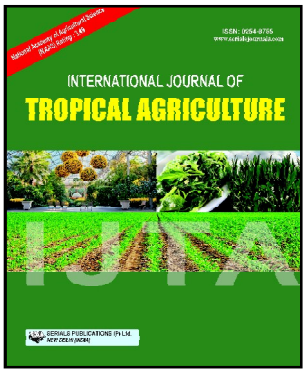

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Impact of Black Polythene Mulching in Mulberry Garden on Weed Infestation, Soil Moisture, Plant Growth and Leaf Yield under Tropical Conditions

N. Sakthivel

Regional Sericultural Research Station, Central Silk Board, Government of India, Salem – 636017, Tamil Nadu
Email: drnsakthivelcsb@gmail.com

Abstract: Studies were conducted to find out the impact of black polythene mulching in mulberry garden on weed infestation, soil moisture conservation, growth of plants and leaf yield comparable to conventional hand weeding practice. Black polythene mulching registered significantly higher values 97.06% & 93.42% of weed control efficiency, 60.20% & 52.52% increase in soil moisture content and 58.14 & 25.89 % increase in mulberry leaf yield over weedy check and hand weeded plot respectively. The studies revealed that adoption of black polythene mulching in mulberry garden could help for sustainable production of cocoon by overcoming the problems of scarce of agriculture labours for weeding and limited availability of water for irrigation due to poor showers in the tropical zones.

INTRODUCTION

India ranks second in global silk production and the sericulture industry provides employment and livelihood security to about 9 million peoples in the country. Mulberry, *Morus alba* L. is the food plant of silkworm *Bombyx mori* L. and cultivated over 2.3 lakh hectares in India mainly under irrigated conditions and exploited for silk production. Being perennial in nature it is planted with wider spacing with paired row system of 5'+3'x 2' and once cultivated it is used continuously for about 20-25 years. Under tropical conditions, the plants are pruned 5-6 times annually to take up silkworm rearing. Maintenance of soil fertility with routine applications of manures is an integral part of moriculture to produce quality mulberry leaf for healthy growth of silkworm and cocoon yield.

Mono-cropping, wider spacing and regular applications of manures and fertilizers to mulberry garden under irrigated conditions encourage the

growth of number of weeds which become menace to the crop and affect the leaf yield. Concurrently the greatest threat is availability of water for irrigation as the water table is going down year after year because of failure of monsoon and poor rain fall due to climate change. Hence water management is also important for sustainable silk production. A major portion of irrigated water in mulberry garden gets evaporated from the soil surface as well as consumed by the competitive weeds. Sakthivel *et al.* (2011) standardized package of practices for black polythene mulching for weed management as well as to conserve the soil moisture in mulberry garden. Though black polythene mulching is proved to be highly effective in weed control, conserve soil moisture in many crops, the studies with large scale trials on mulberry is scanty and this technique is not popular among the sericulture farmers. The present study, thus attempted to find out the impact of black polythene mulching on weeds, soil moisture conservation and yield parameters of mulberry compared to conventional practice of hand weeding.

MATERIALS AND METHODS

Field trials were conducted in potential sericulture clusters of Virudhunagar, Tirunelveli and Namakkal district of Tamil Nadu, India covering 3 mulberry gardens per district during 2015-17. Mulberry gardens with variety V1 cultivated in paired row system (5'+3'x 2') under irrigated conditions were selected for the study. Three paired rows in the length of 100 meter each with black polythene mulching, hand weeding and without weeding (weedy check) were maintained in RBD replicated five times. Low density black poly ethylene sheets of 200 micron was used as mulch material and placed between the rows. In hand weeding plots, weeding was done by hoeing after each pruning and weeding was not effected in control plots. The gardens were maintained with recommended package of practices (Dandin *et al.* 2003) uniformly during the experimentation. Irrigation was made in 10 days interval. One day prior to each irrigation, composite soil samples were collected from 3 locations per plot at the depth of 15, 30 & 60 cm separately and soil moisture content was recorded using gravimetric method (Black, 1965).

