

## INVENTORY OF THE INVASIVE ALIEN PLANT SPECIES IN INDONESIA

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### ABSTRACT

An inventory of the alien plant species in Indonesia based on the existing references and herbarium specimens concluded that 1936 alien plant species are found in Indonesia which belong to 187 families. Field studies should be done to get the complete figures of alien plant species in Indonesia. Based on the existing figures of the plant species, the invasive alien plant species can be identified, followed by studies on the assessment of losses, biology, management and their possible utilizations. Alien plant species are imported to Indonesia for cultivation, collection of the botanical garden, as experimental plants or other curiosities. Aside from plants purposely imported, there are also introduced plant propagules contaminating imported agricultural products. These alien plant species can be beneficial or have a potential of being invasive. The alien cultivated species consisted of 67% of the total number. More than half of the cultivated plants are ornamental plants. Some of the species are naturalized or escaped from cultivation and become wild and invasive. Some other naturalized species, adapted well without any problems of invasion. There are 339 species or 17% of the species recorded as weeds. The highest record of weeds is found in the family of Poaceae (57 species), followed by Asteraceae (53 species) and Cyperaceae (35 species). There are 6 families having more than 10 species of weeds: Amaranthaceae, Asteraceae, Cyperaceae, Euphorbiaceae, Poaceae, and Rubiaceae. Three families have more than 100 species: Asteraceae 162 species, Poaceae 120 species, and Papilionaceae 103 species. Five species of aquatic and 20 species of terrestrial plants considered as important alien plant species in Indonesia were identified and some of their distributions noted.

**Keywords :** *Alien plant species/Invasive alien plants/Weeds/Environmental weeds/Aquatic and terrestrial alien plants*

### INTRODUCTION

Indonesia, with its many large and small islands, has a great diversity of plants. However, natural disasters, logging and other activities destroy the habitat and reduce biodiversity.

As people move around the world, they bring together plants with them (Weber 2003). Expanding global trade in agriculture, forestry and other industries that depend on raw materials has allowed the transport of species to various parts of the world including Indonesia.

Not all of the alien species are harmful. Most of them are crops or ornamental plants. Some species are naturalized and adapted well to the local environment, while some become invasive.

Biological invasion by alien plant species constitutes one of the leading threats to natural ecosystems and biodiversity, and they also impose an enormous cost on

agriculture, forestry, fisheries, and other human enterprises, as well as human health. The effects of alien species on native species and ecosystems are numerous and usually irreversible. The impact is sometimes massive but often subtle. Natural barriers such as oceans, mountains, rivers, and deserts that allowed the intricate co-evolution of species and the development of unique ecosystems have been breached over the past five centuries, especially during the twentieth century, by rapidly accelerating human trade and travel. Plane, ships, and other forms of modern transportations have allowed both intentional and unintentional movement of species between different parts of the globe, often resulting to unexpected and sometimes disastrous consequences.

The invasive plant species; some of them have been well recognized as weeds in agricultural production systems, while weeds in natural habitat have been recognized as environmental weeds. Agricultural weed problems have received more attention than in other areas.

Weeds in agro-ecosystems differ in their ecology from invasive plants because the invaded ecosystems are different. Agro-ecosystems are highly artificial and represent simple, species poor habitats with environmental homogeneity and predictable disturbance regimes. In contrast, natural habitats are mostly species-rich, environmentally heterogeneous and often unpredictable. Plants invading agro-ecosystems represent mostly herbaceous species, often adapted to the crop system, whereas plants invading natural habitats comprise the full range of life forms (Weber 2003).

Environmental weeds have received increasing attention, because their impact on native biodiversity has been increasingly recognized and the direct costs of controlling them have increased (Groves 1999).

Invasive alien species are taxonomically diverse. Many local species are extinct or at the risk of being out-competed by invasive alien plants species, and many native ecosystems have been irreversibly lost to invasion.

