Invasive Alien Weeds in Thailand and
Case Study on Bidens pilosa L. var radiata Shultz-Bip.

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Summary

Alien plant species surveys were made during 2000-2004. Many unidentified invasive plants were found. Of many alien weeds, 6 species, Acrachne racemosa (Roemer & J.A. Schultes) Ohwi, Cynodon nlemfensi Vanderyst, Drymaria cordata (L. Wendl.), Galinsoga parviflora Cav., Mimosa invisa Mart. and Typha angustifolia L. were reported for their invasiveness. A newly introduced plant, Bidens pilosa L. var. radiata was found in northern Thailand in late 2000. Biology of the plant was studied in Bangkok. Data from surveys and its biological data were used to evaluate its weed potential. The plant can complete its life cycle within 2 months, while in the northern region, it may be shorter. One plant of freely growing (1 pl/m²) B. pilosa var. radiata produce at least 13,929 seeds per year. While the plots of 4 and 58 plants/m² produced 8,404 and 761 seeds per plant, respectively. The seed has no dormancy and 90-100% germinate in the laboratory while 72% in the soil. Seed of the plant has 2-6 hooks at the end and many tiny spines along the seed assist in dispersion. Allelopathic potential of the plant, together with the ability to produce a great number of seeds and its competitiveness probably play an important role for its relatively pure community.

1. Introduction

Plants do not play only important roles as sources of food, medicines and raw materials for many industries, but also are important components of the environment. Many recreational areas are always decorated with plants which are mainly introduced ones. Many intentionally introduced plants are important crops but some of those introduced plants cause inverse impact years later not only on agriculture but also on biodiversity. Many of these species cause large and unnecessary expenditures both in the public and private sectors. After invasive alien species spread out and become problems, it is very difficult or almost impossible to get rid of them.

After introduction to a new habitat, a plant will adapt and establish itself to survive in new habitat. If a plant adapt and establish well, propagules will be produced and disperse and the population build up. A successful spread out depends on the ability of dispersion and competitiveness of the plant and it surrounding native plants. The aggressive plant may spread out very quickly and colonize new suitable habitats and then become a weed or noxious weed. Each alien plant takes a different duration to become a problem to the new environment after introduction. This depends on the nature of the plant and environmental factors. Such as Eichornia crassipes (Mart.) Solms or water hyacinth took about 12 years to be a problem after introduction, Mimosa pigra L. or cat claw mimosa took 22 years (Table 1). Improvements in communications and transportation have allowed plant species to spread far and wide, establishing themselves where climatic conditions favor their growth. Most serious weeds are not native but exotic and naturalized species (Holm et al, 1977). Prevention of introduction and early
detection of new invasive plants are beneficial for prevention of inverse impact of those invasive alien species. Information is needed for assessment and evaluation before the problems occur. Database of alien invasive species is therefore a very important source of information and should be shared by everyone.

Table 1. Duration of becoming a problem of some noxious weed in Thailand after introduction.

<table>
<thead>
<tr>
<th>Species</th>
<th>Year of Intro.</th>
<th>Year of Prob.</th>
<th>Duration (Year)</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Eichornia crassipes</em></td>
<td>1901</td>
<td>1913</td>
<td>12</td>
</tr>
<tr>
<td><em>Mimosa pigra</em></td>
<td>1952</td>
<td>1974</td>
<td>22</td>
</tr>
<tr>
<td><em>Pennisetum polystachyon</em></td>
<td>1955</td>
<td>1964</td>
<td>9</td>
</tr>
<tr>
<td><em>Pennisetum setosum</em></td>
<td>1955</td>
<td>1987</td>
<td>32</td>
</tr>
</tbody>
</table>

2. Material and methods

2.1 Detection

Invasive alien plants survey project was set up to detect those plants in agricultural areas and the environment starting from 2000, aiming to detect those plants before they become problems for farmers and the environment. Alien plants with some invasive characteristics, such as growing in abundance, dominant in the area, growing in pure stands without other plants, or having no natural enemies, will be collected for further biological studies in Bangkok. The survey was first started in the northern areas of Thailand where many temperate plants, both annual and perennial, were introduced for research and extension purposes.

