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# The Impact of Type and Level of Tree Leaf Mulch on Pearl Millet Yield Attributes, Yield and Economics in Custard Apple Based Agri-Horti System

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## ABSTRACT

An evaluation of the effects of leaf mulch type and leaf mulch level on the yield attribute, yield, and economics of pearl millet was conducted in a field experiment using a custard apple-based agri-horti system. The experiment used a factorial randomized block design with three types of mulch - *Azadirachta indica*, *Eucalyptus species*, and *Leucaena leucocephala*and three leaf mulching levels - 0, 2, and 4 tha$^{-1}$ replicated thrice. The application of 4 t mulch ha$^{-1}$ produced the highest no of grain panicle$^{-1}$1188, grain weight panicle$^{-1}$ 12.82gm, test weight 10.55, grain yield of 1735 kg ha$^{-1}$, gross return Rs75468ha$^{-1}$, net return Rs 50982.33ha$^{-1}$, and B:C ratio 3.18. while the use of *Leucaena leucocephala* leaf mulching produced the highest no of grain panicle$^{-1}$1113, grain weight panicle$^{-1}$12.35gm, test weight 10.96 gm, grain yield of 1657 kg ha$^{-1}$ gross return (Rs 72817ha$^{-1}$), net return (Rs 488922ha$^{-1}$), and B:C ratio (3.15)

**Keywords:** Agri-horti system, Pearl millet, Custard apple and tree leaf mulch

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## INTRODUCTION

Among the different land use systems, the agri-horti system is the most significant in terms of the farmers' financial gains. Numerous agro-horticultural and agro-forestry systems have proven to be very profitable. An observable net effect of one component on another in a system can be used to explain the nature of interaction between two components.

In the early stages of orchard establishment, the agri-horti systems provide a more efficient use of land and a higher economic return than the corresponding sole crop because the tree and crop components support each other by fostering growth conditions that are favourable to their respective growth. Additionally, the component interactions are advantageous when rain is present.

The tropical custard apple, or *Annona squamosa* L., is primarily a desert fruit that is typically consumed fresh. There is a noticeable amount of vitamin C (35-42 mg/100 g). Thiamine, potassium, and dietary fibre have important nutritional values as well. Vermicidal and insecticidal properties are effectively exhibited by green fruits, seeds, and leaves. There have been reports of medicinal benefits for leaves, shoots, bark, and roots. The root is a strong purgative, and the unripe fruit is astringent. It grows well with short-duration arable crops and can be planted as a shade tree.

The majority of the world's pearl millet is grown in Asia (roughly 12 million ha) and Africa (roughly 14 million ha). After rice, wheat, and maize, pearl millet is the fourth most extensively grown food crop in India. With an average production of 8.61 million tonnes and a productivity of 1243 kg/ha in 2018-19, it covers an area of 6.93 million ha. Of all the pearl millet produced in India, about 44% is produced in Rajasthan.

The remaining major producers, with a 15% share, are Gujarat, Maharashtra, Haryana, and Uttar Pradesh. 11.4%, 10.8%, and 10.5% in that order. Due to its superior adaptation to hot, marginal soil compared to other cereals, it is a significant crop in the arid and semi-arid regions. It is frequently grown in harsh environments with regular droughts, high temperatures, variable rainfall, and rich soils that cannot hold much water.

Mulching has been shown to be a very successful method of preserving moisture and inhibiting the growth of weeds. The growth and yield of crops grown in arid regions during the *Kharif* season are significantly impacted by the unpredictable rainfall of the monsoon season. Effective use of soil and water conservation techniques is essential for a crop to be successful in these areas (Hari Om *et al*., 2013) and (Sharma *et al*., 2017).

By reducing evaporation, increasing infiltration, controlling runoff, and suppressing weed growth, leaf mulching influences soil water. Through radiation shielding, heat

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conduction and trapping, and evaporative cooling, they influence the temperature of the soil. By adding organic matter, promoting differential nitrification, increasing mineral solubility, enhancing soil structure, and influencing microbial and soil fauna populations, leaf mulching enhances the nutritional status of the soil. It also has a positive impact on the soil biological regime. They also lessen evaporation and the subsequent return of salts to the leaching zones, which has an impact on soil salinity.

## MATERIALS AND METHODS

The study was conducted in the Vindhyan area of the Mirzapur district at the Agricultural Research Farm, Rajiv Gandhi South Campus, Banaras Hindu University, Barkachha, Mirzapur (UP). The experimental site is situated at a height of 147 metres above mean sea level and lies inside the sub-tropical zone, specifically at latitude 250 10' N and longitude 820 37' E.