Alien plant species introductions might become invasive, and degrade the ecosystems as well as economic income. Degraded environment due to alien plant invasions is not easy to rehabilitate. The extinction of local organisms is not easily renewable.

The United Nations convention on biodiversity or Convention on Biological Diversity (CBD) which was declared in 1992 was ratified by the Indonesian Government in 1994. Protecting our biodiversity will be very valuable to development in the future.

SEAMEO BIOTROP has been working on weeds for quite sometime. At present, not only weeds cause considerable agricultural losses, degrading catchments areas and fresh water ecosystem, invasive alien plant species which constitute one of the leading threats to natural ecosystem and biodiversity are studied in cooperation with the Indonesian Ministry of Environment since 2003 (Tjitrosoedirdjo & Tjitrosemito 2005).

The records on the invasive alien plant species in Indonesia have been dispersed in many publications. However, there are very few comprehensive information on invasive alien plant species.

There are some problems in studying the invasive alien plant species in Indonesia i.e.:

- 1). People are not aware of the harmful effects of invasive alien species and the government is not prepared to handle the problems yet.
- 2). The limited information scattered among various institutes; fail to impress the government on the urgency of the matters although the government ratified CBD in 1994.
- 3). It takes a long time among the departments to lead coordination. It is now recognized that the focal point for invasive alien species is the Ministry of Environment which currently coordinates the activities.
- 4). The Ministry of Environment is currently studying the principles of handling invasive alien species.

The objective of this work is to identify the invasive alien plant species and their distribution in Indonesia

## **MATERIALS AND METHODS**

### **Inventory and distribution**

A large amount of literature has been searched for inventory. The main sources of the list include the following: Flora of Java, Flora Malesiana, Weeds of Rice in Indonesia, Weed Leaflets papers of the Weed Science Society Conference Proceedings, various other publications in edited books and journals. Other additional informations were searched from common floras and from the Internet. The list included the number of families, species and the origin of each species.

Some of the important invasive alien plant species were analyzed for their distribution. The distributions were noted from the references and examination of the herbarium specimens conducted at the Herbarium Bogoriense (BO) and SEAMEO BIOTROP Herbarium (BIOT).

### **Important Indonesian Invasive Plant Species**

The decision on which species to consider as important is based on the availability, importance and distribution. The species included here is only a fraction of all invasive species in Indonesia. Only the species considered as seriously problematic and regarded to deserve attention in terms of monitoring and control are included.

## RESULTS AND DISCUSSIONS

### Inventory

Based on the inventory of alien plant species as of January 2005, there are 1936 species belonging to 187 families extracted from the compilation of Tjitrosoedirdjo & Tjitrosemito 2005, as shown in Table 1. The inventory was conducted from the existing references and information from the herbarium specimens. Field studies were not conducted yet. If the field studies were conducted, the number of the species recorded will increase with additional records from the fields and new records will be available.

New species and varieties of plants have been brought into Indonesia since the colonization era. The demand to import new plants continues in a global environment of free trade and this demand is likely to increase.

Some of these alien species are beneficial and contribute to the quality of the Indonesian life, a similar proportion have naturalized and become weeds in agricultural ecosystems or the natural environment. As indicated in Table 2, the cultivated one and the ornamental plants are the highest containing 63% of the total numbers, followed by weed species 17.5%. More than half of the cultivated plants are ornamental plants. Some of the alien species are naturalized or escaped from cultivation and become wild. There are 81 species whose benefits are unknown.