2.2 Biological study

Seeds or fresh specimens were collected and grown in a net house for studying its growth and development, seed production ability and seed germination, both in the laboratory and net house conditions. Allepathic potential of the plants was studied by using the sandwich method in the laboratory, comparing with similar or close species existing in Thailand.

3. Results and discussions

Plants found from the survey were recorded and identified. Known species were verified with existing documents. Only those alien plants with no records or information in Thailand were further studied for their invasive weed potential. However, some plants already well known but whose situation have changed, were also reported to update their data base. From surveys, many species were collected with 5 species found dominant in big communities, without natural enemies and cannot be identified. One species detected earlier before becoming a problem was *Bidens pilosa* L. var. *radiata*. The plants and seeds were collected for further studies. Another 5 alien species which already exist in Thailand were reported as the situation changed. They are described below.

3.1 *Acrachne racemosa* (Roemer & J.A. Schultes) Ohwi

Common name: Goosegrass

Synonyms: *Eleusine racemosa* Roemer & J.A. Schultes;

*Eleusine racemosa* Heyne ex Roemer & J.A. Schultes;

*Acrachne verticillata* (Roxburgh) Lindley ex Chiovenda;
Eleusine verticillata Roxburgh;
Sclerodactylon micrandrum P. C. Keng & L. Liou.

Family: Poaceae (Order: Cyperales)

Goosegrass is an annual weed. Culms tufted, erect or geniculately ascending. Leaf sheaths glabrous, compressed; leaf blades narrowly lanceolate, adaxial surface tuberculate-pilose at base, tapering to a setaceous apex. Inflorescence subdigitate or racemes arranged along a central axis; racemes mainly grouped in pseudo-whorls or pairs, ascending. Spikelets densely imbricate, oblong with serrate outline, florets 6 - 20, stramineous at maturity; glumes chartaceous-membranous; lower glume narrowly oblong, apex acute, mucronate; upper glume lanceolate, acuminate, awn-pointed; lemmas broadly ovate, keel scabrid, shallowly concave above middle and excurrent into a stout awn-point, lateral veins fractionally excurrent.

There is no record of introduction. The plant was found in Kanchanaburi province, western Thailand, about 20 years ago. Today, this plant is abundant in many upland crops, such as maize, cassava, sunflower, as well as along roads in Kanchanaburi province. This plant is also found in other areas not densely populated.

3.2 Cynodon nlemfensi Vanderyst

Common name: Giant star grass, Stargrass, African star grass, robust star grass
Family: Poaceae (Order: Cyperales)
Native: South Africa (Tóth et al., 2004)

Giant star grass is a stoloniferous perennial without rhizomes. The stolons are woody and lie flat on the surface up to 2 meters long. Culms are soft and robust, up to 60 cm high, flowering culms somewhat slender. Leaf blades are linear, acute, flat, 5-15 cm by 2-6 mm. Inflorescence of 4-10 digitate racemes in 1 whorl. Racemes are spreading, 4-10 cm long, purple. Spikelets are 2-3 long; upper glumes more are more than half the length of the spikelets.

The grass was introduced into Thailand as a soil binder to prevent erosion but then et al/become a serious weed in orchards and coffee plantations in the highlands of northern Thailand (Harada et al. 1987). This plant is abundant in highland agricultural areas, especially vegetable fields. Moreover, in Bangkok where elevation is near sea level, the plant can grow well and form pure communities in abandoned areas. Today it is a noxious weed in many areas, from sea level to the highlands and can be found throughout the country.

3.3 Drymaria cordata (L.) Willd.

Syn: Drymaria diandra Bl., Holosteum cordatum L.
Family: Caryophyllaceae (Order: Caryophyllales)
Native: Tropical America

Heartleaf drymary is an annual or a perennial herb. Stems are glabrous, trailing and straggling upwards. Rooting at nodes. Leaves are opposite, ovate, rounded or reniform, base cucate, petiole short. Flowers are terminal on the stem, about 5-8 mm in diameter, densely and shortly viscid pubescent, 5 white petals. Fruits are ovate and sticky, easily falling off together with pedicels, 1-8 seeds. The plant is propagated by seeds.

