Effect of Different Mulching Materials on Productivity of Papaya (*Carica papaya*) and Soil Moisture Availability

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Abstract

Mulching is the process or practice of covering the soil/ground to make more favorable conditions for plant growth, development and efficient crop production. Effects of different mulching materials on the productivity of papaya and soil moisture availability was conducted at the Aralaganwila Research Station during 2005/06 *maha* to 2006 *yala* seasons in a Non Calcic Brown soil. Six mulching materials and a control (without mulch) were tested in a randomized completely block design with four replicates as follows: T1; (Rice straw)-8t/ha, T2; Gliricidia (*Gliricidia sepium)*-8t/ha, T3; Guinea grass (*Panicum maximum*) - 8t/ha, T4; Ipil ipil (*Leucaena leucocephala*)- 8t/ha, T5 - Control (No mulch), T6- Polythene mulch, T7- Straw (2t/ha) + Gliricidia (2t/ha) + Guinea grass (2t/ha) + Ipil-Ipil (2t/ha). The highest crop growth and yield was recorded by the treatment of Straw (2t/ha) + Gliricidia (2t/ha) + Guinea grass (2t/ha) + Ipil-Ipil (2t/ha). Highest soil moisture availability in the surface soil was also recorded by the same treatment. Other than above treatment, only Guinea grass 8t/ha (T3) recorded the higher papaya yield than the control. Based on the results it can be recommended to use the mixture of mulching materials at the rate of 2t/ha each among the treatments tested to achieve higher papaya yield and soil moisture availability.

Key words : Mulching, Papaya, Soil moisture, Papaya yield

Introduction

Limitation of water resources is a cause of decreasing of crop production in agricultural systems especially in dry zone of Sri Lanka. Many approaches have been proposed to provide crop water requirements and alleviate the impacts of water shortage on plant production. Fallowing and mulching are the two commonly used methods of organic matter management and thereby nutrient recycling in tropical farming systems. Surface applied mulches reduce soil erosion and evapotranspiration, thus enhancing the potential for increasing water conservation, which is highly important for improving dry land crop production.

Mulching ameliorate soil moisture deficits and extremely high soil temperature regimes. Mulching in addition has also been shown to improve water infiltration, reduce evaporation and run-off, control weeds and improve soil structure (Chopra and Chauhadry, 1980).

Soil mulching has been reported to influence soil organic matter content, activity of microorganisms, availability of soil nutrients, control of soil erosion and soil compaction. Soil microorganisms are active in the plant residue types of mulches especially at the soil surface where both the soil and mulch are moist. The nitrogen-fixing bacteria require nitrates for their metabolism while breaking down organic matter. Mitchell and Lanini, (1999) reported that the use of mulch materials with different C/N ratios (which vary from low/moderate to high) produced differences in N mineralization, C and N formation in soil. Therefore, the objectives of this study were to examine the suitability of different mulch materials on growth and yield of papaya and soil moisture availability.

Materials and Methods

The effect of mulching materials on the productivity of Papaya (*Carica papaya*) and soil moisture availability was studied from 2005/06 *maha* to end of the 2006 *yala* season at the Regional Agricultural Research and Development Centre, Aralaganwila, (DL_{2b} Agro

Ecological Zone) Sri Lanka under Non-Calcic Brown soil. The study area has distinctly uni-modal rainfall pattern with an average rainfall of 1100 mm. The texture of the soil of the experimental site was sandy clay loam with slightly acidic in reaction. Six mulching materials were tested in a randomized complete block design with four replicates. Treatments used were T1: 8t/ha of Rice straw, T2: 8t/ha of Gliricidia (*Gliricidia sepium*), T3: 8t/ha of Guinea grass (*Panicum maximum*), T4: 8t/ha of Ipil ipil (*Leucaena leucocephala*), T5: Straw (2t/ha) + Gliricidia (2t/ha) + Guinea grass (2t/ha) + Ipil-Ipil (2t/ha), T6: Straw (1t/ha) + Gliricidia (1t/ha) + Guinea grass (1t/ha) + Ipil-Ipil (1t/ha),T7: Polythene mulch. Each treatment plot was consisted four papaya plants (variety Rathna) in 3m x 3m spacing. Mulching materials were applied uniformly half meter away from the base of the papaya plants and covering the rest of the plot. Chemical fertilizer application and other crop management practices were done according to the recommendation of the Department of Agriculture (Anon, 1990). Equal amount of irrigation water was applied to the each treatment plot using a bucket. Plant height was measured at 3 months after planting. Fruit yield was measured both as number of fruits per tree and total weight of fruit per plant. Irrigation was practiced in weekly interval. Surface (0-15 cm) soil moisture content was measured at two months intervals using gravimetric method just before the irrigation.

Results and Discussion

There was a total of 923.5 mm of rainfall received during the experimental period. Out of that, 619.4 mm rainfall was received during the *maha* season and the balance was received during inter monsoon and the *yala* season.

Plant height of papaya at 3 months after planting was significantly higher in both Straw (2t/ha) + Gliricidia (2t/ha) + Guinea grass (2t/ha) + Ipil-Ipil (2t/ha) and Gliricidia 8t/ha treatments. However, increased plant height recorded under Gliricidia (8t/ha) was not reflected in the fruit yields (Table 1) and the reason might be the fast decomposition of gliricidia leaves and resulting nutrient release before papaya trees attaining the reproductive stage.

