



## Clearing the Weeds Create more Space for Weeds infestation

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### Abstract

#### Keywords:

Weed management,  
Herbicides,  
Weed succession,  
Plant species richness,  
Similarity indices

*This study was carried out to investigate the effect of different methods of weed management on weed succession and dynamics. A plot measuring 96 m<sup>2</sup> was used for the field experiments on an uncultivated soil beside the Plant Science and Biotechnology Botanical Garden at Adekunle Ajasin University, Akungba-Akoko. The plot was divided into five subplots each with three replicates. Five treatments which include two different herbicide brands, mixture of the two herbicide brands, manual weeding and control (where no weeding was done) were applied on the subplots. Plant identification were recorded to species level before and after treatments were applied. Plant species richness, abundance and similarity were estimated for the treated and control sites from the study plots. A total of 27 plant species belonging to 12 families were enumerated in the plots before treatments were applied. Aside *Talinum triangulare* that cut across all the plots, other plant species persistent in the different plots include *Chromolaena odorata*, *Andropogon tectorum*, *Gomphrena celosiodes*, *Ipomea asarifolia*, and *Sida acuta*. Two families that cut across the plots were *Portulacaceae* represented by *Talinum triangulare* and the *Malvaceae* represented by *Sida rhombifolia* and *S. acuta*. A low similarity index was obtained for plots treated with herbicides compared to the hand weeded and control plots. It was evident from the study that the removal of weed as management method create open space for recolonization by new set of weeds.*

Accepted: 19 April 2023

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### INTRODUCTION

Weeds are serious environmental issues following their negative impact in agricultural (Fried et al., 2017) and non-agricultural settings (Bulu et al., 2017). In agriculture, weeds are problematic as they compete with other crops for limited resources (mainly nutrients, water and light) and are sometimes difficult to eradicate. They are therefore identified as factors that increase production cost, reduce the quality and quantity of yield produce by crops (Saunders et al., 2017). Weed invasion could therefore be a serious threat to biodiversity by altering both the structural and functional attributes of the ecosystem. Although riddled with lot of negative effects, certain weed species perform important ecological function. In fact, some farmers in some parts of the world have developed

management systems that permit moderate populations of the more desirable weed species to grow with their crops (Altieri, 1995; Smith et al., 2020). Weeds perform vital ecosystem services such as providing habitat for beneficial organisms, source of food, medicine and fodder (Maroyi, 2013; Mavengahama et al., 2013; Daum et al., 2022), protecting and restoring exposed or degraded soils (Akobundu, 1992). In natural ecosystem, the vegetative cover of a forest or grassland helps prevent soil erosion, replenish ground water and control flooding by enhancing infiltration and reducing water runoff.

Excessive weed growth has been reported as one of the most important factors limiting crop production in the world. While physical methods of controlling weeds can be laborious and expensive due to labour

cost (Bulu, 2018), the use of herbicide is considered a viable option both in agriculture and non-agricultural settings. Its use has become the most widely accepted method of weed control in most countries of the world (IITA 1998; Bulu, 2018).

Recently, there has been a general call to limit the use of herbicides as a result of the attendant health and negative effect on the ecosystem. Continuous application of a single herbicide, or herbicides with similar properties or modes of action, led to the development of weed resistance and herbicide persistence. This application is also reported as one factor responsible for shift in weed flora in an environment (Booth and Swanton, 2002).

This study therefore seeks to assess the composition of weeds on abandoned farmland where different control measures are used for weed management. The study also seeks to identify succession weed species on study plots with the aim of determining shift in the weed flora.

## MATERIALS AND METHODS

This study was carried out in an abandoned farmland near the botanical garden of the Department of Plant Science and Biotechnology, Adekunle Ajasin University, Akungba-Akoko, Ondo State, Nigeria. Observation of the area was carried out to identify sites with known history of weed management methods for the study.

## EXPERIMENTAL DESIGN

A Randomized Complete Block Design (RCBD) of five treatments with three replications in an area measuring 96 m<sup>2</sup> was used for this study. Each treatment is contained within a plot of size 2 m by 2 m with 1 m between the plots. The field had a total of 15 plots for the three replicates. Each plot was demarcated with rope and tagged for easy identification. Plant composition on the plots were identified to species level before treatments were applied. The identification was done using the Weeds of West Africa (Akobundu and Akgoyawa, 1987) and Flora of West Tropical Africa (Hutchinson and Dalziel, 1952, 1963, 1968, 1972). Species whose identities were in doubt were collected and taken to the taxonomist at the Department of Plant Science and Biotechnology for proper identification.

