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Study on Frequency Distribution of Lianas on Trees in Dry Deciduous Forests of Guvvalacheruvu, Southern Eastern Ghats, Andhra Pradesh, India

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***Abstract*:** In the dry deciduous forest of Guvvalacheruvu, 43% of trees (>30 cm gbh) are colonized by at least one liana. Majority of lianas featured twining climbing mode in the forest. Liana infestation rate was higher among medium girth trees and a positive relation was observed between tree girth and liana infestation rate. No relation between a specific tree species and liana infestation was observed, but multiple stem trees were with high infestation rate. Spatial occurrence of lianas seemed to influenced the liana colonization rate on trees in these dry deciduous forests.

***Keywords*:** Dry deciduous forests, Lianas, Liana infestation rate, Stem twiners

Lianas are woody climbing plants that rely on trees for physical support in order to reach the tree canopy to avail better light conditions (Schnitzer and Bongers 2002) and represent nearly 25% of woody species in varied forest areas, but occur in high abundance as well as species rich in seasonal dry forests (Vivek and Parthasarathy 2015). The ability to grow and acquire nutrients in the dry season may allow lianas to occur in high abundance in seasonal forests (Tang et al 2012). In these dry forests also, lianas predominantly occur in canopy gaps and forest edges. In addition, for lianas, host finding and colonizing the suitable hosts form an important role in their life history (Perez-Salicrup 2005). Different lianas evolved different climbing modes and strategies that help in climbing the host trees (Vivek and Parthasarahty 2015). Tree-liana association studies provided inputs to both hypotheses that trees provide variety of niches and varied morphological features that could lead to specific relation between trees and lianas (Perez-Salicrup 2005, Vivek and Parthasarathy 2016) or trees just act as neutral support structures so that lianas near to trees will colonise them (Carse et al 2000, Cai et al 2009, Malizia and Grau 2006). Trees constituting rough bark, medium tree diameter and high tree or bole height may increase the liana frequency on trees and features like fast growth rates, evergreen foliage, stem flexibility may correspond to lower liana frequency (Vivek and Parthasarathy 2017). Further, small sized trees could be more negatively affected in their biological fitness in comparison with larger trees as they can balance the liana loads with their own big size and biomass (Carse et al 2000). Liana specific attributes like clonal growth, dispersal mechanisms, high abundance in tree fall gaps will determine the spatial distribution of lianas (Nabe-Nielsen 2001). The dry forests in the study sites have relatively lower tree species richness but comprise of higher tree individuals per unit area (Ramana and Reddy 2021) and this can form a well replicated unit for studying liana association on trees. Hence the study intends to inventory the number of lianas on trees to know specific tree-liana associations by recording the trees with and without the presence of lianas.

MATERIAL AND METHODS

Study area: The enumeration of the number of lianas on trees fieldwork was carried out in Guvvalacheruvu forest of Palakonda hill ranges 14^0 16'02.1"N latitude and 78^0 45'26.4"E and 14^0 16'25'25.9"N and 78^0 52'33.5"E longitude at an elevation of 330-470 msl. The forest hill ranges receive an annual average rainfall of 688mm and annual temperature range of 33^0C to 46^0C. In order to estimate the presence of lianas per tree, a total of 190 tree individuals (≥30 cm gbh) were observed in a random manner by laying a total of eight (10 X 100m) belt transects with atleast 100m distance between them and 20m distance from the edge of the forest. The field work effort was made to select atleast 33 tree individuals in each of the tree girth categories namely 30-50 cm, 51-70 cm and >70 cm gbh. The number of trees with and without lianas per girth classes were counted. All lainas (≥3 cm girth at 1.3 m distance from the root) either present in the

tree canopy or liana climbed by taking the support of tree bole or branches were counted and identified. A correlation test was carried out to know the relation between tree girth and liana infestation rate. A chi-square test was applied to evaluate whether each girth class and the probability of being colonised by liana was independent or not. The observed frequency distribution of the number of lianas per trees was compared with the expected poison distribution with chi-square goodness test.

