Morphology and Physiological Characteristics of Invasive *Eupatorium odoratum* in Laos and China

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Abstract: *Eupatorium odoratum* is a global invasive species that poses great harm to biodiversity. This study explores the morphological and physiological genetic leaf changes in China and Laos. The results showed that the leaf length / width ratio between China and Laos was significantly different, while the chlorophyll content, average leaf area and specific leaf area were not different, indicating that some genetic changes have been emerged in the invasion from Laos to China. Further comparison of the morphology, physiological and genetic characteristics in Laos and China is conducive to further analysis of the genetic evolution for *E. odoratum*, which puts forward suggestions on the future research direction and provide theoretical basis for the prevention and control of *E. odoratum*.

1 INTRODUCTION

Biological invasion refers to the phenomenon that a certain creature is naturally introduced from other places or artificially introduced into a wild state, and causes certain harm to the local ecosystem. *E. odoratum* is mainly distributed in subtropical and tropical areas, and China is mainly distributed in the southern areas. *E. odoratum*, a weed with malignant invasive properties because of its very tenacious reproductive properties, asexual or sexual reproduction belongs to the Zeeland family of Chrysanthemum aceae. The origin of *E. odoratum* is South America, where there are a large number of insects with *E. odoratum* as food, and pathogenic infection, making *E. odoratum* does not have a large number of growth. However, when *E. odoratum* was introduced into other new areas, because of its physiological characteristics, such as in patches of single community, generally exclude other plants to death by blocking the sun. Therefore, the invasion of *E. odoratum* has great harm to the local plants and crops in the invaded sites.

Further researches comprehensively analyzed the invasion mechanism of *E. odoratum* through its distribution characteristics, spatial pattern, age structure, physiological characteristics, reproductive characteristics and life history characteristics and found that: First, grass has wide ecological scale and low requirements on water and nutrient conditions. As long as the areas where human activities have destroyed, it can also grow. Second, it can occupy many habitats. In different airport distribution areas, regardless of the habitat conditions, it can become the dominant community of the local environment. And that can cause harm to the local biological environment and affect the growth of other organisms

1.1 Hazard of E. odoratum

The first is to erode the grass, *E. odoratum* reproduction capacity is very strong, can be a lot of asexual reproduction, at the same time the seeds are small, breeding speed is fast. In the grassland area, as long as the plane grass occupies the grassland, it will compete with the grass plants for sunshine, water, fertilizer, and can produce chemical substances,

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inhibit the growth of neighboring plants. When high at 15 cm or higher, it can significantly affect the growth of other herbs, and reject insects, and seriously damage ecological stability. In addition, the *E. odoratum* leaves are lush. When taking root and sprouting, the lush leaves as tools to cover the grass and seize resources, resulting in the original growing grass malnutrition, thus occupying the whole grassland. The second affects crop production, which when 120 days after airgrass invasion, will cause severe land degradation. According to incomplete statistics, *E. odoratum* generally results in grain reduction by 3 percent, up to 11 percent. This means that farmers fail to harvest more than 20% of grain every year. At the same time to prevent and eradicate *E. odoratum*, then each farmer should invest more when planting, which leads to a rise in food prices, which leads to the instability of the whole economy, and the economic market will fluctuate.

Finally, it is poisonous in nature, and the seeds and pollen can cause asthma in horse animals, and even cause necrosis and death of livestock tissues. Leaves are poisonous, contain coumarin, can cause human allergic diseases, used to gaskets or field compost will cause livestock hoof and fork, human hands, feet suffer from skin inflammation, so it is also known as rotten foot grass by the masses. Livestock accidentally eat a certain amount of poisoning, walking shaking, foaming at the mouth, seriously fell to the ground limbs spasm, and finally heart failure. Wipe the skin with leaves will cause redness and swelling, foaming, mistakenly eating tender leaves can cause dizziness, vomiting, but also can cause livestock and fish poisoning, under serious circumstances can lead to its heart failure and death.

1.2 The Spread of *E. odoratum*

There has a wide range of transmission routes. In addition to wind and water media, it can also be spread through human and animal activities. If the airgrass from maturing, it can reduce its spread. Grass cutting combined with tree planting to control is a better method, by significantly reducing the number of plane grass heads and reducing its seed production; on the other hand, plane grass is shaded by growing alternative plants, thus long-term control. In reducing the transmission route of grass, but also actively prevention and control. At present, the means of prevention and control are physical control, chemical control, biological control and comprehensive prevention and control. However, the existing prevention and control methods have their own advantages and disadvantages in the use of the real eradication of all aspects of the need to strengthen the research.