Five treatments which include; Striker (Nicosulfuron) SKH on Plot 1, Uproot (active ingredient; 360g/l of glyphosate) UPH on Plot 2, a combination of the two herbicide brands (Striker and Uproot) SUH on Plot 3, hand weeding HWD on Plot 4 and control CTL (Plot 5 where no treatment was applied) were applied separately. A 16 litres knapsack sprayer with flat fan nozzles was used to apply the herbicides to the different plots. The plots were observed at four weeks after application of treatments to identify weed species. Complete identification of plants to species level were repeatedly done on the plots at two weeks interval consecutively.

## Data Analysis

The presence and absence data obtained were ordered in multivariate analysis using constrained seriation techniques (Brower and Kyle, 1988) available in Paleontological statistics (PAST) version 4.03

The species richness and abundance of species on each of the studied plots were determined. The change in vegetation was determined by comparing the plants on the plots before and after disturbance of the studied plots. Similarity in species composition before and after application of treatment on the vegetation of the studied plots were assessed by Sorenson Index of Similarity  $IS = 2C/(A+B) \times 100$  (where C is the common number of species in two comparable plots, and A and B are the total number of species in comparable plots) (1948).

## RESULTS AND DISCUSSIONS

In Figure 1 shows that a total of 27 plant species belonging to 12 families and one unidentified species were present in the standing vegetation of all the plots before treatment was applied. Plot 1 contain 15 plant species while plot 2 and 3 contain 12 species. A total of 10 plant species were observed in plot 4 and 16 species in plot 5 which served as the control plot. Plant species enumerated on the different plots were mainly herbs and shrubs with few climbers and grasses. Tree species enumerated were *Ficus exasperata* in plot 1 and plot 5. *Antiaris africana* occurred in plot 5 only. *Talinum triangulare* and *Sida rhombifolia* cut across all the experimental plots.

Figure 2 shows the enumeration of plants species in the different plots during the period of treatment. In Plot 1, two plants species, *Talinum triangulare* and Mimosae species were found surviving up to the fourth period of visitation after herbicide application. At the fifth period of enumeration, while the mimosa was lost, among the plants species that recruited include *Abutilon mauritianum*, *Mormodica charantia*, *Senna hirsuta* and *Perquetina nigrescens* while among the new recruits include, *Ipomea triloba*, *I. asarifolia*, *Centrosema pubescens*.

Two species were notably present in Plot 2 before and after treatment (Figure 2), *T. triangulare* and *Chromolaena odorata*. Resident plant species such as *Andropogon tectorum*, *Synedrella nodiflora* and *Momordica charantia* were absent after herbicide application. New plants species that emerged include *Centrosema pubescens*, *Panicum maximum*, *Passiflora spp*, *Cynodon dactylon*, *Sida acuta* and *Brachiaria deflexa*. The families Tiliaceae, Malvaceae, Solanaceae, Moraceae, Amaranthaceae, Sterculiaceae, Mimosae and Curcubitaceae which were initially present before herbicide application were absent at the end of the experiment.

The following plant species occurred in plot 3 before treatment; *Gomphrena celosoides*, *Calapogonium mucunoides*, *Sida acuta*, *S. rhombifolia*, *Abutilon mauritianum*, *Synedrella nodiflora*, *mimosa spp.*, *Malvastrum coromandelianum*, *Physalis angulata*, *Manihot esculentum*, *T. triangulare* and *Andropogon tectorum*. Except *Andropogon tectorum* and *Talinum*