Table 1. Introduced plant families in Indonesia

No.	Family Alphabet	Name of the Family	No. of Families	No. of Species
1.	A	Acanthaceae, Acoraceae, Agavaceae, Aizoaceae, Alismataceae, Alliaceae, Aloaceae, Amaranthaceae, Amaryllidaceae, Anacardiaceae, Annonaceae, Anthericaceae, Apiaceae, Apocynaceae, Aponogetonaceae, Araceae, Araliaceae, Araucariaceae, Arecaceae, Aristolochiaceae, Aslepiadaceae, Asparagaceae, Asphodelaceae, Asteraceae, Aucubaceae, Azollaceae	26	426
2.	B	Balsaminaceae, Basellaceae, Begoniaceae, Berberidaceae, Betulaceae, Bignoniaceae, Bixaceae, Bombacaceae, Boraginaceae, Brassicaceae, Bromeliaceae, Buddlejaceae, Burseraceae, Butomaceae	14	111
3.	C	Cactaceae, Caesalpiniaceae, Campanulaceae, Cannaceae, Capparaceae, Caprifoliaceae, Caricaceae, Caryophyllaceae, Casuarinaceae, Chenopodiaceae, Chloranthaceae, Clusiaceae, Cochlospermaceae, Colchiaceae, Combretaceae, Commelinaceae, Convallariaceae, Convolvulaceae, Costaceae, Crassulaceae, Cucurbitaceae, Cupressaceae, Cyanastraceae, Cycadaceae, Cyclanthaceae, Cyperaceae	26	237

Table 1. Continued

No.	Family Alphabet	Name of the Family	No. of Families	No. of Species
4.	D	Dioscoreaceae, Dipsaceae, Dracaenaceae	3	8
5.	E	Ebenaceae, Elatinaceae, Eriocaulaceae, Ericaceae, Erythroxylaceae, Escalloniaceae, Euphorbiaceae	7	56
6.	F	Fagaceae, Flacortiaceae	2	6
7.	G	Geraniaceae, Gesneriaceae, Gleicheniaceae, Goodeniaceae	4	15
8.	H	Haemodoraceae, Haloragaceae, Hamamelidaceae, Heliconiaceae, Hemerocallidaceae, Hyacinthaceae, Hydrangeaceae, Hydrocharitaceae, Hydrophyllaceae, Hypericaceae	10	35
9.	I	Iridaceae	1	28
10.	J	Juncaceae	1	1
11.	L	Lamiaceae, Lauraceae, Lecythydaceae, Lentibulariaceae, Linaceae, Loasaceae, Loganiaceae, Lythraceae	8	76
12.	M	Magnoliaceae, Malphiaceae, Malvaceae, Marantaceae, Marsileaceae, Melastomataceae, Meliaceae, Menispermaceae, Menyanthaceae, Mimosaceae, Molluginaceae, Moraceae, Moringaceae, Musaceae, Myoporaceae, Myristicaceae, Myrsinaceae, Myrtaceae,	18	179
13.	N	Nelumbonaceae, Nyctaginaceae, Nymphaeaceae	3	8
14.	O	Oleaceae, Onagraceae, Orchidaceae, Oxalidaceae	4	156
15.	P	Pandanaceae, Papaveraceae, Papilionaceae, Passifloraceae, Pedaliaceae, Philesiaceae, Philydraceae, Phormiaceae, Phytolaccaceae, Pinaceae, Piperaceae, Pittosporaceae, Plantaginaceae, Plumbaginaceae, Poaceae, Polemoniaceae, Polygalaceae, Polygonaceae, Pontederiaceae, Portulacaceae, Primulaceae, Proteaceae	22	315
16.	R	Ranunculaceae, Resedaceae, Rhamnaceae, Rhizophoraceae, Rosaceae, Rubiaceae, Rutaceae	7	80
17.	S	Salicaceae, Salviniaceae, Sapindaceae, Sapotaceae, Saururaceae, Saxifragaceae, Scropulariaceae, Simarubaceae, Simmondsiaceae, Solanaceae, Sterculiaceae	11	95
18.	T	Taccaceae, Tamaricaceae, Taxodiaceae, Theaceae, Theophrastaceae, Thymelaeaceae, Tiliaceae, Trapaceae, Tropaeolaceae, Turneraceae	10	18
19.	U	Urticaceae	1	4
20.	V	Velloziaceae, Verbenaceae, Violaceae, Vitaceae	4	38
21.	X	Xanthorrhoeaceae, Xyridaceae	2	2
22.	Z	Zamiaceae, Zingiberaceae, Zygophyllaceae	3	12
Total			187	1936

