* persists in a wide range of habitats including primary and secondary rainforest in mesic and wet environments (mean annual rainfall >2,000mm) at 10-1300m elevation (Meyer, 1996). In areas of primary rainforest it appears to invade areas that show no obvious signs of disturbance.

On the island of O'ahu (Hawai'i), *M.c.* was present in the Wahiawa Botanical Gardens by 1961. It was subsequently sold by several Hawaiian nurseries and transported to other islands of Hawai'i. By 1990, it had formed pure stands in middle and high elevation rainforests up to 30km from the point of introduction (Loope and Medeiros, 1995). This is when control action was first undertaken in Hawaii. It was declared noxious in 1992 and in mid-1993 the Hawaii Department of Agriculture initiated biological control research. To date,

a range of fungi, weevils, leaf-feeding beetles, butterflies and moths have been found in South and Central America. Perhaps the most damaging species, the Chinese rose beetle (*Adoretus sinicus*), causes up to 50% defoliation but does not cause tree mortality (Medeiros *et al.*, 1997). Chemical control programs, including aerial spraying, have been undertaken in Hawai'i. Eradication appears feasible on some of the small islands, however, re-invasion from nearby islands and a resilient soil-seed bank associated with older stands are on-going problems (Meyer and Malet, 1997).

Cultivated specimens have been reported in the Philippines, Grenada and New Caledonia, whereas naturalized populations of *M.c.* exist in Jamaica and Sri Lanka (Meyer, 1996). Holm *et al.* (1979) list five other species of *Miconia* as weeds (*M. chamissois* Naud in Brazil, *M. laevigata* DC. in Jamaica, *M. lateriflora* Cogn. and *M. nervosa* Triana in Peru and *M. stenostachya* (Schr. & Mart.) DC. in Trinidad).

STATUS AND WEED POTENTIAL IN AUSTRALIA

In 1992, F. R. Fosberg, a botanist from the National Museum of Natural History (Smithsonian Institute) warned Australian authorities that "no expense be spared to search it (*M.c.*) out and destroy it before you have a hopeless problem" (Humphries and Stanton, 1992). More recently, it has been listed as a high priority candidate for eradication in Australia (Csurhes and Edwards, in press).

Using the CLIMEX computer program (Maywald and Sutherst, 1989; 1991), the potential distribution of *M.c.* has been predicted by P. Mackey (Edwards, 1996). The CLIMEX model confirmed the high suitability of climates in Tahiti and Hawaii (Fig. 1) and suggested that climates in northern and eastern Australia may be highly suitable (Fig. 2). Distribution and abundance of *M.c.* within the area of climatic suitability will, of course, be restricted by edaphic factors and land use. Since the plant has invaded mesic and wet rainforests in the Polynesian and Hawaiian archipelagoes it appears well suited to coastal, wet tropical and sub-tropical rainforest in eastern Australia (which occur primarily in Queensland).

Fig. 1. Predicted world distribution of *M.c.* (produced by Mackey in Edwards, 1996) (the size of the circles indicates the relative size of the climate match index).



Fig. 2. Predicted distribution of *M.c.* in Australia (produced by Mackey *in* Edwards, 1996) (the size of the circles indicates the relative size of the climate match index).



The impact of *M.c.* in Australian rainforest communities is difficult to predict. A worst case scenario is that the plant will have an impact comparable to that experienced in Tahiti, where it forms extensive pure stands. It has been suggested, however, that oceanic islands, such as Tahiti (which was formed by volcanic activity some 1M years ago), may be more vulnerable to invasions, due in part to a relatively impoverished flora (Loope and Mueller-Dombois, 1989; Meyer, 1996). Australia's older and generally more diverse rainforest communities may be more resilient to plant invasions. Accepting the worst case scenario, *M.c.* could form extensive, mono-specific stands in Australia's rainforests. As a consequence, native plants could be excluded and prevented from regenerating. Since *M.c.* can germinate and grow in very low light levels, it could invade and persist in relatively undisturbed primary rainforests.

Zosterops lateralis, one of the major avian dispersal vectors of *M.c.* in Tahiti, is abundant in eastern Australia ranging from Cape York to Tasmania. Within this range, *Z. lateralis* is migratory (Blakers *et al.*, 1985) and is expected to be an effective dispersal vector throughout the plant's predicted range.

The earliest record of *M.c.* in Australia is the introduction of seeds from the Peridenya Botanical Gardens (Sri Lanka) to the Townsville Botanical Gardens in 1963 (Edwards, 1996). Specimens were subsequently cultivated in the Melbourne, Sydney and Mt Coot-tha (Brisbane) botanic gardens (Edwards, *op.cit.*). Several specimens were grown in the Flecker Botanic Gardens in Cairns but were removed in 1996, in response to a request from the Queensland Department of Natural Resources (local nursery owners have commented that people have sourced seeds of *M.c.* from specimens in these gardens prior to removal). The Queensland herbarium has two records of the plant, one from a private garden in Brisbane and another from a wholesale nursery in 1990. *M.c.* was common in Queensland nurseries in the 1970's, a period when exotic, tropical foliage plants were particularly popular. Investigation by the Queensland Department of Natural Resources in 1996 revealed that at least five nurseries in Queensland and at least three in New South Wales propagated and sold *M.c.* in the 1970's and 1980's. Nurserymen in the Cairns area sourced plants from Sydney and Tully in and around 1980 (Edwards, 1996). More recently, the plant appears to have gone out of "fashion" as a foliage species and few, if any, nurseries currently offer the plant for sale. In 1996, the Queensland Nursery Industry Association advised that the plant was not known to be in trade (in Queensland) and there was no opposition to its listing as a declared weed (as defined in the Queensland "Rural Lands Protection Act 1985").

To date, there are two reports of naturalized *M.c.* in Australia; one adjacent to rainforest north of Mossman and a second near El Arish in North Queensland. In both cases, naturalized specimens were derived from nearby nursery stock and private garden specimens. The extent of these infestations will be investigated by the Queensland Department of Natural Resources as part of a planned early detection and eradication program in 1997/98.

Since the plant has been cultivated in Queensland gardens for at least the past 20 years, a public awareness campaign has been implemented to help locate specimens. A color brochure on the plant is currently being distributed in Queensland. Hopefully, the plant can be detected and removed before it has a chance to become firmly naturalized.

Although *M.c.* was declared noxious in Queensland in May 1997, it can be legally cultivated and sold in all other States and Territories. Ideally, the plant should be prohibited from sale on a National basis to prevent interstate movement and naturalization.

CONCLUSION

M.c. possesses attributes common to many of Australia's most invasive plants: high fecundity, rapid growth, shade tolerance, early reproductive maturity, long distance seed dispersal (by birds) and the persistence of a substantial seed bank in the soil. It appears well suited to the climates of coastal, eastern Queensland. Considering the plant's impact in the rainforests of Tahiti and Hawai'i, early detection and eradication of this plant in Australia is vital. Preventative measures, including uniform national restrictions over the plant's sale and cultivation, are required to preclude the need for more intensive control programs in the future.

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