Percentage Light Interception Variations on Opuntia Fiscus-Indica Due to Dactylopius Tomentosus Insect Infestation and Impacts on Phytomorphology

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Abstract:

Many studies have described the parasitic relationship between *Opuntia ficus-indica* and *Dactylopius tomentosus* in the light of biological control systems. This has been done with no or little concern on the direct cost the agent insect causes on the host plant and diversity of other organisms surrounding the plant's existence. The aim of this study was to assess the percentage light interception variations on *Opuntia fiscus-indica* due to *Dactylopius tomentosus* insect infestation and its impact on phytomorphology around Masvingo City in Zimbabwe. The assessment was done by measuring changes in cladode/stem thickness, nymph density and PLI (Percentage Light Interception), the difference between the incoming (I0) solar irradiance and the outgoing (I1) solar radiation, of *D. tomentosus* infested plants over a period of 162 days. With increased infestation period, measurements on *O. ficus-indica* cladode/stem thickness and PLI were significantly lower than their initial states (p .000). These changes effected significantly on the structure of the host plant (*O. ficus-indica*), that is, lanceolated shape of the cladodes/stems collapsed, while at the same time the plant lost its green colouring. This allowed more light to pass through, hence reduced PLI. Pearson correlation between cladode/stem thickness and PLI over the same measurement period was significantly positive ($p < .000$). The correlation between nymph density and PLI over the same 4 time measurement period was significantly negative ($p < .000$). A relatively low but significant total dependence of PLI on nymph density was also shown ($p < .000$).Changes in the measurements of the three variables that is, cladode/stem thickness, nymph density and PLI over the study period affected the overall morphological structure of the host plant, predictive of total plant death and hence host plant local extinction beyond the study period.

Keywords:

Opuntia Fiscus-indica, Phytomorphology, Dactylopius Tomentosus, Masvingo

1. Introduction

Cactic plants are found in semi-arid rocky and savanna areas [1]. There are about 1000 Cactacea species which are thought to be native to Canada and Southern South America [2]. The plants have been introduced to other parts of the world and are now considered cosmopolitan [3]. The *Opuntia fiscus-indica* is a succulent shrub or tree ranging 1.5-3 m but can grow up to 5 m. It develops a sturdy trunk with age, the branches (cladodes) are flattened, grey to grey-green and 30-60 cm long and 6-15 cm wide [4]. Leaves are reduced and shed early [1]. The plant has conspicuous, bright yellow, or orange or red flowers [5]. It produces edible fruits called tunas. The plant has long been grown as an economically important crop plant, throughout arid and semi-arid parts of the world [5]. The plant has been grown for its sweet fruits and as forage for domestic animals. *Opuntioid cacti* are unique ideal crops for arid regions because they are highly efficient in converting water into biomass [6]. Certain members of this taxon have been declared threatened species, hence are listed on the IUCN red data list, however, most of these are listed as species of least concern, because of their widespread and commonness. For example, *Oputia stricta* and *Opuntia ficus-indca* are listed as data deficient, although they are widely spread due to introductions and their invasive characteristics [7].

In terms of habitat, *Opuntia* species are extremely drought tolerant, cold hardy and fast growers, hence they can thrive in dry and hot regions of many such countries, for example, in warm and drier regions of Zimbabwe [8]. O*puntia ficus-indica,* or simply prickly-pear, has received different common names around the globe [9]. It is predominantly found within the tropic of Cancer, in Mexico and tropic of capricon in South America [10]. The plant has also established itself well in arid regions of Australia and South Africa. In Zimbabwe the plant is mostly found in warm and dry regions of the country, especially the south and south western regions that include Gwanda, Beitbridge and Masvingo areas respectively. In these regions *O.ficus-indica* is the primary forage plant for livestock [11]. In areas where the plant is not foraged or the foraging is limited, the plant's under story harbours a high diversity of macro and microinvetebrates making it a valuable plant to the country's flora [11].

