Sahel Journal of Life Sciences FUDMA 4(1): 544-558, 2026

Sahel Journal of Life Sciences FUDMA (SAJOLS)
March 2026 Vol. 4(1): 544-558
ISSN: 3027-0456 (Print)
ISSN: 1595-5915 (Online)
DOI: https://doi.org/10.33003/sajols-2026-0401-60

Research Article

Impact of Canopy Suppression on the Eco-Taxonomic Structure of Weed Communities Associated with *Gliricidia sepium* in a University Campus in Benin City, Nigeria

***Gloria O. Omoregie[1]; Amina A. Amedu[2]; Esther Otoibhi[3], Godson A. Onophuri[3], Osazee E. Ohanmu[4], Emma Ossola[5], and Beckley Ikhajiagbe[3]**

[1]Department of Environmental Management and Toxicology, Federal Univ. of Petroleum Resources, Effunrun, Nigeria
[2]Department of Biological Sciences, Federal Polytechnic Offa, Kwara State, Nigeria
[3]Department of Plant Biology and Biotechnology, University of Benin, Benin City, Nigeria
[4]Department of Biological Sciences, Edo State University Iyamho, Nigeria
[5]Department of Environmental Systems Science, ETH Zurich
****Corresponding Author's email*: omoregie.gloria@fupre.edu.ng**

ABSTRACT
This study focuses on the use of *Gliricidia sepium*, where its canopy can suppress growth of weeds by preventing sun light. It seeks to understand how this affects weed diversity and composition for sustainability. The research aimed to investigate the impact of *G. sepium* on weed diversity in the built-up campus environment. Conservation sites and fields were surveyed, including the Department of Plant Biology and Biotechnology Botanical Garden, Bursary field, and Life Science Complex field. The study compared weed species in shaded (undisturbed) and unshaded (disturbed) environments under *G. sepium* canopy, and in open environments around the institution. Results showed that *Gliricidia sepium* morphometrics varied significantly by light environment. Trees in open areas achieved a higher average height of 8.5m compared to 7.62m for shaded trees. Conversely, shaded individuals demonstrated superior development in other metrics: a mean bole volume of 0.132m^3 (versus 0.093m^3) and a substantially larger canopy area of 50.72m^2 (versus 36.83m^2). This lateral expansion suggests adaptation for light capture. In distal zones 10m away, the ecosystem shifts toward sun-adapted species like *Paspalum dilatatum* (147 individuals) and *Asystasia gangentica*, confirming that the absence of canopy suppression allows light-demanding taxa to thrive. The results provide insights into the ecological dynamics of urban ecosystems and the role of introduced tree species in shaping plant community structure. The findings contribute to sustainable campus management practices, urban planning, and biodiversity conservation in tropical regions, offering valuable implications for ecologists, urban planners, and environmental managers seeking to optimize ecological benefits of urban green spaces.

Keywords: Allelopathy; Biodiversity conservation; Ecotaxonomy; *Gliricidia sepium*; Urban ecosystems; Weed diversity

Citation: Omoregie, G.O., Amedu, A.A., Otoibhi, E., Onophuri, G.A., Ohanmu, O.E., Ossola, E., & Ikhajiagbe, B. (2026). Impact of Canopy Suppression on the Eco-Taxonomic Structure of Weed Communities Associated with *Gliricidia sepium* in a University Campus in Benin City, Nigeria. *Sahel Journal of Life Sciences FUDMA*, 4(1): 544-558. DOI: https://doi.org/10.33003/sajols-2026-0401-60

INTRODUCTION

Gliricidia sepium is recognized for its ability to improve soil conditions through nitrogen fixation, with studies indicating that it can fix between 131 to 144 kg of nitrogen per hectare per year (Narendra and Pratiwi, 2016). This nitrogen-rich foliage not only enhances soil fertility but also contributes to the suppression of weed growth, making it a valuable component in agroforestry systems (Gunaratne *et al*., 2013; Narendra and Pratiwi, 2016). The interaction between *G. sepium* and the surrounding flora, particularly weeds, presents an intriguing area of study, as it may reveal insights into biodiversity dynamics within urbanized landscapes.

The ecological role of *G. sepium* extends beyond mere nitrogen fixation; it also influences soil moisture retention and temperature regulation, thereby creating a more favorable microenvironment for various plant species (Narendra and Pratiwi, 2016). The presence of this tree species can lead to changes in the composition and abundance of weed communities, as it may alter the competitive dynamics among plants. Previous research has shown that the introduction of leguminous species can significantly affect weed diversity and abundance, often leading to a reduction in the prevalence of certain invasive or aggressive weed species (Benaragama *et al*., 2019; González-Andújar *et al*., 2019). This is particularly relevant in the context of the University of Benin, where the built environment may be subject to various anthropogenic pressures that influence plant community dynamics.

The built-up campus environment of universities, particularly in tropical regions, presents a unique ecological setting where native and introduced plant species coexist. The study of weed diversity in relation to *G. sepium* is essential for understanding the ecological balance within the ecosystem of the university. Weeds are often viewed as undesirable plants; however, they play critical roles in maintaining ecological functions, such as providing habitat for various organisms and contributing to soil health (Ferrero *et al*., 2017; Bourgeois *et al*., 2019). The diversity of weed species can significantly impact agricultural productivity and ecosystem resilience, as diverse plant communities are generally more stable and better able to withstand environmental stressors (González-Andújar *et al*., 2019; Naeem *et al*., 2022). By assessing the weed diversity associated with *G. sepium*, this study aims to elucidate the ecological interactions that occurred within the study area.

G. sepium, a widely cultivated and naturalized tree species, is a common feature in many Nigerian universities, including the University of Benin, Benin City. As a leguminous tree, *G. sepium* has been valued for its shade provision, soil improvement, and ornamental purposes Elevitch, *et al.,* 2023. However, its impact on the surrounding plant community, particularly weed diversity, remains poorly understood. This study aims to investigate the ecotaxonomic relationships between *G. sepium* and associated plant species in the University of Benin campus, exploring how this tree influences weed diversity in the built-up environment.

The outcomes of the study will have practical implications for environmental management and policy-making. By identifying the ecological relationships between *G. sepium* and associated plant species, policymakers and urban planners can make informed decisions about tree planting and urban landscape design. Ultimately, this research will advance our understanding of tropical urban ecosystems, contributing to the development of more sustainable and eco-friendly cities in Nigeria and beyond.

MATERIALS AND METHODS

Site Selection and Survey

The study commenced with a reconnaissance survey of selected sites within the University of Benin, targeting areas with mature *Gliricidia sepium* trees. The selected sites included protected vegetations, such as botanical gardens, and frequently disturbed areas, including halls of residence, faculty orchards, and open fields. A total of 9 sites were identified, including the Botanical Garden at the Plant Biology and Biotechnology Department, Halls of Residence (Hall 7) field, and University Farm Project Site.