Based on Table 1, the introduced families which have 10 or more weedy species are listed in Table 3. There are 17 families having more than 5 species of weeds, namely Amaranthaceae, Asteraceae, Caecalpiniaceae, Carryophyllaceae, Cyperaceae, Euphorbiaceae, Lamiaceae, Lytraceae, Onagraceae, Papillionaceae, Polygonaceae, Poaceae, Rubiaceae, Solanaceae and Verbenaceae. Three families have more than 100 species, Asteraceae, Poaceae and Papillionaceae. The highest number was recorded from Asteraceae 162 species, followed by Poaceae 120 species and Papillionaceae 103 species.

The highest number of cultivated plants is found in Asteraceae. Some 77% of the cultivated plants of Asteraceae are ornamental plants. Papillionaceae has 61 species of cultivated plants, followed by Poaceae 42 species.

The highest record of weeds is found in the family of Poaceae 57 species, followed by Asteraceae 53 species, Cyperaceae 35 species, Euphorbiaceae 16 species, Rubiaceae 11 species, Amaranthaceae 10 species, while the other families have only less than ten species (Table 3).

Table 2. Alien plant species in Indonesia, their cultivation and weedy ness

No.	Cultivated/weedy ness	Number
1.	Cultivated	551
2.	Cultivated as ornamental	671
3.	Naturalized	252
4.	Escaped	60
5.	Weeds	339
6.	Curiosity	6
7.	Unknown	63
	Total	1936

### Origin of the Alien Species

The alien plant species came from almost all parts of the world and continents, Europe, Africa, Asia, Australia, Pacific and America. Most of the species came from tropical America or other parts of America. The highest number came from America 40%, mostly from tropical America (Figure 1), followed by Asia 26%, and Africa 12.8%. The lowest number of alien plant species came from Australia and New Zealand only 4%.

Table 3. The families of introduced species with 10 or more weed species

No.	Family	Cultivated	Cultivated as ornamental Plants	Naturalized	Escaped	Weeds	Not Known	Total No.
1.	Amaranthaceae	0	3	3	0	10	0	16
2.	Asteraceae	<b>19</b>	<b>63</b>	20	4	<b>53</b>	3	162
3.	Caecalpiniaceae	<b>15</b>	<b>22</b>	5	0	5	6	53
4.	Carryophyllaceae	0	<b>12</b>	2	1	7	0	22
5.	Cyperaceae	0	2	0	0	<b>35</b>	2	39
6.	Euphorbiaceae	<b>12</b>	5	10	0	<b>16</b>	0	43
7.	Lamiaceae	<b>12</b>	10	12	0	8	0	42
8.	Lytraceae	5	3	2	0	7	1	18
9.	Onagraceae	7	0	3	0	5	0	15
10.	Papillionaceae	<b>49</b>	12	24	5	9	4	103
11.	Polygonaceae	6	1	2	1	5	0	15
12.	Poaceae	<b>31</b>	11	19	2	<b>57</b>	0	120
13.	Rubiaceae	<b>15</b>	19	2	0	<b>11</b>	0	48
14.	Solanaceae	<b>14</b>	5	17	2	5	1	44
15.	Verbenaceae	3	19	3	1	6	0	32

