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# Effect of organic mulches on yield, physico-chemical qualities and leaf mineral composition of litchi cv. Bombai in Indo-Gangetic plain of West Bengal

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**ABSTRACT**

*An investigation was carried out over three years in the farmer's field of litchi cv. Bombai to study the effect of mulching on yield, physico-chemical qualities and leaf mineral composition of litchi grown in new alluvial zone of West Bengal. Experimental findings revealed that different mulches significantly increased the soil moisture per cent, fruit retention, physico-chemical qualities of fruits and leaf mineral (N, P, and K) composition. Among different mulches, paddy straw mulch showed maximum (22.80%) soil moisture content and fruit retention (18.42 nos panicle$^{-1}$) with highest (94.42 kg plant$^{-1}$) yield followed by mulches with mango leaves. This treatment also showed maximum TSS (20.20° Brix), total sugar (14.80%) with minimum (0.60%) acidity of fruit. Leaf mineral composition was also increased with the application of different mulches. Among different mulches paddy straw proved effective in all respect.*

***Keywords*:** Organic mulches, leaf minerals, *Litchi chinensis*, quality, yield

Mulches have a substantial impact on enhancing the sustainable yield and quality of fruit. It improves the physical and chemical qualities of the soil and availability of nutrient pool and biological qualities by increasing beneficial soil microbes. Mulches impart manifold beneficial effect, like stabilization of soil temperature, reduced water loss through evaporation, resulting more stored soil moisture, which is utilized by the crop plants especially in the dry season (Shirgure *et al*., 2003), suppression of weed growth (Kaur and Kaundal, 2009; Sharma and Kathiravan, 2009), improvement in growth and yield (Pande *et al*., 2005). The practice of applying a layer of dead vegetative waste mulch as straw mulch, to the soil surface has been prevalent for a very long time in many parts of the world. The mulching materials of organic origin are known to contribute plant nutrient elements to the plant. Various materials of plant origin like straw, leaves and crop residues increases the aggregate stability and structure of soil add nutrients and humus to the soil as they decompose, improving its tilth and moisture holding capacity (Smets *et al*., 2008) and Borthakur and Bhattacharyya, 1992. But, scanty information is available regarding use of organic mulches in litchi crop which is one of the most excellent, delicious fruit and considered queen of fruits in the sub-tropical religion of the world. Keeping this in view, the present investigation was carried out to study the effect of mulching on yield, physico-chemical qualities and leaf mineral composition of litchi cv. Bombai grown in Indo-Gangetic plain of West Bengal.

## MATERIALS AND METHODS

The present investigation was carried out in the farmer's field of Murshidabad district of West Bengal during 2013-2015 on uniformly grown litchi tree cv. Bombai planted at 6 x 6m apart. There were five treatments viz. mulching with paddy straw, dry mango leaves, dry banana leaves, water hyacinth and no mulch (control). Each treatment was replicated five times following randomized block design and each replication consisted of four plants. The mulches were applied in the month of March around the trunk of the tree to a thickness of 8-10 cm. Mulches were kept in the field for one year. The plants were fertilized through organic means like bio-fertilizer, vermin-compost and FYM. Plant protection measure was also done through organic sources. The soil moisture percentage at 0-25, 25-50, 50-75 and 75- 100 cm depth was recorded on 15 March and 15 April and average was calculated. The physico-chemical qualities of ripe fruits were analysed following the standard methods as described by Ranganna (2003). For mineral composition of leaf, 3 month old leaves borne on 3rd and 4th position from the top of the shoot arising during autumn season flash were taken for sampling. The leaf mineral content (N, P and K) were estimated using standard procedure as described by Jackson (1973). The data were analysed statistically statistically by the analysis of variance as suggested by Goon *et al*. (2001).