Site Characterization and Quadrat Sampling

The environments surrounding *G. sepium* trees were categorized as disturbed or undisturbed. Within each site, a 5 m radius around every *G. sepium* tree trunk was demarcated for vegetative composition analysis. A 1 m x 1 m quadrant was randomly used within this radius to identify and count the weed species present. A tree was selected for use only when the mean canopy radius was 4 m or when the estimated canopy area was at least 50 m^2.

Tree Morphometry

Morphometric measurements of *G. sepium* trees were recorded according to Ikhajiagbe *et al.* (2025), including tree height, girth, and canopy size. These measurements provided additional context for understanding the ecological relationships between *G. sepium* and associated weed species.

To measure the tree bole, diameter at Breast Height (DBH) at 1.3 m above ground level using a diameter tape was taken, and bole length from the ground to the first major branching. These measurements helped in calculating the bole volume, surface area, and other forest metrics, as follows:

Bole volume = π × (DBH/2)2 × bole length

Bole surface area = π × DBH × bole length.
Trunk Surface Area (A) = π × DBH × Height
To calculate canopy cover, the diameter of the canopy was measured in two perpendicular directions (east-west and north-south), which was followed the determination of the average diameter which was then used in the formula:
Canopy Cover = π × (Average Diameter/2)2

Data Collection and Analysis

Qualitative and quantitative data on weed species composition and abundance were collected within the designated quadrats. Ecological diversity indices, including species richness, evenness, and diversity, were calculated to assess the impact of *G. sepium* on weed diversity.

Data Documentation and Calculation

All data collected were documented and analyzed to identify patterns and relationships between *G. sepium* and associated weed species. The ecological diversity indices calculated provided insights into the effects of *G. sepium* on weed diversity and community structure, informing the study's conclusions and recommendations.

Data Analyses

Species count and frequency distribution was analyzed. The floral diversity analysis employed PAST software to calculate diversity indices, including Shannon-Wiener Index (H'), Simpson's Index (λ), Species Richness (S), and Evenness (E). This provided insights into the species composition and distribution within the study area. Descriptive statistics was calculated for *G. sepium* morphometrics, including Diameter at Breast Height (DBH), Height, Canopy Cover, and Trunk Surface Area.

RESULTS

The morphometric analysis of *Gliricidia sepium* in the botanical garden revealed distinct growth patterns between trees under the influence of shade and those growing in open areas (Table 1). Trees positioned outside the canopy of larger trees exhibited a higher average height of 8.5 m compared to 7.62 m for shaded individuals, although the maximum height recorded actually occurred in the shaded group (11.3 m at t11). Trees under the influence of shade demonstrated a superior mean bole volume of approximately 0.132 m^3, which was significantly higher than the 0.093 m^3 observed in open-area trees ($p<0.005$). This suggest that while competition for light may drive some shaded trees to reach greater vertical heights, it also correlates with a greater overall trunk biomass in this specific environment.

The horizontal development and surface metrics also show marked differences based on the atmospheric environment. Trees under the shade of larger canopies maintained a substantially larger average canopy covered area of 50.72 m2, nearly 38% larger than the 36.83 m^2 mean found in trees outside the canopy. This disparity is exemplified by tree t3 under shade, which achieved a massive covered area of 153.86 m^2, whereas the largest canopy in the open group was only 78.57 m^2 (t16). Similarly, the mean surface area was higher for shaded trees (6.73 m^2) than for those in open spaces (6.02 m^2), suggesting that the shaded microclimate may encourage wider lateral branching and greater foliar surface expansion to maximize light capture in low-light conditions.

The frequency of occurrence data for plants associated with *G. sepium* highlights a high level of species adaptability to open environments lacking both ground cover and tree canopy. Several species, including *Ageratum conyzoides*, *Amaranthus spinosus*, *Asystasia gangentica*, and *Sida acuta*, achieved a maximum frequency of 100% in the "No GS+No canopy" category. In contrast, species such as *Peperonia pellucida* showed a definitive preference for shaded conditions, recording a 100% frequency "under canopy" while dropping to 75% in open environments. This indicates that while many associated herbs and shrubs thrive in high-light, disturbed areas, others are ecologically dependent on the microclimate and shade provided by the *G. sepium* canopy.

The plant distribution within a 5 m radius of *G. sepium* trees under a large tree canopy was characterized by a high abundance of shade-tolerant herbaceous species (Table 2), with *Peperonia pellucida* emerging as the most consistent associate with a 100% frequency of occurrence across all sampled trees. *Synedrella nodiflora* recorded the highest individual count with 191 individuals, while *Asystasia gangentica* and *Peperonia pellucida* followed with 145 individuals each, reflecting their strong ecological affinity for the moist, sheltered microclimate provided by the dual canopy. The community is predominantly comprised of herbs and shrubs from families such as Asteraceae, Poaceae, and Acanthaceae, with a mix of annual and perennial life cycles. Statistical variations across individual trees like t3 and t4—which hosted large populations of *Synedrella nodiflora*—suggest that specific tree morphometrics, such as the large covered areas of 153.86 m^2 and 50.24 $m^{2,}$ respectively, may play a significant role in determining the density of the understory flora.

Table 1: Tree morphometrics of *Gliricidia sepium* in the botanical garden under the influence of shade from larger trees in the Botanical garden

Tree identity	Girth at 30cm above soil (m)	Diameter at breast height, DBH (m)	Bole length (m)	height (m)	Bole surface area (m^2)	Bole volume (m^3)	Estimated canopy radius (m)	Covered area (m^2)
Tree under the influence of shade from larger trees in the Botanical garden								
t1	0.77	0.245	1.6	5.2	4.007	0.076	4.03	50.24
t2	1	0.318	1.4	4.8	4.803	0.112	2.01	12.56
t3	0.9	0.287	2.3	10.3	9.276	0.148	7.02	153.86
t4	0.87	0.277	3.3	8.89	7.739	0.199	4.01	50.24
t5	0.91	0.29	1.8	4.1	3.733	0.119	3.03	28.26
t6	0.5	0.159	1.4	6.5	3.252	0.028	4.05	51.77
t7	0.11	0.035	2.3	4.5	0.495	0.002	2.11	14.19
t8	1.1	0.35	1.4	6.8	7.485	0.135	3.02	28.26
t9	1.3	0.414	2.3	9.2	11.968	0.31	1.51	7.28
t10	0.9	0.287	2.4	10.2	9.186	0.155	3.51	38.47
t11	0.89	0.287	1.8	11.3	10.19	0.116	5.51	94.99
t12	0.9	0.287	2.8	9.6	8.646	0.181	5.01	78.5
Tree distinct and outside other tree canopies in the Botanical garden								
t13	1.16	0.369	1.4	6.8	7.893	0.15	2.13	13.82
t14	0.22	0.07	2.3	4.7	1.035	0.009	1.53	7.42
t15	0.63	0.201	2.4	6.3	3.972	0.076	3.02	28.26
t16	1.2	0.382	2.3	10.2	12.248	0.264	5.03	78.57
t17	0.81	0.258	1.4	9.6	7.781	0.073	1.21	3.89
t18	0.9	0.287	1.8	10.3	9.276	0.116	4.02	50.55
t19	0.48	0.153	2.7	8.4	4.035	0.05	3.05	28.26
t20	0.76	0.242	2.3	6.7	5.095	0.106	3.08	29.31
t21	0.4	0.127	3.3	10.2	4.083	0.042	4.14	51.23
t22	0.56	0.178	2.8	10.8	6.052	0.07	4.53	63.59
t23	0.5	0.159	3.3	9.5	4.753	0.066	4.13	50.24