There is no record of introduction into Thailand. This plant is widely distributed in humid areas of 100 - 1,500 m high and is found abundantly in agricultural areas in highlands of
northern Thailand. The fruits of this weed are sticky and attach easily to clothes, animal hairs or any object, which help in distribution to other areas. Recently, it was found that the plant can grow in abundance as pure stands in paddy fields with lots of water.

### 3.4 *Galinsoga parviflora* Cav.

**Common name:** Gallant-soldier  
**Syn.:** *Galinsoga semicalva* (Gray) St. John & White  
**Family:** Asteraceae (Order: Asterales)  
**Native:** Tropical America

Gallant-soldier is an annual herb. Stems are erect or procumbent with many branches and covered with soft hair. Leaves are opposite, ovate, with shallowly serrated margin, short petiole but upper leaves are sessile. Inflorescences are heads, often in pairs, terminal and axillary. Ray-flowers are white and disc-flowers are yellow. Seeds (fruits) of ray-flowers are flattened with pappus of very few tiny scales. Seeds (fruits) of disc-flowers are obconical with well-developed pappus of whitish-grayish scales. The plant propagates by seeds.

There is no record of introduction. The plant is a noxious weed in agricultural areas especially in mountainous areas of northern Thailand at about 1000 meters above sea level. Recently the plant was found in Bangkok where the temperature is much higher than mountainous area and has less moisture. The plant can grow well and produce flowers, but no information on seeds are at hand because the plant was eradicated before seed maturation.

### 3.5 *Mimosa invisa* Mart.

**Common name:** Giant sensitive plant, giant false sensitive plant  
**Syn.:** *Mimosa diplotricha* C. Wright ex Sauvalle  
**Family:** Fabaceae or Pea family (Order: Fabales)  
**Native:** Brazil

Giant sensitive plant is an annual or perennial climbing herb. Stems are branches and oblique with 5 ridges having dense retrorse spines. Leaves are bipinnate, 15-30 pairs of leaflets, moderately sensitive to touch. Inflorescence is glabrous with several flowers arising from the end of the stem and from the axils. Florets are reddish purple, 8 stamens for each floret. Pods are spiny and hispid. Seeds are brown or pale brown, propagate by seeds.

Seeds of many leguminous plants were introduced into Thailand for soil fertility improvement (green manure crop) around 1952, including cat-claw mimosa (*Mimosa pigra* L.) and giant sensitive plant. The seeds were distributed among tobacco growers in the northern region of the country. It was confirmed by farmers that those plants are thornless mimosa. Since this plant is much easier to mix into soil than that of cat-claw mimosa. So, it was distributed to other crops such as sugarcane and fruits. Then around 1992 or 40 years after introduction, the plant became troublesome in the northern areas (Kittipong, 1998). Today, the plant is still a serious problem for agricultural and non-agricultural areas.

### 3.6 *Typha angustifolia* L.

**Common name:** Narrowleaf cattail  
**Syn.:** *T. domingensis* Pers; *T. angustala* Bory et Chaub  
**Family:** Typhaceae (Order: Typhales)  
**Native:** South America
Typha angustifolia is a perennial herb, colonial, rhizomatous with long, slender, green stalks topped with brown, fluffy, sausage-shaped flowering heads. The plant is 1 - 2.5 meters tall. It spreads diageotropic subterranean stem and produces numerous large roots. Leaf blades are linear, with entire margin, glabrous, thick, narrow and obtuse at the tip and enclose the stem as a sheath at the base. Flower stalks arise and bear male flowers at the top with female flowers a little below. The naked axis between the staminate and pistillate flowers is generally 1 - 8 cm long. Fruits are about 5 - 8 mm long, subtended by copious white hairs. The plants can be propagated by seeds and rhizomes and grows in shallow marshes and ponds.