The *O. ficus-indica* has exhibited many advantages that gives the plant an ecological advantage over the other plant species in most rangelands and deserts [12]. The plant can reproduce both vegetatively and sexually, this increases its chances of survival under different environmental conditions. In addition the host plant has effective methods of conserving water, is protected from herbivores by spines and can photosynthesise throughout the year [13]. Prickly pears are prolific seed producers. Each pad produces one to several fruits and each fruit contains a large number of seeds. The fruits are sweet, succulent and very palatable to cattle, horses, sheep, goats, deer, coyotes and many other wildlife species [12]. Seed coats are very hard, impermeable to water and contain plant regulatory substances that inhibit germination [14]. Germination of seeds require optimum temperatures of 47.8 ^{0}C and soil water content should remain high. Seeds do not germinate at the same time. This minimizes the risk of depletion of the soil seed bank of prickly-pear [15]. Livestock and wildlife play an important role in the germination of prickly-pear seeds. Seeds that pass through animal gut have higher chances of germination than those that dry-up in fruits. Ingested seeds undergo mechanical scarification and have increased chances of germination.

The morphological characteristics of *O. ficus-indica* gives it, yet other ecological advantages of surviving in harsh, arid environments. Such characteristics include; the small leaves that appear at the aeroles of the pads. The reduced leaf size limit the amount of water vapour lost through transpiration. Maturing new pads develop a thick cuticle that also prevents water loss from the plant. The stomata of prickly-pear only open for gas exchanges during daytimes when relative humidity is high [12]. The plant has the capacity to absorb large quantities of water and storing it. The water is used during extended dry seasons for photosynthesis. A shallow spreading root system helps the plant to efficiently utilize moisture from small rainfall events [16].

Opuntia ficus-indica has become invasive in most Australian states [17] and in some parts of Kenya and Tanzania [4]. In the mentioned countries the invasiveness of the plant could have resulted from the optimum conditions that favour the vegetative growth of the plant. Unfortunately for countries like Zimbabwe where the plant is in limited numbers, the species has become vulnerable to attack by Cochineal insects (for example *Dactylopius tomentosus*) [11]that can eventually damage or kill the entire plant population.

O. ficus-indica has long been domesticated as a crop plant in arid and semi-arid regions of the world. It has been grown primarily as a fruit crop and also for vegetable nopales (pads) [8]. The most commercially valuable use of *O. ficus-indica* today is the large sweet fruits, called tunas [18]. The pulp of the fruit is sweet, gelatinous, and green in colour with numerous seeds inside. The fruit contains vitamin C and was one of the cures of scurvy. Other constituents of the tuna fruit are carbohydrates (glucose, fructose and starch), proteins and fibres rich in pectin [18]. Areas with significant tuna-growing cultivation include Mexico, Chile, Brazil, Spain, Southern Italy, Greece, Tunisia, Morocco, Egypt etc. Other products derived from the tunas include jams and jellies. The Mexican alcoholic drink called Colonche is made from Opuntia. *O. ficus-indica* has been used for centuries as a feed source for cattle and as a boundary fence [5]. Farmers have burned the spines of *Opuntia* to avoid mouth injuries to the cattle. The cactus nopales(pads) have low dry matter and crude protein, however, the pads have proved to be a useful supplement in drought conditions. Evidence also exist that prickly-pear may improve soil conditions, that is, its canopies and roots are thought to help protect the soil from erosion on hilly terrain or where the herbaceous plants have been destroyed [19]. The roots protect the soil from wind erosion and desertification, especially in more arid regions of the world that experience long periods of drought [20]. Soil water content has been seen to be greater under prickly-pear colonies than under grass cover [19].This allows a diverse of organisms under prickly-pear canopies.