DBH = diameter at breast height of 1.3 m

Table 2: Frequency of occurrence of plants associated with *G. sepium* in the open environment (i.e. selected open areas not within the confines of the botanical garden

Species	Family	Habit	Life cycle	Frequency of occurrence (%)		
				under canopy+GS	No canopy+GS	No GS+No canopy
Ageratum conyzoides	Asteraceae	Herb	Annual	50.0	40.0	100.0
Ageratum nonstoncanum	Asteraceae	Herb	Annual	16.7	0.0	25.0
Altermantaera brasilliana	Amaranthaceae	Herb	Perennial	66.7	40.0	75.0
Amaranthus spinosus	Amaranthaceae	Herb	Annual	50.0	40.0	100.0
Arthraxon hispidus	Poaceae	Herb	Annual	33.3	20.0	75.0
Asystasia gangentica	Acanthaceae	Herb	Perennial	83.3	100.0	100.0
Baulninia purpurea	Fabaceae	Shrub	Perennial	50.0	0.0	25.0
Carmelina erecta	Commelinaceae	Herb	Perennial	0.0	20.0	25.0
Cestrum nocturnum	Solanaceae	Shrub	Perennial	0.0	20.0	0.0
Clerodendrum paniculatum	Lamiaceae	Shrub	Perennial	50.0	20.0	50.0
Coccinea grandis	Cucurbitaceae	Herb (Climber)	Perennial	50.0	0.0	25.0
Commelina erecta	Commelinaceae	Herb	Perennial	0.0	20.0	50.0
Cyperus esculentus	Cyperaceae	Herb	Perennial	16.7	20.0	75.0
Cyperus rotundus	Cyperaceae	Herb	Perennial	33.3	80.0	50.0
Desmodium tortuosum	Fabaceae	Herb/ Shrub	Annual/ Perennial	16.7	20.0	75.0
Dioscorea commis	Dioscoreaceae	Herb (Climber)	Perennial	0.0	20.0	50.0
Elaeis guineensis	Arecaceae	Tree	Perennial	0.0	20.0	25.0
Galinsoga quadriradiata	Asteraceae	Herb	Annual	33.3	20.0	75.0
Ipomoea setifera	Convolvulaceae	Herb (Climber)	Perennial	16.7	20.0	75.0
Ipomoea purpurea	Convolvulaceae	Herb (Climber)	Annual	0.0	20.0	50.0
Merremia tuberosa	Convolvulaceae	Herb (Climber)	Perennial	0.0	20.0	25.0
Panicum maximum	Poaceae	Herb	Perennial	33.3	20.0	75.0
Paspalum scrobiculatum	Poaceae	Herb	Perennial	50.0	0.0	50.0
Paspalum dilatatum	Poaceae	Shrub	Perennial	33.3	20.0	75.0
Peperomia pellucida	Piperaceae	Herb	Annual	100.0	40.0	75.0
Petiveria alliacea	Phytolaccaceae	Herb	Perennial	16.7	0.0	50.0
Physalis philadelphica	Solanaceae	Herb	Annual	50.0	20.0	75.0
Pueraria montana	Fabaceae	Herb (Climber)	Perennial	33.3	20.0	75.0
Parthenium hysterophorus	Asteraceae	Herb	Annual	16.7	20.0	50.0
Setaria palmifolia	Poaceae	Herb	Perennial	33.3	20.0	0.0
Setaria barbata	Poaceae	Herb	Annual	33.3	40.0	75.0
Sida acuta	Asteraceae	Herb	Perennial	50.0	40.0	100.0
Sida rhombifolia	Malvaceae	Shrub	Perennial	50.0	0.0	50.0
Synedrella nodiflora	Asteraceae	Herb	Annual	83.3	60.0	75.0
Syngonium podophyllum	Araceae	Shrub	Perennial	50.0	40.0	75.0
Talinum triangulare	Talinaceae	Herb	Perennial	66.7	40.0	75.0
Thunbergia species	Acanthaceae	Shrub	Perennial	33.3	20.0	50.0
Tradescantia fluminensis	Commelinaceae	Herb	Perennial	50.0	40.0	75.0
Unidentified 01	Unknown	Herb	Perennial	50.0	20.0	75.0
Unidentified 02	Unknown	Herb	Perennial	66.7	0.0	75.0
Vepris trichocarpa	Rutaceae	Shrub	Perennial	16.7	40.0	50.0

Unidentified 01 are dicots and Unidentified 02 are monocots

Table 3: Plant distribution within a 5 m radius around *G. sepium* under a large tree canopy in the botanical garden

