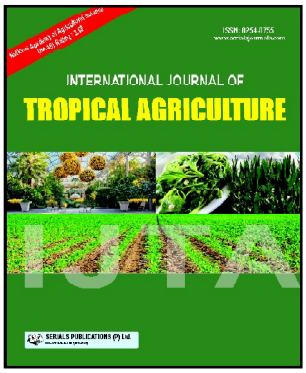

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Effect of Live Mulch on Soil Temperature, Moisture, Weed Biomass and Lac Yield in Eastern India

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Abstract: Advances in agriculture through recent innovations and technology flow along with huge demand of food grains by mushrooming human population remarkably transformed the agriculture from traditional to contemporary with complete dependence on external inputs of synthetic fertilizers and pesticides. Though intensive agriculture aimed on high production through inorganic means increased agricultural yield by many folds, but contributed significantly to environmental degradation including green house forcing. The relevance of sustainable agriculture emerged in response to the questions raised on soil health, environment and livelihood security issues, reviving the traditional practices of soil conservation in the form of cover crop technology during the past few decades. Owing to these issues, there is paradigm shift in agriculture from productivity to sustainability. Sustainable agriculture means an integrated approach to increasing farm yield and managing resources in order to address all three critical aspects of sustainability: economic, environmental and social. Integrated farming systems (IFS) stabilize income through natural resource management and livelihood diversification. The IFS approach has multiple objectives of sustainability, food security, farmer security and poverty reduction. In fact, integrated farming system will play very effective role in the utilization of the natural resources in most rational manner or sustained crop diversification of farm enterprises which have less demand on space and time with very limited resources especially in rain fed area. Lac has good potential to be included in Agro-forestry as it is relatively low cash and labour input crop with high returns; compatible with existing rural livelihood activities in terms of its labour requirement and encourages conservation of host trees and leads to a re-greening of land.

INTRODUCTION

Conventional tree hosts of lac like *ber* and *palas* can easily be integrated in farming system models and other quick growing bushy hosts like *Flemingia semialata* also hold the potential for integration. *F. semialata* is quite promising for production of winter *kusmi* (*aghani*) lac under rain fed conditions. But for raising summer crop (*jethwi*) on *Fleminigia semialata*, frequent irrigation is required, otherwise *Flemingia* stem on which lac is encrusted, shrinks. Due to which lac encrustation loosens and shredded off the stem. The present studies were undertaken to reduce the number of irrigations and conserve soil moisture to facilitate raising of summer lac crop on *Flemingia semialata* through live mulching.

MATERIAL AND METHODS

The study was conducted at Institute Research Farm, IINRG, Ranchi for two years from 2012 to 2014. The experiment was laid out in RBD. There are four treatments (T1 bottlegourd, T2 bittergourd, T3 cucumber and control) and 4 replications. These crops were raised beneath *Flemingia semialata* to serve the purpose of live mulch in the month of February. Observations recorded were

1. soil moisture
2. soil temperature
3. weed infestation and
4. yield

Soil Moisture

The soil moisture was measured a week after irrigation at 15 and 30 cm depth for May and June depth by gravimetric method (Black, 1965). The soil from different depths were sampled by manual coring. Gravimetric moisture content (g/g) of the soil samples was calculated on oven dry weight basis

Soil Temperature

Soil temperature at 5 cm and 10 cm depth was measured with stainless steel Fisher brand bi-metal dial thermometers having a stem length of 20.3 cm and gauge diameter of 4.5 cm. Observations were recorded every week from mid April to mid June till the onset of monsoons at 0010 and 1800 h (in both mulched and unmulched plots). At each depth, two observations were taken; each from a different ridge of the same treatment.

Weed Infestation

The weed biomass was collected from 1 sq m plot at 5 locations in each replication of 4 treatments fortnightly for two months i.e. May and June. The weed biomass was recorded after oven drying at 60°C for 72 hours. The weed biomass (dry weight) was taken fortnightly during May and June for two years (2012 to 2014).

Lac Yield

Summer crop of lac was harvested in first week of July.