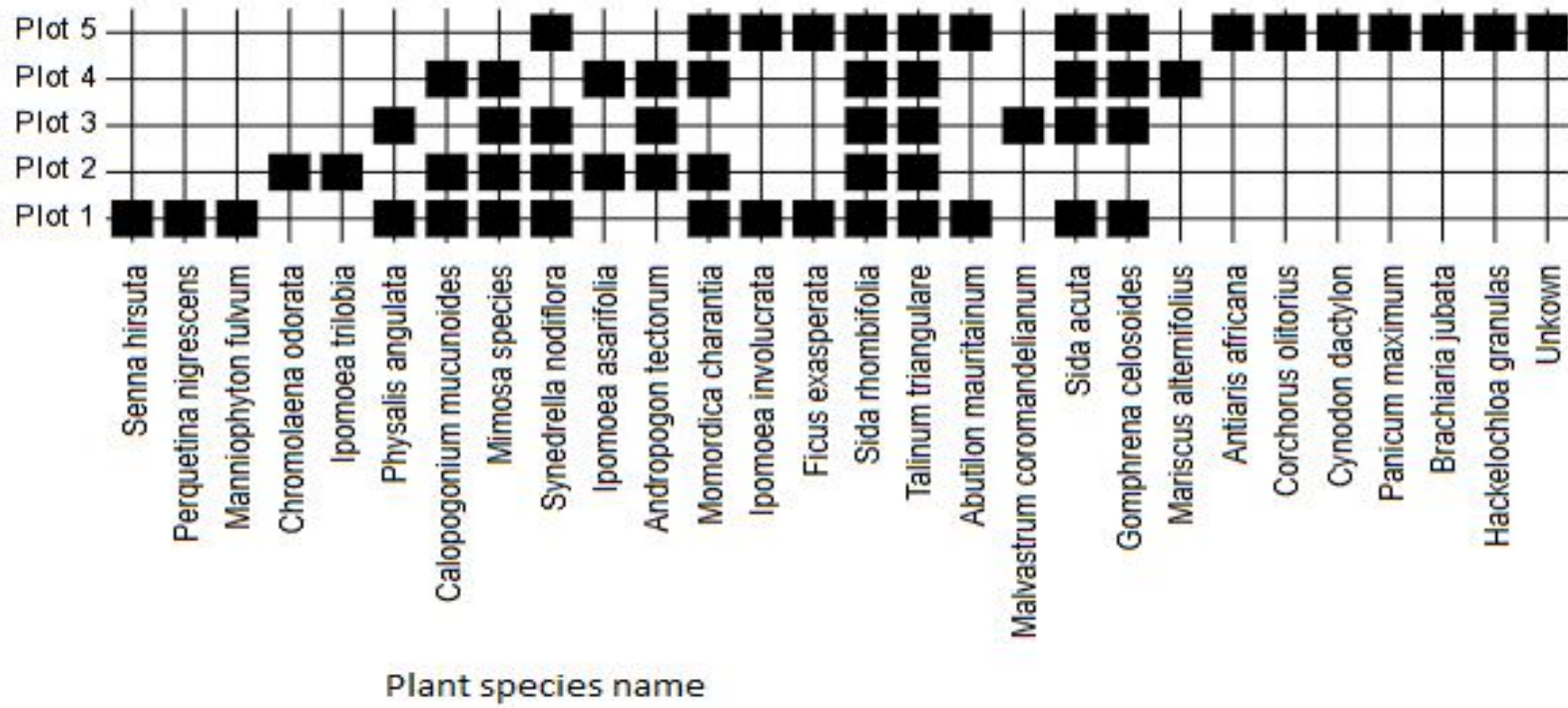


Figure 1: Enumeration of plant species on plots before treatment application

*triangulare*, all the other plants listed did not survive the application of the mixture of herbicide on the plot. New plant species that emerged include *Ipomoea asarifolia*, *Passiflora* species, *Mariscus alternifolius*, *Centrosema pubescens*, *Peruquina nigrescens*, *Ipomoea triloba*, *Albizia zygia* and *Corchorus olitorius*.

In plot 4 (Figure 2), plant species observed include *Talinum triangulare*, *Ipomoea asarifolia*, *Gompherana celosoides* and *Sida acuta* were present before and after the application of treatment till the end of the treatment. *Calopogonium mucunoides* present initially before treatment was lost after treatment. Variety of new plant species however recruited from the soil and include *Acalypha segetalis*, *Ageratum conyzoides*, *Acalypha fimbriata*, *Mariscus flabelliformis*, *Tridax procumbens*, *Chromolaena odorata* etc.