Species	t1	t3	t4	t6	t11	t12	Total species (N)	*Average plant species per location	Freq. of occurrence (%)
Ageratum conyzoides	0	10	4	0	2	0	16	3	50.0
Ageratum nonstoncanum	0	0	0	0	0	16	16	3	16.7
Altermantaera brasilliana	0	5	20	6	4	0	35	6	66.7
Amaranthus spinosus	22	0	3	0	12	0	37	6	50.0
Arthraxon hispidus	0	0	0	4	6	0	10	2	33.3
Asystasia gangentica	70	11	0	2	17	45	145	24	83.3
Baulninia purpurea	0	1	0	1	0	2	4	1	50.0
Carmelina erecta	0	0	0	0	0	0	0	0	0.0
Cestrnum nocturnum	0	0	0	0	0	0	0	0	0.0
Clerodendrum paniculatum	0	0	2	2	0	30	34	6	50.0
Coccinea grandis	0	1	0	1	0	3	5	1	50.0
Commelina erecta	0	0	0	0	0	0	0	0	0.0
Cyperus esculentus	0	2	0	0	0	0	2	0	16.7
Cyperus rotundus	1	0	0	0	1	0	2	0	33.3
Desnodium tortuosum	0	3	0	0	0	0	3	1	16.7
Dioscorca commis	0	0	0	0	0	0	0	0	0.0
Elaesis guineensis	0	0	0	0	0	0	0	0	0.0
Galonsoga quadriradiata	0	2	0	0	12	0	14	2	33.3
Ipoea setifera	0	4	0	0	0	0	4	1	16.7
Ipomea purpurea	0	0	0	0	0	0	0	0	0.0
Merremta tuberosa	0	0	0	0	0	0	0	0	0.0
Panicum maximum	0	2	1	0	0	0	3	1	33.3
Paspalum scrobiculatum	0	0	2	1	3	0	6	1	50.0
Paspalum dilatatum ?	0	0	0	1	3	0	4	1	33.3
Peperonia pelucida	23	11	34	5	26	46	145	24	100.0
Petireria alliacea ?	0	0	2	0	0	0	2	0	16.7
Physalis phyladelphica	0	2	0	1	4	0	7	1	50.0
Pueraria motana	0	6	6	0	0	0	12	2	33.3
Rarthentum hysterophones	0	0	0	0	1	0	1	0	16.7
Setarna palmiflora	3	0	0	1	0	0	4	1	33.3
Seteria babata	0	32	0	0	7	0	39	7	33.3
Sida acuta	4	40	0	9	0	0	53	9	50.0
Sida rhombifolia	0	0	15	4	3	0	22	4	50.0
Synedrella nodiflora	2	30	150	5	4	0	191	32	83.3
Syngonium palophyllum	0	14	0	4	7	0	25	4	50.0
Talium trangolare	50	0	0	9	3	30	92	15	66.7
Thunbergia species	0	0	0	1	7	0	8	1	33.3
Tradescantia fluminensis	0	0	11	9	3	0	23	4	50.0
Unidentified 01	0	60	0	22	10	0	92	15	50.0
Unidentified 02	10	0	0	3	2	2	17	3	66.7
Vepris trichocarpa	0	0	0	0	1	0	1	0	16.7

** = Rounded off to the nearest integer; Unidentified 01 are dicots and Unidentified 02 are monocots

The floral distribution around distinct *G. sepium* stands growing in open environments shows a high prevalence of specific opportunistic species, with *Asystasia gangentica* achieving a 100% frequency of occurrence across all sampled tree stands (t16, t18, t21, t22, and t23). Other species with significant presence include Cyperus rotundus (80% frequency) and *Synedrella nodiflora* (60% frequency). In terms of absolute abundance, *Paspalum dilatatum* recorded the highest individual count at a single site with 100 individuals around tree t21, while Asystasia gangentica maintained a high total count of 91 individuals distributed across the entire study area. These values indicate that in the absence of a secondary large tree canopy, the environment favors sun-tolerant species that can effectively colonize open ground around the *G. sepium* stands.

The community is dominated by herbs and shrubs exhibiting a mix of annual and perennial life cycles. For instance, annual herbs such as *Galinsoga quadriradiata* (70 individuals at t21) and *Physalis philadelphica* (50 individuals at t22) show localized bursts of high density. In contrast, perennial herbs like *Talinum triangulare* and *Tradescantia fluminensis* maintain more moderate but steady populations across multiple sites, with total counts of 62 and 35 individuals, respectively. The presence of climbers such as *Ipomoea setifera* (totaling 52 individuals) suggests that distinct *G. sepium* stands serve as vital structural supports for vertical growth within the otherwise open campus landscape.

The plant distribution recorded 10 meters from the *G. sepium* canopy (Table 5) reveals a distinct shift toward resilient, sun-adapted species that dominate open spaces. *Asystasia gangetica*, *Ageratum conyzoides*, *Amaranthus spinosus*, and *Sida acuta* each achieved a 100% frequency of occurrence in these distal zones, highlighting their robust ability to colonize areas lacking the tree's direct microclimatic influence. Regarding total abundance, *Paspalum dilatatum* recorded the highest count with 147 individuals, followed by *Peperomia pellucida* with 102 individuals. Additionally, two prominent unidentified species groups (consisting of 60 and 98 individuals, respectively) indicate a high density of ground cover across these open campus areas (Table 5). Structurally, the vegetation at this distance is defined by a blend of annual and perennial growth habits, featuring a significant number of opportunistic herbs. For instance, *Galinsoga quadriradiata* and *Panicum maximum* showed high localized counts of 88 and 78 individuals, respectively. In contrast, specialized species like *Dioscorea commis* and *Elaeis guineensis* remained rare, with only 1 to 2 individuals found. This pattern confirms that moving beyond the *G. sepium* shade facilitates the proliferation of diverse, light-demanding taxa—particularly within the Poaceae and Asteraceae families—which thrive in the absence of canopy suppression.

Table 4: Floristic composition and plant distribution within a 5 m radius of isolated *G. sepium* stands.

Species	t16	t18	t21	t22	t23	Total species (N)	*Average plant species per location	Freq. of occurrence (%)
Ageratum conyzoides	10	0	3	0	0	13	3	40.0
Ageratum nonstoncanum	0	0	0	0	0	0	0	0.0
Altermantaera brasilliana	12	25	0	0	0	37	7	40.0
Amaranthus spinosus	0	0	40	0	6	46	9	40.0
Arthraxon hispidus	0	0	35	0	0	35	7	20.0
Asystasia gangentica	30	40	6	5	10	91	18	100.0
Baulninia purpurea	0	0	0	0	0	0	0	0.0
Carmelina erecta	0	0	0	5	0	5	1	20.0
Cestrnum nocturnum	0	0	0	2	0	2	0	20.0
Clerodendrum paniculatum	0	0	4	0	0	4	1	20.0
Coccinea grandis	0	0	0	0	0	0	0	0.0
Commelina erecta	0	10	0	0	0	10	2	20.0
Cyperus esculentus	0	0	15	0	0	15	3	20.0
Cyperus rotundus	1	12	2	2	0	17	3	80.0
Desnodium tortuosum	30	0	0	0	0	30	6	20.0
Dioscorca commis	0	0	0	1	0	1	0	20.0
Elaesis guineensis	0	0	0	5	0	5	1	20.0
Galonsoga quadriradiata	0	0	70	0	0	70	14	20.0
Ipoea setifera	52	0	0	0	0	52	10	20.0
Ipomea purpurea	0	5	0	0	0	5	1	20.0
Merremta tuberosa	0	5	0	0	0	5	1	20.0
Panicum maximum	66	0	0	0	0	66	13	20.0
Paspalum scrobiculatum	0	0	0	0	0	0	0	0.0
Paspalum dilatatum ?	0	0	100	0	0	100	20	20.0
Peperonia pelucida	0	12	0	0	30	42	8	40.0
Petireria alliacea ?	0	0	0	0	0	0	0	0.0
Physalis phyladelphica	0	0	0	50	0	50	10	20.0
Pueraria motana	60	0	0	0	0	60	12	20.0
Rarthentum hysterophones	0	0	3	0	0	3	1	20.0
Setarna palmiflora	0	0	0	0	1	1	0	20.0
Seteria babata	32	0	0	12	0	44	9	40.0
Sida acuta	40	0	15	0	0	55	11	40.0
Sida rhombifolia	0	0	0	0	0	0	0	0.0
Synedrella nodiflora	30	43	0	24	0	97	19	60.0
Syngonium palophyllum	14	0	0	30	0	44	9	40.0
Talium trangolare	0	50	0	0	12	62	12	40.0
Thunbergia species	0	0	0	0	40	40	8	20.0
Tradescantia fluminensis	0	30	0	5	0	35	7	40.0
Unidentified 01	60	0	0	0	0	60	12	20.0
Unidentified 02	0	0	0	0	0	0	0	0.0
Vepris trichocarpa	0	0	2	0	1	3	1	40.0