Statistical Analysis

Data was collected from sowing to harvest. The variables investigated were analyzed using statistical Analysis Procedures (SAS, 1994). Fisher's protected least significant difference (LSD) test was used to detect mean differences between the treatments (Steel and Torrie, 1980).

RESULTS AND DISCUSSION

Soil Moisture

Evaporation from the soil accounts for 25–50% of the total quantity of water used (Hu *et al.*, 1995). An important practice for rainfed agriculture, therefore, is to decrease evaporation of soil water. Mulch prevents soil water evaporation, and thus helps retain soil moisture. Live mulch retards soil erosion and facilitate rapid infiltration of rainwater into soil. Optimum soil moisture ensures good emergence and seedling growth. The observations show that

evaporation was high in unmulched plots. Maximum soil moisture was found under cucumber (17.85) which is at par with bittergourd (17.50). The soil moisture under all three live mulches was significantly higher than control. The greater soil moisture under mulch has important implications on the utilization of water by crop and on soil reactions that control the availability of nutrients and biological nitrogen fixation (Surya *et al.*, 2000). Research has shown that mulch provides many benefits to crop production through soil and water conservation, enhanced soil biological activity and improved chemical and physical properties of the soil (Cooper, 1973). Adeoye (1984) recorded high moisture content up to a depth of 60 cm in grass-mulched soil together with good infiltration and reduced evaporation.

Soil Temperature

The soil under live mulches compared to unmulched treatments consistently had significantly lower temperature at 10 cm soil depths during both the seasons. Minimum soil temperature was recorded under cucumber (24.78°C) followed by bittergourd (25.21°C), significantly lower than control (27.08°C) (Figure 2). No significant differences in soil temperature were recorded between cucumber and bittergourd mulch treatments during both seasons.