Highest fruit yield per tree was recorded by the mulch combination of Straw (2 t/ha) + Gliricidia (2 t/ha) + Guinea grass (2 t/ha) + Ipil-Ipil (2 t/ha). However, it was on par with the mulch treatments of Guinea grass and Ipil-ipil. Among the treatments, only the Straw (2 t/ha) + Gliricidia (2t/ha) + Guinea grass (2 t/ha) + Ipil-Ipil (2 t/ha) treatment and Guinea grass (8 t/ha) recorded a fruit yield higher than the control. Highest fruits per tree was also recorded by the treatment of Straw (2 t/ha) + Gliricidia (2 t/ha) + Guinea grass (2

Table 1. Plant height, fruit yield, and gravimetric soil moisture content under different mulching treatments

Treatments	Growth and yield			Gravimetric soil moisture % (months after planting)			
	Fruit yield /tree (kg)	Fruits/tree	Plant height (cm)	2 month	4 month	6 month	8 month
T1	5.8^{bc}	10.5^{b}	116.6^{ef}	14.2^{b}	14.7^{ab}	7.3^{ab}	7.7^{b}
T2	5.1^{c}	9.0^{b}	143.3^{a}	11.1^{cd}	11.5^{cd}	5.1^{e}	5.5^{de}
T3	10.5^{ab}	12.0^{ab}	133.0^{bc}	12.7^{bc}	13.7^{bc}	6.8^{bc}	7.2^{bc}
T4	8.0^{abc}	8.5^{b}	127.3^{cd}	12.3^{c}	13.2bcd	6.4^{cd}	7.0^{bc}
T5	12.6^{a}	15.2^{a}	145.0^{a}	16.6^{a}	16.6^{a}	7.5^{a}	8.9^{a}
T6	6.8^{bc}	8.2^{b}	119.0^{def}	11.7^{cd}	12.5^{bc}	5.8^{d}	5.8^{d}
T7	4.4^{c}	7.5^{b}	109.0^{f}	9.8^{d}	10.1^{d}	4.2^{f}	4.9^{e}
SED	2.2	2.1	4.6	0.9	1.0	0.3	0.4
CV %	37.4	29.7	4.4	8.8	9.9	6.5	7.7

Means within a row bearing same superscripts are not significantly different (p>0.5)

t/ha) + Ipil-ipil (2 t/ha). It was the only treatment which recorded the higher number of fruits per tree than control. This may probably due to the nutrient release pattern of the different mulching materials with different decomposition rates as compared with the other organic mulches which might have lack of variety of decomposition and synchrony of nutrient release and crop demand. Selecting and mixing prunings of different quality is a possible option for improve synchrony when prunings are used as a source of N for crops.

Application of high quality prunings can result in release of N too soon leading to higher losses, whereas, poor quality prunings release nitrogen too slow to satisfy requirement of crops. The underline principle behind mixing the prunings of different quality is that since N release is linked to protein binding capacity of the prunings, mixtures of prunings with low and high protein binding capacities can have the effect of delaying N release from high quality prunings with low protein binging capacity. Accelerated N release can occur later as the Pholyphenols are degraded. It is also hoped that in case that the prunings of different quality releases N independently, early nitrogen requirement by crop is met from the high quality prunings, whereas, the requirement during later stages of growth is satisfied by the slow- decomposing low quality prunings.

Mulching may also have synergistic effects with fertilizer use. Crop residue mulches with low C:N ratios had more beneficial effects than those with high C:N ratios. On an Ultisol in eastern Nigeria, the yield of plantain and bananas was drastically improved by residue mulch.
Gravimetric soil moisture content of surface (0-15cm) soil were highest under the treatment of Straw (2t/ha) + Gliricidia (2t/ha) + Guinea grass (2t/ha) + Ipil – ipil (2t/ha). Gliricidia mulch showed lower surface soil moisture content from the beginning of measurement which was similar to the control treatment. This may probably be due to the higher decomposition rate of the Gliricidia leaves and the majority of the applied Gliricidia mulch might have decomposed within the first few weeks after application (De Costa, and Atapattu, 2001). Compared to the other organic mulches, straw mulch recorded relatively higher surface and sub surface soil moisture content, however, inferior to the Straw (2 t/ha) + Gliricidia (2 t/ha) + Guinea grass (2 t/ha) + Ipil – ipil (2 t/ha) treatment. The recalcitrant nature of the straw might have shown some resistant to decomposition as well as it might have acted as a sponge and might have absorbed much of the rain water and irrigation water. It was also reported that straw mulch can be considered as an agronomic input with the potential to ameliorate stress by reducing evaporation of moisture from the soil and increasing infiltration rate. While the season progress there was a declining trend of surface soil moisture content. Polythene sheet mulch however, failed to maintain a relatively higher soil moisture range throughout the growth period. Although, it might have minimized the soil moisture evaporation, it also might have reduced the rainwater infiltration by acting as a barrier. Lowest soil moisture status was obtained under no mulch treatment (control) throughout the seasons. The improved soil moisture regimes might have enhanced the growth of papaya plants possibly through greater soil moisture and nutrient uptake.

Conclusion

This study showed that Papaya responded to mulching mixture. The advantages derived from mulching mixture were reflected in improved plant height, fruit yield and soil moisture availability.

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