$$Moisture\ content\ (\%) = \frac{Weight\ of\ wet\ soil - Weight\ of\ dry\ soil}{Weight\ of\ dry\ soil} \times 100$$

The data on weed density and weed biomass were recorded 45 days after pruning (DAP) using a 1 m^2 sized quadrate randomly at 3 places in each plot. The weeds from the quadrate were uprooted, cleaned, sun dried and later dried in oven at 70°C until constant weight was attained and dry weight was recorded in g/m^2. Weed control efficiency (WCE) was calculated with the following formula (Gill and Vijayakumar, 1969).

$$WCE = \frac{Weed\ dry\ weight\ in\ control\ plot - Weed\ dry\ weight\ in\ treated\ plot}{Weed\ dry\ weight\ in\ control\ plot} \times 100$$

The growth and yield parameters of mulberry *viz.* plant height (cm), leaf area (cm^2), leaf moisture content (%) and leaf yield (g / plant) were recorded at 50 DAP from randomly selected 5 plants per replication. To estimate the moisture content of leaf, leaf samples were collected from plants and immediately transferred to polythene bags to prevent moisture loss and weighed. The samples were dried at room temperature for 3 days, then oven dried at 70^0C until constant weight was attained and dry weight was recorded. The moisture percentage was calculated by using the formula:

$$Leaf\ moisture\ \% = \frac{Fresh\ leaf\ weight - Oven\ dry\ weight}{Fresh\ leaf\ weight} \times 100$$

The plant height was measured from the base of the plant to the terminal growing point of the main stem and the average plant height was worked out and expressed in centimeters. Leaf area was recorded from 6 randomly selected leaves per replication from the composite samples comprising of tender, medium and coarse leaves in almost equal

proportion. The leaf area was measured by the non-destructive graphical method (Lockard *et al.*, 1985). The leaf was placed on the graph paper, having smallest grid size of 1 mm and outlined with a pencil accurately and carefully on the graph paper. The total number of grids covered by outline edge of the leaf was calculated. If edge outline occupied more than one half grids, it was treated as one otherwise zero. The number of grid count corresponds to the actual area of leaf was worked out and expressed in cm^2. The leaf harvested from each plant was weighed in an electronic balance and expressed in gram. Treatment means were analyzed for standard deviation and significance at $P < 0.05$.

RESULTS AND DISCUSSION

The effect of black polythene mulching in mulberry garden on weeds and the soil moisture content is presented in table 1. Black polythene mulching registered lowest population of weeds and weed biomass (13.86 / m^2 & 9.67 g/m^2) when compared to weedy check (385.66 / m^2 & 329.73 g/m^2) and hand weeded plots (128.25 / m^2 & 147.10g/m^2). The soil moisture content was significantly higher in black polythene mulched plots with 11.98%, 18.25% and 21.35% at the depth of 15, 30 & 60 cm when compared to the hand weeded plots and non weeded plots and they were exhibited statistically on par results with lowest values 8.55%, 10.50% & 14.78 % and 7.48%, 9.43% & 15.30% respectively.

Table 1
Effect of black polythene mulching on weeds and soil moisture content in mulberry garden

Treatments	*Weed density (No./m^2)*	*Weed biomass (Dry wt. g/m^2)*	*Soil moisture content (%)*			
			15cm	*30cm*	*60cm*	*Average*
Black Polythene Mulching	13.86*± 3.17	9.67*± 3.08	11.98*± 1.16	18.25*± 2.08	21.35*± 2.47	17.19*± 2.73
Hand weeding	128.25*± 18.18	147.10*± 16.29	8.55± 0.93	10.50± 1.06	14.78± 2.12	11.27± 1.37
No weeding (Control)	385.66± 23.08	329.73± 55.40	7.48± 1.25	9.43± 1.03	15.30± 1.90	10.73± 1.06

Values are mean ± SD; *Significance at $P < 0.05$.