During the *Kharif* season, a field experiment was carried out using seven-year-old custard apples that were planted with a spacing of 5.0 X 5.0 meters. In this experiment, three types of mulch-*Azadirachta indica, Eucalyptus species,* and *Leucaena leucocephala*as well as three leaf mulching levels-0, 2 and 4 tha$^{-1}$were imposed on pearl millet using a factorial randomized block design replicated thrice. All other practices were maintained as usual. Plants were separated from one another by roughly 15 cm through thinning. Following the established protocols, data were recorded. The net plot's seed production was carefully cleaned, sun dried, and weighed according to treatment. After that, the net plot yield was translated and given in kg/ha. After the panicles were removed, the plants in each plot were taken out of the ground, and the stover was allowed to completely dry before the total weight was noted. Grain yield plus stover yield equals biological yield. The harvest index was calculated by dividing the economic yield by the biological yield and multiplying by 100.

Based on the current market pricing, the cost of cultivation, gross return, net returns, and benefit cost ratio of the various treatments were calculated. Power and labour were estimated ha$^{-1}$ using standard rates for various processes such as harrowing, ploughing, planting, weeding, and harvesting. Seed and fertilizer costs were taken into account while determining market prices. The benefit cost ratio and net return (Rs ha$^{-1}$) were calculated using the following. Net return (Rs ha$^{-1}$) is equal to gross return (Rs ha$^{-1}$) minus cultivation costs (Rs ha$^{-1}$). Benefit: cost ratio: gross return (Rs ha$^{-1}$) divided by cultivation costs (Rs ha$^{-1}$)

The data was analysed using the analysis of variance technique. According to Steel & Torrie (1984), differences in the treatment mean were compared using the least significant difference (LSD) at a 5% probability level.

**Table 1:** Under a custard apple-based agri-horticulture system, the type and quantity of tree leaf mulch affected the test weight (gm), the number of grain panicle -1, and the grain weight (gm) of pearl millet.

| Treatment | Grain Weight Panicle$^{-1}$ (gm) | No of Grain Panicle$^{-1}$ | Test Weight (gm) |
|---|---|---|---|
| **Type of Mulch** | | | |
| *Azadirachta indica* | 11.88 | 1081 | 10.74 |
| *Eucalyptus spp.* | 11.73 | 1078 | 10.21 |
| *Leucaena leucocephala* | 12.35 | 1113 | 10.96 |
| S.Em. ± | 0.35 | 10 | 0.16 |
| CD at 5% | NS | 30 | 0.49 |
| **Quantity of Mulch (t/ha)** | | | |
| 0 | 10.88 | 958 | 9.71 |
| 2 | 12.26 | 1127 | 10.65 |
| 4 | 12.82 | 1188 | 11.55 |
| S.Em. ± | 0.35 | 10 | 0.16 |
| CD at 5% | 1.06 | 30 | 0.49 |
| **TxQ Interaction** | **NS** | **NS** | **NS** |

## RESULTS AND DISCUSSION

Table 1's data showed that while the changes in grain weight panicle $^{-1}$ (gm) related to mulch type were found to be non-significant, the application of 4 t and 2 t ha$^{-1}$ of mulch was found to be considerably better than that of 0 t ha$^{-1}$. The interaction was not found to be significant.

The application of *Leucaena leucocephala* leaf mulch produced the maximum grain panicle$^{-1}$; this difference was significant when compared to the application of *Azadirachta indica* and Eucalyptus spp. mulch, yet these two types of mulch did not differ from one another. The amount of mulch applied varies greatly from one another. The highest grain panicle had a 4 t ha$^{-1}$application of mulch, whereas the lowest had a 0 t ha$^{-1}$ application. There was no meaningful interaction identified.

The application of leaf mulch from *Leucaena leucocephala* produced the highest test weight, while Eucalyptus spp. produced the lowest. The application of leaf mulch from *Azadirachta indica* and *Leucaena leucocephala* did not differ significantly from one another, however both were determined to be superior to Eucalyptus spp. The test weight (g) for 0, 2, and 4 t ha$^{-1}$mulch applications varies greatly from one another and increases gradually as the mulch dose increases. There was no meaningful interaction identified.

Table 2's data showed that, although the differences were comparable to those of *Azadirachta indica*, the highest grain yield (1657 kg ha$^{-1}$) was obtained with *Leucaena leucocephala*, while the lowest grain yield (1554 kg ha$^{-1}$) was produced with the application of Eucalyptus species mulch. It was discovered that there were considerable differences between each mulch quantity. The application of 4 t ha$^{-1}$ of mulch produced the highest yield (1735 kg ha$^{-1}$), while the application of 0 t ha$^{-1}$ produced the lowest yield (1412 kg ha$^{-1}$). It was determined that there was no significant interaction between the kind and quantity of mulch for grain yield.

