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Quality and Quantity of Mulberry Leaf Influenced by Bio-organic Amendments and Mulching under Rain Fed Lateritic Soil Condition of West Medinipur, West Bengal

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Abstract—*A field experiment was conducted during 2006-2008 in lateritic soil (with pH 5.2 and organic carbon 0.42%) under rain fed condition of Nayagram Block, Paschim Medinipur, West Bengal, India to develop a sustainable organic farming management approaches along with the effective uses of mulches and its impact on the yield attributes and quality of leaf in mulberry. The objective was toevaluate the influence of mulch materials especially Sunn Hemp(Crotalaria juncea) and combined application of organics andphosphofert(Arbuscular Mycorrhizal fungi) biofertilizers in regulating soil moisture and major nutrients to increase the production and quality of mulberry leaves under water stress condition. It has been well documented that use of phosphofert biofertilizer reduces the phosphate requirement in mulberry upto 70% both under irrigated and rainfed conditions. Pooled data analysis of three crops revealed that the poultry manure in combination with phosphofert biofertilizer and the reduced doses of inorganic fertilizers applied in mulch plots have a significant effect on growth, leaf yield and quality of mulberry plants. However, the effect of using recommended rate of inorganic fertilizers was the same as that of using 50 % of the recommended rate of inorganic nitrogen and 60% of the recommended rate of phosphorus.*

Key words*: Laterite, rainfed, Mulberry, Sunn Hemp, phosphofert biofertilizer*

1. INRODUCION

The production of mulberry leaf and cocoon crop is entirely depending on the maintenance of the soil fertility of mulberry garden, through the periodical application of organic manures, green manures and fertilizers in required quantity (Watanbe and Andsoon, 1998).

As mulberry is a perennial crop can be maintained for many years, selection of land, follow-up of recommended package of practices and water management are inevitable for producing quality leaf concomitant productivity throughout. Further the quality of mulberry leaves as single factor contributes about 38.2% for the success of silkworm crop (Miyashita, 1986), Although the lateritic belt of west part of Midnapore has good potentialities in the silkworm rearing due to its dry climate, nevertheless mulberry farming remains poor because of scarcity of water (Mookherjee, 1992). The use of inorganic fertilizers during past few decades has played a prominent role in bringing out a green revolution in India but their indiscriminate use has not only evolved in their under utilization or leaching of nutrients to the underground water resources created an adverse effect to the nutrient balance in the soil (Sud, 2005). It is now being realized that the concept of integrated nutrient management by the use of organic manures or residues and mineral fertilizers together can help for sustainable crop production, alongside maintaining the soil ecosystem. The lateritic soil of the dry area of West Bengal contains poor level of phosphorus. Moreover, soil health declines owing to constant use of these chemical fertilizers. It is imperative to exploit maximum use of biofertilizers and/or organic manures in any cultivation to reduce the indiscriminate use of mineral fertilizers. Use of Phosphofertbiofertilizer reduces the phosphate requirement in mulberry upto 70% both under irrigated and rainfed conditions.

It is now well established that arbuscular mycorrhizas (AM) are capable of solubilizing the non-available form of phosphate. Also, the diffused path for transport of the plant-available form of phosphate is shortened, favouring the growth and yield of crop plants (Iqbal and Qureshi 1977; Sulochana and Manoharachary 1989; Nye and Tinker 1977).

Mulberry leaf is the major economic component in sericulture and quality leaf produced per unit area has a direct effect on cocoon quality Water content in mulberry leaves is considered as one of the criteria in estimating the leaf quality (Paul et al., 1992). Mulching has been proved very effective in conserving the soil moisture thereby leading to better yield in various crops. (De *et al*., 1983), (Mittal *et al*., 1986), (Mondal *et al*., 1987). The use of organic mulches has also been reported to enhance 16-48.63% leaf yield in mulberry (Purohit *et al*., 1990). Live mulching with the legumes like SunnHemp (*Crotalaria juncea*) is a highly beneficial practice for enhanced moisture and nutrient conservation in soil. (Sharma 2009). This research aims to evaluate the combined effect of SunnHemp (*Crotalaria juncea*) mulching and the utilization of organic nutrients and arbuscular mycorrhizal fungi to increase the growth and yield of mulberry plants under water stress condition of lateritic soil of WestMedinipur, West Bengal, India and to identify the best suited ecofriendly nutrient management practice for sustainable leaf yield in mulberry (*Morus alba*).

2. MATERIALS AND METHODS:

The present investigation was conducted during the rainy seasons (June to September) of 2006-2008 to assess the impact of organic manures, bio fertilizers along with leguminous mulches on the status of soil fertility, yield and quality of leaf of mulberry (*Morus alba* in pre-established rainfed(variety-S1) mulberry garden at Kharikamathani village under Nayagram Block of Paschim Medinipur, West Bengal, India.

The experiment was laid out in a randomized complete block design with five treatment combinations and three replications. The absolute control plots i.e., zero fertilization treatment and the plots supplied with recommended doses of fertilizers for rain-fed mulberry were treated as bare plots i.e. without legume mulching. The other agronomical practices were carried out uniformly for all the treatments. The legume crops SunnHemp (*Crotalaria juncea*) was sown in between the rows of mulberry plantation in the rest of the plots during the first week of June of the respective year with the onset of monsoon rains. The raised legume inter-crops were subjected to grow until they attain flowering stage. To obtain mulches, these cover crops were harvested by clipping plants at the base, removing above-ground biomass, and applying it to the desire plots. The resulting mulches (3-5 cm deep) were a composite of leaves and stems and were spread over by hand over the entire plots, excluding two control plots. Cultural practices were followed as per the package of practices for rain-fed mulberry (Dandin*et al*., 2003).

