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Distribution of Invasive Weed *Parthenium hysterophorus* in Natural and Agro-Ecosystems in Arusha Tanzania

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Abstract: ***The invasive weed Parthenium hysterophorus is aggressive and hazardous weed causing harms to biodiversity of natural plant communities, humans and animals in more than 20 countries worldwide. In Tanzania, Parthenium weed was first reported in Arusha region in 2010. Since 2010, areas invaded by parthenium weed in Arusha region has increased. However, detailed information on the distribution, density, frequency and abundance of P. hysterophorus weed in Tanzania are rare. Therefore, the present study was carried out to address two objectives: 1) to identify areas infested with parthenium weed in Arusha region in Tanzania 2) to determine density, frequency and abundance of parthenium weed. Field surveys were carried out at Njiro suburb, Arusha-Kilimanjaro border and Arusha Airport in Arusha region during January to February 2013. Parthenium weed was identified using visual method; and quadrates were used to determine number of parthenium weeds in the fields. The weed was found growing along the roadsides, near residential areas, crop land and grazing lands. The mean number of parthenium weeds were significantly among the three locations (p<0.05). The density, frequency and abundance of parthenium weeds were high at Njiro suburb compared to Arusha-Kilimanjaro border and at Arusha airport.***

Keywords: Biodiversity, *Parthenium hysterophorus*, invasive weed, Tanzania

1. Introduction

The invasive weed *Parthenium hysterophorus*has become one of the world's seven most devastating and hazardous weeds in more than 20 countries worldwide. The weed is originated from subtropics of North and southern America. [1]. Recently, *P.hysterophorus* has invaded Asia, Australia, Pacific islands and Africa. [2, 3].The weed possess an adverse effect on crop production, animal production, human health, and biodiversity in the area of infestation due to the allelopathic nature[2, 4].Many studies reported on the impact of parthenium weed in crops[5, 6]. In agricultural fields, parthenium weed has allelopathic chemicals mainly parthenin, which show high competitive ability for soil moisture and nutrients. In addition, the allelochemical produced by parthenium weed found to inhibit germination and growth of adjacent crops and other plant species has become [7].These studies showed that chemicals released by parthenium weed to the immediate environment found to inhibit germination and growth of crops such as wheat, sorghum and other plant species. In addition, effects of parthenium weed in agricultural fields in different parts of the world has been reported [4, 5, 7, 8]. These studies demonstrated that parthenium weed caused 30% yield losses in sorghum and 20% in maize crop in Pakistan. The weed found to affect agriculture, environment, human and animal health and biodiversity. Thus, invasion of parthenium weed in agricultural lands may contribute to social and economic instability, causing poverty and food insecurity.

1. Furthermore, parthenium weed threatens biodiversity by competing with crops and indigenous plant species for resources (sunlight, moisture, nutrients and even for spaces). Previous study reported on the effects of parthenium weed in grazing lands[9].Study by Chippendale and Panneta showed that the parthenium weed completely dominated grazing land in Australia and led to weed monoculture and reduced stocking rate of up to 80%. Thus, parthenium weed affected biodiversity by displacing the native, as well as exotic species and medicinal plants [10].

2. Moreover, allelopathic chemicals produced by parthenium weed causes human and animal health problems [7]. Parthenium weed causes allergenic rhinitis, asthma, bronchitis, dermatitis, and hay fever while contact with parthenium leaves and inhalation of pollen grains. Toxin produced by parthenium weed has been reported to cause effects in milk and meat of the livestock [7]. Thus, toxins produced by parthenium cause tainting in milk, reduction of milk yield and reduced quality of meat of livestock such as goats, sheep and cows. Therefore, if animals consume large quantity of parthenium weed can cause death due rupturing of internal organs.