Highest average soil moisture content (17.19 %) was recorded in the plots mulched with black polythene sheets whereas control plots (10.73%) and hand weeded plots (11.27%) exhibited on par results with significantly lower values than black polythene mulching. Considering the average soil moisture content, there was 60.02 % increase in the plot mulched with black polythene sheets than weedy check. However there was no much difference between hand weeded and non weeded plots (Fig. 1).

The growth and yield parameters of mulberry differed significantly among the treatments. The values of plant height (226.49 cm), leaf area (198.63 cm^2), leaf moisture content (78.55%) and leaf yield (688.33 g) was recorded highest in treatment of black polythene mulching. Weedy control plots recorded lowest values of respective parameters (155.30 cm, 165.92 cm^2, 57.66 % and 435.25 g) while the practices of hand weeding resulted to significantly more values (173.11 cm, 178.00 cm^2, 63.36 % and 546.73g) than the plots without weeding but found inferior to the black polythene mulching practice (Table 2).

Table 2
Effect of black polythene mulching on growth and yield parameters of mulberry

Treatments	*Plant height (cm)*	*Leaf area(cm^2)*	*Leaf moisture Content (%)*	*Leaf yield (g/plant)*
Black Polythene Mulching	226.49*±18.56	198.63*±16.75	78.55*±3.28	688.33*±153.82
Hand weeding	173.11*±12.10	178.00*±18.37	63.36*±3.99	546.73*±123.95
No weeding (Control)	155.30±8.75	165.92±17.25	57.66±4.51	435.25±128.26

Values are mean ± SD; *Significance at $P < 0.05$.

In black polythene mulched plots, growth of weeds was found completely arrested whereas recorded little weed count which germinated in the uncovered area near the trunk portion of mulberry trees. The weed control efficiency of black polythene mulching was 97.06% (Fig. 1) over weedy check and 93.42 % over hand weeded plot (Fig. 2). However, the WCE of hand weeding in mulberry garden was recorded as 55.38% compared to non weeded plots. Similarly, better WCE with polythene mulching was reported by Ramakrishna *et al.* (2006) and Nalayini *et al.* (2009).

Wider spacing, irrigated conditions and regular application of manures encourage growth of plenty of weeds in mulberry ecosystem. The weeds compete for space, sunlight, soil moisture and nutrients, thus affect the crop production. In the present investigation, the adverse effect of weeds was well pronounced in the non weeded control plots. However, black polythene mulching recorded 97.06 percent reduction in weeds and 60.20% improvement in soil moisture and these factors might have attributed to higher value in growth parameters of mulberry like plant height, leaf area, leaf moisture content and improvement in leaf yield about 58.14 % over weedy check and 25.89% over hand weeded plot (Fig. 1 & 2).

In control plots the growth parameters were less because of deficit in soil moisture due to evaporation from bare soil and profuse weed growth which compete with mulberry crop for water and nutrients thus hinders normal growth of plants. The higher

