Investigation on Effect of Irrigation Methods on Betel (*Piper betle* L.) Production.

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ABSTRACT

An experiment was conducted to study the effect of three different irrigation methods on betel (*Piper betle* L) production. They were arranged in a Randomized Complete Block Design (RCBD) with 3 replicates. The experiment was conducted from September 2004 to April 2005. The weight of "*Peeduna Kola*", "*Kanda Kola*" and mean growth rate of betel vine were recorded. Weight was recorded at three weeks interval and growth rate was recorded at two weeks interval. The results revealed that daily drip irrigation had a higher performance compared to daily splash manual irrigation and drip irrigation once in every three day interval.

KEY WORDS-Drip Irrigation, Evapo-Transpiration, Root Distribution, Soil Moisture Percentage.

INTRODUCTION

Betel vine (*Piper betle* L.) belongs to the family Piperaceae. Betel is native to central Malaysia and has spread throughout tropical Asia to Africa and history of betel in Sri Lanka reads since 340 A.D. (Senavirathna and Rathnasoma, 2002). Chewing is the main purpose of leaves. Other than that it is used in cultural, ceremonials and ayurvedic medicine.

It can be grown in elevations up to 1000m above Mean Sea Level in areas that receive, well spread rainfall throughout the year. Betel grows in well-drained Latarite soil. The major betel growing districts in Sri Lanka are Kurunegala (65%) and Gampaha (22%) for export (Anon, 2003).

Betel is a dioecious, perennial, climbing and semi-strong vine. Two types of simple leaves can be seen. They are called "*Kanda Kola*" and "*Peeduna Kola*", which arise from plagiotropic branches and orthotropic branches respectively.

Pakistan is the major market for Sri Lankan betel (Anon, 2002). Total betel exportation in 2002 was estimated to be 2778.088 T and it accounted for Rs 273.981 millions. In 2003 valued as exportation was Rs 301.115 millions for 2857.823 T (Anon, 2003).

Betel vine is very sensitive for both water stress and excess water. Therefore, it is essential to maintain an optimum moisture regime for a maximum yield. Under water stress conditions, leaves show buckling, reduction in leaf area, and production, while excess water may enhance fungal and bacterial diseases (Michael, 1973).

The frequent intermittent dry spell experienced during December to March in this region is able to cause moisture stress resulting in considerable production variation. Supplementary irrigation is essential during short intermittent dry spells for there continuous production of betel leaves.

The cost of irrigation for betel production has varied from 34% to 36% of total cost for betel, over five year duration budget (Anon, 1997).

In general, most betel farmers break dryness throughout splash. The available pattern on watering frequency is very limited for betel. There is a problem for farmers whether to apply water daily or at a few days interval. Therefore, the objective of this study was to further investigate the correct frequency and type of irrigation on betel production.

MATERIALS AND METHODS

A) Background.

This study was conducted at the Intercropping and Betel Research Station in Narammala (N.W.P) during the period of September 2004 to April 2005. The site is situated in the Low Country Intermediate Zone (L.C.I Z.) of Sri Lanka. The soil is moderately well drained, Latarite (De Alwis et al., 1973).

The plots were "flat sunken" beds in a size of 240cm × 120cm arranged on betel plant. The plots were demarcated using Cajan. There were 24 sticks for 48 vines (two betel vines per stick) in one plot. The betel was planted in three rows in spacing of 45cm between rows and 30cm within a row on September 3rd 2004. The spacing was 150 cm between two consequent plots. Betel was harvested at 21 days interval for export market. Pest management and other cultural practices were conducted as recommended by Department of Export Agriculture.

B) Design and analysis

Pressurized Drip Irrigation was used as the irrigation system. Water was conveyed through the gravity force. The 40 mm PVC (1.25") main supply line and NPC drippers (Non Pressure Compensated) of 4 (l/hr) rated discharge capacity were used for irrigation.

The following three supplementary irrigation methods were used in this study.

1. T1- Daily application of 5mm equal depth of water as splash by a bucket. (conventional manual watering).
2. T2-Daily drip irrigation at 5mm equal depth.
3. T3- Drip irrigation once in every 3 day interval – at 15mm equal depth.