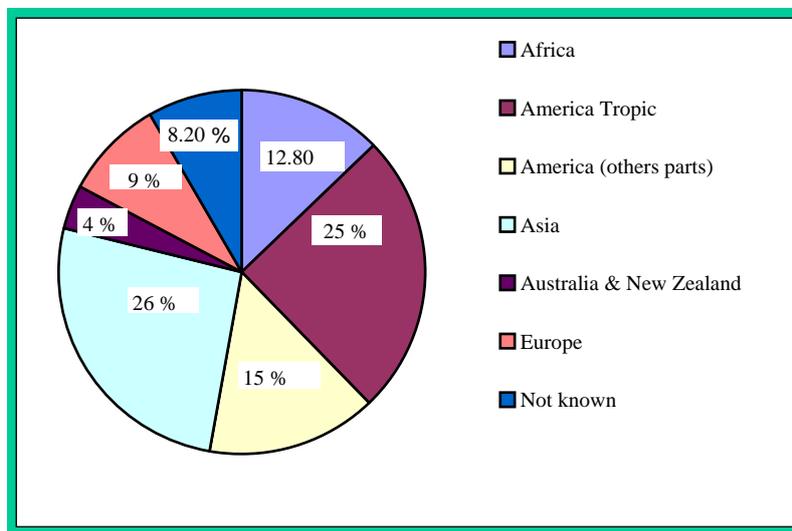


Fig 1. Origin of the Alien Plant Species in Indonesia

### Important Invasive Alien Plant Species in Indonesia

Important invasive alien plant species in Indonesia are classified into two different habitats: aquatic and terrestrial, as shown in Tables 4 & 5.

Tabel 4. Important aquatic alien invasive plants species

No.	Species	Family	Origin
1.	<i>Eichhornia crassipes</i> (Mart.) Solms	Pontederiaceae	South America
2.	<i>Hydrilla verticillata</i> (L.f.) Royle	Hydrocharitaceae	Asia
3.	<i>Mimosa pigra</i> L.	Mimosaceae	Tropical America
4.	<i>Pistia stratiotes</i> L.	Araceae	Not Known
5.	<i>Salvinia molesta</i> D.S. Mitchell	Salviniaceae	South America

For a long time, we have been aware of the existence of infestation problems of aquatic alien plant species in open waters, such as natural lakes, man-made lakes, irrigation channels, fish ponds, and others (Tjitrosoedirdjo & Widjaja 1991).

The first record of aquatic plants in Java, Bali and Sumatra was made during the year 1928 to 1939 by the "Deutschen Limnologischen Sunda Expedition" which recorded over 80 species present in some open waters in Indonesia (van Steenis & Ruttner 1933). Most of the records came from the open waters in Java with only few records from outside Java.

Pancho and Soerjani (1978), Soerjani (1979) and Tjitrosoedirdjo & Widjaja (1991) reviewed that *Eichhornia crassipes*, *Hydrilla verticillata*, *Mimosa pigra*, *Pistia stratiotes* and *Salvinia molesta* were the most important species of invasive aquatic plants in Indonesia. There were some species specific to certain open waters such as *Polygonum barbatum* which invaded Ir. P.M. Noor Reservoir in South Kalimantan (Hisbi 1990); *Hanguana malayana* invaded Lake Kerinci in Sumatra and Lake Semayang in East Kalimantan (Staff University of Indonesia 1970; Sastroutomo & Utomo 1985); *Phragmites karka* invaded Lake Rawa Danau, Banten and Lake Curug, West Java (Sastroutomo & Utomo 1985). The only native species is *Phragmites karka*, while other species belong to the alien species.

These alien species easily established themselves in their new environment, and spread so rapidly that native species were sometimes suppressed. This indicates that these plants possess a high power of adaptation when accompanied by a lack of natural predators. Another characteristic of these plants is their rapid reproduction both vegetatively and generatively.

