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Determination of Root Growth of Betel (*Piper betle*) in the Presence of Gliricidia (*Gliricidia sepium*) as a Live Support Tree

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ABSTRACT

Betel cultivation is done according to two main systems called bed system and single pole system. A number of experiments were conducted during last few years at the Intercropping and Betel Research Station to find alternative support system. As a result, *Gliricidia* support tree found to be appropriate as an alternative live support for single pole system. Therefore, objective of this study is to assess root growth and development of betel under single pole system with either *Gliricidia* live support or concrete pole. As an initial step, this study was carried out in a four year old betel vines at the Intercropping and Betel Research Station, Dampalassa, Narammala. For this study 1/8 sector of cylindrical root environment of each planting point was excavated. Root separation was made on four layer basis (0-5, 5-10, 10-15, 15-20 cm) and at four distance classes (0-15, 15-30, 13-45, 45-60 cm) from the base. The root mean diameter, root length density and root dry weights were tabulated. In generally, betel root length density and root dry weight values under *Gliricidia* support trees were found to be higher than under concrete support. This may be attributed to the conduce microenvironment under live support than concrete support. Therefore, fertilizer quantity for *Gliricidia* supported betel is lower than concrete supported betel. As well as fertilizer application can be recommended 40 cm distance from support tree base.

KEYWORDS: Betel, *Gliricidia*, Root dry weight, Root length density, Root mean diameter

INTRODUCTION

Betel (*Piper betle*) is a perennial creeper belongs to the family piperaceae and the genus piper. The product is leaf obtained from the betel creeper (Anon, 2008).

Betel cultivation is generally practiced according to two main systems called bed system and single pole system. Traditionally, most of the betel farmers use dead wood sticks under bed system and some of the suitable species are Vearaniya *(Justica gendarussa)*, Korakaha *(Memecylon pinnata)*, and Malkera *(Ochna jabodapita)* (Anon 2011a). As there is paucity of dead wood poles, traditional betel farmers face many procedural difficulties in getting stick materials of these wild species. It's difficult to transport and fell these sticks due to legal issues (Anon 2011b).

As an alternative, some farmers use concrete poles as dead supports instead of wooden poles in Gampaha district (Anon, 2008). When considering about the single pole system, farmers use both of dead and live supports.

A number of experiments were conducted during last few years at the Intercropping and Betel Research Station to find alternative support system (Anon, 2008). As a result, *Gliricidia* support tree found to be appropriate as an alternative live support for single pole system. Hence single pole system is becoming popular among farmers. Therefore, the present study is to investigate the root distribution pattern of betel under single pole system and the observations of this study would be beneficial for preparing protocols for fertilizer and watering strategies for this new betel cultivation system. Therefore, the objective of this study is to assess root growth and development of under single pole system with either *Gliricidia* live support or concrete pole.

MATERIALS AND METHODS

Location

The study was conducted at the Intercropping and Betel Research Station, Dampalassa, Narammala, Department of Export Agriculture.

Soil Sampling Design

Root containing soil samples were collected using a serrated edge root sampling auger. Betel vines with live and dead supporters were selected from an existing experimental field. In order to obtain representative root samples from the combined root sphere of Betel and *Gliricidia*, 15 cm, 30 cm, 45 cm and 60 cm radius unicentered rings were marked around the base of the support tree. Further, for the purpose of obtaining root samples from different soil depths, soil samples were taken from segments of each ring randomly. Then in the same sampling

point of segment depth layer of 5 cm, 10 cm, 15 cm and 20 cm was marked and root containing soil samples were taken from different depth layers as described by Sumanasena and Wikramasingha (1997).

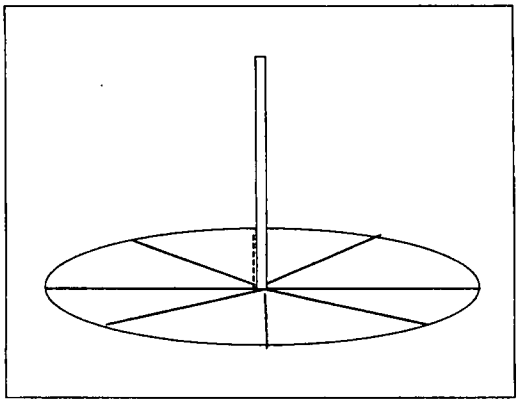

Figure 1. Soil sampling design

Before separating the roots from soil samples, those samples were stored for a maximum of 72 hr at 4°C until washing. The soil of each sample was thoroughly mixing with approximately 2l of water in a plastic container and then suspension was decanted through a 250 µm sieve, leaving sand in the plastic container and roots on the sieve fine root fragments were further separated from adhering silt and sand particles by directing a gentle flow of water through sieve using a wash bottle (Sumanasena, 2003).

Four year old betel vines trained as single pole system either on *Gliricidia* live supports (T1) or concrete poles (T2) was compared over 96 samples that were separately washed and root samples of each Betel and *Gliricidia* an appropriate were separated while washing. Volume of each soil sample was 251 cm^3.