**Rounded off to the nearest integer; Unidentified 01 are dicots and Unidentified 02 are monocots*

Table 5: Floristic distribution and species abundance recorded 10 meters beyond the *G. sepium* canopy.

Species	**o-1**	**o-2**	**o-3**	**o-4**	**Total species (N)**	***Average plant species per location**	Freq. of occurrence (%)
Ageratum conyzoides	11	3	3	4	21	5	100.0
Ageratum nonstoncanum	0	1	0	0	1	0	25.0
Altermantaera brasilliana	14	6	0	7	27	7	75.0
Amaranthus spinosus	11	6	40	9	66	17	100.0
Arthraxon hispidus	0	10	35	8	53	13	75.0
Asystasia gangentica	11	6	6	6	29	7	100.0
Baulninia purpurea	0	1	0	0	1	0	25.0
Carmelina erecta	0	0	0	1	1	0	25.0
Cestrnum nocturnum	0	0	0	0	0	0	0.0
Clerodendrum paniculatum	0	0	4	1	5	1	50.0
Coccinea grandis	2	0	0	0	2	1	25.0
Commelina erecta	0	3	0	1	4	1	50.0
Cyperus esculentus	0	2	15	3	20	5	75.0
Cyperus rotundus	0	1	0	3	4	1	50.0
Desnodium tortuosum	11	6	0	3	20	5	75.0
Dioscorca commis	1	0	0	1	2	1	50.0
Elaesis guineensis	0	0	0	1	1	0	25.0
Galonsoga quadriradiata	0	5	70	13	88	22	75.0
Ipomea setifera	24	8	0	5	37	9	75.0
Ipomea purpurea	0	4	0	1	5	1	50.0
Merremta tuberosa	0	1	0	0	1	0	25.0
Panicum maximum	66	1	0	11	78	20	75.0
Paspalum scrobiculatum	0	19	0	15	34	9	50.0
Paspalum dilatatum ?	0	26	100	21	147	37	75.0
Peperonia pelucida	23	46	0	33	102	26	75.0
Petireria alliacea ?	0	2	0	1	3	1	50.0
Physalis phyladelphica	11	14	0	13	38	10	75.0
Pueraria motana	12	1	0	2	15	4	75.0
Rarthentum hysterophones	0	0	3	1	4	1	50.0
Setarna palmiflora	0	0	0	0	0	0	0.0
Seteria babata	21	4	0	6	31	8	75.0
Sida acuta	13	11	15	7	46	12	100.0
Sida rhombifolia	0	5	0	3	8	2	50.0
Synedrella nodiflora	16	31	0	37	84	21	75.0
Syngonium palophyllum	14	9	0	9	32	8	75.0
Talium trangolare	18	23	0	9	50	13	75.0
Thunbergia species	0	2	0	7	9	2	50.0
Tradescantia fluminensis	1	3	0	3	7	2	75.0
Unidentified 01	60	24	0	14	98	25	75.0
Unidentified 02	11	8	0	3	22	6	75.0
Vepris trichocarpa	0	0	2	1	3	1	50.0

**Rounded off to the nearest integer; Unidentified 01 are dicots and Unidentified 02 are monocots*

The diversity indices provided in Table 6 highlight significant variations in plant community structure between the immediate vicinity of *Gliricidia sepium* trees and the surrounding open fields. In the zones within a 5m radius of the trees, taxa richness (Taxa S) peaked at 22 species for tree t11 (under canopy) and reached a high of 13 species for tree t16 (distinct stand), with Shannon diversity (Shannon H) values ranging from 1.43 to 2.73. In contrast, the open fields (o-1 to o-4) exhibited generally higher biodiversity levels, with species richness reaching up to 35 taxa in region o-4 and Shannon diversity scores as high as 3.08. This indicates that while the *G. sepium* canopy creates a specialized niche for certain plants, the open fields support a more diverse and expansive array of species that are not constrained by the microclimatic or competitive effects of the tree canopy.

Comparative analysis of dominance and evenness further illustrates these ecological differences across the sampling regions. Dominance was highest around tree t4 (0.39), where a lower Shannon diversity of 1.43 suggested a community heavily skewed toward a few successful species, such as *Synedrella nodiflora*. Conversely, the open fields showed much lower dominance (as low as 0.06) and higher evenness scores, reflected by Equitability values reaching 0.87 to 0.88. These high evenness and Shannon indices in the open fields suggest a stable and well-distributed plant community, whereas the sampling regions closer to the *G. sepium* stands show more variable levels of complexity, likely influenced by the specific physical morphometrics and shade density of individual trees.