## RESULTS AND DISCUSSION

Perusal of pooled data from table 1 revealed that different mulches significantly increased the average soil moisture content, fruit retention per panicle and

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yield of litchi. Among different mulches, mulching with paddy straw showed maximum (22.80%) soil moisture content with maximum (18.42 Nos. panicle$^{-1}$) fruit retention and thereby yield (94.42 kg plant$^{-1}$) of crop. The least in all respect was observed in control (unmulched) plants. Such an improvement in soil hydrothermal regime with mulching was also reported by Ghosh and Bauri (2003) in mango and Borthakur and Bhattacharyya (1999); Dutta and Majumder (2009) in guava.

**Table 1: Effect of mulches on soil moisture status, fruit retention and yield of litchi cv. Bombai (Pooled data of two years)**

| Treatment | Soil moisture (Avg. of 4 depths) % | Fruit retention (No panicle$^{-1}$) | Yield (Kg plant$^{-1}$) |
|---|---|---|---|
| Paddy straw | 22.80 | 18.42 | 94.42 |
| Dry mango leaves | 20.10 | 16.22 | 90.92 |
| Dry banana leaves | 17.41 | 14.71 | 89.12 |
| Water hyacinth | 18.20 | 15.86 | 89.95 |
| Unmulched (control) | 9.70 | 11.00 | 75.12 |
| **SEm(±)** | **0.22** | **0.40** | **0.15** |
| **LSD (P=0.05)** | **0.93** | **1.32** | **0.49** |

Significant improvement in fruit physical parameters (weight, length and diameter) and quality attributes of litchi fruit except anthocyanin content at ripe stage was influenced significantly by application of various mulches as depicted in fig.1 and table 2. The Maximum fruit weight (23.70 g), fruit length (3.9 cm) and fruit diameter (3.1 cm) were recorded from paddy straw mulch. This treatment also recorded maximum total soluble solids (20.20$^0$ brix), highest TSS: acid ratio (33.6:1), total sugar (14.80%) and ascorbic acid (37.20 mg 100 g$^{-1}$) and with minimum acid content (0.60%) of fruit while control recorded least of the fruit qualities with maximum (0.80%) acidity. Anthocyanin content of fruit did not show any significant difference with the different mulches applied. However, paddy mulch showed maximum anothocyanin content (23.70 mg 100g$^{-1}$) of fruit. Increases in fruit quality with mulching might be due to the effect of leaf potassium and an increased rate of photosynthesis which cumulatively improved the fruit quality. Our results corroborate with the results of Dutta and Majumder (2009) in Guava, Singh *et al.* (2010) in aonla and Bhusan *et al.* (2015) in mango.

Pooled data (Table 3) revealed that leaf mineral component (N, P and K) was also influenced significantly by the application of different organic mulches. The Paddy straw mulch proved most effective and had the highest content of leaf mineral (1.89 % N and 0.92% K) except phosphorus. Mulching with dry mango leaves showed the maximum phosphorus content (0.37 %) of leaf followed by mulches with paddy straw. The least mineral content in all cases were recorded form un-mulched (control) plot. The increased level of nitrogen due to mulching indicates that diffusion of nitrogen into the roots grown under the mulches was greater than unmulched plots. The increased leaf nitrogen may also be ascribed to the high moisture regime observed under mulched plots, mitigating

**Table 2: Effect of mulches on bio-chemical attributes of litchi cv. Bombai (Pooled data of two years)**

| Treatments | TSS ($^0$Brix) | Acidity (%) | TSS:acid ratio | Total sugar (%) | Ascorbic acid (mg 100g$^{-1}$) | Anthocyanin content (mg 100 g$^{-1}$) |
|---|---|---|---|---|---|---|
| Paddy straw | 20.20 | 0.60 | 33.6: 1 | 14.80 | 37.20 | 23.70 |
| Dry mango leaves | 20.00 | 0.60 | 33.3: 1 | 14.30 | 30.70 | 23.20 |
| Dry banana leaves | 18.80 | 0.70 | 26.8: 1 | 12.90 | 29.20 | 20.90 |
| Water hyacinth | 18.60 | 0.60 | 31.1: 1 | 12.80 | 27.20 | 20.70 |
| Unmulched (control) | 18.20 | 0.80 | 22.7: 1 | 12.20 | 24.50 | 20.70 |
| **SEm(±)** | **0.30** | **0.04** | **-** | **0.08** | **0.10** | **0.03** |
| **LSD (P=0.05)** | **1.42** | **0.13** | **-** | **0.27** | **0.33** | **N.S.** |

