e-2795-3248
p-2795-3222

GPH - JOURNAL OF AGRICULTURE & RESEARCH

10.5281/zenodo.6859845 Vol. 04 Issue 07 July - 2021 Manuscript ID: #0466

THE EFFECTS OF ANTHROPOGENIC ACTIVITIES ON THE DISTRIBUTION OF A LATEX-PRODUCING PLANT *(CALOTROPIS PROCERA AITON)* ALONG ROAD SIDES IN JOS AND IT'S ENVIRONS

[I] PAPI, DANLADI YAKUBU & [II] KWAPYIL, JEFFREY TIJANI

[I] Department of Plant Science and Biotechnology, Faculty of Natural Sciences, University of Jos, Jos, Nigeria.
[II] Department of General Health Sciences, Plateau State College of Health Technology Zawan, Jos, Plateau State, Nigeria.

Corresponding author: *Dr. Yakubu Danladi PAPI
Phone: +234 08035052412 ***Email***: ydpapi@yahoo.com

ABSTRACT

This study is carried out to investigate the effects of anthropogenic activities on the availability of Calotropis procera on the roadside in Jos. The line transect sampling technique was used to establish 10 plots with a diameter of 10 X 10 meters (100 m²) wide in each location and the total number of plants was enumerated. The frequency of occurrences, species richness, and diversity index was calculated using Shannon Weiner index methods. The results of the survey revealed a total number of plants at Old Airport Rayfield road indicated highest number of 133, followed by Low-Cost Miango road had 116, Rikkos Lamingo road showed 88, while Gada Biu Zaria road had 70 and Bukuru to Anguldi road had the least number of 43 plants. The frequency of occurrence at Old Airport Rayfield road and Low-Cost Miango road had the figure of 100 %, followed by Gada Biu Zaria road bypass with 90 % and Bukuru to Anguldi road and Rikkos Lamingo road had the occurrence of 70 % each, while species richness revealed a descending order of Old Airport Rayfield road> Low-Cost Miango road>Rikkos Lamingo road>Gada Biyui Zaria road>Bukuru Express to Anguldi. Anthropogenic activities are limited at roadsides due to the sloppy, slippery, and stony nature of the roads, thus latex-producing plants are indicators of the intense anthrogenic activities that have hampered the environmental development of Nigeria.

KEYWORDS

Latex–producing plants, Distribution, Anthropogenic activities, roadsides, Jos.

INTRODUCTION

Calotropis procera (Aiton) is a plant which is a soft-wooded, evergreen, perennial shrub. It has one or a few stems, few branches, and relatively few leaves, mostly concentrated near the growing tip. The *asclepias* (Milkweeds), which apart from the *Calotropis* species, include more than 140 species of plants, have long been included in traditional medicine and have been named after the Greek god of healing (Krings, 2005: Space *et al.*, 2009).

Latex is a complex emulsion of starch, gum, sugar, oils, alkaloids, which is produced upon plant tissue damage and it's coagulates on exposure to air (Hopkins and Harper, 2001). It may be natural or synthetic in nature (Richard *et al*., 2011). Latex found in nature is a milky fluid found in 10% of all flowering plant species (Angiosperm) and it has no known function in primary metabolism (Lewinsohn, 1991; Metcalfe, 1967). Latex is also used as a defense against grazing animals, this is because some of the plants lattices are very bitter or even poisonous (Agrawal and Konno, 2009).

Human activities such as agriculture expansion, pastoralism, fuel-wood extraction, loading of fuel-wood, vehicular movement, and hunting, poaching, mining, bush burning have been suggested to be part of the causes of land degradation in Nigeria (Warren, 2002). These anthropogenic activities have immensely down-graded the natural vegetation cover and subsequently exposed the soil surface and rendered it vulnerable to the element of weather. About 80% of the inhabitants of Northern Nigerian are involved in crop production, pastoral farming and nomadic pastoralism (Papi, 2017).

The diversity of latex-producing plants decreases from the Southern and Northern Guinea Savanna probably because of the increase in the open grazing and other human activities which has impacted on plants negatively. Some of the latex-producing plants are fragile and hollow as a result it reduces their resistance to pressure resulting from trampling effects by large animals and man's activities in the different vegetation belts of Nigeria (Papi and Onaji, 2019). Species invasion usually result from environmental and anthropogenic factors such as disturbance, nutrient availability, topography and habitat fragmentation (Gelbard and Belnap, 2003).