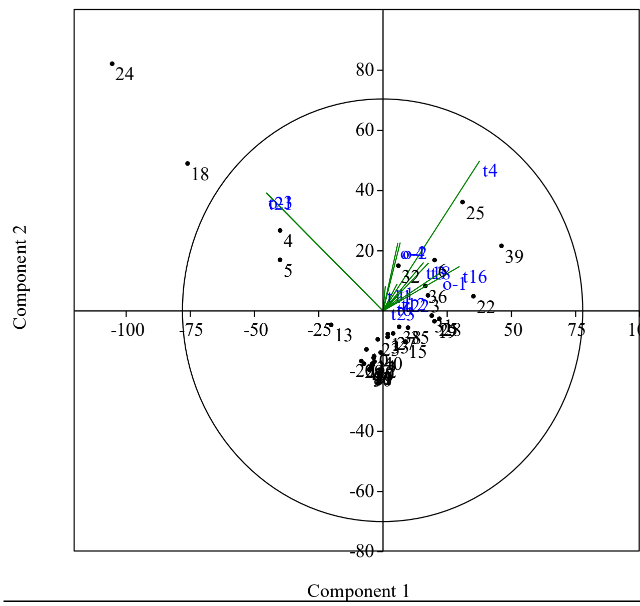
The Principal Component Analysis (PCA) biplots in Figures 1 and 2 collectively demonstrate that while most sampling sites share a core group of generalist species, the specific growth environment of *G. sepium* significantly drives floral community divergence. Figure 1 reveals that shaded sites (t1–t12) and distinct stands (t13–t23) are differentiated by their unique species associations, such as the strong link between shaded locations and species 24 (*Peperomia pellucida*), which thrives in the microclimatic stability of the botanical garden. Figure 2 reinforces this by showing that sites like t4 and t21 act as ecological outliers, pulled along divergent vectors due to high localized abundances of species like 25 (*Petiveria alliacea*) and 18 (*Galinsoga quadriradiata*). Together, these figures indicate that the open fields (o-1–o-4) maintain a broader, more even diversity, whereas the *G. sepium* trees—particularly those under a large canopy—function as specialized filters that foster distinct understory clusters not found in the wider campus landscape.

The Principal Component Analysis (PCA) biplot in Figure 2 provides a visual representation of the ecological relationships and species associations across the various sampling locations at the University of Benin campus. The plot effectively clusters sampling sites—represented by blue labels such as t1–t12 (shaded), t16–t23 (distinct), and o-1–o-4 (open fields)—based on the similarity of their floral composition. Most sampling locations are tightly clustered near the origin, indicating a shared core group of common species. However, specific sites like t4 and t21 are pulled along divergent vectors (green lines), suggesting that these particular trees host unique plant communities or exhibit significantly higher abundances of certain "outlier" species compared to the rest of the study area.

The black numbered points represent individual plant species, and their distance from the origin indicates their influence on the variance of the data. For instance, species 24 (*Peperonia pellucida*) and 18 (*Galinsoga quadriradiata*) are positioned far in the upper-left quadrant, showing a strong association with the environmental gradients defined by Component 2. Similarly, species 39 (*Unidentified 01*) and 25 (*Petiveria alliacea*) are associated with the rightward pull of Component 1. This spatial distribution confirms that while many plants are ubiquitous across the campus, the microclimates created by different *G. sepium* growth forms—whether heavily shaded or distinct—drive specific taxonomic associations that differentiate these ecological niches.

Table 6: Diversity indices for plant species around sampling regions

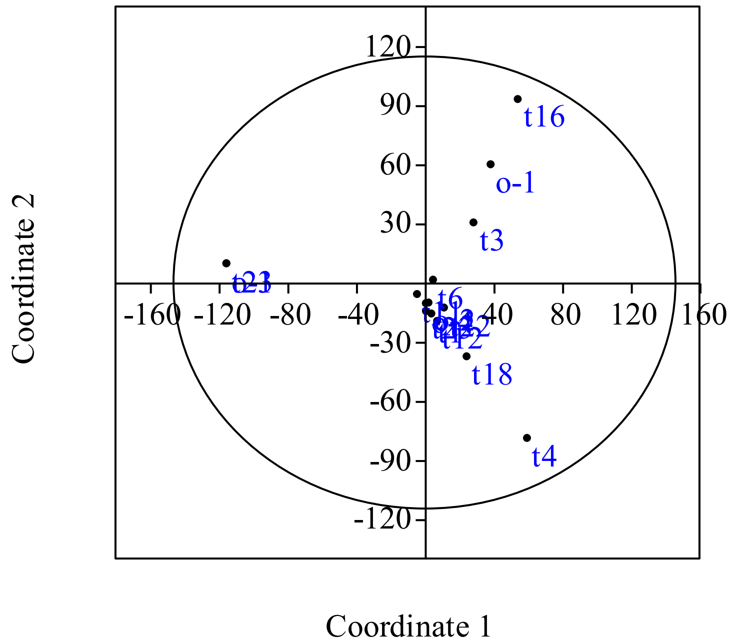
Parameters	Around 5m rad. of *G. sepium* tree											In open fields			
	t1	t3	t4	t6	t11	t12	t16	t18	t21	t22	t23	o-1	o-2	o-3	o-4
Taxa S	9	18	12	20	22	8	13	10	12	11	7	20	32	11	35
Individuals	185	236	250	91	138	174	437	232	295	141	100	351	292	293	263
Dominance D	0.25	0.14	0.39	0.11	0.09	0.21	0.10	0.15	0.21	0.21	0.28	0.09	0.07	0.21	0.06
Simpson 1-D	0.75	0.86	0.61	0.89	0.91	0.79	0.90	0.85	0.79	0.79	0.72	0.91	0.93	0.79	0.94
Shannon H	1.62	2.28	1.43	2.57	2.73	1.70	2.36	2.06	1.83	1.84	1.47	2.65	2.95	1.81	3.08
Evenness eH/S	0.56	0.54	0.35	0.65	0.70	0.68	0.81	0.78	0.52	0.57	0.62	0.71	0.60	0.55	0.62
Brillouin	1.54	2.15	1.36	2.27	2.49	1.62	2.29	1.97	1.76	1.71	1.37	2.54	2.77	1.74	2.87
Menhinick	0.66	1.17	0.76	2.10	1.87	0.61	0.62	0.66	0.70	0.93	0.70	1.07	1.87	0.64	2.16
Margalef	1.53	3.11	1.99	4.21	4.26	1.36	1.97	1.65	1.93	2.02	1.30	3.24	5.46	1.76	6.10
Equitability J	0.74	0.79	0.58	0.86	0.88	0.82	0.92	0.89	0.74	0.77	0.76	0.88	0.85	0.75	0.87
Fisher alpha	1.98	4.53	2.63	7.92	7.38	1.73	2.52	2.13	2.51	2.79	1.71	4.60	9.16	2.26	10.84
Berger-Parker	0.38	0.25	0.60	0.24	0.19	0.26	0.15	0.22	0.34	0.35	0.40	0.19	0.16	0.34	0.14