1.3 Prevention and Control of *E. odoratum*

Mechanical prevention and control is a universal control method around the world, mainly refers to manual cutting, but this method can not completely eliminate *E. odoratum*. And this way for a small area of *E. odoratum* invasion to add some later radical cure, in order to have a certain effect. The approach for extensive clearance is too costly. In addition, this control method has another drawback, the leaves of the plane grass are poisonous, and it is easily poisoned in the process of manual cutting, leading to a large area of skin infection. Alternative control is a common way of biological control, but we do not know what to happen to natural enemies. Because the introduction of insects will have unknown effects on both the environment and people. Therefore, the biological replacement of this biological control becomes a new means. There is a red gray leaf tree in Sri Lanka similar to *E. odoratum*, both use cover techniques to prevent other plants from absorbing sunlight for growth, and this plant is of ecological value and not demanding on soil, suitable for a variety of climates and terrain. Its deep roots, very suitable for wind and sand, not only can eradicate the invasion of *E. odoratum*, but also can further change the terrain, it can be said to kill two birds with one stone.

From the perspective of biological control, chemical control, artificial control, farming, etc, each kind of control has its own advantages and disadvantages, in the actual process of control can use of comprehensive control, combining several control methods, complement each other, this way is very popular abroad, but now our country or a single means, no matter how there are disadvantages. Therefore, the research focus of China should be on the basis of understanding the biological characteristics of *E. odoratum* and comprehensive control of its harm

1.4 Genetics of *E. odoratum*

There are two *E. odoratum* with distinct morphological differences in the invasion region distribution. One occurs in West Africa, Central Africa, Asia, Western Pacific and Oceania islands, known as the Asian West African Biotype (Asian/West Africa Biotype, AWAB); the other in South Africa, known as the South African Biotype (Southern African Biotype, SAB). The community

inheritance of grass into China has very low diversity, using DNA fragments of chloroplasts and ITS (Internal transcribed spacers) and other DNA analysis, grass in many countries in Asia are haplotype and low genetic diversity, and relatively low, all genetic diversity is 0.0406, Shannon index is 0.0623, so Feng Yulong guess that the grass has a foundation role in entering China. *E. odoratum* land is produced in America and invaded China through Southeast Asia. In order to reveal the genetic variation of *E. odoratum* through Laos and China, this study compared the physiological and ecological characteristics of *E. odoratum* population in similar environments to reveal the strong invasion mechanism of *E. odoratum*.

2 MATERIALS AND METHODS

2.1 Materials

The subjects of this study were *E. odoratum* in China and *E. odoratum* in Laos respectively. 3m x3m samples are selected in China and Laos, each divided into 9 samples of 1m x 1m. Two sample samples were randomly selected from 9 sample samples. Four *E. odoratum* were randomly selected in each sample square, and each plant removed the immature leaves from top to bottom and collected 10 grow well leaves. *E. odoratum* leaves in China and Laos are collected in the same way back to the laboratory for processing.

2.2 Chlorophyll Concentration.

Take fresh leaves, cut off the thick leaf veins into fragments, weigh 0.5g to the bowl and then added pure acetone 3ml, a little calcium carbonate and quartz sand, grind into a slurry, add 80% (volume ratio) acetone 5ml, to hook the slurry to human centrifuge tube, 4000 r/min centrifugal 10 min abandoned precipitation, upper clearance with 80% acetone to determine the capacity to 10 ml. The pigment extract was 0.5 ml, plus 80% acetone 4 ml and diluted into the cup, with 80% acetone, the absorption values at 663 nm, 645 nm were measured respectively. The concentrations of chlorophyll a and b and total chlorophyll (mg/L) were calculated.

2.3 Leaf Length-width Ratio and Specific Leaf Area (SLA)

10 aircraft blades from Laos and Pu'er were used, the length of the longest and width of each blade was measured with straight ruler, and the length and width ratio was calculated by length / width. The specific leaf area (specific leaf area, SLA) is the ratio of the area of the leaf to its dry weight.

3 RESULTS AND ANALYSIS

3.1 Botany Characteristics of Laos and China

E. odoratum growing in Laos is generally up to 3-7 m. Leaves are born out of the opposite phases, seed shape similar to triangle, the front end gradually small, coarse serrated edges, some like Cang ears, with obvious three veins, rough sides, soft and reddish brown gland points, crushed with pungent smell; umbrella room head flower order; total bud cylindrical, 1cm, total bracts 3-4 layers. Corolla tubular, pale yellow, and stigma pink. Slender fruit narrow linear, angular, 5 mm, long edges with short hard hair; crown hair white, with brown hair.