The *Dactylopius tomentosus* is an arthropod, class insect, order *Hermiptera*, superfamily *Cocoidea*, family Dactylopidae, genus *Dactylopius*. These are scale insects and the only genus in the family *Dactylopiidae [21]*. The insects are commonly known as cochineals. Cochineal insects are a group of sap sucking insects that feed and develop only on cactus plant species [22]. The best known species of these is *D. tomentosus* [23]. *Dactylopius* is common in the Americas, originating in South America, North America, Mexico and Southwestern United States [21]. However, molecular phylogenetic studies of *D. coccus* suggest that the insect originated in South America and was introduced to Mexico with various agricultural products during the Pre-Columbian era [23]. The genus is now distributed throughout the world due to accidental and intentional introductions [24]. The cochineal insect could have reached Zimbabwe accidentally after it had been released as a biological control agent on chain fruit cholla (*Cylindropuntia fulgida*) in 2008 in South Africa. Two releases were done, one near Douglas in the Northern Cape, South Africa. The other on an Island in the dry river bed of the Limpopo near Musina in Limpopo Province. It is most probable that the release in Musina made it possible for the insect to reach some parts of Zimbabwe, especially the south west parts of the country. Dispersal of the insect is by wind. *O. ficus-indica* is the preferred host plant for *D. tomentosus.* The insect feeds on the plant's moisture and nutrients. The insect is of economic and historical importance as a main source of natural red colorant/ red dye "carmine" that has been used since the 10^{th} century [25].

Dactylopius species can be found on cacti plants in many types of dry habitats, including forests, grasslands, cultivated fields, disturbed and weedy areas and gardens. The cochineals are soft-bodied, flat, oval scale insects [26]. The female cochineal insects (or bugs) are wingless and legless about 5mm [27]. The female insect is often found under a waxy cotton substance on its host plant. The cotton cover protects the insect from its predators, water loss and excessive sun. Males are small with legs and long wings [28]. Both adults are red to pinkish red and have a beak-like mouth parts to help them suck substances from their host plants [29]. The insects clump to the cactus pads, feeding on the sap. *Opuntia* genus is the target host for *D. tomentosus*. The *Opuntia* genus has more than 200 species and *D. tomentosus* can attack any of these cacti plants. However, its most common host plant is *O.ficus-indica*. The cochineal insect can damage the plant as it feeds and eventually killing the plant by injecting a toxic substance into the plant.

D. tomentosus has been evaluated as a pest for cactus plants in many regions of the world [30]. However, in areas/regions where the host plant is scarce the chochineal insect has become nonsensical to the host plant. The insect has been employed to biologically control the spread of *Opuntia species* in areas where it has become invasive [4]. Infestation of cacti plants by this insect can slow down plant growth and can eventually kill [1].

Observations made in the Masvingo province of Zimbabwe have revealed that *Dactylopius tomentosus* was rapidly attacking *O. ficus-indica*. There is need therefore to assess the nature and extent of infestation of the host plant (*O. ficus-indica*), by the agent insect (*D. tomentosus*), and to determine and establish the ultimate morphological damage of the host plant. The research therefore aims to to measure incoming (I_0) and outgoing (I_1) solar radiation on *O. ficus-indica* plants infested with *D. tomentosus* and use these to calculate Percentage Light Interception (PLI) over the study period and also to determine whether there are significant changes in *Opuntia ficus-indica* cladode thickness and PLI with increased *D. tomentosus* infestation over the measurement period.

The results from this study would avail information on how *D. tomentosus* affects its host plant, *O. ficus-indica* in and around Masvingo City in Zimbabwe. The results will also provide scientific knowledge on the extent of the parasitic relationship between *D. tomentosus* and its host plant observed during the period of study. Results from the study would enable the ability to deduce if any, the direct costs of *D. tomentosus* infestation on *O. ficus-indica* that may include morphological/physical damage in the study area over the measurement period. The study would save as past reference for future studies on *D. tomentosus* with its host plant and other related species that is, contributing to the body of knowledge to previous studies, by explaining direct costs of the agent insect may pose on its host plant. The study may also generate interest from local plant pathologists, biologists and the general public. The outcome of the study may influence policy formulation on local plant conservation by related government agencies such as the Environmental Management Agency, hence forming the basis for conservation and management plans for the host plant (*O. ficus-indica*).