The plant may have been introduced into Thailand as an ornamental plant with flower being used for arrangements about 35 - 40 years ago. Because of numerous tiny, light, wind-borne seeds, the plant spread to wetlands everywhere, competing for space with other plants, such as Sesbania bispinosa (Jacq.) W.F. Wight, whose flower is eaten as a vegetable. The plant grows well in shallow marshes and ponds throughout the country. The leaves are used as material for mat making. No information on consumption of narrow-leaf cattail in Thailand. Reportedly, it fueled a big fire in north-east Thailand sometime ago.

3.7 Bidens pilosa L. var radiata Shultz-Bip.

Common name: romerillo, bidens
Family: Asteraceae (Order: Asterales)
Native: tropical America

Romerillo is a short life perennial, about 1.0 –1.5 m high with many branches. Leaves are composite with 3-9 leaflets, serrated edge and opposite. Flowers apical forming heads with diameter of 2 -4 cm and with 5 -10 ray flowers per head. Petals white about 1 cm long surrounding yellow disc flowers. Seeds are black, slender and long with 2-6 hard terminal hooks.

a) Discovery and distribution

Small stands of romerillo were first discovered in the provinces of Chiang Rai and Payao in August 2000. The sample was checked with specimens in Bangkok Herbarium and various documents such as “Thai plant Names- Tem Smitinand” (Forest Herbarium, 2001), Medicinal herb (Booranatham, 1996), Medicinal Plant of Lanna Thai (Mahidol University, 1996). No sample of this plant was found in the herbarium. Furthermore, those documents mention only spanish - needle (Bidens bipinnata L.), yellow flowered black jack or beggar ticks (Bidens biternata (Lour.) Merr. & Sherff ) and beggar’s tick or hairy beggarticks (Bidens pilosa L.) without detailed descriptions on their variations. The plant resources of South East Asia or PROSEA mention that there are only 4-5 species of Bidens found in South-east Asia, Bidens pilosa being the most common but due to wide variations, the taxonomy of this species is not yet definitive (Alonzo and Hidebrand, 1999). None of these documents mention romerillo.

In mid year 2001, it was confirmed that seeds of this species were brought into the Kingdom around 1998 -1999 by a Taiwanese beekeeper to be a food source as it flowers all year round, is a fast grower and needs very little attention. Seeds have been scattered in many nearby areas and the species eventually became known as Taiwanese cosmos, after the introducer. Some call it Chiang Rai daisy, for its daisy-like flower.
By December 2001 scattered stands could be seen in varying sizes along the roads of many provinces in the northern region such as in Phrae, Nan and Lampang.

In September 2002 an isolated, healthy and thick 5 x 10 meters patch of romerillo was found along the road to Kanchanaburi province, at amphur Ta Rua, about 100 km west of Bangkok. No one in the vicinity could give information as to when the weed first came and who planted it. They only said it was noticeable that year.

In September 2003 one stand of the plant was found in Ayuthaya province, 70 kilometers north of Bangkok.

In June 2004, two locations in North-east region were found infested with this weed.

During surveys in 2003-2004 of the northern region, which include Chiang Mai, Chiangrai, Payao, Phrae, Nan, Lampang and Lampoon, it was found that the weed grows in all conditions. Along the road edge, along the banks of the canal, mid-road islands and even in cracks of hot and dry concrete banks along the Mekong River. It has spread into vegetable areas, citrus groves, mango and longan orchards as well as maize fields. Farmers in the area mention that herbicides have been sprayed in the maize plot to control romerillo but what herbicide used could not be determined. The stands tend to be dense, grow along roads and in many places encroach into fruit orchards. Some farmers said the plants have been around a few years already. Some collect seeds for growing near their homes for the attractive flowers.

b) Weed potential of romerillo

The study to assess weed potential in Thailand of romerillo consisted of both field surveys and laboratory tests. The laboratory tests were made at Department of Agriculture in Bangkok with the results reported below.