Table 5. Important invasive terrestrial alien plant species

No.	Species	Family	Origin
1.	<i>Acacia nilotica</i> (L.) Willd. ex Del.	Mimosaceae	Africa & Asia
2.	<i>Austro eupatorium inulaefolium</i> (Kunth) R.M. King & H. Rob.	Asteraceae	Tropical America
3.	<i>Chromolaena odorata</i> (L.) King & H. Rob.	Asteraceae	Central & South America
4.	<i>Cryptostegia grandiflora</i> R. Br.	Asclepiadaceae	India & Madagascar
5.	<i>Dicranopteris linearis</i> (Burm. F.)	Gleicheniaceae	Tropical America & Subtropic
6.	<i>Eupatorium sordidum</i> Less	Asteraceae	Mexico
7.	<i>Jatropha gossypifolia</i> L.	Euphorbiaceae	Central & South America
8.	<i>Lantana camara</i> L.	Verbenaceae	Tropical America
9.	<i>Mikania micrantha</i> Kunth	Asteraceae	Central & South America
10.	<i>Melastoma affine</i> D. Don	Melastomataceae	Asia
11.	<i>Mimosa diplotrica</i> C. Wright ex Sauvalle	Mimosaceae	Brazil
12.	<i>Panicum maximum</i> Jacq.	Poaceae	Tropical Africa
13.	<i>Passiflora ligularis</i> A. Juss	Passifloraceae	South America
14.	<i>Pennisetum polystachion</i> (L.) Schult.)	Poaceae	Africa Tropic
15.	<i>Piper aduncum</i> L.	Piperaceae	South America
16.	<i>Sida rhombifolia</i> L.	Malvaceae	Asia
17.	<i>Stachytarpetta indica</i> (L.) Vahl	Verbenaceae	Tropical America
18.	<i>Stachytarpetta jamaicensis</i> (L.) Vahl	Verbenaceae	Tropical America
19.	<i>Themeda arguens</i> (L.) Hack.	Poaceae	Not Known
20.	<i>Tribulus terrestris</i> L.	Zygophyllaceae	Warm Temperate

Most of the species listed in Table 5 have been recorded as important weeds in agricultural crops. However, some additional species which have not been reported before are the important environmental weeds such as *Piper aduncum*, *Jatropha gossypifolia*. Two species, *Cryptostegia grandiflora*, and *Tribulus terrestris* are also included in Table 5. Rubber vine or *C. grandiflora* is included here, since it has become an important invasive species in Australia after their introduction. New records in Indonesia have to be monitored, although up to now, it is only reported in Java. The other species *T. terrestris* also have to be monitored. *T. terrestris* is cultivated as medicinal plants in Central Java. The spread or escape from cultivation has to be prevented.

*Passiflora ligularis* is included due to its invasiveness in Mount Gede Pangrango, where its climbing habit covers the crown of the trees and suppresses their growth. This species will be more problematic in the future than they are at present, if there is no effort to control it.

### **Distribution of some important invasive alien plant species**

The distribution of some important invasive alien plant species in Indonesia are discussed in this paper. Distribution of invasive alien plant species is necessary to be studied to prevent the spread to other areas and for the Plant Quarantine to decide which species is considered as OPTK A2 (Organisme Pengganggu Tumbuhan Karantina A2)/ the invasive alien plant species which are found in Indonesia but not widely distributed and being officially controlled and prevented from entering other parts of the islands.

#### *Eichhornia crassipes*

It was introduced to beautify the ponds of Bogor Botanical Garden in 1886. Soon afterwards this plant had already spread all over the country (Tjitrosoedirdjo & Widjaja 1991). It is recorded in Sumatra: South Sumatra, Lampung, West Sumatra, Jambi and North Sumatra; Kalimantan; South Kalimantan; Nusa Tenggara: Bali, Lombok and Flores; Papua: Jayapura and Merauke. Almost all open waters are infested by water hyacinth.

The most well known and striking example is the water hyacinth problem at Rawa Pening Lake, Central Java where the problem up to now is still unsolved.

#### *Hydrilla verticillata*

It is recorded in three islands: Java, Sumatra and Sulawesi. It is found in Sumatra: Lampung, South Sumatra, West Sumatra and Jambi; Sulawesi: South Sulawesi; and no record yet from Kalimantan and Papua (Figure 2).

