RESEARCH ARTICLE

Growth Measurements of Invasive Plant *Mikania micrantha* Kunth (Mile a Minute Weed), A Threat of Biodiversity

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DOI: 10.18811/ijpen.v5i01.4

Abstract

This study attempts to measure the growth of invasive plant species *Mikania micrantha* Kunth, which is considered as one among the top hundred worst invasive weeds worldwide. Seedlings of *Mikania micrantha* were propagated through vegetative part as well as seed for the study. The juvenile plants were allowed to grow on different hosts such as poles (nonliving support) and a garden plant (living support) in a soil that contains minimum requirements for growth. Growth of the seedlings was recorded daily by measuring the length of the stem, a number of twines and number of leaves for a growth period of fourteen days. The plants thrived on both types of support. The growth rate was higher in vegetatively propagated plants. It ensures re-growth even from a single node and is responsible for successful invasion of the weed after mechanical weeding.

Keywords: Invasive alien species, *Mikania micrantha*, Plant invasion, Threat to biodiversity, Weed.

International Journal of Plant and Environment (2019)

Introduction

Mikania micrantha Kunth is a perennial weed native to Central and South America (Zhang *et al*., 2004). It was introduced to India after the second world war. The herbaceous vine belongs to the family Asteraceae, commonly known as 'mile a minute weed' because of its vigorous growth and flourishing nature (Barreto and Evans, 1995). The climber grows luxuriantly on nutrient-poor soils but not in undisturbed closed canopy natural forests. They are characterized by the glandular stem and heart-shaped opposite leaves; petiole is 2–4 cm long. Head inflorescences occur (seen as axillary panicles) and contain 3–5 flowers of 5 mm length. The lightweight seeds with pappus hairs ensure dispersal over distance (Reddy *et al*., 2008). It can reproduce through both sexual and vegetative means (Zhang *et al*., 2004). According to the report of GISD, it is considered as one of the hundred worst invasive alien species in the world (Meyer, 2016). The distribution of the species ranges over tropical Asia, parts of Papua New Guinea, Florida in the U.S., Indian Ocean islands and Pacific Ocean islands (Holm *et al*., 1977; Lowe *et al*., 2001; Manrique *et al*., 2011).

Mikania micrantha was introduced to India as the nonleguminous ground cover for tea plantations in the 1940s. In 1968 it was reported from rubber plantations of Kottayam for the first time in Kerala (Sankaran *et al*., 2012). Once established, *Mikania micrantha* kills nearby plants by preventing the sunlight from falling on leaves (Sajeev *et al*., 2012). High reproductive efficiency and phenotypic plasticity make eradication of these weeds difficult; hence designated as high-risk species in Kerala (Barreto and Evans, 1995).

The perennial plant reproduces by both sexual (by windblown seeds) and vegetative (by stem fragments) means. It grows about three feet per week and covers the host plant with foliages. Prevention of sunlight and smothering effect of weed leads to the death of the host plant (Dey, 2011). *Mikania micrantha* spreads at an alarming rate by climbing and twining on any vertical support, including crops, bushes, trees, walls, and fences. Vegetative reproduction is efficient and vigorous. Although it is intolerant of heavy shade, it colonizes in gaps (Meyer, 2016).

Farmers use 30% of their profits for controlling the *Mikania micrantha* invasions of tea plantations in northeast India. Habitat alteration and habitat loss due to the invasion of *Mikania micrantha* and other alien species are considered as the major threat to the one-horned Rhino (which is listed as vulnerable in IUCN red list) in northeastern states of India.

Mikania micrantha creates problems for 75% of teak (*Tectona gandis*) plantations of Kerala. The young trees are affected more by the effects of this weed. In addition to teak, plantain, pineapple, and ginger are also affected by this weed. Invasion of this weed in the plantations makes harvesting of nonwood products a hectic task (Meyer, 2016).