3.1 Germination

a) Laboratory

- Seeds harvested in Chiangrai in 2001 were germinated in 90 millimeters diameter Petri dishes resulting in 90-100% germination. However, seeds harvested from cultivated romerillo planted in Bangkok averaged only 72.3% germination after 10 days.

- Germination ability of immature seeds was compared with mature seeds. Seeds from 5 stages of flower development were collected, kept at room temperature and brought out for germination check in Petri dish every day for 4 days. The number of germinated seeds was recorded on day 7 of the treatment. The 5 stages are: (Fig. 1)
  1) Full bloom, petals of ray flower wilting.
  2) All petals of ray flower dropped, partial wilting of petals of disc flower.
  3) All petals of disc flower dropped but seeds still green.
  4) Seeds darken, drying up.
  5) Fully mature seeds.
At 7 days after seeding, immature seeds of stage 1 did not germinate at all, irrespective of whether seeded 1 day or 4 days (period) after harvest. Seeds of stage 2, kept for 3 days between harvesting and seeding, germinated at a rate of 48%. The seeds at stages 3, 4 and 5, of all periods, between harvesting and seeding, germinated at the rates of 30-100%, as indicated in Fig.2. This indicates that if the plant was cut down after flowering, immature seeds may develop further and are able to germinate, when conditions are suitable.

Fig.2. Germination of seeds of varying maturity in the lab, at 7 days after seeding

b) Soil germination

100 Seeds harvested from northern Thailand were broadcast in 6 plots of 1x1 m² and the number of germinated seeds were recorded every the other day, for 42 days. The average cumulative germination is 74%, as indicated in Fig.3.
c) Growth and development

Trial plots 1x1 m$^2$ were set up to study growth of romerillo. Number of plants varied from 1, 4 and 58 (imitating natural habit) plants per square meter. Height, number of branches, number of flower buds and blooms were recorded every 7 days. Results are indicated in Fig. 4 – Fig. 7.

**Height** during the first 25 days averaged only 10 cm. At 36 days, plots of all planting densities still produce plants of similar height. The heights of all plants increase further even if flower buds appear or when reproductive growth was clearly indicated. However, at 52 days, after flowers bloom, difference in heights could be clearly discerned where a single plant/m$^2$ was at 48 cm while 58 plants/m$^2$ averaged only 24 cm in height. Approaching 75 days, height increase was less and finally at 75 days no further gain was observed (Fig. 4). The single plant was at 120 cm high and 58 plants/m$^2$ were only 95 cm high. This is as expected since there is severe competition for resources among the 58 plants/m$^2$. And the height of the plant in reproductive growth stage may be due to elongation of peduncle.

![Fig. 4 Height of plants at varying density per m$^2$](image-url)
Number of branches per plant will influence the number of flowers as they form apically. Therefore, the more branches, the more seeds produced. The number of branch increases very rapid even when the plant enters reproductive growth. All the branches are from lateral buds which form after the apical growth stop after apical flower blooms. At 113 days after germination, the number of branches of lone plant was 246 branches as there is less competition for resources. The 58 plant plot produced only 57 branches per plant. (Fig.5)

![Fig. 5 Number of branches per plant](image)

3.3 Seed production of this species is phenomenal, meeting the criteria that major weeds of the world are prolific seed producers.

The number of flowers per plot was recorded every the other day, then it was calculated as per plant for each treatment. Maturing flower with white petals of ray flowers was clearly visible at 59 days after germination. This is considered a complete flower bloom and the number of full blooms of a single plant/m² increases up to 180 flowers, due to high number of branches. Where plants with densities of 4 and 58 plants/m² had less branches there were less flowers. While the 58 plants/m² average only 1 new bloom per day per plant, as shown in Fig.6.

![Fig. 6 Number of flowers in each plot of varying density](image)
The number of seeds per plant. Mature seeds (dark brown or black seed) of each plot were counted every other day, when conditions were suitable. The average seed production per plant of each planting density is shown in Fig. 7. The number of collected seeds fluctuated, probably caused by scattering of seeds after full maturation. The seeds may fall due to wind and/or rain. The cumulative numbers of mature seeds produced within 30 days are 13,929, 33,619 and 44,142 seeds per plot of 1, 4 and 58 plants/m² or 13,929, 8404 and 761 seeds per plant, respectively. This clearly indicates that even plants in high density plots can produce less seeds, but the number of seeds produced in a unit area will be higher than a single plant.