#### *Mimosa pigra*

It was first introduced in Indonesia from Mexico for botanical curiosity by the Bogor Botanical Garden (Thysman & Binnendijk 1866). The earliest record of its presence was in 1844 from Bogor, West Java, (Hasskal 1844) and it was spread and naturalized in Java (Tjitrosoedirdjo 1988). In Sumatra, it was reported from Solok, West Sumatra and Sibolangit in 1917. Now it has spread widely from Aceh to South Sumatra (Partomihardjo 1987). In Kalimantan, it was reported since 1979 in Samarinda at the lakes Semayang, Jempang and Melintang as well as at the riversides of Mahakam at East Kalimantan (Tjitrosemito 1997). In Papua, it was firstly noticed in 1995 at the riverside of Maro River between desa (village) Poo and Toray. Apparently, the seeds contaminated materials and equipment transported by boat for constructing the people's settlements at the places nearby Maro River (Barano 1999). *M. pigra* infested the riverside of Maro river at the area of Wasur National Park up to Wango River near the border of Papua New Guinea. In 1999 it was estimated that *M. pigra* covered approximately 15.6 ha, forming a discontinuous belt of 10 m wide (Purba 1999).

As shown in Figure 2 in Indonesia, it has been recorded in Sumatra: Lampung, South, West and North Sumatra, Aceh; Kalimantan: Central, South and East Kalimantan; Papua: Merauke: There is no record yet from Sulawesi.

*Salvinia molesta*

It is recorded in Java, Sulawesi, Sumatra, Kalimantan, and Papua. It is distributed in Sumatra: Lampung; Kalimantan: South and East Kalimantan; Sulawesi: Lake Tempe; Papua: Danau Sentani.

*Acasia nilotica*

A native of Africa and Continental Asia, it was introduced to Java in 1850 and since long time out of cultivation and spread also outside Java. Java: West and East Java; Nusa Tenggara: Timor, and Papua: Wasur National Park (Figure 2). Introduced in 1969 in Baluran, East Java, where *A. nilotica* was planted as fence to protect the teak forests near Baluran National Park. Shortly after that, rapid expansion was begun, more than 5000 ha was occupied by *A. nilotica*. Baluran is the only conserved savanna area left in Java providing herbivore feed for banteng (*Bos javanicus*). The invasion of *A. nilotica* reduces the herbage yield as well as the population of banteng. There is no record yet from Sumatra, Kalimantan and Sulawesi.

*Austroeupatorium inulaefolium*

A native of Tropical America, it is commonly found in tea plantations in West Java and naturalized at Mount Gede-Pangrango. In Jambi, Bengkulu and West Sumatra it is found in highlands.

*Chromolaena odorata*

A native of Central and South America, it is an aggressive invader. In Central and South America, the genus *Chromolaena* has about 165 species, but *C. odorata* is the only species which is now pan-tropically distributed. It is found for the first time in Indonesia in 1934 in Lubuk Pakam, North Sumatra, in tobacco plantations. After the war of independence, it had become quite common and very distinctive by its white violet flowers. It spreads very quickly all over the islands in Indonesia from Aceh, Sumatra to Papua.

*Eupatorium sordidum*

A native of Mexico, it was introduced in West Java as ornamental plant. Running wild it becomes a problem at Gede-Pangrango National Park in West Java at 1400-17 000 m altitude at the forest trails, forest-borders and waste places