Code	Species				
1	*Ageratum conyzoides*	14	*Cyperus rotundus*	28	*Pueraria motana*
1	*Ageratum conyzoides*	15	*Desnodium tortuosum*	29	*Rarthentum hysterophones*
2	*Ageratum nonstoncanum*	16	*Dioscorca commis*	30	*Setarna palmiflora*
3	*Altermantaera brasilliana*	17	*Elaesis guineensis*	31	*Seteria babata*
4	*Amaranthus spinosus*	18	*Galonsoga quadriradiata*	32	*Sida acuta*
5	*Arthraxon hispidus*	19	*Ipoea setifera*	33	*Sida rhombifolia*
6	*Asystasia gangentica*	20	*Ipomea purpurea*	34	*Synedrella nodiflora*
7	*Baulninia purpurea*	21	*Merremta tuberosa*	35	*Syngonium palophyllum*
8	*Carmelina erecta*	22	*Panicum maximum*	36	*Talium trangolare*
9	*Cestrnum nocturnum*	23	*Paspalum scrobiculatum*	37	*Thunbergia species*
10	*Clerodendrum paniculatum*	24	*Paspalum dilatatum ?*	38	*Tradescantia fluminensis*
11	*Coccinea grandis*	25	*Peperonia pelucida*	39	*Unidentified 01*
12	*Commelina erecta*	26	*Petireria alliacea ?*	40	*Unidentified 02*
13	*Cyperus esculentus*	27	*Physalis phyladelphica*	41	*Vepris trichocarpa*

t1,3,4,6,11&12 - trees influenced by shade in the Botanical garden
t16,18,21,22 &23 - trees district and separated from any shade influence
o-1,2,3&4 - open locations with no tree

Figure 1: Biplot of principal components showing the relationship between species composition and the sampled *G. sepium* stands across different environments



t1,3,4,6,11&12 - trees influenced by shade in the Botanical garden
t16,18,21,22,&23 - trees distict and separated from any shade influence
o-1,2,3&4 - open locations with no tree

Figure 2: Principal component biplot showing association among the sampling locations

(a) (b) (c)

Plate 1: (a) and (b) *G. sepium* leaves (c) *G. sepium flower.*

(a) (b) (c)

Plate 3: Assessment of diverse weed species in the Botanic Garden

DISCUSSION

Results showed that the most prevalent species growing under *G. sepium* was *Asystasia gangetica* (Acanthaceae), while *Talinum triangulare* (Portulacaceae) was the second most prevalent. *Asystasia gangetica* is a procumbent and attractive herbaceous ground cover that can reach a height of 30–60cm and is found throughout tropical Asia to Africa, particularly Nigeria (Lithudzha, 2004; GRIN 2007). Due to its strong tolerance for shade and low soil fertility, it can dominate significant areas (Samedani *et al*., 2018). It offers numerous therapeutic, dietary, and cultural benefits, including usage as fodder (Adetula, 2004), with a crude protein concentration reaching 25.5% (Norlindawati *et al*., 2019), which can be higher in the dry season (Adjorlolo *et al*. 2014). Other desirable characteristics include high mineral concentrations (Khalil *et al*., 2018) and excellent animal palatability for broilers and ruminants (Sobayo *et al*. 2012; Wigati *et al*. 2016). However, it is also considered an invasive species from the Acanthaceae family (Yulia *et al*., 2022).

The second most prevalent species, *Talinum triangulare* (waterleaf), is an herbaceous annual and perennial plant with a broad cosmopolitan distribution. Native to tropical Africa, it is cultivated for medicinal (Agbono *et al*., 2010) and culinary purposes (Ifon and Bassir, 1979; Fasuyi, 2007) and is one of the most widely consumed vegetables in southeastern Nigeria (van Epenhuijesen, 1974). Now classified in the family Talinaceae—formerly Portulacaceae (Brilhaus *et al*. 2016)—it is often considered a weed in some parts of Nigeria when found growing amidst grasses, though it is a potential vegetable (Schippers, 2000). It is best recognized by its triangular peduncle and has various indigenous names: 'gbure' (Yoruba), 'mgborodi' (Igbo), 'Ebologie' (Southern Delta), 'bologi' (Sierra Leone), and 'elok-sup' (Cameroon) (Schippers, 2000). It is well adapted to areas near rivers and is found in both wild and domesticated states in Southern Nigeria (Williams *et al*., 1991).

The Acanthaceae were the most dominant plant family present. This family consists primarily of annual and perennial herbs, shrubs, under-shrubs, and climbers, characterized by simple, opposite decussate leaves and round to quadrangular stems. Their flowers are often borne in racemes or spikes with colorful bracts, and the fruit is frequently a dehiscent loculicidal capsule. Ecologically, they are significant as pollinators for butterflies, bees, and birds, and can be used as bio-indicators for plant communities. The etymology "Acan" means "it washes," referring to the oil in the leaves used for laundry.

Shade plays a major role in plant development, as evidenced by the difference in distribution under *G. sepium*. In shaded (undisturbed) environments, there were fourteen plant species with a total occurrence of about 355. In contrast, unshaded (disturbed) environments beneath *G. sepium* hosted twenty-four species with a total occurrence of about 809. The unshaded environment experienced a higher rate of biodiversity compared to the shaded environment. Furthermore, while some weeds thrived under the canopy, popular species found around the institution—such as *Alternanthera brasilliana*, *Galinsoga quadriradiata*, *Vepris trichocarpa*, and *Parthenium hysterophorus*—were missing or poorly represented beneath *G. sepium*. Factors influencing this include allelopathy, where secondary metabolites like phenols affect neighboring plants

(Harborne 1977; Li *et al*., 2010), and poor lighting conditions (Rauha *et al*. 2000).

Ultimately, *G. sepium* greatly influences biodiversity by enhancing ecosystem richness and stabilizing ecosystem services. In agroforestry, it adds organic matter to the soil through fallen leaves, releasing nutrients such as N, K, Ca, and Mg during decomposition. Its deep-rooted structure prevents erosion and recycles nutrients from lower depths. Additionally, it fixes atmospheric nitrogen, generates approximately 30 t/ha of fuelwood, and is suitable for supporting yam vines or growing forage for livestock. Inderjit and Callaway (2003) assert that in order to determine the allelopathic disposition of the trees in question, it is essential to look into the spatial patterns of weeds in the field in relation to silviculture and growth inhibition zones. For this study, *G. sepium* tree alongside other environment factors indeed determine the weed species found growing beneath its canopy and surrounding.

CONCLUSION

The study demonstrates that *Gliricidia sepium* acts as a significant ecological driver within the University of Benin campus, where its presence significantly alters both the physical growth patterns of the trees and the diversity of associated understory flora. While shaded environments in the botanical garden promoted greater vertical height and larger individual canopy areas, the highest levels of biodiversity were recorded in unshaded or disturbed zones, where species richness reached up to 24 taxa compared to only 14 in shaded regions. The dominance of the Acanthaceae family, particularly *Asystasia gangetica*, alongside the presence of nutrient-dense species like *Talinum triangulare*, highlights the tree's role in fostering specialized plant communities that provide high-quality fodder and medicinal benefits. Based on these findings, it is recommended that *G. sepium* be integrated into urban agroforestry and soil restoration projects to take advantage of its nitrogen-fixing capabilities and erosion control properties, though careful management of its canopy is necessary to balance the light requirements of associated herbaceous species. Furthermore, farmers and landscapers should utilize the high-protein biomass of associated weeds like *A. gangetica* for livestock feed to maximize the secondary ecosystem services provided by *G. sepium* stands.

