

Study on Changes in Root Systems of Black Pepper (*Piper nigrum* L) and Support Tree (*Gliricidia sepium* L) between Two Consecutive Support Tree Prunings

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Introduction

Black pepper is highly demanding spice crop among the other spices which is known as 'king of the spices'. It is scientifically known as *Piper nigrum* L and belongs to family Piperaceae. It is the most distinct spice in international trade in Sri Lanka 2007 (Anon., 2007). It can be grown as a mono crop or mixed crop in coconut and tea plantations using a live or dead support. *Gliricidia sepium* is the commonly used support tree in Sri Lanka due to its higher availability, establishment rate, as well as low pest and disease condition (Anon, 1996). In addition to the above benefits, shade provided by *Gliricidia* is essential for growth of young pepper vines and reduces stress for mature vines during dry periods. (Gunarathne and Heenkenda, 2004).

But canopy growth rate of *Gliricidia sepium* is very high. Then there is a competition in between these two for sun light and other resources. Therefore, support for tree pruning is needed to facilitate light penetration to pepper canopy and to reduce the competition. In *Gliricidia sepium* L and black pepper system, removal of *Gliricidia* canopy enhances almost all the physiological activities of black pepper plant, but it reduces those in the support tree. Therefore, It may affect on the root activity and/or root volume of both Black pepper and support tree. These variations in both root systems, may directly affect on water and nutrient up take of pepper and ultimately on it's different yield attributes of the black pepper. Therefore, this study was carried out to study the effect of support tree canopy pruning on growth behavior of both pepper (*Piper nigrum* L) and support tree (*Gliricidia sepium* L) root systems and to find out the relationship in between canopy growth and root growth behavior of both pepper and support tree during two consecutive support tree prunings.

Methodology

The experiment was carried out at Central Research Station, Department of Export Agriculture at Matale, during the period of April to September 2011. The experiment was arranged with two treatments and three replicates using Complete Randomized Block Design. Those are pepper vine with unpruned support tree canopy (Control) and Pepper vine with pruned support tree canopy. Healthy and uniform black pepper vines with *Gliricidia* plants were selected from the research field. 30 black pepper vines were tagged from the selected plants and arranged them according to the experimental design. From the tagged plants, fifteen *Gliricidia* (support tree) plants were completely pruned and the other 15 fifteen plants were kept as unpruned. Three plants from each treatment were used for root data collection at each time interval. Plant base was cleaned and one third of circular area was marked with a radius of 80 cm. Soil layers were removed very carefully without

damaging both black pepper and *Gliricidia* roots up to 60 cm depth. Data on different root parameters were collected in both pepper and *Gliricidia*. First data set was collected immediately after the support tree pruning and other data sets were collected with in 3 weeks intervals in pepper plants with both pruned and unpruned *Gliricidia* plants. And also the height and width of the *Gliricidia* canopy were measured by using meter ruler. The total root length was measured by using grid method. The size of the grid was 1cm². The roots found from the cleared circular area were separated from soil and lengths were measured. Meter ruler was used for measuring thick roots, while the grid was used for fine roots. Then the fine root length of pepper and *Gliricidia* was measured by using the Tennat (1975) formula. Root length = 11/14 * Number of intercepts* Grid unit. Data analysis was done using T-test and Duncan's Multiple Range Test with 'SAS' package.

Results and discussion

There were significant differences between root lengths of pruned and unpruned *Gliricidia* plants. The mean root length of pruned *Gliricidia* plant was 543.37 cm, while it was 956.49 cm with unpruned *Gliricidia* plant. Further the T-test results have shown (P-Value = 0.0483) significant differences between the mean root length of pruned and unpruned *Gliricidia* plant at the 5% significant level. And also there were significant differences between root lengths of pepper under pruned and unpruned *Gliricidia* (P value= 0.0070).The mean root length of pepper under pruned *Gliricidia* was 625.35 cm, while it was 368.08 cm in pepper under unpruned *Gliricidia*.