![Fig. 7 Number of romerillo seeds produced per square meter of varying planting density](image)

3.4 Other properties

Allelopathy was found under preliminary studies in the laboratory using both fresh and dry leaves. In comparison with *B. biternata* and *B. pilosa var pilosa* of equal weights, leaves of all three species at 0.1 and 0.5 gram were able to inhibit growth of young *Mimosa pigra*, with romerillo having the most effect. Hence, in its natural habitat, it is usually seen growing in pure stands without other species mixed in.

Propagation. Cuttings of mature stem were sealed in polyethylene bags with adequate moisture and after 7 days, leaves were still green with many adventitious roots forming from the base up to top 4-5 leaves. Furthermore, when these cuttings were planted in the soil, they established themselves well and continued to grow and compete against other species. Additionally, they can propagate by stem cutting and can produce flowers just 2-3 weeks after transplanting.

Attractive flower. The large white flowers are attractive to man when compared with other *Bidens* existing in Thailand, people harvest seeds and plant them on vacant land. Thus the most important factor in the spread of this species is assistance by humans, advertently or inadvertently.

Dispersal aid of seeds. Seeds have 2 – 6 hooks at one end and tiny spines on the seed surface which attach them to clothing and animal hairs, assisting the plant to scatter far-a-field.
Additional observations, from field surveys and laboratory and net-house tests in Bangkok, indicate that:

- Average number of seeds per head is 31 for planting in Bangkok, while it is 36 for naturally growing plants in the north.
- Plant growing in maize fields in northern Thailand produce flower blooms at 30 days after germination.
- In very dense populations, number of 2-4 leaf stage seedlings is very high at 8376/m².

This study has determined that the seeds have no dormancy, with 90 – 100% germination rate in the laboratory and 74% in the field. Among the newly emerging plants, 81% produced seeds only after 35 – 40 days and complete the full cycle within 57 – 70 days. In Thailand, the climatic conditions enable romerillo to go through 5 – 6 cycles per year, with the original plant still reproducing.

Calculations based on these figures yield a minimum of 31 million plants after 2 year’s growth from one single plant, Table 2, worse than *Bidens pilosa* Linn., which is already established in Thailand. Holm *et al.* (1977) reported in The World’s Worst Weeds that a single plant of *Bidens pilosa* Linn. can produce 3,000-6,000 mature seeds ready to germinate. There are 3 – 4 cycles a year with 95% germination rate. Even after 3 – 5 years storage, the seeds still have 80% germination rate. The romerillo’s capabilities surpass this species. In its natural habitat in the north, romerillo does not grow in mixed stand, most likely due to its stronger alleopathic effects than *B. pilosa*, as well as a stronger competitor.

[Table 2: Number of seeds produced from one plant of *B. pilosa* var. *radiata*]

<table>
<thead>
<tr>
<th>Yr</th>
<th>No. of Seeds Available</th>
<th>72% Germination</th>
<th>80% Survived</th>
<th>No. of Seeds Produced</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>41,787</td>
<td>34,087</td>
<td>24,069</td>
</tr>
<tr>
<td>2</td>
<td>54,950,239</td>
<td>36,441,172</td>
<td>31,651,338</td>
<td>72,260,004,276</td>
</tr>
<tr>
<td>3</td>
<td>72,260,004,276</td>
<td>52,273,507,079</td>
<td>41,621,762,463</td>
<td>95,022,483,703,177</td>
</tr>
<tr>
<td>4</td>
<td>95,022,483,703,177</td>
<td>64,416,091,000</td>
<td>54,732,950,613,030</td>
<td>124,955,326,249,548,000</td>
</tr>
<tr>
<td>5</td>
<td>124,955,326,249,548,000</td>
<td>71,974,267,919,739,500</td>
<td>164,317,253,660,765,000,000</td>
<td></td>
</tr>
</tbody>
</table>