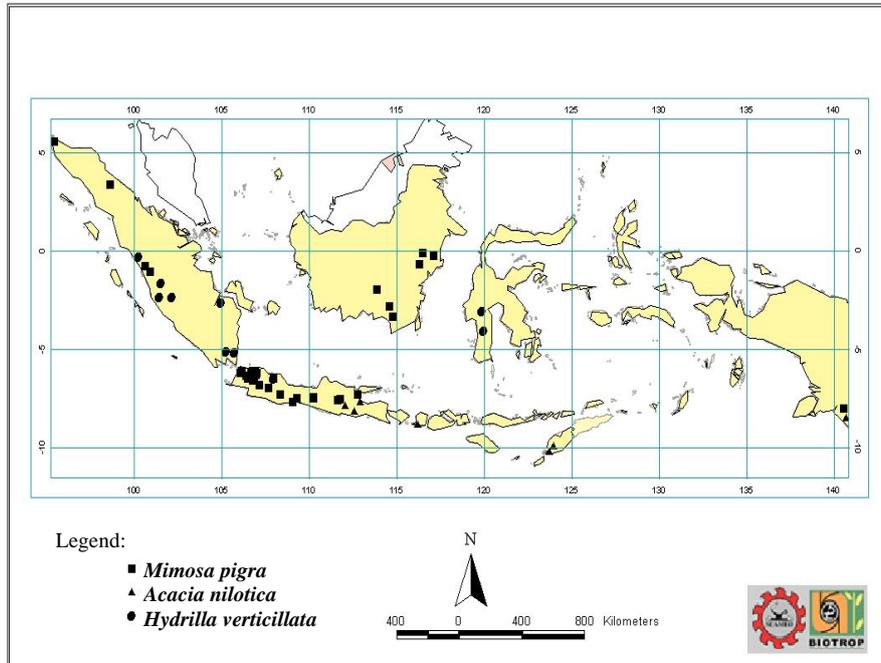


Figure 2. Distribution of *Acacia nilotica*, *Hydrilla verticillata* and *Mimosa pigra* in Indonesia

### *Mikania micrantha*

The genus *Mikania* has about 400 species mainly of the warmer parts of the New World. The only indigenous species in Asia is *Mikania cordata* while *Mikania micrantha* is the only New World species to have been introduced there. The latter species readily takes to disturbed areas and tends to be weedy (Parker 1972). In 1949 it was imported from Paraguay and planted in the Bogor Botanical Garden. In 1956, this species was introduced as a non-legume ground cover in rubber plantations due to the scarcity of legume seeds. Wirjahardja (1976) reported that by 1976, it occupied the greater part of rubber plantations and abandoned agricultural areas in West and East Java and South Sumatra. Now it is widely spread in almost all the islands of Indonesia. Although *M. cordata* is a native species of Southeast Asia, *M. micrantha* is a more aggressive species and causes a lot of problems, especially the maintenance and harvest of the crop become difficult. It is also climbing the trees at the edge of the forest in open areas. In Indonesia, it is now difficult to find *M. cordata*. Their growth is suppressed by *M. micrantha*. The specimens can only be found at the Herbarium Bogoriense (BO) and BIOTROP Herbarium (BIOT) (Tjitroedirdjo 2002).

## CONCLUSIONS

Based on the inventories of the existing references and herbarium specimens there are a total of 1936 alien plant species belonging to 187 families in Indonesia. Field studies should be done to get the complete figures of the alien plant species in Indonesia. Based on the existing figures of the alien plant species, the invasive alien plant species can be identified, followed by studies on assessment of losses, biology, management and their possible utilizations. Most of the alien plant species are cultivated as ornamental plants. There are 67% of the total species number. The weed species consists 17.5% of the total species number.

The alien plant species came from all continents of the world, the highest number of their origin was America mostly the tropical part, followed by Asia, Africa, Europe and the smallest number from Australia and New Zealand. There are three families with more than 100 species, Asteraceae 162 species, Poaceae 120 species and Papilionaceae 103 species. The highest number of the weedy species is found in the family of Asteraceae followed by Poaceae and Cyperaceae.

Twenty-five important aquatic and terrestrial alien plant species in Indonesia were identified and some of their distributions were noted. Field studies should be conducted for completing the records.

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