The variation of pruned and unpruned *Gliricidia* root system with time (Figure 1) there was a reduction of the mean root length in both treatments up to six weeks after pruning, because of the drought condition prevailed during those days. Then because of the regrowth of the canopy, mean root length has been increased gradually. But the reduction rate of the mean root length of the pruned plant was higher than that of the unpruned *Gliricidia* plant. And all the mean root lengths of pruned *Gliricidia* plants are significantly lower than those of the unpruned *Gliricidia* plant with time. Chesney and Vasquez (2005) have reported in *G. sepium*, starch concentration in roots and stems of completely pruned trees was the lowest compared to unpruned and partially pruned, trees as the pruned trees produce more sprouts than unpruned trees. Further they have mentioned that both stem and root starch stores provide energy for shoot regrowth. At the same time, fine root biomass is also decreased with time in pruned trees and fine root length is decreased.

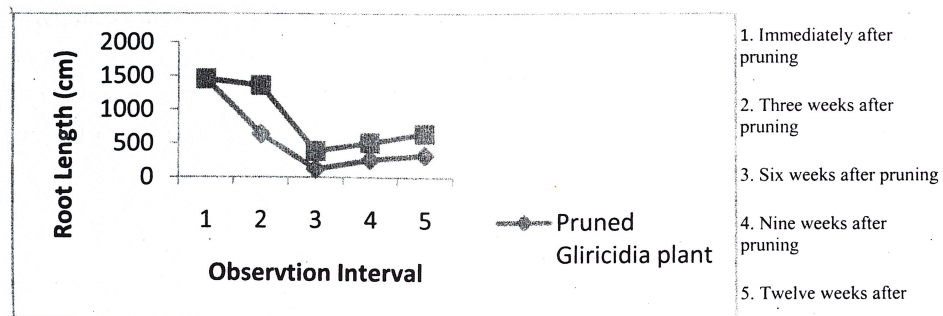


Figure 1: Changes of pruned *Gliricidia* and unpruned *Gliricidia* root system with time

The variation of pepper root under pruned and unpruned *Gliricidia* with time (Figure 2), there was a fast growth rate of the root length of the pepper under pruned *Gliricidia* three weeks after pruning of the *Gliricidia* plant. This may be due to the high amount of dry

matter production with higher light penetration to the pepper leaves. The dry matter would have used to increase the root length of pepper. And also the mean root length of pepper under pruned *Gliricidia* is higher than the mean root length of pepper under unpruned *Gliricidia*. The mean root lengths of pepper under pruned *Gliricidia* are significantly higher than those of the pepper under unpruned *Gliricidia* with time. There was not a significant difference of the mean root length of pepper roots under unpruned *Gliricidia* with the time

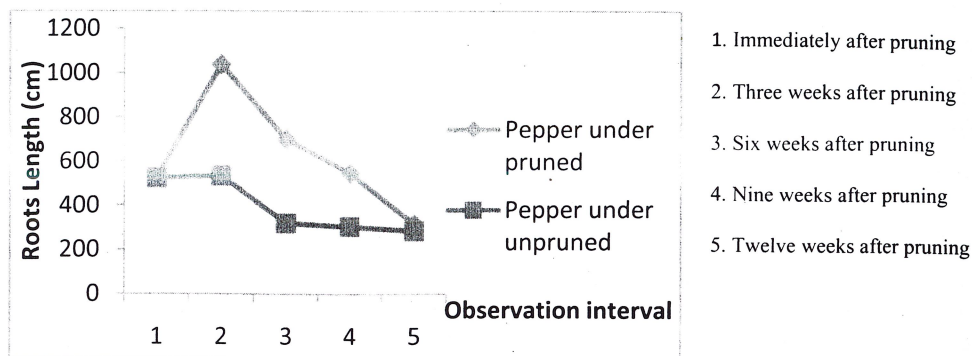


Figure 2: Changes of pepper root length under pruned and unpruned *Gliricidia*

There was a positive correlation (Correlation coefficient value 0.580) between *Gliricidia* canopy height and *Gliricidia* plant root length. But there was a negative correlation (Correlation coefficient value 0.662) between *Gliricidia* canopy height and pepper plant root length. Mean root length of Pepper decreases progressively with the growth of *Gliricidia* canopy.

Conclusions

Removal of *Gliricidia* canopy has greatly affected on the root behavior of both pepper and *Gliricidia* plants. Initially the growth of the fine roots of *Gliricidia* is retarded by the removal of *Gliricidia* canopy. Later it has increased with the re-growth of the *Gliricidia* canopy. Meantime, the growth of the fine roots of pepper has increased with removal of *Gliricidia* canopy initially. Again it is reduced with the re-growth of *Gliricidia* canopy.

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