RESULTS AND DISCUSSION

A total of 190 tree individuals that belong to 36 tree species and 12 families was enumerated. Among them, 43% of trees have carried at least one liana individual. These lianas belong to 19 species and 11families; of them 12 species showed twining climbing mechanism, two species featured both twining and hook climbing mechanisms, three species have twining climbing mode and spines and two species are stragglers (Table 1). The frequency distribution of lianas on trees revealed a mean (lianas per tree) of 1.37 and a range of 0-7 liana individuals per tree. The majority of enumerated liana species were stem twiners as also recorded in Kolli hills (Chitti Babu and Parthsarathy 2001), southern Eastern Ghats of Tamil Nadu (Muthperumal and Parthasarathy 2010), dry evergreen forests (Reddy and Parthsarathy 2006), Sri Lankamalleswara wild life sanctuary (Mastan et al 2015) and Anamalais (Muthuramkumar and Parthsarathy 2001). In addition, the present study liana infestation rate (43%) is lower than the percent of liana infestation rate on trees in dry evergreen forests of point Calimere wild life sanctuary (57.9%; Vivek and Parthasarathy 2016) and profoundly higher than the liana infestation observed in Kolli hills (10%; Chitti Babu and Parthsarathy 2001) and Anamalais (28%; Muthuramkumar and Parthsarathy 2001).

The liana frequency distribution on trees was significantly different from the expected poison distribution (χ^2 = 77.03, P<0.05) indicating a clumped distribution of lianas on the trees (Table 2). The Chi –square test revealed a significant difference in liana infestation among the three different gbh class trees (χ^2 = 14.25, P<0.05. It suggests that liana presence on trees was found to be dependent on the tree gbh as tree individuals with 51-70 cm gbh showed high infestation rate (51.6%) followed by lower gbh trees (39%) and trees with higher gbh featured lower infestation rates (26.6%; Fig. 1). In addition, the correlation between trees (on log scale) and number of lianas was positive (0.646) revealing a considerable effect of tree gbh on the probability of liana occurrence on trees (Fig. 2). These observations are in line with the reports from Calimere (Vivek and Parthasarathy 2016), Los Tuxlas forest of Mexico (Perez-Salicrup (2005) and sub-tropical montane forest of Argentina (Malzia and Grau 2006) that higher gbh class trees provide longer exposure period for lianas to not only locate them and as well use them as supports to reach the top canopy and further venture to another tree canopy.

These dry deciduous forests constitutes trees with typical leafless period of around 4-6 months and in majority of trees leaf initiation occurred in the dry period, flowering peaked in summer period and got synchronized with leaf flushing activity (Mastan et al 2020). Similarly the large girthed lianas

Table 1. Liana species in the eight transects of dry deciduous forests of Guvvalacheruvu, Southern Eastern Ghats, Andhra Pradesh, India

Species	Family	Climbing mechanism
Abrus precatorius L.	Fabaceae	Twiner
Acasia caesia (L.) Wild.	Mimosaceae	Twiner
Aganosma cymosa (Roxb.) G.	Apocynaceae	Twiner
Calycopteris floribunda Lam.	Combretaceae	Twiner
Canavalia virosa (Roxb.) Wight & Arn.	Fabaceae	Twiner
Capparis zeylanica L.	Capparidaceae	Stragler
Carissa spinarum L.	Apocyanaceae	Stragler
*Combretum albidum*G.Don.	Combretaceae	Twiner
Decalepis hamiltonii Wight &Arn.	Asclepiadaceae	Twiner
Derris scandens (Roxb.) Benth.	Fabaceae	Twiner
Hugonia mystax L.	Liniaceae	Stragler
*Jasminum angustifolium*Vahl.	leaceae	Twiner
Mucuna pruriens (L.) DC.	Fabaceae	Twiner
Pterolobium hexapetalum (Roth) Sant. &Wagh	Caesalpiniaceae	Twiner
Rivea hypocrateriformis (Desr.) Choisy	Convolvulaceae	Twiner
Sarcostemma acidum (Roxb.) Voight Hort.	Asclepiadaceae	Twiner
Ventilago maderaspatana Gaertner	Rhamnaceae	Twiner
Wattakaka volubilis (L.f.) Stapf	Asclepediaceae	Twiner
Ziziphus oenoplia (L.) Mill.	Rhamnaceae	Scrambler

Table 2. Frequency distribution of lianas on observed trees in Guvvalacheruvu dry deciduous forest area

Frequency	Observed frequency distribution of Lianas on tree	Expected frequency by poison distribution
0	108	70
1	20	80
2	24	46
3	16	18
4+	8	6