Roadsides also influence the spread and growth of species by serving as corridors for movement as well as providing habitats for establishment of propagules (Christen and Matlack, 2009; Ferguson *et al*., 2002; Gelbard and Belnap, 2003; Hansen and Clevenger, 2005; Spooner, 2005). Some studies have also shown that plant propagules can be transported on vehicles (Forman *et al.*, 2002; Pickering and Mount, 2010). Non-native species are more likely to occur along roadsides and their probability of establishing on flat surfaces is generally lower (Ferguson *et al*., 2002; Hansen; Clevenger, 2005 and Flory and Clay, 2006).

LITERATURE REVIEW

Botanical Description

Calotropis procera is an erect, tall, large, much branched and perennial shrubs or small trees that grow to a height of 5.4 m., with milky latex throughout. Bark is soft and corky. Branches, stout, terete (rounded) with fine appressed cottony pubescence (especially on young). Leaves sub-sessile, opposite, decussate, broadly ovate-oblong, elliptic or obovate, acute, thick, glaucous, green, covered with fine cottony pubescent hair on young but glabrous later and base cordate. Flowers in umbellate-cymes and tomentose on young, Calyx glabrous, ovate and acute. Corolla glabrous, lobes erect, ovate, acute, coronal scales 5-6, latterly compressed and equally of exceeding the staminal column. Follicles are sub-globose or ellipsoid or ovoid. Seeds broadly ovate, acute, flattened, minutely tomentose, brown coloured and silky coma is 3.2 cm long (Yelne, 2000).

Plate 1; Typical plant of Calotropics procera

NON-MEDICINAL USES OF *Calotropics procera*

Use as a Building Materials

The wood from *Calotropis* procera is light-weight with a typical air-dried wood density of 0.39 g/cm³ (Nasser *et al.,* 2012). The stem of the plant is used for roof-making and suitable for paperboard (Khristova and Tissot, 1995; Ali and Pat, 2013).

Use as Adsorbent

The water-resistance and hydrophobicity of *Calotropis* fibers, treated and untreated, made them potentials to be used as adsorbents for hydrocarbons, such as for oil (Zheng *et al*., 2016).

Usage as Fuel

Within limits, the wood of *C. procera* is utilized as cooking fuel or as a source of biofuel (De *et al*., 1997; Padmaja *et al*., 2009).

Animal Feed

In many regions, livestock feeding on Calotropis plants is limited, and toxicity associated with animal feeding on the plants is a constant problem, with sheep fatalities having been reported at 5-10 g of latex feed per kg of bodyweight (Sharma, 1934; Abdullahi *et al*., 2017).

Pesticidal Use of the Plant

The reports on the bioactivity of extracts from both species are numerous, where the extracts have been utilized as herbicide, fungicide, insecticide, nematicide acaricide and as molluscicide (Zaman *et al*., 2012).

Insecticidal Use

The larvicidal role of *C. procera* in mosquito control has been reported for more than 25 years ago (Girdhar *et al.,* 1984). The latex from the green parts of the plant severely affects larvae development and mortality and suppresses egg hatching, in the mosquito *Aedes aegypti*, which is a vector of the dengue virus (Singhi *et al*., 2004).

Nematicidal/Schistosomicidal/Antihelminthic Activity

Calotropis procera has been used for the control of plant-pathogenic nematodes *Meloidogyne javanica* and *Meloidogyne incognita*. It must be remarked that the mortality rates of *Meloidogyne incognita* juveniles induced by the leaf extracts of *C. procera* are not as high as that induced by the extracts of some other plants such as *Acacia nilotica*, *Aristilochia bracteolate* or *Chenopodium album* (Devi and Gupta, 2000).

Molluscicidal Activity

Much of the here-mentioned activity can be attributed to the cardenolide content of the extracts as could also be shown by the molluscicidal activity of cardenolide extracts from *C. procera* against the land snail *Monacha cantania* (Al-Sarar *et al*., 2012) and single-compound toxicity studies of uscharin in the snail *Thepa pisana* (Abo *et al*., 2013).