2. Materials and Methods

2.1. The Study Area

The research was carried out in and around Masvingo City, in Zimbabwe. Masvingo is in found in South Eastern Zimbabwe at GPS coordinates 20°45′ South and 30°25′ East [31]. It is approximately 286 km north of the Musina (South Africa) which is the probable origin of the cochineal insect. The area is mostly hot and dry throughout the year, except when rains between October and March. It is in region 5 of the country’s climatic regions with average maximum temperatures of 35°C and average minimum temperatures of 26°C. The rainfall is low and uncertain with an average annual rainfall of about 545mm [32]. The larger parts of Masvingo Province are drought prone. These prevailing conditions of the province are conducive for the vegetative growth *Opuntia ficus-indica* and the reproduction of *D. tomentosus*. Figure 1 shows the location of the study area and study sites.

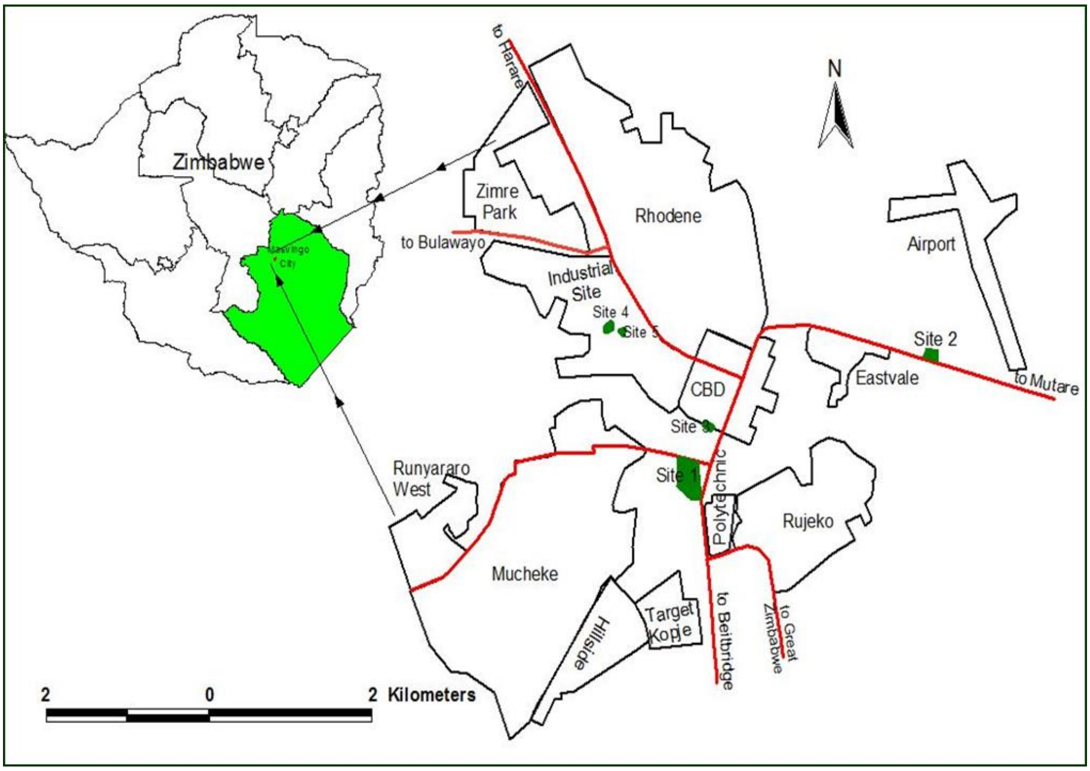

Figure 1. *Study Area.*

2.2. Research Design and Data Collection

The study was carried out August 2016 and January 2017. Five (5) sites (shown in Figure 1) were chosen for study. From each site, four (4) clusters of *Opuntia ficus-indica* plants were chosen, with each cluster approximately equi-distance from the other. 20 cladodes from each cluster were randomly chosen for data collection. A total of 400 cladodes formed the working sample for the study. Measurements of cladode thickness, nymphal density, incoming and outgoing solar irradiance were done on each chosen cladode on each visit. 4 visits were done to collect data, one after every 42 days for six (6) months, that is, from August 2016 to January 2017.