3. Several studies reported on the distribution of parthenium weed [5, 6, 10]. These studies showed that *Parthenium hysterophorus* is major invasive weed of cropped and non-cropped areas of North and South America, Africa and Asia [2]. In Tanzania, parthenium weed was first recorded in Arusha region along the roadsides near Arusha airport, in Arusha city, and near Kilimanjaro International airport [11]. An earlier ecological survey before 2010 in different regions of the country does not report the occurrence of parthenium

weed. Despite the presence of parthenium weed in Arusha region in Tanzania, little is known about current distribution, density, frequency and abundance of this weed in Tanzania. Therefore, the present study was carried out to address two objectives: 1) to identify areas infested with parthenium weed in Arusha region in Tanzania 2) to determine density, frequency and abundance of parthenium weed in areas infested with parthenium weed.

2. Materials and Methods

2.1. Study areas and sampling description

Field surveys were conducted at Njiro suburb, Arusha-Kilimanjaro border and Arusha Airport (Table 1) in Arusha region during January to February 2013. The locations of the study were selected based on the presence of parthenium weed following pre-survey study carried out in December 2012.

Table 1: Geographical location of the study areas

Location	*Latitude*	*Longitude*	*Altitude*
Arusha-K,njaro	-3°25' 45"N	37° 4' 28" E	894m
Arusha Airport	3° 22' 0" S	36°40' 59" E	1387m
Njiro-suburb	-3° 21' 57" N	36°40' 28" E	1400m

2.2. Sampling description

In each location one field site was randomly selected for data collection. Distribution or invasion was determined as presence or absence of parthenium weed in the agricultural fields, along roadsides, residential areas and grazing lands. Quadrates were used to determine number of parthenium weeds in the fields; and 25 quadrates were randomly located at approximately 4 m intervals throughout the 100 m length of the field. Number of parthenium weeds was counted within 25 randomly placed quadrates (1 m x 1 m) across the 25 m x 100 m of the fields. Abundance, density and frequency of parthenium weeds were determined in a total of 25 (1 m x 1 m) quadrates. Density, frequency and abundance of parthenium weeds were determined by the formula described by El-Azazi et al. [12].

$$\text{Density} = \frac{\text{Total number of parthenium weeds in all quadrates}}{\text{Total number of quadrates used}}$$

$$\%\ \text{Frequency} = \frac{\text{Total number of quadrates in which parthenium weed occurred}}{\text{Total number of quadrates studied}} \times 100$$

$$\text{Abundance} = \frac{\text{Total number of parthenium weeds in all quadrates}}{\text{Total number of quadrates in which parthenium weed occurred}}$$

2.3. Statistical Tests

The differences of the mean number of parthenium weeds among the locations per quadrate were tested by Analysis of variance single factor using Genstat 15th edition software program[13].

3. Results and Discussion

3.1. Distribution of Parthenium weeds

The weed was found growing along the roadsides, near residential areas; crop land and grazing lands in all three locations (Fig. 1(a-d)).Results of this study show that total of 247 parthenium weeds were recorded from Njiro suburb, 163 from Arusha-Kilimanjaro border and 107 from Arusha Airport. The mean number of parthenium weeds were significantly among the three locations ($p<0.05$) (Fig. 2). Results of the present study show that parthenium weeds were found growing and spread rapidly in agricultural fields, alongside the road, residential areas and grazing lands.

(a) Maize field infested with parthenium weed

(b) Residential area infestation

(c) Alongside the road infestation

(d) Pasture infestation

Figure 1 (a-d): Areas of infestation of *P. hysterophorus* in Arusha region, Tanzania