Plant Fungicidal Use

Different aerial parts of *C. gigantea*, such as the leaves, have been used as anti-fungicide, especially against *Phyllactinia corylea* (powdery mildew), *Peridiopsora mori* (brown rust), *Pseudocercospora mori* (black leaf spot), *Myrothecium roridum* (brown leaf spot), *Colletotrichum graminicola*, *Drechslera sorokiniana* (Drechslera leaf blight), *Fusarium solani*, *Macrophomina phaseolina*, and *Phomopsis sojae* (soybean stem blight) (Abu-Taleb *et al*., 2011).

Allelopathic Activity

Aqueous extracts of dried leaves have a strong adverse effect on the germination of wheat (*Triticum aestivum*, Graminaea) (Al-Zahrani and Al-Robai, 2007) and influence the germination of barley (*Hordeum vulgare*, Graminaea), cucumber (*Cucumis satires*, Curcurbitaceae), radish (*Raphanus sativus*) and Fenugreek (*Trigonella foenumgraecum*, Leguminosae) to a lesser degree.

Calotropis for Environmental Monitoring and Bioremediation

Calotropis procera plant can grow under adverse conditions and have been found to be tolerant of pollution. This suggests that the species can be grown in the neighborhood of polluted sites as a remedial measure (Achakzai *et al*., 2017). Thus, the uptake of metals by *C. procera*, both from the soil *via* the roots and from the air *via* the leaves (Gajbhije *et al*., 2016), has received some interest (Nawab *et al*., 2016).

MEDICINAL USESE OF Calotropics procera

Anticonvulsant effects

The anticonvulsant activity of different root extracts of *Calotropis procera* in rats, in order to evaluate the traditional use of this plant. The anticonvulsant activity of different extracts of *Calotropis procera* roots was studied against seizures induced by maximal electroshock seizures (MES), pentylenetetrazol (PTZ), lithium-pilocarpine and electrical kindling seizures.

Antimicrobial activity

Antimicrobial activities of chloroform and methanol extracts of seeds of *Calotropis procera*. Chloroforms extract of *Calotropis procera* seeds exhibited better antimicrobial activity. On the other hand, the extracts obtained *Calotropis procera* seeds tested have been evaluated for their possible in vitro antibacterial activities based on paper disc method.

Antibacterial and Antifungal potentials

Calotropis gigantea ethyl acetate extract was used for the isolation of 1Di-(2-ethylhexyl) phthalate (compound 1) and anhydrosophoradiol-3-acetate (compound 2). The 1Di-(2-ethylhexyl) phthalate (Compound 1) showed better activity when compared against gram positive (*Bacillus subtilis, Staphylococcus aureus* and *Sarcina lutea*) and gram negative (*Shigella sonnei, Escherchia coli, Shigella shiga* and *Shigella dysenteriae*).

Traditional uses

Calotropis species is used for the treatment of bronchitis, pain, asthma, leprosy, ulcers, piles, spleen, tumors, liver, abdomen and dyspepsia; it is also used frequently for cold, fever, diarrhea, rheumatism, indigestion, eczema and jaundice.

Anti-ulcer activity

The hydro alcoholic and chloroform extract of *Calotropis procera* stem bark was used for evaluation of anti-ulcer and anti-inflammatory activity.

Aanti-malarial activity

The ethanolic extracts of *Calotropis procera* leaves were fractioned with petroleum ether, chloroform and ethyl acetate respectively.

Wound healing activity

Calotropis gigantea root bark extract was used for the evaluation of wound healing activity. Ethanol extract of *Calotrpois gigantea* was administered orally at different doses in incision model and dead space wound models.

Toxicological study

Calotropis procera (giant milkweed) has been reported to have numerous medicinal economic importance's but was observed to be potentially injurious to the body especially after prolonged or chronic use Calotropin which is found in latex cause slowing of heart beat and gastroenteritis if injected into the lymph sac of frog (Basak *et al*., 2009)

MATERIALS AND METHODS

Study areas

This project work was carried out in five (5) different locations along major roadsides within the Jos and its environs

Location 1: Gada Biyiu Zaria road
Location 2: Bukuru to Anguldi road
Location 3:Old Airport Rayfield road
Location 4: Rikkos Lamigo road
Location 5: Low Cost Maingo road

Sampling site

The study will be conducted using Global positioning system (GPS), with a view to cover maximum possible area for data collection, along the altitudinal transect a total of 10 plots each at a representative location. At each site 10 km transect will be set along. All the ten transect of each location will be homogenous and comparable to each other with regard to plants location.