On plot 5 which also served as the control plot, enumerated plant species remain persistent all through the study plots. New plants that emerged on the plot include *Mariscus Flabelliformis*, *Acalypha frimbriata*, *A. segetans*, *Rhynchelytrum repens*, *Centrosema pubescens*, *Chromolaena odorata*, *Mucuna utilis* etc.

A total of 13 families were initially enumerated on the plots before treatment was applied as presented in Figure 4. Two families that cut across the plots were Portulacaceae represented by *Talinum triangulare* and the Malvaceae represented by *Sida rhombifolia* and *Sida acuta*. While Plot 1 had the highest number of families (85%), Plot 3 had the lowest (54%) before treatment.

A survey of the families present on the plots after the experiment were shown in Figure 5. 16 families were recorded on all the plots. Plot 4 had the highest number of families (93%) followed by Plot 5 (87%) after treatment. New families that were added include Rubiaceae in Plot 4, Tiliaceae in all the plots except Plot 2 and Passifloraceae in all except Plot 5.

As shown in Table 1, low similarity index was observed in Plot 1 and Plot 3 between the plant species composition before and after the use of treatment. In Plot 2, a similarity index of one was recorded during the seventh period of observation. The hand weeded plot recorded an average similarity index all through the period of observation.

The Similarity index of the control plot (Plot 5) shows that the plant species composition of the plot was similar with an index of 1.00 to the third period of observation. An index of 0.7441 was recorded from the fourth period and was maintained till termination of the experiment.

In plot 1, 2, 3 and 4, relative abundance of plant species present before treatment application was 65.22%, 64.71%, 50.00% and 41.67% respectively.

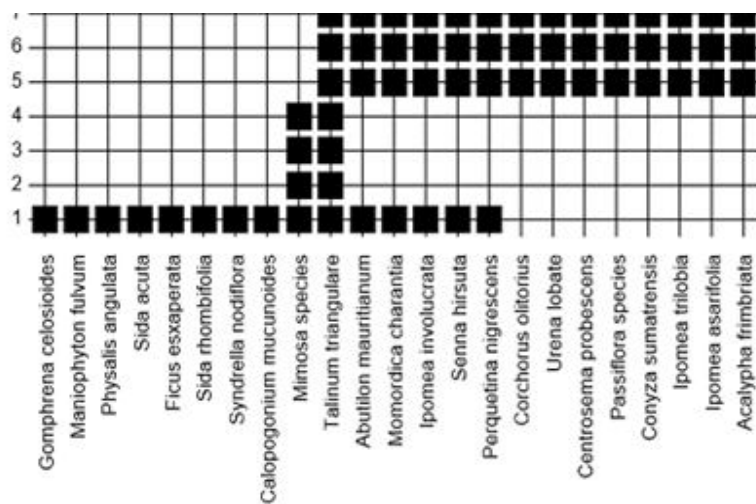
This abundance was reduced to 8.69%, 11.76, 18.18% and 16.67% for the plots respectively after treatment. An increased in relative abundance was observed in all the plots from the fourth visitation till the termination of the experiment. For instance, the initial 41.67%, RA of plot 4 was reduced to 16.67% after treatment. At recovery, the RA increased as follows, 41.67, 58.33, 70.83 and 95.83% at the consecutive periods of plant species enumeration.

Table 1: Similarity index of the plots after treatment application compare to before application

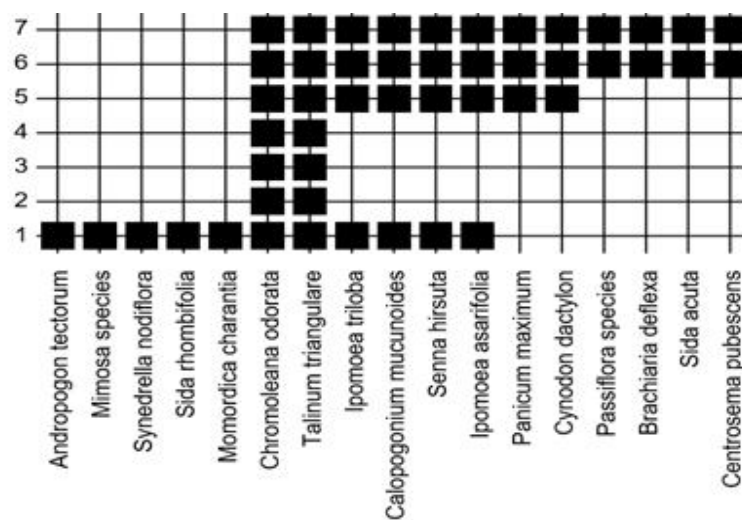
	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5
Periods					
2	0.2352	0.5218	0.375	0.5714	1
3	0.2352	0.2858	0.2353	0.5	1
4	0.2352	0.2858	0.25	0.5	0.7441
5	0.387	0.2858	0.1739	0.6667	0.7441
6	0.387	0.6	0.1739	0.5455	0.7441
7	0.387	1	0.1739	0.5455	0.7441