Analytical Methods

Total Root Length

Root length was taken by counting the number of roots observed overlaying intersection between 1 cm grid lines. Root length was obtained by Newmen's methods as describe by Tennant (1975). According to them, total root length is given by,

Total root length (R) = Number of intercepts x π

Root length data were presented as root length densities (Lv) (cm\cm^3) for each sampling depth.

Total Root Volume

The volume of each root sample was measured by using a phycnometer (Herath, 2003). Results were reported as root volume density (cm^3 roots per cm^3 soil) for each sampling depth.

Root Dry Weight

Each root samples were oven dried at 70 °C for 24 hr and were weighed the samples.

Root Mean Diameter (RMD)

RMD was calculated by assuming that; roots are perfect cylinders. Under this assumption RMD is given by;

$$RMD = 10 \times \sqrt{\frac{4 \times root\ volume\ density}{\pi \times root\ length\ density}}$$

Data Analysis

The observations were in a wide range of 100 of magnitudes with different depth classes. Therefore, data were converted into Log scale and analyzed using GLM procedure of SAS 9.1.3 as appropriate. Results were converted back to using antilog. Least significant ratio values are presented as an appropriate (Sumanasena, 2003).

RESULTS AND DISCUSSION

Root Length Density (Lv) of Betel

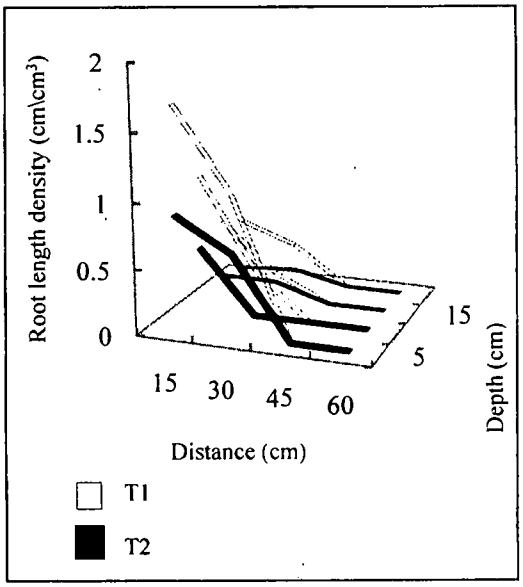

Figure 2. Root length density (lv) distribution of Betel under each system

Note: LSR values at the 0.05 level for different depth classes: 0–5 cm – 139.18, 5-10 cm -100.76, 10-15 cm -69.98, and 15-20 cm – 37.88)

Inspective of support material root length density (Lv) of betel significantly ($p<0.05$) decrease with distance from the base 0-15 cm to 45-60 cm distance class (Figure 2). Similarly Lv values were also significantly dropped from surface layer to 15-20 cm depth classes. Usually betel Lv values of betel roots

under *Gliricidia* support tree higher than concrete support. But it is not significantly different.

Root Mean Diameter of Betel

Inspective of support material Root Mean Diameter (RMD) of betel significantly ($p<0.05$) decrease with distance from base 0-15 cm to 45-60 cm distance (Figure 3). But RMD values were also not significantly dropped from surface layer to 15-20 cm depth classes.

Generally, betel RMD values under concrete support are higher than *Gliricidia* support tree. But these values are not significant.

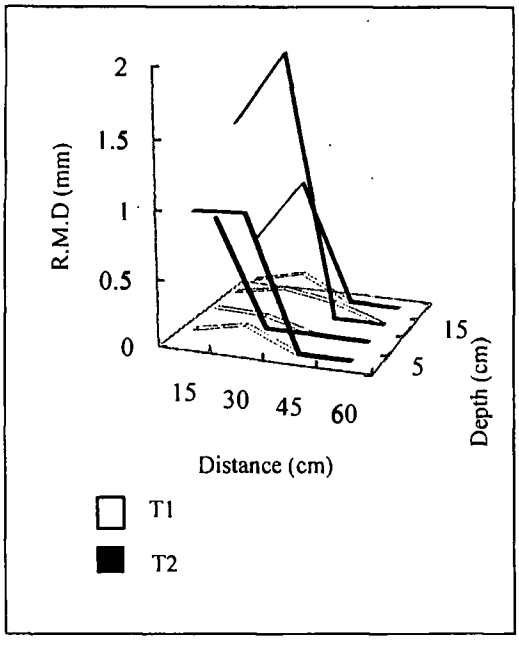

Figure 3. Root Mean Diameter distribution of Betel under each system

Note: (LSR values at the 0.05 level for depth classes: 0-5 cm – 288.7, 5-10 cm – 207.34, 10-15 cm –94.92, 15-20 cm – 139.63)

The smaller RMD values were observed under *Gliricidia* support trees. It indicates more branching on betel leaves under live support and this may be associated with comfortable microclimate for root growth of betel under companion support tree of *Gliricidia.*

Root Dry Weight (RDW) of Betel

Irrespective of support material, root dry weight of betel significantly ($p<0.05$) decrease with distance from 15-30 cm to 45-60 cm distance (Figure 4). Similarly RDW values were significantly dropped from surface layer to 15-20 cm depth classes also.