A micro-screw gauge was used to measure cladode/stem thickness. Each cladode was measured at four different positions and the average thickness was recorded. Average nymphal density (number of nymphs/cm^2) was determined by counting the number of nymphs in different mesh-wire squares. A UV E8H29036 light sensor, was used to measure solar irradiance in W/cm^2 (watts/cm^2). The sensor was held 2cm from the cladode surface and the amount of solar radiation (I_o) reaching the cladode/stem was recorded. The amount of solar radiation (I_o) passing through the sampled cladodes/stems was also recorded, either underneath or behind each cladode. PLI (Percentage Light Interception), was calculated using the following formula PLI = I_1/I_ox100 where PLI is the Percentage Light Interception, I_1 is the outgoing solar irradiance; I_0 is the incoming solar radiation.

2.3. Data Analyses

All statistical analyses were done using SPSS v20. The data was tested for normality before any analyses were performed. Where the data did not show a normal distribution, then it was transformed to normalise it [33]. One way ANOVA was employed to determine if there existed any significant difference in *O. ficus-indica* cladode/stem thickness, nymph density and PLI (Percentage light interception) over the measurement period. Where ANOVA showed significant differences in any of the variable, Post Hoc test using Turkey HSD were done to identify the measurement times that differed significantly.

A Pearson correlation analysis was also done to determine whether there was any correlation between each pair of the three variables. This was followed by a Regression Analysis that was performed to predict the dependent variable between pairs of variables, that is, cladode/stem thickness and nymph density, cladode thickness and PLI (Percentage Light Interception), nymph density and PLI.

3. Results and Discussion

3.1. Percentage Light Interception (PLI) Over the 4 Time Measurement Period

At site 1 mean PLI (Percentage Light Interception) for the 4 measurement times were (92.20 81.12, 71.38 and 57.01 (Table 1). One way ANOVA showed statistically significant difference in PLI (Percentage Light Interception), over the study period, ($F=367.981$, $p < .000$).

The Turkey Post Hoc test showed that mean PLI at time period 1 differed significantly from that of successive time periods ($p <.000$). At site 2, mean PLI were, (92.68, 84.01, 71.82 and 56.23) % respectively, (Table 1). One way ANOVA for PLI at the 4 different times of measurement for the site showed a statistically significantly mean difference ($F = 1142.039$, $p <.000$). The Post Hoc test for PLI using Turkey HSD for site 2 showed that PLI was significantly higher at each calculated time period than at previous calculated time periods ($p <.000$). At site 3 mean PLI were (93.65, 83.85, 68.50, 53, 39) % respectively, (Table 1). One way ANOVA for site 3, revealed a statistically significant mean difference of PLI ($F= 863.379$, $p < .000$), for the 4 measurement times. Post hoc test for this site showed that mean PLI at time period 1differed significantly from the rest of the period, which also differed significantly from each other and from that obtained from time period 1, (p <.000).

Table 1. *Site 1 Mean PLI for the time period 1-4.*

Site	**1**	**2**	**3**	**4**	**5**
time	**Mean PLI**	**Mean PLI**	**Mean PLI**	**Mean PLI**	**Mean PLI**
1	93.20	92.68	93.65	92.94	94.98
2	81.12	84.01	83.85	81.90	83.31
3	71.39	71.83	68.50	68.23	68.95
4	57.01	56.22	53.39	52.75	51.19

At site 4, the mean PLI were (92.94, 81.90, 68.23 and 52.75%) respectively, (Table 1). One way ANOVA, for PLI for the 4 different times of measurement showed a statistically significantly different mean PLI, (F = 788.088, p < .000). For site 4, a Post Hoc test for PLI using Turkey HSD was performed for time period 1, which differed significantly from that of the rest of the time periods (p <.000).

At site 5, mean PLI were, 94.98, 83.31, 68.95 and 51.19, (Table 1) One way ANOVA performed showed that mean PLI were statistically significantly different (F = 1431.070, p < .000). Post hoc test using Turkey HSD, for this site for PLI showed that Percentage light interception differed significantly for each of the 4 calculated time period, (p <.000).