Figure 1: Morphology of Laos (left) and Chinese E. odoratum (right).

Most of the *E. odoratum* growing in China are perennial herbs, with strong roots and walking horizontally. The stem is erect, 1-3 meters tall, white with fine stripes; branches, often opposite, horizontal shot, straight angles to the main stem, and rarely sharp angles with the main stem; all the branches are thick yellow hairy or soft. Leaves are opposite, ovate, triangular or ovate triangular, and the leaves in the lower inflorescence are small and often fully related. Most or few inflorescence row into compound umbrella chamber or umbrella chamber at the top or

end of the stem or branches, inflorescence stem thick, densely dense short soft hair, total bud cylindrical, total bracts 3-4 layers, tile-covered arrangement, outer bracts egg shape, wheat yellow pole. Flowers are white or pink. Thin fruit is black-brown, 4 mm long, 5 angular, glandless dots along which sparse white stick pressed short pubhairs. Flower and fruit period is April-December.

3.2 Chlorophyll, Leaf Length / Width Ratio, SLA and Leaf Area

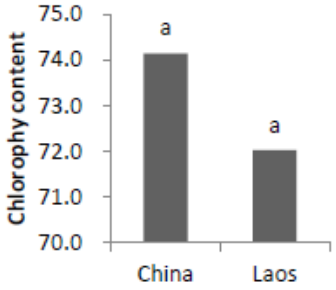

Figure 2: Chlorophyll content in leaves.

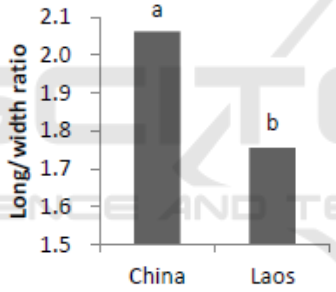

Figure 3: Ratio of leaf length to width.

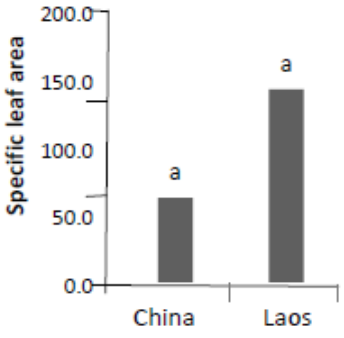

Figure 4: Comparison of leaf area.

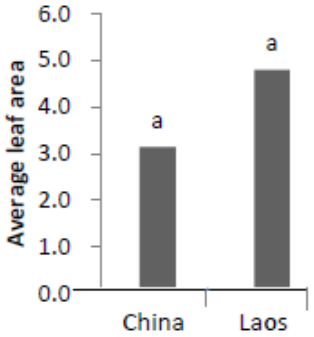

Figure 5: Comparison of average leaf area.

Poor leaf chlorophyll, leaf area and SLA differences in China and Laos ($p > 0.05$). The leaf length / width ratio were significant between China and Laos.

4 CONCLUSIONS

Through Laos and China plane of botany characteristics, chlorophyll content, leaf grass, comparing the aspect ratio, leaf area index can be obtained, in terms of morphological traits, Laos grass and Chinese *E. odoratum* are similar in morphological characteristics in most, but in some aspects, such as height, leaf shape, design and color of a certain difference. In terms of chlorophyll content, the difference of chlorophyll content in c. odorata leaves between the two countries was not significant. In terms of leaf length-width ratio, there was significant difference between the two countries. There was no significant difference in leaf area between the two countries. The results showed that *E. odoratum*, as a natural plant, could grow and reproduce normally in a variety of different natural environments. However, by comparing the various traits of *E.odoratum* under different growth environments, we can know that the various traits are generally the same, but there are certain differences in some aspects.

From this study, we show that Lao and Chinese *E. odoratum* are mostly similar in morphological characteristics, but not significantly in some such as leaf edge shape, color, chlorophyll content,while the blade leaf length / width ratio ratio was significantly different. Analyzing the reasons, the variability in traits exhibited by uniform species growing across environments is the result of directional selection by the external environment for the undirected variants occurring in the organism.

Due to the limited experimental conditions, there were relatively few traits included in the study. The

content of the elements inside the *E. odoratum* blade and the internal organelle morphology can be included in the study of invasive mechanism of *E. odoratum* More characters are studied, the conclusions of this research can be more convincing, it can also lay the foundation for further research projects on grass genestic changes.

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