Data processing and analysis

The total population of *C.procera* in each of the ten plots in the five plots were counted. The mean population density per plot of each species was determined from its population in the 10 plots were areas assessed.

RESULTS

The results of the survey reveals a total of 450 *C.procera* plants were sample from the five location and the ten plots established in each location. In the total number of plants Old Airport Rayfield road had the highest number of 133, followed by Low Cost Miango road 116, Rikkos Lamingo road had 88, Gada Biyui Zaria road 70 and Bukuru to Anguldi road had the least number of 43 plants. In terms of the frequency of occurrence Old Airport Rayfield road and Low Cost Miango road had occurrence of 100 %, followed by Gada Biyui zaria with 90 % and Bukuru to Anguldi road and Rikkos Lamingo road had the occurrences of 70 % each. In terms of diversity index and species richness the descending order is old Airport Rayfield road>Low Cost Miango road>Rikkos Lamingo road>Gada Biyui Zaria road>Bukuru to Anguldi road.

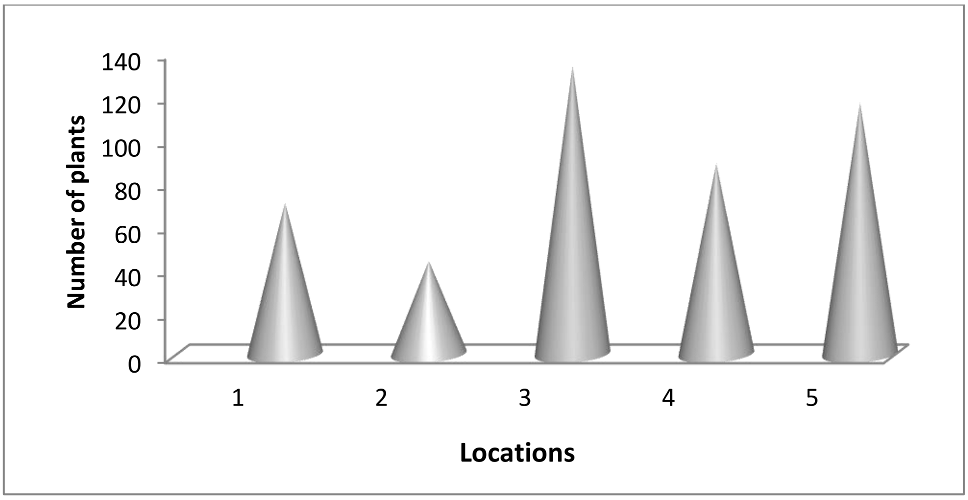

Figure 1. The total number of Calotropis procera collected during the research wood

