Impacts of Paraquat Based Herbicides (Slasher) on the mean abundance of Soil Arthropods in Kogi State University botanical garden

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ABSTRACT

Botanical garden is a place where ornamental plants are grown for beautification, conservation, research and economic purpose. This plant needs fertile soil to grow, flourish and produce seeds for continuity. The fertility of soil is maintained and improved majorly by the decomposition and aeration activities of soil arthropods which mainly dwell in the soil. This work was conducted to determine the impacts of Paraquat based herbicides (slasher) on the abundance of soil arthropods in Kogi State University botanical garden from November, 2017 to January, 2018. The botanical garden covered an area of 19600m² (140×140m), was divided into 3 sets of 4 plots each. Each plot measured 400m² (20×20m) with a distance of 20m. The first three plots of each set had different concentration; 350ml, 250ml and 150ml while the fourth plot served as control. Each plot was furtherly divided into four quadrats with a modified pitfall trap of height 14.40cm and diameter 9.50cm set with equal level to the ground at the middle of each quadrat. Collection of arthropods was done three weeks before and three weeks after application of herbicides between 7am-10am every day with forceps into a killing jar. Trapped arthropods was killed with chloroform and preserved with (70%) diluted formaldehyde and transported to Biological science laboratory of Kogi State University for identification to order level. A total of 6,389 arthropods belonging to 23 orders with order Hymenoptera having the highest abundance of 3,465 (54%).

Keywords: Abundance; Herbicides; Hymenoptera; Ornamental plants and Soil arthropods.

1. INTRODUCTION

Botanical garden is a place where ornamental plants are grown for the purpose of beautification of the environment, source of income, recreation, education, scientific research and conservation of plants species [1]. Plants play important role in our environment such as; purification and replenishing of the
environment through absorbing carbon (iv) oxide (CO₂) gas and release of oxygen (O₂) into the environment, restoration of degraded ecosystem and sustaining green infrastructure [1,2]. Plants need fertile soil to grow and produce seeds for continuity; and the fertility of soil is maintained or improve naturally by the presence and activities of soil arthropods [3].

Soil arthropods are fauna that mainly dwell in the soil; they help to maintain and increase soil fertility through decomposition, aeration and mixing of soil particles [4]. They breakdown dead organic materials which influence plant performance, competition and composition in a community or habitat [5,6,7,8]. They function as litter transformers” or “ecosystem engineers [9]. As the former, they moisten ingested plant debris and improve the quality as a substrate for microbial decomposition while as the later they physically change the habitat by regulating the availability of resources to other species [10]. The population of this fauna are threaten by herbicides applied to control weed in the environment. Herbicides are mostly agro-chemicals used to control or kill plants considered to be weeds that compete with desired plants for nutrients, water and light in botanical gardens [11].

1.1. Major functions of soil Arthropods

1.1.1. Decomposers:

Mites, ticks, centipedes, and millipedes are decomposers which break down dead plants and animals and turn them into soil nutrients [12]. For example, approximately 90% of aboveground primary production, in terrestial ecosystems, enters the below ground system [13] where the soil biota undertakes the decomposition and mineralization of soil organic matter [14].

1.1.2. Bio-indicator:

Soil arthropods are considered bio-indicators because they have short generation time, large population size and relatively easy to sample [15,16]. An increase in plant diversity, density and cover can be positively correlated to the abundance of soil arthropods [17,18]. But Modern practices such as the use of inorganic herbicides in the control of weeds in farms and botanical garden influenced the vegetation structure of botanical gardens which directly affects the habitats of some of the soil arthropods [17].

This study is investigates the impact of Paraquat based herbicides (lasher) on the mean abundance of soil arthropods before and after herbicides application in Kogi State University Botanical garden.