In order to control 'mile-a-minute' plant extensive research has been conducted on mechanical, chemical, biological, and ecological removal methods during the past two decades (Barreto and Evans, 1995; Kuo *et al*., 2002; Zhang *et al*., 2004; Moran *et al*., 2005; Shen *et al*., 2013). Nevertheless, due to high capacity for both asexual and sexual reproduction, morphological plasticity (Yu *et al*., 2009), high compensation capacity (Li *et al*., 2012) and rapid adaptive evolution (Lian *et al*., 2006), a single control method cannot completely alleviate the species. More comprehensive prevention and control measures must be adopted to prevent its invasion. Replacement of control technology and utilization of plant biomass are more promising integrated management strategy. The present study attempts the measurement of growth of both vegetative and seed propagated *Mikania micrantha* Kunth in various hosts at minimal requirements of growth.

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How to cite this article: Vijayan, S., & Joy, C.M. (2019). Growth Measurements of Invasive Plant *Mikania micrantha Kunth* (Mile a Minute Weed), A Threat of Biodiversity. Int J of Plant and Environ, 5(1):23-25.

Source of support: Nil

Conflict of interest: None

Submitted: 04/02/2018 **Accepted:** 01/01/2019 **Published:** 01/01/2019

Materials and methods

The study was conducted in Arookkutty (at 9.87° North latitude and 76.35° East longitude and 1 m elevation above the sea level), Kerala, in the South West coast of India. It is a village on the banks of Vembanad estuary. The location is tropical climate, featuring heavy rainfall and monsoon climate. Seasonal rainfall averages 1521.5 mm per year and the annual mean temperature is 32°C (Seasonal Report, 2016). The range of mile-a-minute plant has been expanding rapidly in this region for the last few years, invading both agricultural areas and bare lands.

The seedlings of *Mikania micrantha* Kunth were propagated through vegetative parts as well as seeds, were allowed to grow on different hosts such as poles (nonliving support) and garden plant (living support) in a soil that contains minimum requirements for growth. The growth of plants was assessed daily for fourteen days by measuring the length of the stem, number of twines and number of leaves. Similar plants that grow on living support in natural habitat were also observed for fourteen days.

The rate of stem elongation was computed as the difference between the final and initial length as given below.

$$\text{Growth rate day}^{-1} = \frac{L_2 - L_1}{d}$$

Where,

L_1 is the initial length, L_2 is final length and d is a number of days. Any significant difference in growth (measured as stem length) between living and nonliving support, and between experimental and wild plant was verified through student t-test.

Results and discussion

The seed propagated experimental plants had a growth rate of 1 cm day^{-1} in both living and nonliving support attaining a length of 0.15 m ± 0.01 m and 0.13 m ± 0.004 m respectively in fourteen days (Fig. 1). There was no significant difference in growth (p = 0.67) at 0.05 level of significance.

The vegetative propagated plants had similar growth rates of 3 cm day^{-1} on either type of support (Fig. 2). The plants grew to a length of 0.37 m ± 0.02 on living support, and 0.39 m ± 0.02 on nonliving support in fourteen days. There was no significant difference in growth (p = 0.79) at 0.05 level of significance.

The growth rate of the plant in the field conditions (natural habitat) was 6 cm day^{-1} reaching a length of 0.79 m ± 0.01 in fourteen days (Fig. 3). The difference in the growth rate of the experimental plant (seed propagated on the living host) and that in the natural habitat was highly significant (p = 0.003).

The number of leaves produced by these plants varied from twelve to twenty-two with one to five twines (Table 1).

In this study, the vegetative propagated plants have a higher growth rate than seed propagated. According to Pieterse and Murphy (1990), vegetative reproduction is responsible for increased habitat compatibility and successful invasion. The plants observed in the natural habitat have still higher growth rate. Maybe it grows in a better niche than that of the nutrient-limited experimental environment. According to the report of GISD *Mikania micrantha* stem can elongate 27 cm^{-1}. Distribution of weeds was predominant along the roadsides of the study area. It is proved that the new open spaces created by road lying will prompt the introduction of new species (Avevalo *et al*., 2005; Pickering and Hill, 2007). A taxon is said to be successfully naturalized after overcoming geographical, environmental and reproductive barriers (Richardson *et al*., 2000).

Although the rate of growth has not been influenced by the nature of support as observed in this experiment, it is widely accepted that association of the invasive plant with native flora will lead to the reduction of growth of host species (Dey, 2011). In this case, vegetative reproduction was observed to be more predominant than seed propagation which makes the plant more invasive because the whole plant can originate from a single nodal cut.