**Table 3: Mineral composition of leaf as influenced by application of different mulches (Pooled data of two years)**

| Treatment | N (% dry wt.) | P (% dry wt.) | K (% dry wt.) |
|---|---|---|---|
| Paddy straw | 1.89 | 0.31 | 0.92 |
| Dry mango leaves | 1.72 | 0.37 | 0.84 |
| Dry banana leaves | 1.70 | 0.29 | 0.87 |
| Water hyacinth | 1.67 | 0.28 | 0.81 |
| Unmulched (control) | 1.61 | 0.28 | 0.79 |
| **SEm(±)** | **0.04** | **0.008** | **0.02** |
| **LSD (P=0.05)** | **0.09** | **0.018** | **0.06** |

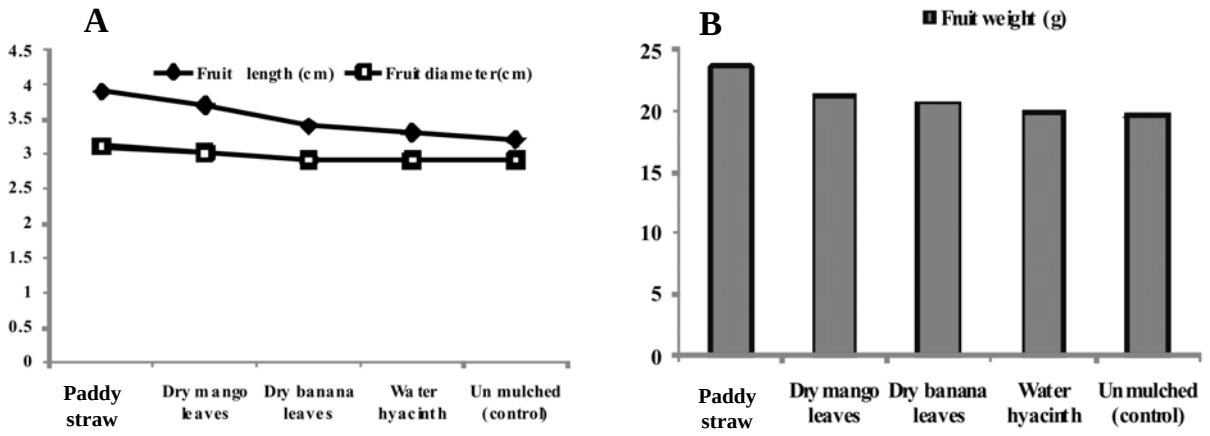


**Fig. 1 : Effect mulches on fruit length and diameter (A) and fruit weight (B) of litchi cv. Bombai**

shrinkage of roots and soil solution (Kozlowski, 1972). Different mulches increased the phosphate content of leaves because surface soil is kept moist for a longer time. The highest potassium uptake under mulched plots may be due to presence of a higher moisture regime, maintenance of optimum level of soil temperature and a reduction in temperature fluctuation (Russell, 1975). Mulches from different organic materials with variable properties have different effects on the soil food web, as well as the mineralization of the elements such as N and P as reported by Forge *et al*., (2003). The results of our current study are also in close conformity with the earlier findings of Dutta *et al.* (2009) in guava.

Finally, it can be concluded that mulching is beneficial for improving fruit yield and quality of litchi fruit along with the improvement in biological properties of orchard soil. Among the different mulches used, paddy straw mulch was found to be most effective in improving the fruit physico-chemical, leaf mineral composition and biological attributes of soil. Therefore, this information can be transmitted to the litchi growers for commercial adoption.

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