Root DW of betel under *Gliricidia* was higher than that under concrete support. However, it is not significantly different.

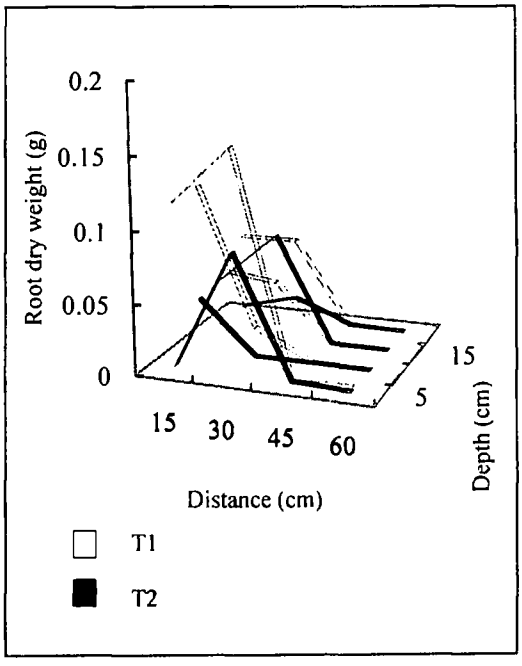

Figure 4. Root Dry Weight distribution of Betel under each system

Note: (LSR at the 0.05 level for depth classes: 0-5 cm –83.29, 5-10 cm – 184.45, 10-15 cm – 44.86, 15-20 cm – 28.45)

Combine effect of Gliricidia, Betel on Gliricidia and Betel on Concrete Root Growth and Development

The highest figure of each root parameter was observed for top soil depth class of 0-5 cm. Therefore, details for root length density as well as root dry weight with distances are shown for different distance classes.

The Lv values of each species become almost negligible at 40 cm distance under 0-5 cm depth class irrespective of treatment. It is important to observe that betel root Lv under concrete support were consistently higher until 40 cm distance with 0-5 cm depth class (Figure 5), values of Lv for *Gliricidia* were higher than betel root Lv of under the *Gliricidia* pole at 0-10 cm distance and beyond that different disappeared.

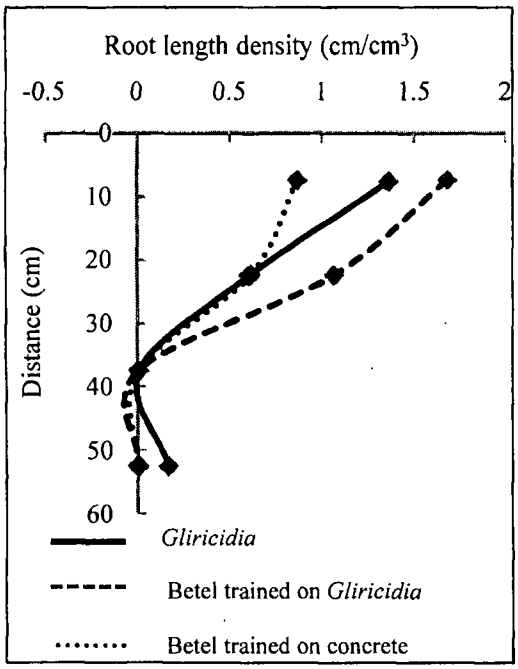

Figure 5. Combination of *Gliricidia*, Betel trained on *Gliricidia* and Betel trained on concrete root length density

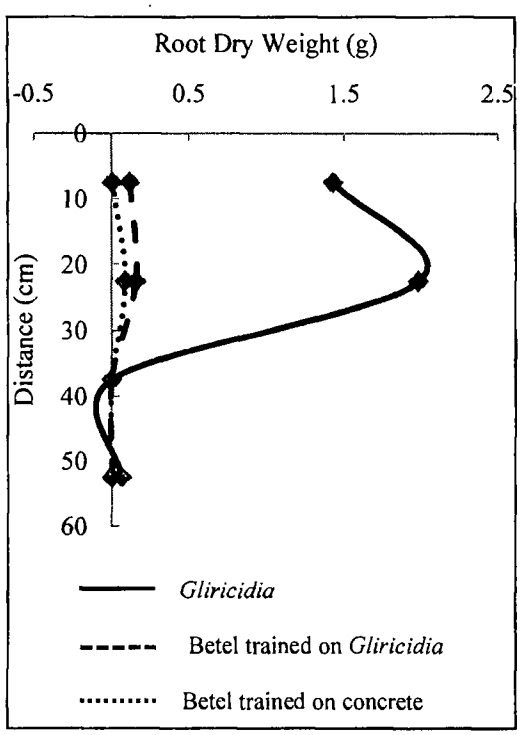

Figure 6. Combination of *Gliricidia*, Betel trained on *Gliricidia* and Betel trained on concrete RMD

CONCLUSIONS

Gliricidia support supply favorable condition for betel to root growth and development. Therefore, fertilizer quantity for *Gliricidia* supported betel is lower than concrete supported betel. As well as betel root distribution is disappeared at 40 cm distance in both support systems. Therefore, fertilizer application can be recommended 40 cm distance from support tree base.

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