3.2. Correlation and Regression Analyses Between Cladode/Stem Thickness and Nymph Density, Cladode Thickness and PLI (Percentage Light Interception), Nymph Density and PLI

Table 2. *Pearson Correlation for all sites for the 4 times measurement period.*

	Cladode/stem thickness	**PLI(Percentage Light Interception)**
Nymph density	-.680	-.530
PLI	.883	

The Pearson correlation analysis for all sites, for the 4 times measurement period between cladode/stem thickness and nymph density revealed a negative but statically significant correlation (r =.-680, p <.000), (Table 2). Correlation analysis between cladode/stem thickness and PLI (Percentage Light Interception) over the study period showed a statistically significantly positive correlation (r = .883, p <.000), (Table 2). Pearson correlation analysis between nymph density and PLI for all sites, over the research period was negative, but significant (r =.-530, p <.000), (Table 2).

Table 3. *Linear regression analysis for all sites over the study period.*

	Cladode/stem thickness	**PLI (Percentage Light Interception)**
Nymph density	r^2 = .462	r^2 = .281
PLI	r^2 = .779	

The regression analysis between cladode/stem thickness and nymph density showed a significant predictor-response relationship (r^2 =.462, p <.000), (Table 2). Another regression analysis between cladode/stem thickness and PLI revealed a statistically significant predictor-response relationship (r^2 =.779, p <.000), Table 3. The curve estimate Figure 2 shows the dependency relationship between PLI (response variable) and cladode/stem thickness (predictor variable), over the study period. Further regression analysis between nymph density and PLI showed a statistically significant predictor-response relationship (r^2 =.281, p <.000), (Table 3). The curve estimate

Figure 3 shows a graphical dependency of PLI on nymph density, over the research period.