2. MATERIALS AND METHODS

2.1. Study area

The study was carried out in Kogi State University botanical garden, Anyigba with coordinates 07°28' 48.6'' N and 07°10' 47.0'E and elevation of 396m±9m. The University is one of the fast growing state University in Nigeria, made of up six faculties and a population of 20,500 students. The institution is sectionallised into three sections and each is separated by a tarred road which served as student walk way and passage for cars. The first row comprises of the administrative buildings; the second row is made up of classrooms and lecture theatres and the third row is made up of hostels which is been border with the school plantation where the garden is situated.

Anyigba is characterized with guinea savannah type of vegetation, with average maximum temperature of 33.2°C and minimum temperature of 22.8°C. It as mean precipitation of about 747mm per annum and two seasons in a year. The rainy season last from April to October while the dry season last from November to March. The botanical garden comprised of different species of plants such as Mangifera indica (mango trees), Citrus sinensis (orange trees), Anacardium occidentale (cashew trees), Elaeis guineensis (palm trees), Gmelina aborrea (gmelina trees), Pennisetum purpurium (elephant grass), Odorata repen (yellow bush), Ixora cornea (ixora).

2.2. Experimental Design

The botanical garden covered an area of 140×140m², was divided into 3 sets of 4 plots each. Each plot measured 20×20m² with a distance of 20m. Each plots were furtherly divided into four quadrats, each quadrat had a pitfall trap of height 14.40cm and diameter 9.50cm set with equal level to the ground at the middle. The first three plots of each set had different concentration of herbicides measured with a measuring cylinder of 1000ml ml and applied with 16 litres of knapsack; 350ml for high concentration, 250ml for standard concentration and 150ml for low concentration with the fourth plot served as control with no application of herbicides. Collection of arthropods was done two weeks before (24th November - 4th December 2017) and two weeks after application of herbicides (2nd January - 12th January, 2018) between 7am-10am after every twenty-four hours with forceps into the killing jar.
Impacts of paraquat based herbicides on mean abundance of soil arthropods

Figure 1. Location of study area

Figure 2. Bar Chart showing the mean abundance of soil arthropods
Trapped arthropods was killed with chloroform inside a well labelled killing jar and preserved with diluted formaldehyde and taken to Biological Science laboratory of Kogi State University for identification to order level [19, 20].

3. RESULTS AND DISCUSSION

3.1. Identification of Arthropods

Identification of collected samples was done to order level using standard taxonomic keys by [21] and [22] with the aid of a dissecting binocular microscope.

3.2. Description of Data

A total of 6,389 arthropods belonging to 23 orders, with order hymenoptera (Ants) having the highest abundance of 3,465 (54%). Arthropod abundance was high before application than after application (table 2). (324.53; mean abundance before), (205.38; mean abundance after)

3.3. Calculation of mean abundance of arthropods

Mean abundance of arthropods was done by calculating the sum total of individual arthropods caught per day divided by the numbers of plots. Total numbers of arthropods / total numbers of plots.

Table 1. Mean abundance of soil arthropods before and after herbicide application.

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<th>Before</th>
<th>After</th>
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<td>1298.12</td>
<td>821.50</td>
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Results obtained from this study indicated that the mean abundance of arthropods before application of herbicides was higher than after application (Table 2). There was more species abundance before application (1298.12; mean abundance) than after application (821.50) this difference is strongly attributed to the loss of habitat and harsh environmental condition caused by the application of the herbicides. This research correlate with work carried out by; [23] who indicated that changes in the species abundance of soil arthropods following the use of paraquat based herbicide for weed control were likely to be indirect effects caused by the death and destruction of angiosperms. [24] Highlighted that excessive application of herbicides significantly reduced soil arthropods number and biomass due to its disturbance effects. [25] revealed that the reduction in the abundance and diversity of soil arthropods in the farmlands of Practical Year Training Program (PYTP) was due to the consistent application of paraquat based herbicides that impacted negatively on the environment.

This study has demonstrated that Paraquat based herbicide can reduce the population of soil arthropods therefore, alternative source of controlling weeds should be employ such as the use of organic herbicides, use of machine or cutlass. This will go a long way to conserve biodiversity in the environment.

Conflicts of Interest

There are no conflicts of interest.

References


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