The experiment was arranged in a Randomized Complete Block Design with 3 replicates. The

standard computer package, statistical analysis system (SAS, 1999) was used for data analysis and General Linear Model (GLM) procedure was used as the analytical tool. Mean separation was done using the Least Significant Difference (LSD).

C) Supplementary watering strategy.

The readily available soil water content was taken as 5 mm for 20 cm of root zone depth (Herath, 2003) .The above irrigation treatments were selected, referring to the result of a research study carried out on betel cultivation (Chandana, 2004).

Daily water requirement was taken as 5mm, considering the long term average daily pan evaporation of 5 mm for December to April at Regional Agricultural Research Station, Makandura. During the intermittent portion of receiving sufficient rainfall, the irrigation interval was extended. For example, the rainfall exceeded 20mm, 15mm, 10mm and 5mm the respective next irrigation was done in 4 days, 3 days, 2 days and 1day after considerable sunshine. If the rainfall was close to 5mm then the next irrigation was done in 1 day with a considerable sunshine (Chandana, 2004).

D) Betel vine selection.

The nine couple of betel vines were randomly selected from each plot for data collection.

E) Data collection.

1. Soil moisture content.

Soil moisture content was measured one hour after irrigation. Undisturbed core samples were collected using the standard sampling auger with a core guard and 100 cc stainless steel core. Samples were collected at 0-5cm, 5-10cm, 10-15cm and 15-20cm, depth intervals from the center of two rows, between two vines and 10cm apart from the vine. Then the soil samples were weighted and placed in an oven at 105°c temperature for 72 hours. The dry weights were taken from each sample. Finally core weight of respective sample was taken individually.

Gravimetric soil moisture

$$\text{Percentage\%} = \left(\frac{W1-W2}{W2}\right)\times 100$$

$$\text{Bulk density} = \left(\frac{W2}{V}\right)$$

W1 = Wet soil –core
W2 = Dry soil –core
V = Volume of core
Bulk density =T1:- 1.08 g/cm^3
T2:- 1.15 g/cm^3
T3:- 1.17 g/cm^3
Volumetric water content =Gravimetric soil moisture percentage × Bulk density.

2. Weight of betel leaves.

The selected betel vines leaves, were harvested in every 3-weeks. Weighing was done immediately after harvesting using an electric balance.

3. Growth rate of betel vine.

The height of betel vine was measured from the stem base as described in a previous research study (Chandana, 2004).

$$\text{Mean growth rate of betel vine} = \frac{\text{Final height- Initial height (cm)}}{\text{Duration (Wks)}}$$

RESULTS AND DISCUSSION

1. Weights of mean "*Peeduna Kola*" leaves were recorded at 16, 19, 22, 25, and 28 weeks after planting.

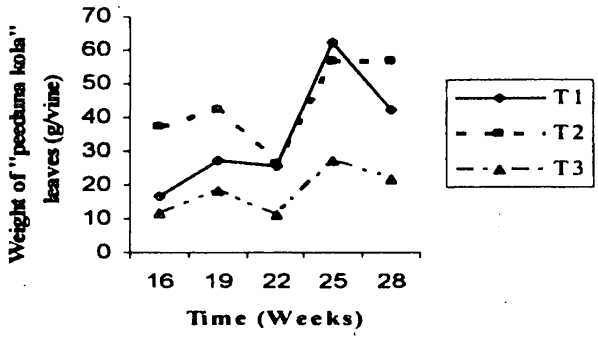

Figure 1. Weight of "*Peeduna Kola*" with time.

It was observed that weight of "*Peeduna Kola*" in betel vines under T2 treatment had a significant difference with other two treatments, only during the 16th week. The weight of "*Peeduna Kola*" under T3 had a significant difference with other treatments during the 16th to 28th weeks. But yields under T1 and T2 did not have a significant difference except in the 16th week. Treatment (T2), recorded a higher value than T1 in every week except in 25th week (Figure-1). Treatment (T3) gave the lowest weight throughout the harvesting period (Figure 1).