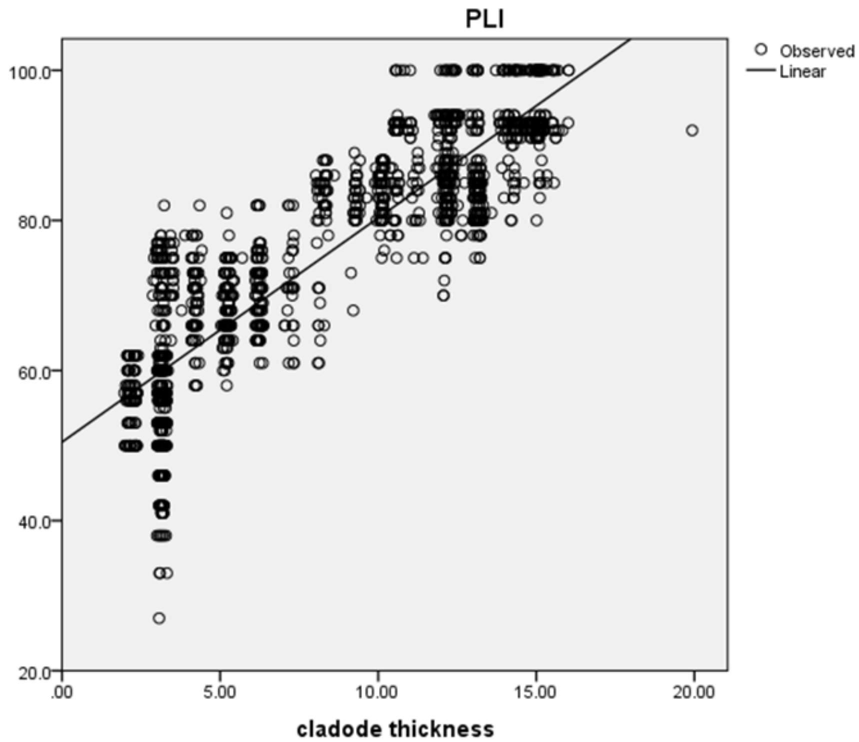

Figure 2. *Curve estimate for PLI against Cladode/stem thickness.*

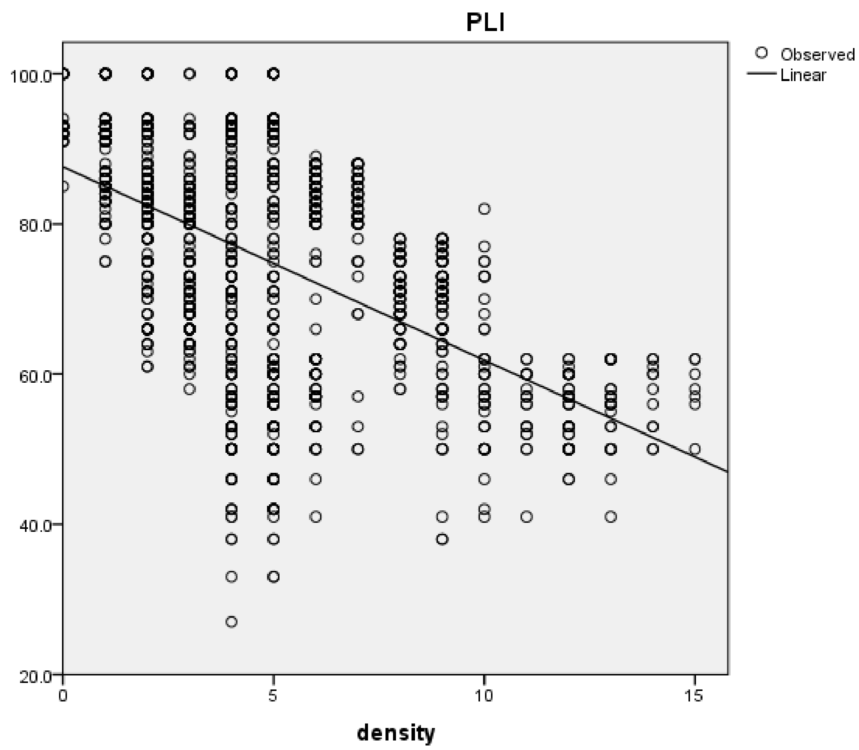

Figure 3. *Regression estimate curve for PLI (Percentage Light Interception), against nymph density over the 4 time measurement period.*

There is evidence from the study that *D. tomentosus* is the terminator agent for *O. ficus-indica*. The overall assessment of the morphological damage of the host plant (*O.*

ficus-indica) by its agent (*D. tomentosus*) for all sites and at individual/within sites and over the measurement periods reveals a host- parasite terminal relationship that reduces host cladode/stem thickness, nymph density and PLI over the infestation period. Changes in cladode/stem thickness, nymph density and PLI are major measurable determinants of the morphological damage of the host plant in the study area over the study period, Figure 4 and Figure 5).

Figure 4. *O. ficus-indica infestated with D. tomentosus late period two of the study (October 2015).*

Figure 5. *O. ficus-indica infestated with D. tomentosus late period 4. (December 2015).*

The observed effect of *D. tomentosus* on its host plant over the study period, agrees with the previous studies in Kenya where the cochineal insect (commonly known as dudu in that country) was used as a biological control for *O. ficus-strica* (member of the family *Opuntiadeae*) caused adverse damage of the cladodes/stems of the host plant [34]. In another related study of D. tomentosus control of *Cylindropuntia fulgida var*. in South Africa, it was shown that the insect is an effective and efficient biological control of its host plant. The study revealed that, six months (168 days) after the release of the insect all inoculated plants were heavily infested, with small plant dying and within a year most plants were dead and after two years 87 ha. of *C. fulgida var*. had been colonised by the cochineal insect [35]. The results of this study suggest a physical/morphological damage of the host plant *(O. ficus-indica*) which is influenced by an increased mean nymphal density, over the infestation period.

Because of the limited population numbers of *O. ficus-indica* in the study area, the possibilities are that the host plant may go extinct. Ecologically the study shows the possibility of a host plant local extinction. The local extinction would predict subsequent loses of macro and micro-invertebrates that inhabit the cactus' understory, for example, leaf beetles and spider mites. Also a reduction in and/or increase in successional plant species diversity in the study area is anticipated during and beyond the study period as the host plant continue to be destroyed by the cochineal insect. This loose of plant species diversity can be better explained by the intermediate disturbance hypothesis [36]. The hypothesis asserts that moderate levels of disturbance increases species diversity, while high and low levels of disturbance reduce species diversity. The results from this study reveal high levels of localised disturbance, as the host plant morphology continue to be damaged, hence an anticipated decrease in macro and micro-invertebrate species diversity over the 4 time measurement period.