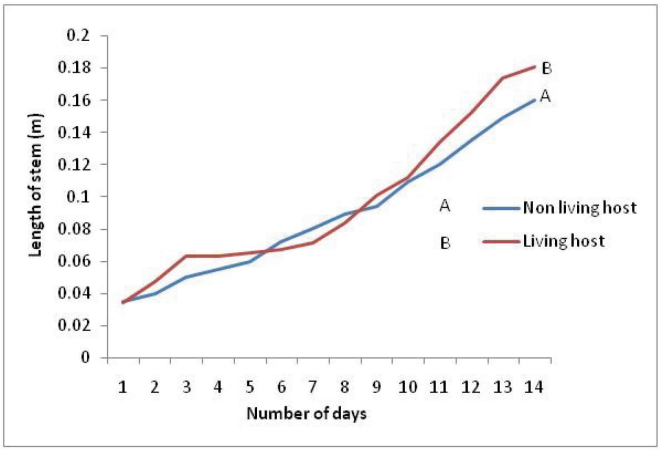

Fig. 1: Stem elongation of seed-propagated *Mikania micrantha* plant on living and nonliving host

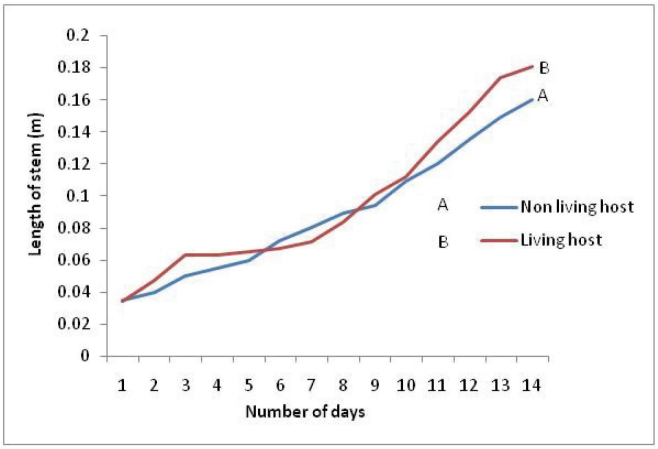

Fig. 2: Stem elongation of vegetative propagated *Mikania micrantha* plant in living and nonliving host

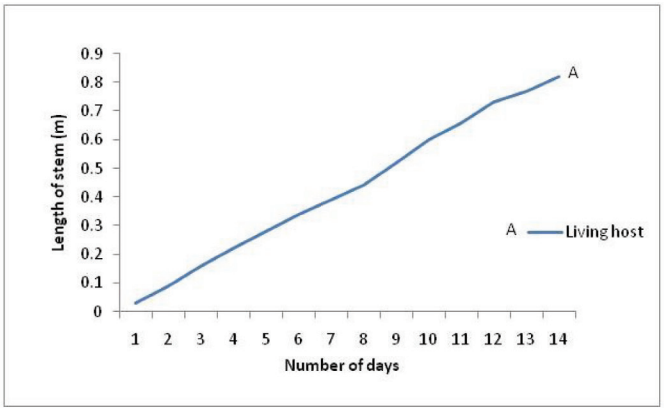

Fig. 3: Stem elongation of *Mikania micrantha* in a natural habitat on a living host

Table 1: Growth of *Mikania micrantha* in experimental conditions and natural habitat

	Number of leaves			*Number of twines*		
Support	*Seed propagated*	*Vegetatively propagated*	*Natural habitat*	*Seed propagated*	*Vegetatively propagated*	*Natural habitat*
Living	20	22	22	1	2	5
Nonliving	12	25	-	1	4	-

Conclusion

Mikania micrantha Kunth is enlisted as one of the top hundred worst invasive species worldwide by GISD. It has a wide range of distribution worldwide and its association with native flora can inhibit the growth of host species. The plant spreads widely by small light weight seeds with pappus hairs and by vegetative means. In this study, vegetative propagated plants have grown faster than those propagated by seeds in both nonliving pole and living species. The nature of the support did not affect the growth rate. Probably it affects the type of spread. Vegetative reproduction was observed to be more predominant than seed propagation which makes the plant more invasive. It ensures re-growth even from a single node and is responsible for successful invasion of the weed after mechanical weeding.

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