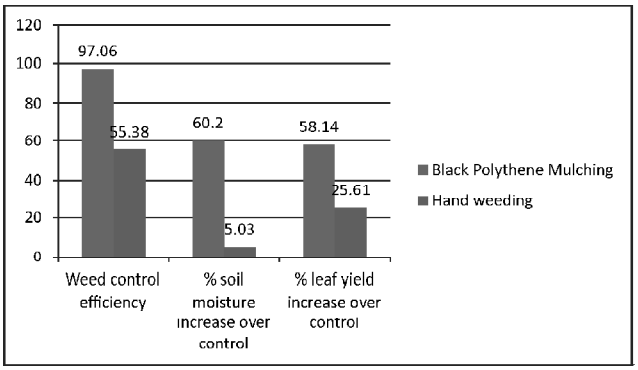

Figure 1: Efficiency of hand weeding and black polythene mulching over control

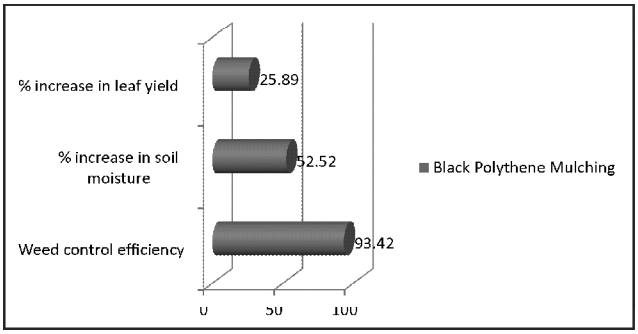

Figure 2: Efficiency of black polythene mulching over hand weeding

moisture content in the leaves harvested from the black polythene sheet mulched plots may be due to the fact that plant utilized the conserved soil moisture with increased water use efficiency under mulched conditions. These results are in harmony with those obtained by Kashiviswanathan *et al.* (1971).

The higher moisture under plastic mulches may be due to reduced exposed surface area resulting to reduced evaporation. High surface soil moisture and reduced evaporation under plastic mulches have been

reported under several studies (Ramakrishna *et al.*, 2006; Liu *et al.*, 2014, Bakshi *et al.*, 2015). The average soil moisture content in hand weeded plot (11.27%) and weedy check (10.73%) were on par and lower than black polythene mulching. However, in hand weeded plots 25.61 % improvement in leaf yield over control might have attributed to considerable reduction (55.38%) in weed population and consequently less competition for soil moisture and nutrients. Similar reduction in growth and yield parameters of okra due to crop weed competition was reported by Usman *et al.* (2005). Benefits of black polythene mulching like its efficiency on weed control, increase of soil moisture content, favourable alterations in soil temperature *etc* were well established in several crops like rose (Rodrigues *et al.*, 1999), garlic (Haque *et al.*, 2003), strawberry (Singh *et al.*, 2006), pineapple (Alwis *et al.,* 2012), tomato (Rajablariani *et al.*, 2012) and chilli (Sathiyamurthy *et al.*, 2017).

Increase in soil temperature and moisture content promote nutrient uptake as well as stimulate root growth. Therefore, mulched plants usually grow and mature more uniformly than unmulched plants (Sarolia and Bhardwaj, 2012) and these factors might have attributed to highest plant height, leaf area, leaf moisture content and leaf yield in the black polythene mulched plots. Similar results were also reported by Kim *et al.* (2000) in *Crocosmia crocosmiiflora*, Hong *et al.* (2001) in lilies and Lourduraj *et al.* (1996) in tomato. In mulberry paddy straw mulch was reported to be more effective than the other organic mulches like sorghum, black gram, sunhemp and *Gliricidia* (Nagalakshmi *et al.*, 2002, Shashidhar *et al.,* 2009, Gangawar *et al.*, 2000). Purohit *et al.* (1990) observed that black polythene mulch improved the leaf yield by 48.1 % over control and the present study corroborates his findings.

CONCLUSION

Black polythene mulching is an emerging practice in agricultural and horticultural cropping system as it prevents growth of weeds, conserves soil moisture and alters root zone temperature favourably for growth and yield of crops. The opaqueness of black polythene sheet is a greatest advantage to arrest the growth of weeds as it does not allow the sunlight to pass through it to the soil surface. Further its waterproof property prevents the evaporation of soil moisture from the surface. The irrigation water or rainfall moves into the soil through holes around the trunk area or through the un-mulched area. Thus moisture is conserved in the soil for several days after irrigation and farmers could successfully produce mulberry leaf for silkworm rearing with limited water use. In the present investigation the efficacy of black polythene mulching on weed control and conservation of soil moisture content and its beneficial effect on mulberry leaf production was well established. Popularization of this technology among the sericulture farmers could help them for sustainable production of cocoon by overcoming the problems of scarce of agriculture labours for weeding and limited availability of water for irrigation.

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