Morphological damage here refers to the damage of the plant's cladodes/stems, which bear on them modified buds called aeroles, which give rise to large spines commonly known as glochids. Also flowers, new and old cladodes/stems, shallow spreading roots, the cuticle and mucilage-producing cells are all damaged [37]. Damage or heavy infestation of these plant parts can slow down the plant's growth rate and can eventually kill it. Damage or spread control of *O. ficus-indica* in areas where it is not sufficiently abundant like in the study area can have adverse impact on wildlife habitat, all depending on the control or level of damage incurred by the host plant. *O. ficus-indica's* propensity to reproduce vegetatively, its rapid growth rate, the availability of various growth forms and its tenacity makes it an ideal plant material for restoration for wildlife habitat in areas where it is not sufficiently abundant [38]. These results imply that continued morphological/physical damage of the host plant would lead to its death and eventually its local extinction The host plant physical damaged may be associated with some external influences that include the prevailing hot weather, frequently high speed wind that blows the nymphs from one plant to the next plant, dust and smog that are exuded by the passing traffic. All these factors found in the study area are presumed to have accelerated the rate at which *O. ficus-indica* is being infested by its cochineal agent (*D. tomentosus*), over the study period.

In this study PLI (Percentage Light Interception) is a function of the incoming and outgoing solar radiation. PLI is one of the measurable core determinants of morphological damage of *O. ficus-indica* in the study area, over the 4 time measurement period. The decreasingly low values of PLI (Percentage Light Interception) at time period 3 and 4 is indicative of reduced light interception by the cladodes/stems, that is, there is increased outgoing solar irradiance (I0) than is intercepted. Hence a predictive physical/morphological (stem) damage of *O. ficus-indica.* (2). In other studies such changes in PLI has provided an understanding of the changes in plant productivity, has served as an indicator of stressed forests and a measure of forest insect damage [39]. In this study PLI has been used to assess the extent of the host plant (*O. ficus-indica*), damage by its agent insect (*D. tomentosus*). The findings also show that there exist an inverse relationship between PLI (Percentage Light Interception) and plant morphology, that is, an increased morphological damage results in decreased PLI-values, (Figure 4) This continued morphological damage of the host plant *(O. ficus-indica),* also implies that the phenology (flowering and fruiting), are delayed or prevented, suggesting some possibilities of a host plant death and hence its local extinction.

The hypothesis that there is no relationship between cladode/stem thickness and nymph density, cladode thickness and PLI, nymph density and PLI is not true and is also not supported by any of the findings from the study. *D. tomentosus* is a sap sucking insect, increased infestation by this insect means reduced plant fluid content of the host plant and hence increased plant cell death and ultimately overall morphological plant damage. Figure 2 and Figure 3 show that as nymph density increases, cladode/stem thickness decreases and as nymph density increases, PLI-values decrease, hence less light interception but increased stem and root damage of the host plant, indicative of a possible future host plant local extinction. Also the trend of the results from the study could be evident of a future possible host plant local extinction.

4. Conclusions

It can be concluded that *D. tomentosus* is the potential terminator agent for its host plant (*O. ficus-indica*). This is evident from the changes of such variables as nymph density and PLI, over the study period. The study has shown that increased and continued infestation with *D. tomentosus* can physically damage the host plant and ultimately kill it. This also signals that in the areas where the cactus plant is sparsely populated, the plant can go extinct if conservation and management measures are not taken up soon. The findings also show a causal relationship between infestation and plant damage. Cladode/stem thickness and PLI (percentage Light Interception), are both affected by continued *D. tomentosus* and hence causing pronounced damage to the entire plant. This morphological damage has impacted much on biodiversity that inhabit the understory of the host plant. However the findings do no show how much biodiversity is affected, hence there the need for further research. Most studies in Zimbabwe on invasive species have concentrated mostly invasive plants, for example *Cylindropuntia fulgida* and the *Landana camara*. It therefore recommends that the country starts to control the damage *D. tomentosus* is causing on its host plant in the study area and adopt conservation and management policy that ensures a sustainable conservation of threatened cacti plants in the country.

Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this article.

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