Acknowledgements

The authors are grateful to all the interns from the Department of Plant Science and Biotechnology, Ambrose Alli University, Ekpoma, at the Prof. Ikhajiagbe's Laboratory, who assisted with fruit collections during this study. We are also grateful to Emma Ossola, who was on 3-month internship at the Lab.

Conflict of Interest

The authors declare none

Authors' Contributions

Omoregie: Literature review, Data analyses, results interpretation, drafting of manuscript
Amina; Literature review, results interpretation, drafting of manuscript
Onophuri: Data collection, drafting of manuscript
Otoibhi: Data collection, drafting of manuscript
Ohanmu: Data analysis, drafting of manuscript
Ossola: Data collection
Ikhajiagbe: Concept of study and design, supervision, data analysis

REFERENCES

Agbana, C. and Boampong, E. (2020). Aboveground biomass production and nitrogen content of *G. sepium* under different pruning regime- a case study at the department of agroforestry farm (kwame nkrumah university of science and technology-knust). *International Journal of Innovative Science and Research Technology*, 5(9), 149-153. https://doi.org/10.38124/ijisrt20sep171

Benaragama, D., Leeson, J. and Shirtliffe, S. (2019). Understanding the long-term weed community dynamics in organic and conventional crop rotations using the principal response curve method. *Weed Science*, 67(2), 195-204. https://doi.org/10.1017/wsc.2018.64

Bourgeois, B., Munoz, F., Fried, G., Mahaut, L., Armengot, L., Denelle, P., … and Violle, C. (2019). What makes a weed a weed? a large-scale evaluation of arable weeds through a functional lens. *American Journal of Botany*, 106(1), 90-100. https://doi.org/10.1002/ajb2.1213

Campiglia, E., Radicetti, E. and Mancinelli, R. (2018). Floristic composition and species diversity of weed community after 10 years of different cropping systems and soil tillage in a mediterranean environment. *Weed Research*, 58(4), 273-283. https://doi.org/10.1111/wre.12301

Elevitch, C.R.; Francis, J.K. Gliricidia sepium (*Gliricidia*), ver. 2.1. In *Species Profile for Pacific Island Agroforestry*; Elevitch, C.R., Ed.; Permanent Agriculture Resources (PAR): Holualoa, HI, USA, 2006; Available online: **https://www.traditionaltree.org** (accessed on 28 February 2023).

Ferrero, R., Lima, M., Davis, A. and González-Andújar, J. (2017). Weed diversity affects soybean and maize yield in a long term experiment in michigan, usa. *Frontiers in Plant Science*, 8. https://doi.org/10.3389/fpls.2017.00236

Figueiredo, C., Moreira, T., Coser, T., Silva, L., Leite, G., Carvalho, A., … and Urquiaga, S. (2023). Nitrogen use efficiency in an agrisilviculture system with *G. sepium* in the cerrado region. *Plants*, 12(8), 1647. https://doi.org/10.3390/plants12081647

Giri, B. (2017). Mycorrhizal dependency and growth response of *G. sepium* (jacq.) kunth ex walp. under saline condition. *Plant Science Today*, 4(4), 154-160. https://doi.org/10.14719/pst.2017.4.4.348

González-Andújar, J., Ureña, M., Davis, A. and Navarrete, L. (2019). Disentangling weed diversity and weather impacts on long-term crop productivity in a wheat-legume rotation. *Field Crops Research*, 232, 24-29. https://doi.org/10.1016/j.fcr.2018.12.005

Gunaratne, W., Heenkenda, A., Premakumara, K. and Bandara, W. (2013). Screening of woody and shrub legumes for agro-forestry systems based on biomass production, n yield and biological n2 fixing capacity. *Proceedings of International Forestry and Environment Symposium*, 0(0). https://doi.org/10.31357/fesympo.v0i0.1397

Ikhajiagbe, B., Ojanikele, A.W., Eboigbe, L., Omoregie, G.O., Nwachukwu, O. (2025). Assessing the Distribution, Density, and Morphological Diversity of Delonix regia in the University of Benin Campus using GPS and GIS Techniques. NIPES - Journal of Science and Technology Research 7(2): 118-130

Jalonen, R., Timonen, S., Sierra, J. and Nygren, P. (2012). Arbuscular mycorrhizal symbioses in a cut-and-carry forage production system of legume tree *G. sepium* and fodder grass *dichanthium aristatum*. *Agroforestry Systems*, 87(2), 319-330. https://doi.org/10.1007/s10457-012-9553-1

Naeem, M., Farooq, S. and Hussain, M. (2022). The impact of different weed management systems on weed flora and dry biomass production of barley grown under various barley-based cropping systems. *Plants*, 11(6), 718. https://doi.org/10.3390/plants11060718

Narendra, B. and Pratiwi, P. (2016). Adaptability of some legume trees on quartz tailings of a former tin mining area in bangka island, indonesia. *Journal of Degraded and Mining Lands Management*, 4(1), 671-674. https://doi.org/10.15243/jdmlm.2016.041.671

Oliveira, J., Lira, M., Santos, M., Freire, F., Júnior, J., Freitas, E., … and Costa, S. (2018). Methodologies in the evaluation of forage mass in tree legumes. *Revista Brasileira De Ciências Agrárias - Brazilian Journal of Agricultural Sciences*, 13(1), 1-7. https://doi.org/10.5039/agraria.v13i1a5500

Poggio, S., Chaneton, E. and Ghersa, C. (2010). Landscape complexity differentially affects alpha, beta, and gamma diversities of plants occurring in fencerows and crop fields. *Biological Conservation*, 143(11), 2477-2486. https://doi.org/10.1016/j.biocon.2010.06.014

Primo, D., Menezes, R., Filho, R., Dutra, E., Silva, E., Alves, R., … and Lucena, E. (2018). Characteristics physico-chemical and carbon balance in fluvic entisol after six years fertilization with manure and gliricidia. *Journal of Experimental Agriculture International*, 23(4), 1-11. https://doi.org/10.9734/jeai/2018/41694

Senarathne, S. and Udumann, S. (2022). Effect of selected leguminous cover crop species on the productivity of coconut cultivated in reddish brown latosolic soils in sri lanka. *Cord*, 37, 33-44. https://doi.org/10.37833/cord.v37i.435

Tavella, L., Silva, P., Oliveira, V., Fernandes, P. and Alves, L. (2014). Weed control in corn and weed sample size for growth evaluations. *Planta Daninha*, 32(1), 51-59. https://doi.org/10.1590/s0100-83582014000100006