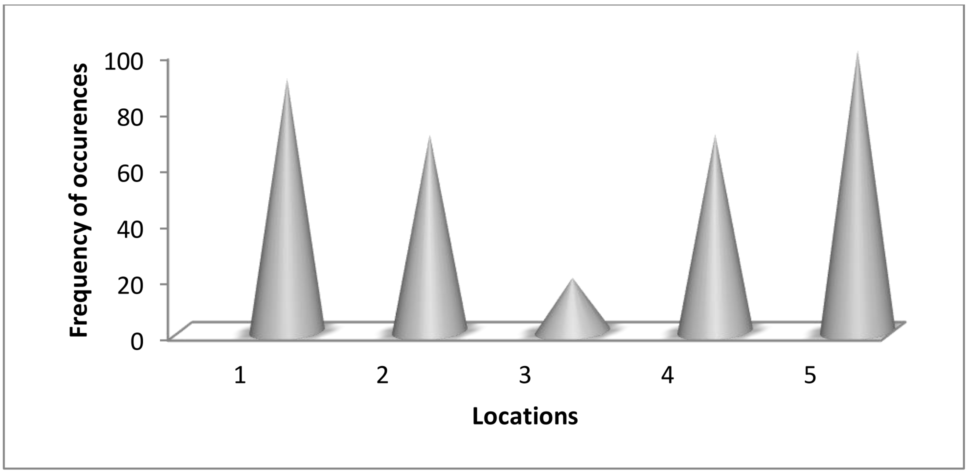

Figure 2. The frequency of occurrence of Calotropis procera at the locations

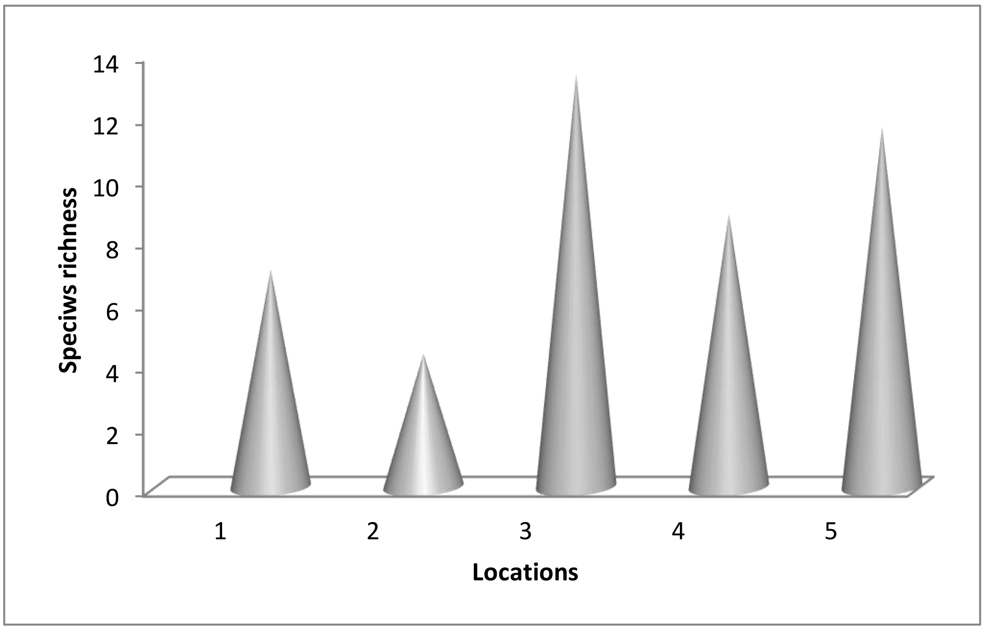

Figure 3. Species richness of Calotropis procera at the locations

Figure 1, indicates that the total number of individuals of *Calotropis procera* is higher in the location 3 and least at location 2. Figure 2, shows that the frequency of *Calotropis procera* is higher in location 5 and least in location 3. The plants were seen growing in bunch and counted less. Figure 3, reveals that species richness of *Calotropis procera* was higher in location 3, because it grows in few places along roadside and densely spotted.

DISCUSSION

Most plant species dominating the roadsides were found to be invasive and there was a likelihood that their distribution could have resulted from road construction and the intensity of anthropogenic activities along area of data collection. Such a finding has been reported in some parts of the world where it was revealed that most species found along roads were invasive and mostly distributed seeds, runners and rhizomes (Forman and Alexander, 1998) transported by road construction machines (Forman *et al*., 2002; Pickering and Mount, 2010; Pauchard and Alaback, 2004).

Anthropogenic activities play a significant role in the distribution and degree of richness of *Calotropis procera* along roadsides and away from the roadsides, the plant's existence is highly threatened by numerous activities of man like grazing, farming, mining, hunting etc. This findings is supported by the work of Papi, 2017 which explained that in the Savanna region of Nigeria, latex producing plants are available in areas that are not easily accessible for anthropogenic activities and that the plants are fragile and can be easily destroy when trampled upon during grazing and other man's activities. The prominent factors that limit the anthropogenic activities on roadsides are the steep slope, slippery and stony nature thereby grazing animals and man are careful when following such areas, these factors dissuade the pastoralists from allowing the grazing animals go near the roadsides, hence reducing incidences of animals entering the road which might cause accident.