[Table 3: Characteristic and habits of weeds (after Muenscher, 1980)]

<table>
<thead>
<tr>
<th>Ideal Weeds</th>
<th>Romerillo</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Growth</td>
<td></td>
</tr>
<tr>
<td>- Grow well in unsuitable conditions and suitable conditions similar to that required by the crop.</td>
<td>- Grow well in moist and drought conditions, even in concrete cracks and in the shade.</td>
</tr>
<tr>
<td>- Contains undesirable odor or unpalatable taste, covered with hairs, thorns or slime, enabling it to survive attacks by insects and animals.</td>
<td>- Contain allelopathic chemicals inhibiting growth of other plants. Leaves release odor when crushed. Leaves not damaged by insects and so far, no known natural enemies in Thailand.</td>
</tr>
</tbody>
</table>
2. Seed Production

- Able to produce many seeds per year.

- Seed viability is long, able to germinate even if in the soil for many years.

- Seeds able to develop into maturity, even if removed from plant early, in some species seeds mature at flowering stage.

- Seeds usually difficult to separate from seeds of crop as usually of similar size and shape.

- Fruits or seeds usually have dispersal aids such as Siamese weed, dandelion and typha which have light, fluffy hairs at the tip to allow seeds float in the air. The whole fruit of Xanthium strumarium has sharp, hooked thorns which attach themselves to animals hairs and human clothing.

- 1, 4 and 58 plants/m² produce 41,787, 25,215 and 2,283 seeds/plant/year, respectively.

- Seeds may have viability up to 6 years same as B. pilosa.

- Seeds mature 10-15 days after bloom and can germinate at only 6-7 days later.

- 2 – 6 hooks found at one end of seeds and along the seed length there are small thorns which attach to animal hairs or human clothing.

3. Propagation

- Able to propagate with stem and roots. Cut stem can form roots and flowers earlier than that from seed.

The most important impact of invasive plant is the impact on diversity of native species which very few people may realize and take action. Especially in developing countries rich in plant diversity. Without negative impacts on the quality of life, few people care about negative impacts on biodiversity. Since we cannot completely separate living things from the environment, changes in the environment caused by human activity may prove highly negative to humans. Many invasive plants were intentionally introduced to another place for profit, especially ornamentals. Weber (2003) reported that more than 40% of invasive plants are from introduced ornamentals and about 15% for soil erosion control and soil improvement.

B. pilosa var. radiata was introduced for a different purpose and took only 3-4 years to be widely distributed throughout the northern region of Thailand and now is increasing in other regions of Thailand. It is human activity that intentionally assists the spread of seeds. Just only one plant in a community initially, then the plant will reproduce with a lot of seeds within few months. Flowering the whole year. Growing freely, with no interference, hundreds of thousands of seeds will be left in the soil and ready to germinate. By its growth characteristics and with its allelopathic potential, the plant will always grow in a pure community. This effects not only annual crop but also native plant species which prior exist in the area.

Preventing inverse impact of invasive alien species on agriculture and biodiversity is very difficult. By the definition of weed, one plant can be both crop and weed depending on its utilization. Lacking awareness on impact of weed makes people ignore its impact. Inverse effect...
of insects and pathogenic alien species is more apparent and more severe than that of invasive plants. People are aware of alien insects and pathogens more than weeds. While in practice, annual cost of herbicide imports is higher than that of other pesticides. Providing clear examples of the impact of invasive species on agriculture, biodiversity and economic to the community may reduce introduction of alien species. International sharing of experience and information through international database will be useful in helping risk assessment for all alien invasive species, especially the identification and verification of specimens.

Acknowledgements

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Acrachne racemosa (Roemer & J.A. Schultes) Ohwi

Drymaria cordata (L.) Willd.
Galinsoga parviflora Cav.

Mimosa invisa Mart.

Typha angustifolia L.
Inflorescence Seeds Habit Seed production Infestation in maize field

Bidens pilosa L. var radiata Shultz-Bip.