Table 2: Relative abundance of plant species on the studied plots

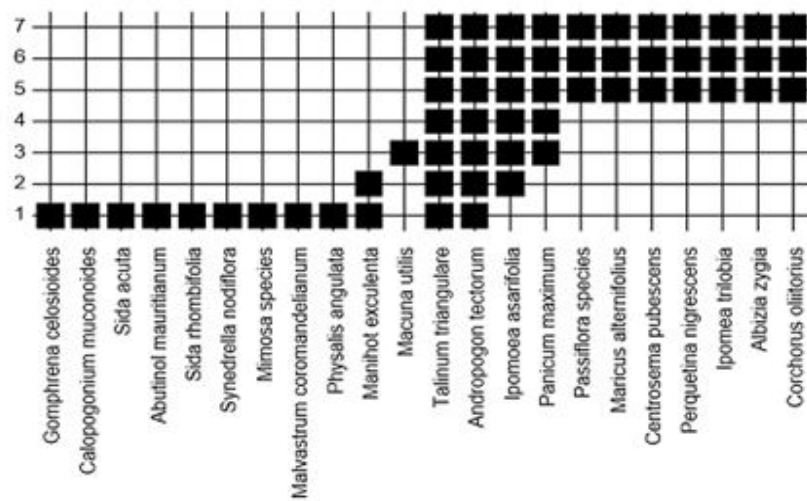
	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5
Period (weeks)					
1	65.22	64.71	50	41.67	59.26
2	8.69	11.76	18.18	16.67	59.26
3	8.69	11.76	22.73	41.67	59.26
4	8.69	11.76	22.73	58.33	100
5	60.86	47.06	50	70.83	100
6	60.86	70.59	50	95.83	100
7	60.86	70.59	50	95.83	100



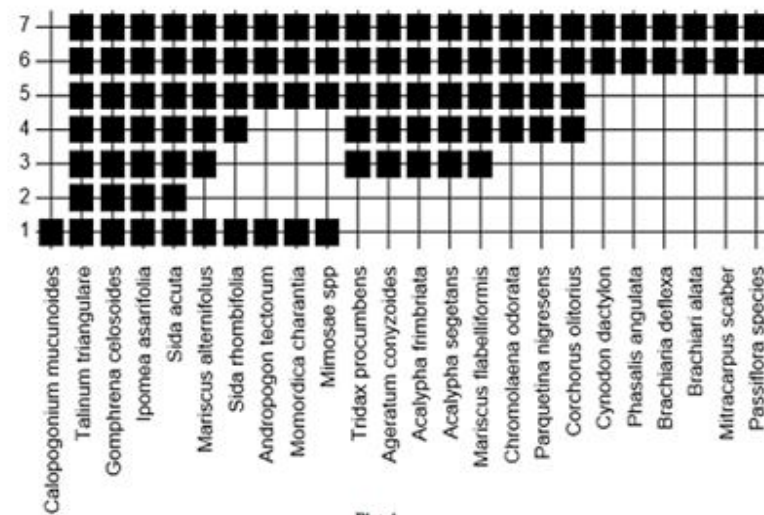
Plot 1



Plot 2



plot 3



Plot 4

Figure 2: Plants enumeration in the plots before and after treatment were applied

## DISCUSSION

The desire to increase agricultural productivity and maintain attractive environment in non-agricultural settings has led to the use of various management techniques to control weeds by individuals of which the use of herbicide and mechanical method are adopted. In this study, two management methods (hand weeding and the use of herbicide) were separately introduced in controlling weed species in different plots.