like *Combretum albidum,* and *Calycopteris floribunda* shed their leaves in January and produced flowers in leafless period and winged fruits got matured for dispersal in May before the rains. Lianas with twining and spines like *Acacia caesia, Pterolobium hexapetalum, Ziziphus oenoplia* also have initiated the leaf fall in January/February and stragglers like *Carissa spinarum* and *Capparis zeylanica* have also promulgated their leaf fall in January indicating that lianas, like trees, also feature typical deciduousness of four-five months to overcome the water shortage and harsh dry conditions. Thus typical variation between trees and lianas in leaf phenology was not observed and indicates that leafless period among trees will not either deter or promote the lianas to reach the illuminated canopy and thus may not influence the liana infestation rate as also observed in Argentianian Montane forests (Malizia and Grau 2006). The lianas that have girth >10 cm gbh like *Combretum albidum*, *Calycopteris floribunda, Acacia caesia, Pterolobium hexapetalum, Ziziphus oenoplia* grow steady upright without structural support up to 1.0 to 1.5m height in the forest edges and then grow onto the canopy of moderate to large girthed trees. *Ventilago maderaspatana* with stem twining and hook structure gain girth increment even on small girthed trees. These lianas flower during the dry season and produce fruits to be matured with wind dispersed seeds at the beginning of the rainy season as it could result in seed set during the rainy season for better opportunities for germination and seedling survival rates, *Rivea hypocrateriformis, Wattakaka volubilis, Mucuna pruriens* with stem twining climbing mode reached the canopy by using the main tree trunks (below 1.3 m height) of low and medium girth trees. Stragglers like *Carissa spinarum* and *Hugonia mystax* were associated with low girthed trees along the rocky boulders. In the study, except for the observations of *Jasminum angustifloium* on *Albizia amara* trees with high mean infestation rate, no particular liana species and tree association was observed. These observations indicate that trees are acting as neutral supports by neither facilitating nor impeding the liana infestation. But trees with multiple stems (≥2 stems) were having high probability of liana occurrence on trees (χ^2= 9.22; P<0.05) than single stem trees as the possession of multiple stems may increase the probability of infestation from boles as well as provide larger area of tree canopy at lower height itself. These observations are in line with observations made in in tropical forests of Mexico and Ecuador, (Nabe Neilsen (2001) and Malizia and Grau (2006) that lianas are able to disperse or colonise along forest edges or canopy openings, then may try to infest whatever the tree individuals are available in the surrounding. In these dry deciduous forests trees with moderate girth and height are in high abundance and they may provide favourable light conditions on their lower canopy itself so that lianas can optimize their growth activity

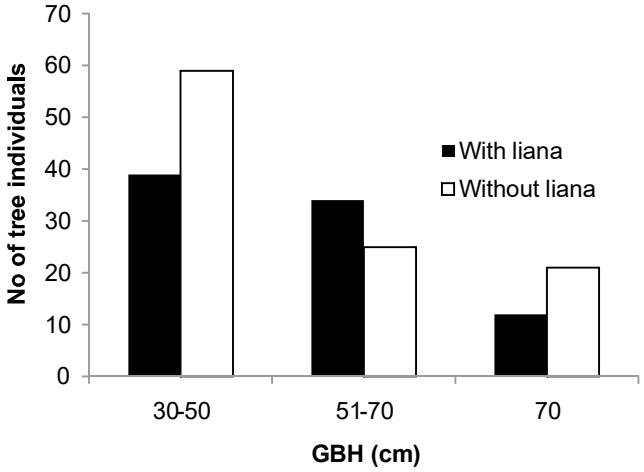

Fig. 1. Number of trees with and without lianas in three different gbh classes

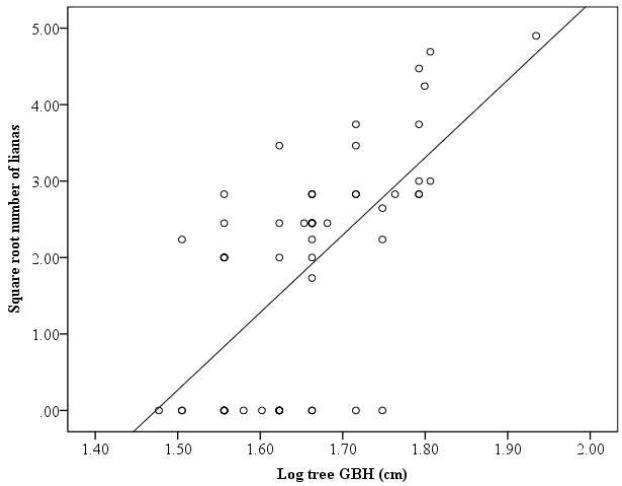

Fig. 2. Positive relationship between tree gbh and liana infestation

CONCLUSION

The study in dry deciduous forest reveal that stem twiners are the dominant liana types and liana spatial distribution, abundance, climbing mode influence the tree-liana interactions. The results are in line with the observations made in other studies that trees mostly act as passive neutral supports and spatial distribution of lianas which tends to occur more in suitable light conditions edges and can climb on to the trees mainly with medium gbh classes.

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