This plant species should have persisted on the roadsides for quite a long time because their growth is very slow. Latex- producing plants survive for a long time because of their stringent adaptive features. According to Heinrich and Siegmar (2002) latex-producing plants of Cactaceae and Euphorbiaceae families grow very slowly and are not available at the pioneer stage of succession. For example, Saguaro plant (*Cactus* species) grows slowly but may live up to 200 years. When at 9 years old, they are about 15 cm high and after about 75 years, the cacti (Saguaro) develop their first branches. So, these plant species exuding lattices do not grow to a reasonable height before they are destroyed in places that experience intermitted anthropogenic activities. Similar findings have also been reported in Tanzania (Mollel *et al.*, 2012) and other parts of the world where *Calotropis procera* and other latex-producing plants have dominated roadsides and less accessible components of the vegetation (Forman *et al*., 2002; Holway *et al*., 2002;; Pauchard and Alaback, 2004; Nath *et al*., 2005; Udo *et al*., 2009; Moktan and Das, 2013; Papi, 2017).

CONCLUSION

The existence and population density of a plant species in a tract of a roadside is a function of the availability of its seeds or propagules existence in favorable micro-climate for the seed germination and growth (Olajide *et al.,* 2008). Furthermore, the abundance and rarity of a plant species, especially those of great economic value, is a function of the intensity and pattern of road construction and other anthropogenic activities the road is exposed to (Udo *et al*., 2009). Papi and Onaji, 2019, opined that latex-producing planst because of their fragile nature and are mostly found on Montane vegetations non accessible peak showed very slow growth rate and when trampled upon by large herbivores, they are destroyed and ceased to exist. The survivals of latex-producing plants indicate the level of anthropogenic activities on Nigerian environment, thus hampered sustainable development.

RECOMMENDATIONS

Road reserves should be corridors for conservation of species diversity and be given special consideration. This piece is coming at a time when biodiversity loss has drawn the attention of very many conservationists especially in the areas perceived to be protected such as game reserves and parks whose accessibility are usually restricted. *Calotropic procera* species along roadsides reserves should be included in the National Biodiversity Conservation Strategies as a way of maintaining floral diversity taking into cognisance their uses to man. In this way, they will contribute valuable data that can supplement the currently available information on species diversity and also help to conserve some plant species that are considered threatened in the region.

REFERENCES

Abdullah, M.; Rafay, M.; Hussain, T.; Ahmad, H.; Tahir, U.; Rasheed, F.; Ruby, T.; Khalil,S (2017. Nutritive potential and palatability preference of browse foliage by livestock in arid rangelands of Cholistan desert (Pakistan). *Journal of Animal and Plant Science,* 27, 1656-1664.

Abo Zaid, K.H.; El-Wakil, H.; El-Hussein, A.; Jomaa, S.; Shohayeb, M. (2013). Evaluati of the molluscicidal activity of *Punica granatum, Calotropis procera, Solanum incantum*, and *Citrullus colocynthis* against *Biomphalaria arabica. World Applied Science Journal*, ***26***, 873-879.

Abu-Taleb, A.M.; El-Deeb, K.; Al-Otibi, F.O.(2011). Bioactivity of some plant extracts against *Drechslera biseptata* and *Fusarium solani*. *Journal of Food Agriculture and Environment,* ***9***, 769-774.

Agrawal, A.A. and Konno K. (2009). Latex: a model for Understanding Mechanisms, Ecology, and Evolution of Plant Defense Against Herbivory. *Annual Review of Ecology, Evolution, and Systematics* **40**: 311–331.

Ali, M.E.S. U.S Pat. (2013). Insulation material based on natural fibers from flowerinplant seeds in a phenol-formaldehyde resin or cornstarch binder. *Chemical Abstact*, *159*

Achakzai, K.; Khalid, S.; Adrees, M.; Bibi, A.; Ali, S.; Nawaz, R.; Rizwan, M. (2017). Apollution tolerance index of plants around brick kilns in Rawalpindi, *Pakistan Journal of Environment and Management,* ***190***, 252-258.

Al-Zahrani, H.S.; Al-Robai, S.A. (2007). Allelopathic effect of *Calotropis procera* leaves extract on seed germination of some plants. *JKAU: Science*, ***19,*** 115-126.

Al-Sarar, A.; Hussein, H.; Abobakr, Y.; Bayoumi, A.(2012). Molluscicidal activity of methomyl and cardenolide extracts from Calotropis procera and Adenium arabicum against the lansnail Monacha cantiana. *Molecules,* ***17*** (5), 5310-5318.

Basak, K., Samar, Bhaumik Arup, Mohanta Ayan, and Singhal Prashant (2009). Ocular toxicity by latex of Calotropis procera (Sodom apple). *Indian Journal of Ophthalmol,* **57** (3):232-4.