Plant species identified on the plots were mainly herbs and few shrubs indicating a typical arable farmland. Tree species present were *Antiaris africana* and *Ficus exasperata* which are forest relics. In plot 1 where herbicides were used for weed management, the initial plant species richness and composition was lost indicating an effective control of the weed population and abundance. Despite the differences in species richness, *Talinum triangulare* reoccurred across the plots surviving throughout the treatment period. *Talinum* has been considered one of the most difficult weeds to control in grain legumes, cassava and yams farms (Akobundu, 1979). Akobundu (1979) opined that *Talinum* reestablishes quickly from chopped stem segments and is not killed by any of the contact herbicides on the market and appears to survive glyphosate application at up to 3.0 kg a.i./ha. The common feature of the life form of these plants is that they have storage rootstocks that confer perennating and recovery advantages on them. These helped them to recover from episodes of herbicide application, flourish and contribute viable seeds to the seedbank.

Other plant species that survived on the different plots include *Chromolaena odorata* in plot 2, *Andropogon tectona* in plot 3. In the hand weeded plot, *Gomphrena celosioides*, *Ipomoea asarifolia* and *Sida acuta* were present all through the treatment period. The role of the perennating organ indicated by Faluyi and Nwokeocha (1992) seems to be a major factor in the population dynamics of many of the plots studied in this work. Their absence on other plots corroborates the facts that the herbicide applied on those plots hindered their establishment. Therefore, herbicide application reduces weed population.

The control plot, plot 5 maintained the composition and richness of weed species present at the commencement of the experiment. This was evident by the presence of 16 plant species on the plots at the first observation. New weedy species however were recruited to the plot when further observation was carried out. A reduction in the number of families contributing weedy species to plot 1, 2 and 3 where herbicides were used is an indication of the efficiency of the chemicals in controlling weedy populations. The plot with manual weeding recorded the highest number of families contributing weedy species followed by the control plots.

The low similarity index between the initial weed flora richness and consecutive period of observation after plots were treated indicates that the plots differ in weed species composition. The low similarity is an indication of loss of initial weed flora and emergence of some new weeds representing fluctuation in species composition of the plots. The high similarity index recorded in the control and the manual cleared plots indicate minimal or no disturbance to the plots.

An evaluation of the relative abundance of plant species on the plots during the period of the study shows that the initial reduction in species composition and richness result in reduction in relative abundance as a result of treatment applied. The abundance however increased when the plots were left to recover from the effects of the herbicide application. Families that cut across at the plots at initial observation were the malvaceae and portulacaceae while gramineae contributed the highest number of species to the control plot and remain dominant in the plot.

## CONCLUSION

It is evident from this study that the removal of weed species by any method of management create open space for colonization by new set of weedy species thereby changing the species composition and structure. An initial reduction in the abundance of weed species only occur temporarily with a change in richness and diversity when the effect of the management technique no longer persists.