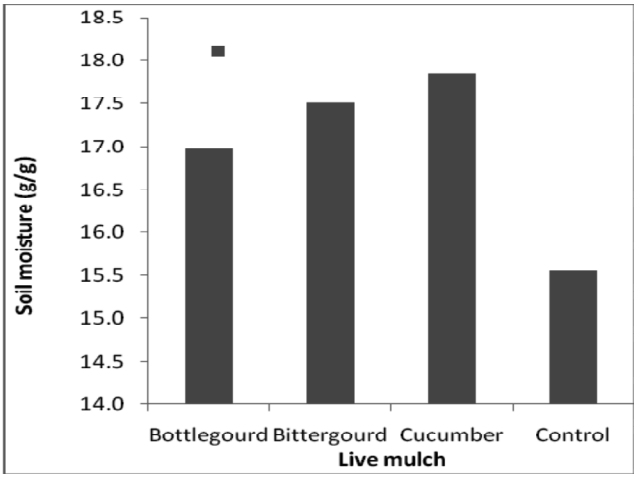

Figure 1: Effect of live mulch on soil moisture

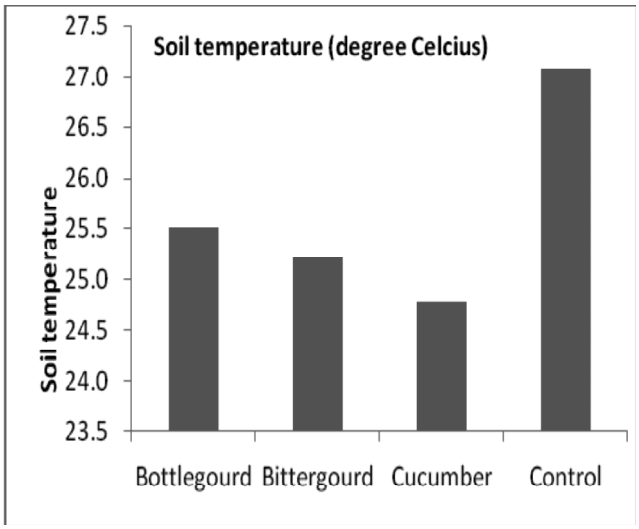

Figure 2: Effect of live mulch on soil temperature

Weed Infestation

The mulched plots showed significantly least weed infestation compared to the unmulched plots. Minimum weed biomass was observed under bitter gourd for both the months (May and June). Unmulched plots showed a greater diversity of weed species than the mulched plots. Plots with bittergourd as live mulch had the lowest number of invading weed species. Weed dry mass showed significant differences between the treatments for both the months. The bittergourd live mulch gave the least weight (27 g/m^2) whereas the unmulched treatment gave the highest weight (315 g/m^2) in June. The study shows that bitter gourd suppressed weeds by 72.18% and 91.42% over control in May and June respectively (Figure 3). Results from this study indicated differences in the ability of live mulches in controlling weeds. Akintoye (2011) in his studies observed that the introduction of pumpkin as live mulch even though resulted in low fruit yield of okra, significantly reduced weed problem in okra production. This could be due to its ability to grow more vigorously than the main crop and other live mulches thus able to compete with weeds and unfortunately, the main crop, for available space, light and nutrients. Thick cover crop according to Teasdale (1993) are able to compete well with weeds during their growth cycle

because they can prevent germinated weed seeds from completing their life cycle and reproducing. Even when weed seeds germinates, they often run out of stored energy for growth before building the necessary structural capacity to break through the cover crop live mulch layer. This according to Kobayashi *et al.* (2003) is known as cover crop smother effect. Generally, it can be assumed that living mulches often suppress weeds when compared with untreated control, especially if sown in early terms (Araki and Tamura 2008).

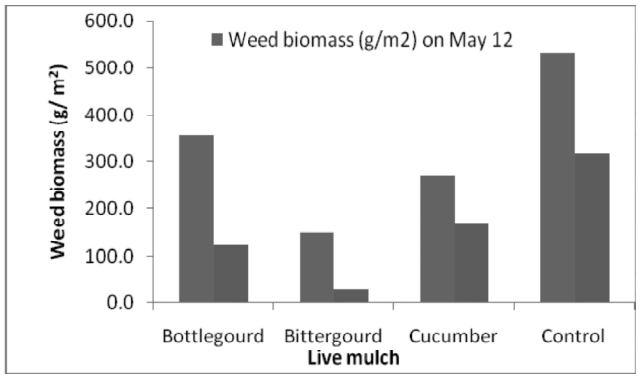

Figure 3: Effect of live mulch on weed biomass

Lac Yield

Highest lac yield per plot was observed under bitter gourd (8.20 kg/plot) statistically at par with cucumber (7.73 kg/plot) but significantly superior over control ((6.10 kg/plot) (Figure 4). Use of live mulches have favorable effect on production as observed earlier by many workers. Akintoye (2003) observed that the use of melon as live mulch resulted in higher fruit yield of sweet pepper. Akintoye *et al.* (2011) also identified cucumber and melon as better live mulches for okra production, producing higher fruit yield.

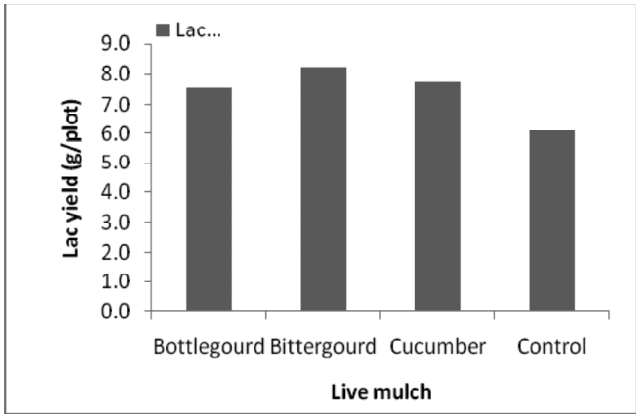

Figure 4: Effect of live mulch on lac yield

CONCLUSION

The problem of shrinkage of *Flemingia semialata* stems in summers due to moisture stress can be solved to some extent through live mulching. Live mulching will help in conserving the soil moisture for longer time than bare soil, thus reducing the frequency of irrigation. In addition, the profit earned by bitter gourd can facilitate in managing the expenses of irrigation. The present studies observed that use of bittergourd as live mulch beneath semialata plantation may help in moisture conservation during summers, moderating the soil temperature, decreased weed infestation and increased lac yield.

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