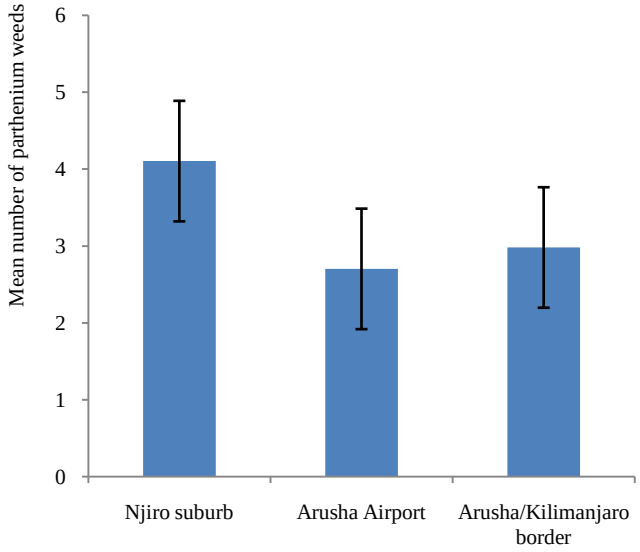

Figure 2: Comparison of the mean number of *Partheniumhysterophorus*weeds at three locations: Arusha-Kilimanjaro border, Arusha Airport and Njiro-suburb in Arusha region, Tanzania

Invasiveness and rapid spread of *P. hysterophorus* weed in Arusha region might be attributed to its major ecological and morphological characteristics and adaptability to wide climatic and soil conditions, photo insensitivity, and drought tolerance [6]. The life cycle of this weed might also contributed to the rapid spread in different locations, it take place within 3-4 months and shows 3 to 4 generations in a year [14].Other possible factors could be production of allelopathic chemicals and the ability to produce large number of seeds (10,000 to 25,000 per plant) which are small in size (1 to 2 mm diameter) and light in weight to travel long distances through wind, water and other dispersal mechanisms [15]. Results of this survey concur with the results of [4-6, 11] who found that parthenium hysterophorus weed spreads on agricultural areas, open space, wastelands and along the roadsides in Tanzania and Ethiopia.

3.2. Density, frequency and Abundance of Parthenium weed

Data from the field survey shows that among the three locations, the highest parthenium weed density 9.88 plants m^{-2} was recorded at Njiro-suburb, followed by 6.52 plants m^{-2} at Arusha/Kilimanjaro border and 4.28 plants m^{-2} at Arusha airport (Table 2). The percentage frequency of occurrence of parthenium weed was 96% at Njiro-suburb and Arusha-Kilimanjaro border while Arusha airport had frequency of 72% (Table 2). Of the three locations, Njiro-suburb had highest abundance of parthenium weeds, followed by Arusha/Kilimanjaro border and Arusha airport (Table 2).Parthenium weed population is high at Njiro-suburb where the soils are disturbed constantly for purposes of building and construction of roads. Thus, the extensive density, frequency and abundance of parthenium weeds along roadsides, near residential areas, croplands and grazing lands in different locations in Arusha region might be due to the transportation of soils from parthenium infested to non-infested areas[6, 10].

Table 2 Density, frequency and abundance of parthenium weeds in three locations: Njiro-suburb, Arusha-Kilimanjaro border and Arusha Airport in Arusha region

Location	*Density (Plants/m^2)*	*Frequency (%)*	*Abundance*
Arusha-K,njaro	4.28	96	6.79
Arusha Airport	6.52	72	5.94
Njiro-suburb	9.88	96	10.29

The present study observed that invaded parthenium weed colonizes disturbed and bare lands along roadsides. The colonization of this weed in disturbed and bare land along roadsides might have helped the dispersal of parthenium weed thereby contributing to quick spread of parthenium weed in agricultural fields and grazing lands in Arusha region. The findings of present survey study added information of the 2010 report about the first observation of Parthenium weed in Arusha, Tanzania. In addition, results this survey can assist weed scientists to develop effective strategies for control of Parthenium weed along roadside, agricultural fields and wasteland and grazing lands.

4. Conclusion and Recommendations

The results of the field survey provide a quantitative comparison of the invasion and spread parthenium weeds alongside roads, croplands, residential areas and grazing lands of Njiro-suburb, Arusha-Kilimanjaro border and Arusha Airport in Arusha region. There is a need for weed scientists to develop effective management strategies to control of this invasive species.

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Author Profile

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