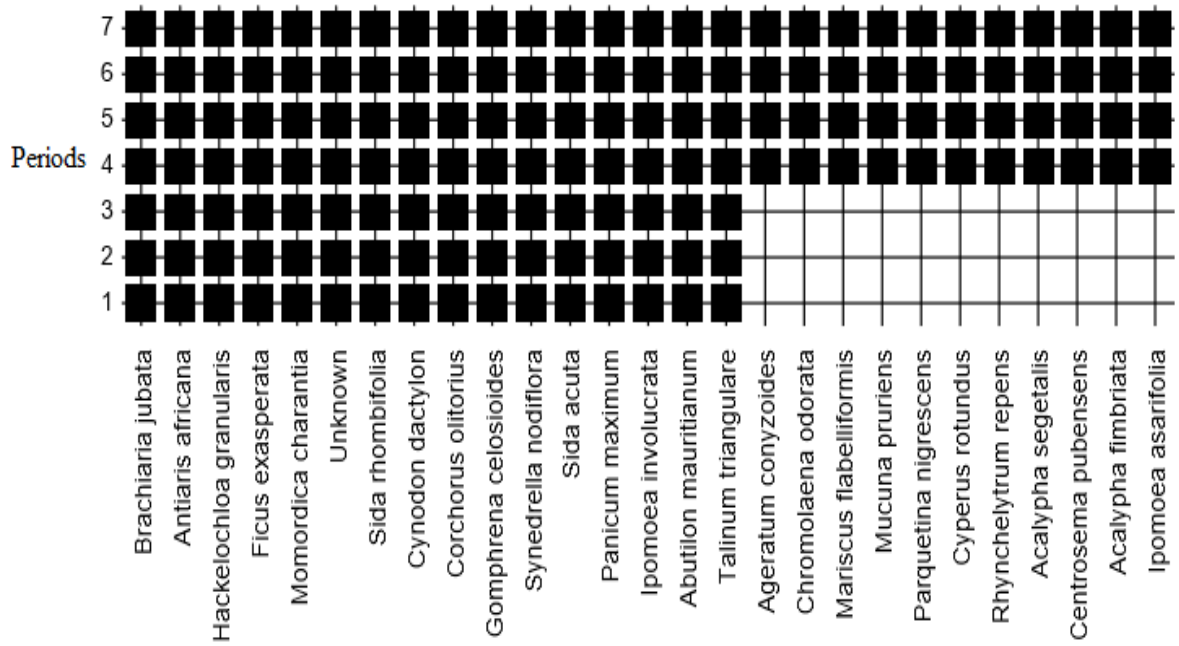


Figure 3: Plant species composition at the control plots

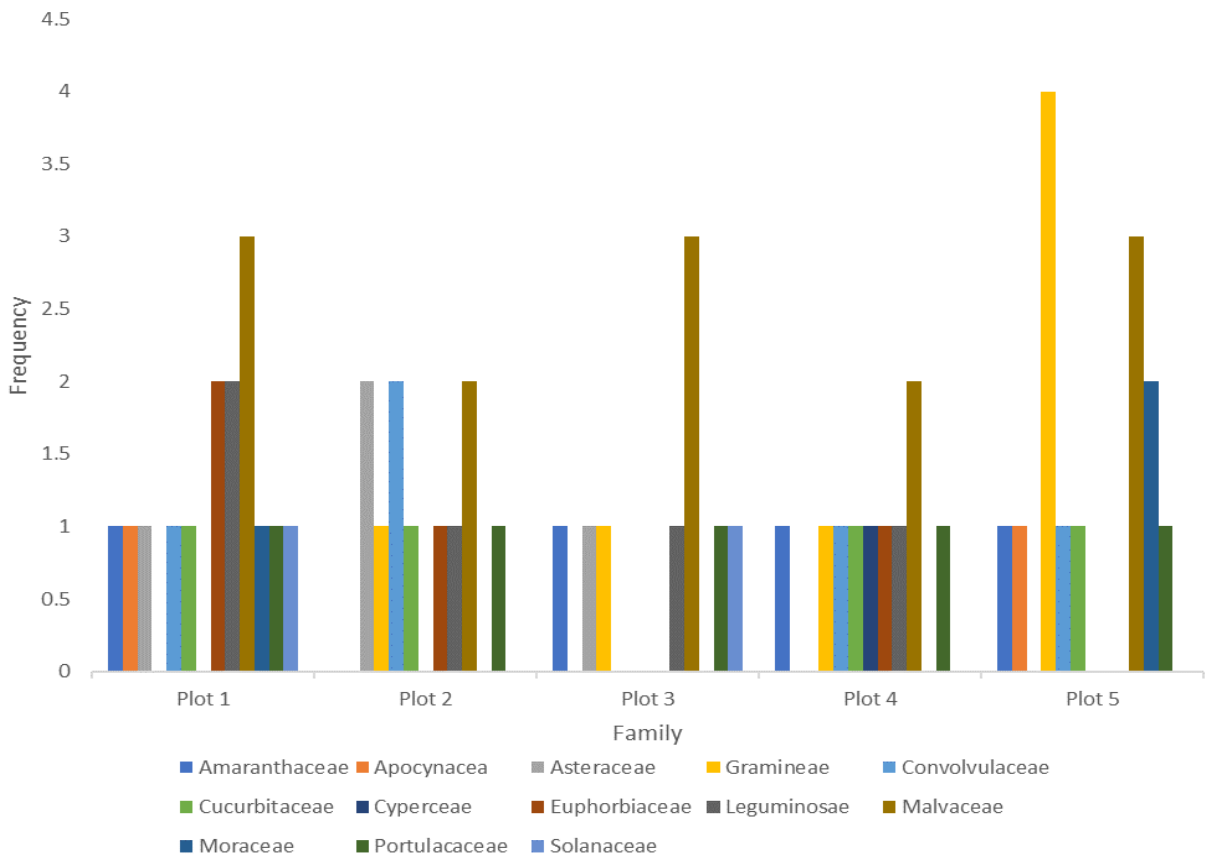


Figure 4: Family represented in all the plots before treatment application