Christen, D.C., and Matlack G.R. (2009). The habitat and conduit functions of roads in the spread of three invasive plant species. *Biological Invasions*, 11: 453-465.

De, S.; Bag, A.; Mukherji, S. (1997). Potential use of *Pedilanthus tithymaloides* Poit. as a renewable resource of plant hydrocarbons. *Botanical Bulletin Academia Sinica*, ***38,*** 105-108.

Devi, L.S.; Gupta, P. (2000). Evaluation of some plant lattices against *Heterodera cajani* in cowpea (*Vigna sinensis*). *National Academy Science Letters,* ***23***, 65-67.

Ferguson, A., McPhee M., Janowich B., and Utzig H. (2002). Forest access and terrestrial ecosystems. BC Ministry of Water, Land and Air Protection, Biodiversity Branch, Victoria, BC.

Flory, S.L., and Clay K. (2006). Invasive shrub distribution varies with distance to roads and stand age in eastern deciduous forests in Indiana, USA. *Plant Ecol*ogy, **184**: 131-141.

Forman, R.T.T., and Alexander L.E. (1998). Roads and their major ecological effects. *Annual Review Ecology and Systematics* , 29: 207-231.

Forman, R.T.T., Sperling D., Bissonette J.A., Clevenger A.P., Cutshall C.D., and Dale V.H.,(2002). Road Ecology: Science and Solutions. Island Press, Washington, ISBN-13: 978-1559639330, Pages: 504.

Gajbhiye, T.; Pandey, S.K.; Kim, K.H.(2016). Factors controlling the deposition of airborne metals on plant leaves in a subtropical industrial environment. *Asian Journal of Atmopheric Environment, **10***, 162-167.

Gelbard, J.L., and Belnap J. (2003). Roads as conduits for exotic plant invasions in a semiarilandscape. *Conservation Biology*, 17: 420-432.

Girdhar, G.; Deval, K.; Mittal, P.K.; Vasudevan, P.(1984). Mosquito control by *Calotropis* latex. *Pesticides, 18*, 26-29.

Holway, D.A., L. Lach, A.V. Suarez, N.D. Tsutsui and T.J. Case, 2002. The causes and consequences of ant invasions. *Annual Revserve Ecological Systems*, 33: 181-233.

Hansen, M.J., and Clevenger A.P. (2005). The influence of disturbance and habitat on thepresence of non-native plant species along transport corridors. *Biological Conserv*ation, **125**: 249-259.

Heinrich, W.; Siegmar-W. B. (2002). Waiter's vegetation of the earth, the ecological systems of the geo-biosphere ,*Springer*. Page. 457.

Hopkins, T.L, Harper M.S. (2001). Lepidpoteran peritrophic membranes and effects of dietary wheat germ agglutinin on their formation and structure. *Archives of Insect Biochemical Physiology,* 47:100–9 Howard JB, Glazer AN. 1969. Papaya lysozyme: terminal sequences and enzymatic properties. *Journal of Biological Chemistry,* 2**44**:1399–409.

Khristova, P.; Tissot, M. (1995) Soda-anthraquinone pulping of *Hibiscus sabdariffa* (Karkadeh) and *Calotropis procera* from Sudan. *Bioresource Technology, 53*, 67-72.

Krings, A.; Areces Berazain, F.; Lazcano Lara, J.C.(2005). New and re-discovered milkweeds from Cuba: *Calotropis gigantea* and *Gonolobus stephanotrichus*. *Willdenowia, 35*, 315-318.

Lewinsohn, M.T. (1991). The Geographical Distribution of plant latex. *Chemoecology* **2** (1): 64–68.

Metcalfe, C. R. (1967). Distribution of latex in the plant kingdom. *Economy Botany*, **21**:115–27.

Mollel, N.P., Elia J., and Sitoni D. (2012). Common roadside plants of Arusha, Tanzania. Environmental and Conservation Program, the Field Museum, Chicago, IL 60605 USA.

Moktan, S., and Das A.P., (2013). Diversity and distribution of invasive alien plants along the altitudinal gradient in Darjiling Himalaya, *India. Pleione*, 7: 305-313.