2. Weight of "Kanda Kola" leaves were recorded in 16th, 19th, 22nd, 25th, and 28th weeks after planting.

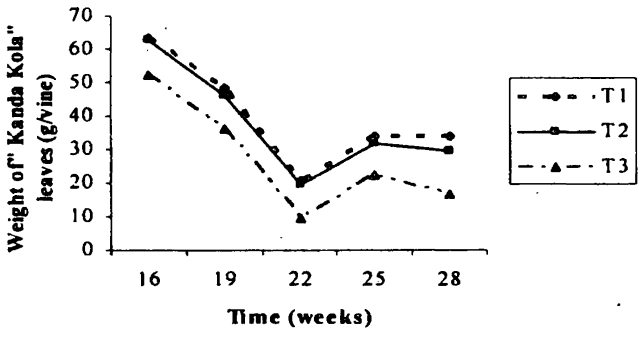

Figure 2. Weight of "*Kanda Kola*" with time

In general, "*Kanda Kola*" weight was decreasing from 16th to 22nd weeks after planting and yield slightly increased at 25th week irrespective of treatment effect (Figure 2).The "*Kanda Kola*" weight of T3 was always smaller than each of T1 and T2. It was important to note that the weight of "*Kanda Kola*" under ,T3 was always significantly smaller than of each T1 and T2 except 16th week (Figure 2). Even though the weight of "*Kanda Kola*" of T1 were always greater than T2 it was no significant.

Table 1- Water balance and irrigation days within the study period (December 2004 to April 2005)

Irrigation treatment	No. of irrigation days	Quantity (mm)	Total Rainfall (mm)	Estimated total ET (mm)
Drip daily	73	365	171.7	377.06
Splash daily	73	365	171.7	377.06
Drip once in every 3 day	21	315	171.7	377.06

Table 2. Mean growth rate of betel vine (cm/wks)

Treatment	Mean growth rate (cm/wks)
T1	12.09b
T2	13.00a
T3	11.80b
LSD	0.8266

Figures denoted by different letters are significantly different by LSD ($p < 0.05$)

It was observed that mean growth rate of betel vine under T2 was significantly different from other two. But no significant difference was found between T1 and T3. Treatment (T3) was given the lowest value of mean growth rate (Table 2).

Slightly positive total soil water balance was observed for the study period (Table 1). Nevertheless, the fact of irrigation rainfall distribution pattern with 24 consecutive dry days out of 73 days of negative water balance for the study period. According to the preliminary statistical analysis significant treatment effect was observed for certain leaf production parameter for certain harvests with the increase of dry spell (Balasubramanium, 1987).

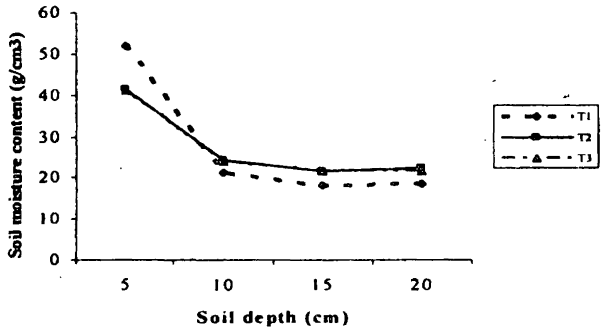

Figure 3. Volumetric water content of soil at different depths.

The highest volumetric water content (0-5 cm depth of profile) of 51.9g/cm^3 was recorded for T1, and T2 and T3 were recorded as 46.6g/cm^{3}and 41.03 g/cm^3 respectively (Figure3). However, the highest volumetric water content of 5-20 cm depth of profile was recorded at T2 and T3 and the lowest value was observed at T1.

The soil profile in 5-20cm depths represented a higher soil moisture percentage under daily drip irrigation than daily splash irrigation. It is in agreement with the results of study on betel cultivation by Herath 2004. The application of drip irrigation was focused on the root zone and not on the whole area as in the splash method. It may be the cause for higher yield and mean growth rate capacity of the daily drip irrigation compared to daily splash irrigation.

CONCLUSIONS

Yield parameters of "*Peeduna Kola*" and all growth rates under daily drip irrigation have shown a higher value than other two treatments. Nevertheless, "*Kanda Kola*" yield parameter on daily splash irrigation showed a higher mean value.

It was observed that growth and yield parameter of once in every three day interval drip irrigation had lower mean values. It may be attributed to large amount of water leaching during the once in every three day interval irrigation. Further studies are to be carried out for recommending a correct interval of drip irrigation for betel.

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