

GROWTH, FLOWERING AND YIELD PERFORMANCE OF PAPAYA (*Carica papaya* L.) UNDER DRIP AND BASIN IRRIGATION

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ABSTRACT

Studies on growth and yield of papaya under drip and conventional irrigation in Sri Lanka are scarce. This study was carried out in Neelabemma (DL3) on RBE soil. Plants were established under drip and basin irrigation systems, each in an area of 1600 m² using Randomized Complete Block Design with four replicates with 256 plants per treatment. Drip irrigation was provided at initial, mid and late growth stages at the rate of 4, 6 and 16 L per day per plant. The conventional method of basin irrigation was used as farmer practice. A fertilizer mixture was prepared according to Department of Agriculture recommendation (DOA) for fertigation using urea, muriate of potash and phosphoric acid at the rate of 335kg, 720kg and 75 L per hectare per annum respectively. In the basin irrigation treatment, the DOA recommended fertilizers were applied manually.

There were no significant differences in growth parameters, time of flowering and yield in the two irrigation systems. Average yield was 37 t/ha. However, water usage, weed infestation and labour requirement were higher in basin irrigation. Hence, drip irrigation may be considered more advantageous than the conventional basin system particularly for commercial scale cultivation, even though the initial cost is higher.

KEY WORDS : Drip Irrigation, Fertigation, Growth, Papaya (*Carica papaya* L.) and Yield

INTRODUCTION

Papaya (*Carica papaya* L.) is an important and popular fruit crop in Sri Lanka due to the wide distribution, year round availability and high demand. Commercial scale cultivation is mainly restricted to the dry and intermediate zones, because of land availability and low incidence of Papaya Ring Spot Virus (PRSV). Under rain-fed conditions, production of papaya has been seriously affected due to low water availability during long dry spells in dry and intermediate zones. In conventional method of irrigation, excess water is applied to the crop and usually much of it is lost. In drip irrigation on the other hand, water is directly applied to the root zone of the crop at the required rate to achieve high water use efficiency. With drip irrigation, it is also possible to apply fertilizers in soluble form. This process known as fertigation has several advantages over the traditional method of fertilizer application. In drip irrigation, the wetted soil volume is limited and the root system is naturally confined to this zone. Nutrients in the root zone are depleted quickly and hence continuous application of nutrients along with the irrigation water is necessary for adequate plant growth (Dasberg and Or, 1999). Basin irrigation system is a conventional method practiced by most farmers.

YIELD PERFORMANCE OF PAPAYA

As information on growth, time of flowering and yield of papaya under drip and basin irrigation systems are scarce, studies were carried out in Neelabemma in the Puttalam district (low country dry zone) to compare the performance of the crop under the two irrigation systems.

MATERIALS AND METHODS

The major soil group in the experimental site was Reddish Brown Earth (Alfisols), which has an available water capacity of 85 mm in meter depth of soil (Panabokke, 1967). Average annual precipitation in Puttalam over a period of ten years (1987- 96) is 1154 mm and is characterized as a bimodal rainfall pattern.

The treatments used were drip and basin irrigation systems, design was Randomized Complete Block Design (RCBD) with four replicates with 256 plants per treatment. Spacing in both treatments was 2.5 m x 2.5 m (1600 plants/ha). Raised beds of dimension 20m x5m (16 plants/bed and 4 beds/replicate) were used for drip-irrigated plants. The basin was prepared by raising the bunds. Each replicate had eight basins with eight plants per basin.

Two months old seedlings of variety "Rathna" were transplanted in November 2000. About 10 kg cattle manure were applied to each planting hole followed by DOA recommended basal fertilizers (urea 60g, TSP 40g, and MOP 130 g) at planting for both treatments. Application of fertilizer mixture for different treatments commenced 2 months after planting. In basin irrigation, the fertilizers were applied manually at 3 months interval. Total quantity of NPK used in both systems was equal.

In drip irrigation Urea and MOP (1100 and 347, g /L at 20°C respectively; Miller *et al.* 1975) were the N and K sources while phosphoric acid was the P source due to its solubility (457 g /L at 20°C) and ability to prevent emitter blockage (Lupin *et al.* 1996; Bar-Yosef, 1998). The nutrient solution was distributed at 3 days interval. Amount of water used for initial, development and late growth stages was 4, 6 and 16 L per day per plant respectively. Water was discharged daily using two emitters at a discharge rate of 3.5 L/h and distributed through two emitters attached to a one-meter long vinyl tube (0.5cm diameter) placed 40 cm from the stem of the tree (Medagoda, 2000).

In the basin irrigation treatment the basins were irrigated weekly to cover the soil as usually practiced by farmers and repeated every 7 days.

No irrigation was supplied to both treatments during the rainy season. Growth, time to 50% flowering and yield parameters of papaya under both irrigation systems were recorded. Height of tree, girth, petiole length, leaf length and leaf breadth were measured in 20 randomly selected hermaphrodite plants of each treatment. Girth was measured 15 cm above ground level. Leaf measurements were taken from the middle, fully opened leaves. Data obtained during 4th, 6th and 11th month after field establishment were analyzed by repeated measure analysis. Yield records were taken during a period of one year.

RESULTS AND DISCUSSION

Water requirement varied according to prevailing climatic conditions, soil type and plant factors such as variety and growth stage. The rainfall pattern in Puttlam district is bimodal and distributed from about mid September to mid January followed by a short spell during April. During the long dry spell, rainfall is not sufficient to meet the water demand of the papaya crop and hence, during this period irrigation is required to ensure better production. However, during the rainy season no irrigation is necessary. Plant growth data at different stages (4th, 7th and 11th month) are given in Table 1.

Table 1. Result of repeated measure analysis of growth measurements

Measurement	P value for trend		P value for trend between treatments	
	Linear	Quadratic	Linear	Quadratic
Height	0.0001	0.9632	0.3128	0.7970
Girth	0.0001	0.0295	0.0517	0.9562
Petiole Length	0.0001	0.0298	0.3257	0.2643
Leaf length	0.3388	0.1962	0.0220	0.6405
Leaf breadth	0.5145	0.0447	0.0061	0.7476

Results indicate that the trend in height changes was linear (p value= 0.0001) in both treatments (p value = 0.3128). The trend in plant girth and petiole length changes were quadratic and the error mean square of the quadratic trend was lesser than in the linear trend. Leaf breadth was also quadratic in both treatments. There was no linear or quadratic trend in leaf length. Number of days to reach 50% flowering was 105 days in both treatments.

During the first year there was no significant difference in yield between the two irrigation systems and average yield was 37 t/ha (Table 2). This is probably because there was no significant water stress during crop growth in both treatments.

Table 2. Papaya yield in the two irrigation systems during first year

Irrigation system	Mean yield (t/ha)
Drip	38.0
Basin	36.7
CV (%)	32.0

The experiment revealed that there is no significant difference in growth, time of flowering and yield between treatments. However, there may be advantages of drip irrigation over conventional basin system in commercial plantation even though the initial cost is high in drip system.

YIELD PERFORMANCE OF PAPAYA

CONCLUSION

Amount of water used for drip irrigation at initial, development and late growth stages were 4, 6 and 16 L per day per plant respectively. The fertilizer mixture used for fertigation comprised of 335 kg urea, 720 kg muriate of potash and 75 L phosphoric acid for a hectare per annum. Average fruit yield was 37 t/ha. Growth, time of flowering and yield data collected over a period of one year showed no significant difference between treatments. However, water usage and weed growth were higher in basin irrigation, while in drip irrigation water usage was more efficient. Low labour requirement for manuring and weeding were added advantages of the drip irrigation system.

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