The experiment was initiated with ground level pruning and recommended cultural practices for rain-fed mulberry were followed with the application of different organic manures like Farm Yard Manure (FYM) @ 10MT/ha. /year, rearing waste composts @ 10 MT/ha. /year & animal manures like poultry manure @ 7 MT/ha. /year was applied. Arbuscular Mycorrhizal Fungi (AMF) was applied @ rainfed soil 40-50 kg /ha once in 4 years after two to three days of every pruning near mulberry rhizosphere by making small furrows and then covered with soil in four equal splits.A total of 735 plants were imposed with seven different treatments viz., To=Absolute control (no fertilization and without mulching) T1 = 10 MT/ha./year FYM + (150 kg N+50 kg P_2O_5+ 50 kg K_2O)/ha. /year& without mulching (Recommended cultural practices), T2 =10 MT/ha./year silkworm rearing waste composts + (AMF + ½ N (50% N): 1/3 P_2O_5 (33% P_2O_5) : K_2O + 75kg N + 20 kg P_2O_5 and 50kg K_2O) /ha. /year of T1, T3 = 7 MT/ha/yr poultry-manure + (AMF + 75kg N + 20kg P_2O_5 and 50kg. K_2O) /ha /year of T1

Data on growth, yield and quality parameters were recorded after continuous application of input for three seasons. The plant height was taken as the height of the tallest shoot from the ground level observations on fresh leaf yield. Moisture percentage along with moisture retention capacity were recorded by harvesting the fresh leaves from five randomly selected plants of each plot after 45 and 60 days of pruning for three seasons. But observation on other quality variables viz, total soluble protein, total soluble sugar of the leaves were made on the second crop after 60 days of pruning. Annually three crops were harvested andthe annual leaf yield was computed by pooling three years data, leaf yield was taken as all leaves of plants in a plot except the border line effect. Leaf area was calculated by following method (Satpathy*et al*., 1992). For leaf area ten healthy leaves were taken from ten plants selected at random in each plot and the area was calculated through the equation (Area=Length x Breadth x 0.66). Leaf moisture (%) was determined by the oven dry method using the following formula

Leaf Moisture% = {(FW- DW)/ FW} X 100

Where FW= fresh weight (g) immediately after harvest, and DW is the woven dry weight

From each variety, leaves between 5th to 9th positions were randomly collected early in the morning (8:00 to 8.30A.M.) and fresh weight recorded immediately. Weight of leaf was recorded using an electronic balance at hourly intervals for up to 5 h. The experiments were conducted at constant temperature (30 -31 ^{0}C) and humidity (50-60%) under a light intensity of 500-550 μ mol $m^{-2}s^{-1}$. At the end of the experiment, leaves were dried to a constant weight in a hot air oven at 75 ^{0}C. The leaf moisture retention capacity (MRC) was estimated using the formula

MRC (%) = $\{(FW_1- DW)/(FW_0 – DW)\}$X 100

Where FW_0= fresh weight (g) immediately after harvest, FW_1(g) is the weight at a particular hour after harvest and DW is the woven dry weight.

Before conducting the experiment, the chemical characteristics of organic manures were recorded following standard analytical method (Table-1).

Table 1: NPK values of animal manures

	Nitrogen %	Phosphorus %	Potassium %
Farm yard manure	1.10	0.40	1.80
Silk worm rearing waste	1.60	1.00	1.50
Poultry Manure	1.60	1.00	0.60

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The pH of the soil was determined (by following the method of Black 1965), Organic carbon was determined (by Walkley and Black method 1934), estimation of nitrogen (following the method of Subbiah and Asija 1956). Total phosphorus and potassium were analyzed (following the standard procedure of Jackson 1973). Data on growth and leaf quality parameter were recorded at the end of every crop and were subjected to statistical analysis. Leaf moisture was determined by oven drying method Total soluble protein and total soluble sugar content in leaf were determined (by following the methods of Lowry *et al*., 1951 and Morris 1948).

Data on growth, yield and quality parameters were recorded after continuous application of input for 3 rainy crops. Seasonal effect on growth, yield and quality parameters were studied and the overall mean of each of the 7 treatments, critical difference value (P = 0.05) and co-efficient of variation (CV %) were also calculated. Statistical analysis of the three years' pooled data had been done using the one-way ANOVA

Table 2: Effect of Bio-organic fertilization and mulching on morphological parameters of mulberry (variety SI)

Treatments	Plant height	No. of shoots/plant	Leaf area (sq.cm.)	Leaf yield (kg./ha./year)
T0	117.44	4.78	137.44	10627.33
T1	124.05	5.11	149.76	11255.33
T2	124.77	4.80	147.18	11293.33
T3	125.96	5.44	150.43	11621.67
T4	124.55	6.04	150.56	12240.00
CD at 5%	1.806	0.560	6.036	647.481
CD at 1%	1.806	0.560	6.036	647.481
SE (mean)	0.724	0.224	2.420	259.613
CV%	0.585	4.159	1.634	2.258

Table 3: Effect of Bio-organic fertilization and mulching on leaf quality parameter of mulberry (variety SI)

Treatments	Leaf moisture %	Leaf moisture retention capacity	Total Sugar (mg./g.freshwt.)	Total Protein (mg./g.fresh wt.)
T0	66.74	66.40	19.72	22.00
T1	68.73	70.55	22.16	24.63
T2	73.48	67.80	21.05	24.75
T3	76.91	75.25	22.49	26.63
T4	79.75	76.27	22.82	27.08
CD at 5%	2.442	1.668	1.318	1.484
CD at 1%	3.423	2.339	1.848	2.080
SE (mean)	1.372	0.938	0.741	0.834

Reference: Sericulture Technologies Descriptor for Eastern and North-Eastern States: CSR&TI, Berhampore, West Bengal.