Nath, O.C., Arunachalam A., Khan M.I., Arunachalam K., and Barhuiya A.R. (2005). Vegetation analysis and tree population structure of tropical wet evergreen forest in Namdapha National Park, Northeast India. *Biodiversity and Conservation* 14: 2109 2136. New-Delhi, Vol.**2**: 69 - 73.

Nawab, J.; Khan, S.; Shah, M.T.; Gul, N.; Ali, A.; Khan, K.; Huang, Q.(2016). Heavy met bioaccumulation in native plants in chromite impacted sites: a search for effective remediating plant species, *Clean – Soil, Air. Water*, ***44***, 37-46.

Nasser, R.A.; Al-Mefarrej, H.A.; Khan, P.R.; Alhafta, K.H.(2012). Technological Propertie of Calotropis procera (Ait.) wood and its relation to utilization. *America.-Eurasian Journal of AgricultureEnvironmental Science*, ***12***, 5-16.

Olajide, O., Udo E.S., and Out, D.O. (2008). Diversity and population of timber tree species producing valueable non-timber products in two tropical forest in Cross River State,Nigeria. *Journal of Agriculture and Social Science* **4**(2): 6568.

Padmaja, K.V.; Atheya, N.; Bhatnagar, A.K.; Singh, K.K.(2009). Conversion of *Calotropi procera* biocrude to liquid fuels using thermal and catalytic cracking. *Fuel*, ***88***, 780785.

Papi, D.Y. (2017). Bionomic Study of Latex-producing Plants in Savanna Region of Nigeria, Lap Lambert Academic publishing Germany. ISBN-106202000925X, 29-08-2017, Pages 152.

Papi, D.Y. and Onaji, I A (2019). Anthropogenic Activities Jeopardizing the Abundance of Latex Producing Plants in the Vegetation Belts of Northern Nigeria. FUDMA, *Journal of Sciences* 3, (3) 499 - 455.

Pauchard, A. and Alaback P.B. (2004). Influence of elevation, land use and landscape context on patterns of alien plant invasions along roadsides in protected areas of South Central Chile. *Conservation Biol*ogy, **18**: 238-248.

Pickering, C., and Mount A., (2010). Do tourists disperse weed seed? A global review of unintentional Human-mediated terrestrial seed dispersal on clothing, vehicles and horses. *Journal of Sustainable Tourism*, **18**: 239-256.

Richard, G. Jones, Przemyslaw Kubisa, Ingrid Meisel, Werner Mormann, Stanisław Penczek Robert F. T. Step-to (2011). Terminology of polymers and polymerization processes, *Pure and Applied Chemistry* **83** (12): 2229–2311.

Singhi, M.; Joshi, V.; Sharma, R.C.; Sharma, K. (2004) Ovipositioning behavior of *Aedesaegypti* in different concentrations of latex of *Calotropis procera*: studies on refractory behavior and its sustenance across genotrophic cycles. *Dengue Bulletin*, ***28***,184-188.

Space, J.C.; Lorence, D.H.; LaRosa, A.M.(2009). *Report to the Republic of Palau: 2008 update on Invasive Plant Species.*, 18.

Spooner, P.G. (2005). Response of Acacia species to disturbance by roadworks in roadside environments in southern New South Wales, Australia. *Biological Conservation*, 122: 231-242.

Udo, E.S., O. Olajide and E.A. Udoh (2009). Lifeform classification and density of plants producing economically valuable non-timber products in Ukpom Community Forest, Akwa Ibom State, Nigeria. *Nigerian Journal of Botany,* Vol. 22(1): 147-154.

Yelne, M.B., Sharma P.C., and Dennis T.J. (2000). Database on Medicinal Plants used in Ayurveda, Central Council for Research in Ayurveda & Siddha, New-Delhi. Vol.2:69 – 73

Zaman, M.A.; Iqbal, Z.; Abbas, R.Z.; Khan, M.N.; Muhammad, G.; Younus, M.; Ahmed, S. (2012). *In vitro* and *in vivo* acaricidal activity of a herbal extract. *Veterinary Parasitol*ogy ***186*** (34), 431-436.

Zheng, Y.; Cao, E.; Zhu, Y.; Wang, A.; Hu, H.(2016) Perfluorosilane treated *Calotropis giganteafiber*: Instant hydrophobic–oleophilic surface with efficient oil-absorbing performance. *Chemical engineering journal,* ***295***: 477-483.