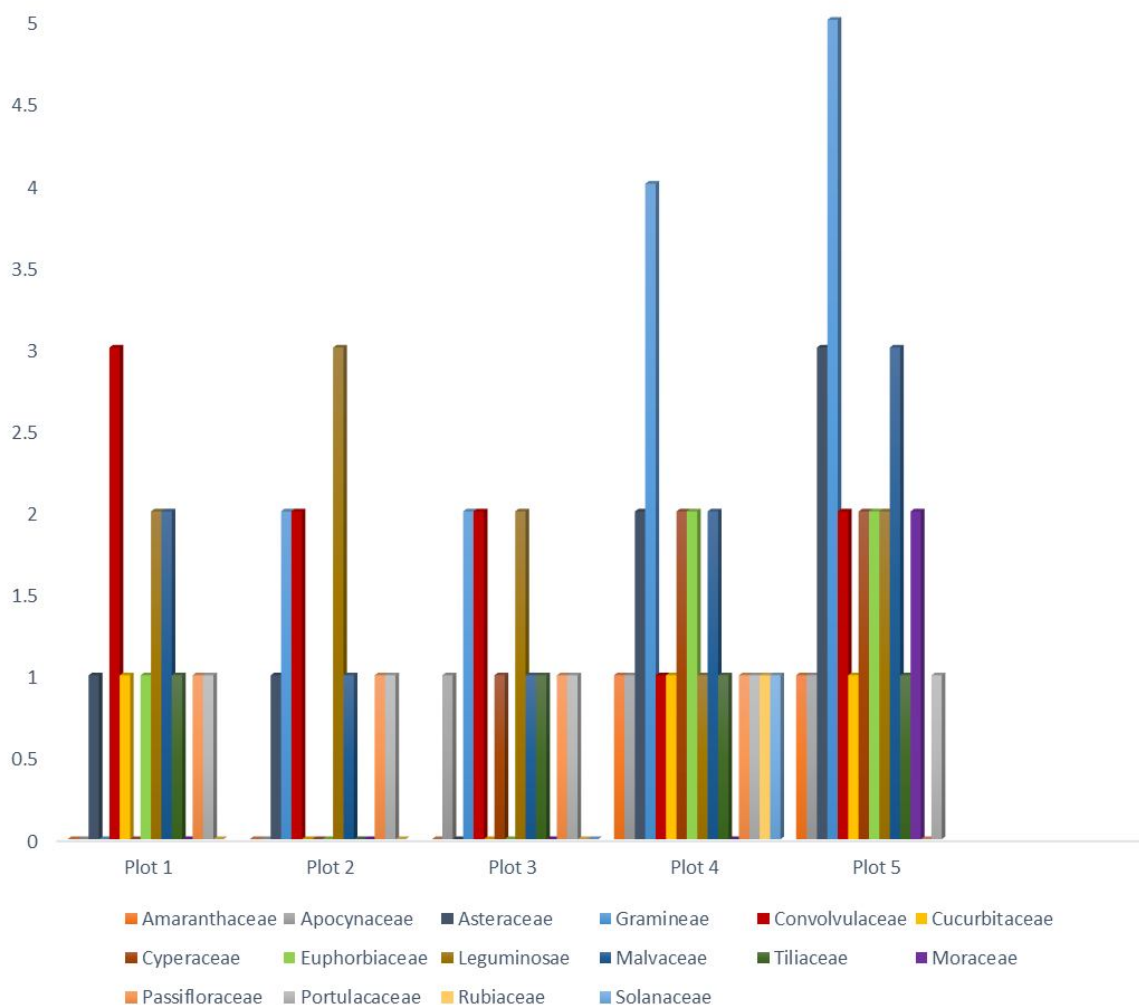


Figure 5: Family represented in all the plots after treatment application

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