**Table 2:** Grain yield (kg ha-1), straw yield (kg ha-1), biological yield (kg ha-1) and harvest index (%) of pearl millet as influenced by type and quantity of tree leaf mulch under custard apple based agri-horti system

| Treatment | Grain Yield (kg ha$^{-1}$) | Straw Yield (kg ha$^{-1}$) | Biological yield (kg ha$^{-1}$) | Harvest Index (%) |
|---|---|---|---|---|
| **Type of Mulch** | | | | |
| *Azadirachta indica* | 1578 | 5004 | 6583 | 24.0 |
| *Eucalyptus spp.* | 1554 | 4850 | 6404 | 24.3 |
| *Leucaena leucocephala* | 1657 | 5000 | 6657 | 25.0 |
| S.Em. ? | 25 | 168 | 169 | 0.68 |
| CD at 5% | 75 | NS | NS | NS |
| **Quantity of Mulch (t/ha)** | | | | |
| 0 | 1412 | 4356 | 5768 | 24.5 |
| 2 | 1643 | 5033 | 6676 | 24.7 |
| 4 | 1735 | 5465 | 7201 | 24.1 |
| S.Em. ? | 25 | 168 | 169 | 0.68 |
| CD at 5% | 75 | 506 | 506 | NS |
| TxQ Interaction | NS | NS | NS | NS |

Upon detailed examination of the data, it was discovered that the variations in straw yield kg ha$^{-1}$ related to the kind of mulch were not statistically significant. Four and two t ha$^{-1}$ mulch applications were shown to be non-significantly different from one another; however they were both noticeably better than 0 t ha$^{-1}$ mulch applications. There was no meaningful interaction identified. The overall analysis of the data revealed that the quantity and kind of mulch had no bearing on the harvest index. Moreover, interaction was not determined to be significant. In the plots where *Leucaena leucocephala* leaf mulch was applied, there was a significant increase in the number of grain panicle$^{-1}$ and test weight, which translated into a higher grain yield kg ha$^{-1}$.Plots with leaf mulch of Eucalyptus spp. had the lowest grain yields, although the differences were comparable to those with leaf mulch of *Azadirachta indica*. Because eucalyptus leaves contain allelochemicals, there may be a negative impact on crop yields from these leaves. Kumar *et al.* (2024).The type of mulch had no discernible impact on harvest index, biological yield, or straw yield. The number of grain panicles$^{-1}$, test weight, and other yield attributes that were enhanced by the application of

**Table 3:** Pearl millet's economics under a custard apple-based agri-horticulture system as impacted by the kind and amount of tree leaf mulch

| Treatment | cultivation (?/ha) | return (?/ha) | return (?/ha) | B: C ratio |
|---|---|---|---|---|
| **Type of mulch** | | | | |
| *Azadirachta indica* | 23895.00 | 71800.3 | 47905.33 | 3.00 |
| *Eucalyptus spp.* | 23895.00 | 70942.0 | 47047.00 | 2.97 |
| *Leucaena leucocephala* | 23895.00 | 72817.0 | 48922.00 | 3.05 |
| S.Em. ± | - | | - | - |
| CD at 5% | - | - | - | - |
| **Quantity of Mulch (t/ha)** | | | | |
| 0 | 23304.00 | 67346.67 | 44042.67 | 2.89 |
| 2 | 23895.00 | 72744.33 | 48849.33 | 3.04 |
| 4 | 24486.00 | 75468.33 | 50982.33 | 3.08 |
| S.Em. ± | - | - | - | - |
| CD at 5% | - | - | - | - |

mulch combine to produce yield. It might be explained by an improved nutrient supply and an enhancement in the soil's ability to hold onto moisture. Mulch generally produces a microclimate that is beneficial to soil microbial activity. These microorganisms work to preserve and enhance the biological and physico-chemical properties of the soil, which enhances growth performance and yield attributes. Sale, FA (2013), Sahoo UK and Vanlalhluna PC (2011)

Table 3 presents the economic effects of mulch type and quantity. *Leucaena leucocephala* produced the best gross return (Rs72817) net return (Rs488922) and B:C ratio (3.05) in ha$^{-1}$, whereas *Azadirachta indica* produced the lowest gross return (Rs71800.3) net return (Rs47905.33) and B:C ratio (3.05) in ha$^{-1}$. With the application of mulch 4 t ha$^{-1}$, the maximum gross return (Rs75468), net return (Rs50982.33), and B:C ratio (3.08) were achieved, while the lowest gross return (Rs67346.67), net return (Rs44042.67), and B:C ratio (3.08) were seen in the control (0 t ha$^{-1}$).

## CONCLUSION

It is concluded from the above experimental results that *Leucaena leucocepha* and 4 t tree leaf mulch ha$^{-1}$produced the highest grain yield net return and B:C ratio.

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