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Effect of biofertilizer in combination with organic manures on growth and foliar constituents of mulberry under rainfed lateritic soil condition

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----------ABSTRACT----------
The beneficial effects of organic fertilizers along with bio-fertilizers, need to be emphasized adequately due to increasing leaf yield and quality in mulberry. A field experimental study was conducted during 2002-2004 in lateritic soil having around pH 5.2 under rainfed condition of West Medinipur areas to evaluate the effect of organic manures in combination with Azotobactor along with reduce dose of inorganic nitrogen have on leaf yield and quality of mulberry variety SI. The experimental results revealed that the effect of organic manures specially poultry manure in combination with Azotobactor bio fertilizers followed by reduced doses of inorganic fertilizers had a significant effect on growth and leaf quality of mulberry plants. However, the recommended doses of inorganic fertilizers application was found to be same with 50 per cent reduced inorganic nitrogen and 60% reduction of phosphorus application when supplemented with bio-organic sources of nitrogen. This indicate that 50 per cent reduction of inorganic nitrogen and 60% reduction of phosphorus application does not adversely affect plant growth, foliar constituents of mulberry when supplemented with the above bio-organic sources of amendments.
KEY WORDS: *mulberry, Bombyx mori, poultry manure, Azotobactor, Rain-fed.*

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I. INTRODUCTION

Among the commercially exploited silkworm mulberry silkworm *Bombyx Mori* L is completely domesticated multivoltine species that is reared year around. Nutrition plays a key role in sericulture. Silkworm, Bombyx Mori L., is a monophagous insect that drives almost all required nutrients for its growth and development from mulberry leaf. Good quality leaf production in mulberry is highly dependent on supply of various inputs especially nitrogen and phosphorus fertilizers (Nasreen et al., 1999). Application of inorganic fertilizers though increased the yield substantially but can not sustain the soil fertility status (Bhardwaj and Omanwar 1994. Recently a great attention was drawn towards the application of bio organic farming to avoid the heavy use of agrochemicals that resulted in numerous environmental troubles (Lampkin 1990).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. Farmyard manure made with cow dung is generally used as a major source of organic residue but its short supply and high price is becoming a major constrain for its large scale uses. As farmyard manure is not available to meet the requirement, an attempt is to find the alternative source of locally available organic/animal manures. Weed biomass is one of the easily available sources of organic matter and plant nutrients so economic utilization of this weed biomass for the production of composts may open a new horizon. (Mogle, 2014). Besides, among other composts, rearing waste compost may be generated throughout the year can easily be recycled into nutrient rich composts which had been advocated as a good organic manures (Setua *et al.*, 2002).The manures derived from animal wastes like other organic manures have been found to be more economical than commercial fertilizers for plant nutrients. Poultry litter provides a relatively inexpensive source of both macro nutrients (N, P, K, Ca, Mg, S) and micro nutrients (Cu, Zn, Fe, Mn, B)and has been reported to increase soil organic C and enhance soil microbial activity (Nyakatawa *et al*., 2001).Among animal manures Mbaguru and Piccolo (1990) noticed that application of piggery manure increased the total nitrogen by 18 percent and 43 percent of available phosphorus. The bio-fertilizers enriched with bacteria and fungi are capable of mobilizing nutritive elements from non-usable form to usable form through biological processes (Tien *et al*., 1979 Mulberry is a perennial crop which continues to grow and produce leaf throughout the year in tropics.

The continuous production of mulberry for a long time results in gradual reduction of leaf yield and quality. This lacuna can be improved through application of organic manures, fertilizers and bio fertilizers with ideal water management (Earanna and Govindan 2002). Moreover to ameliorate soil acidity to a certain extent use of much more organic manures is essential for this lateritic zone of West Bengal. Therefore, in order to increase the leaf yield and to reduce the dependency on continuous use of chemical fertilizers,an attempts have been made to study the effect of different organic residues like Farm yard manures, rearing wastes composts, pig manure and or poultry litter in combinations with bio fertilizers on growth, foliar constituents of mulberry.

II. MATERIALS AND METHODS

Mulberry variety (S1) was raised in the experimental field of Kharikamathani village under Nayagram Block of Paschim Medinipur during the year of 2002-2004. The experiment was laid out in a randomized complete block design with five treatment combinations and three replications. Eight months old mulberry saplings (var. S_1) were planted in the main experimental plot with 60cm x 60cm spacing following pit system of cultivation. The soil of the experimental plot was acidic (pH 5.2). The experiment was initiated with a ground level pruning and recommended cultural practices for rain fed mulberry with the application of four different organic manures like FYM @ 10 ton/ha./year,weed composts and rearing waste composts @ 10 MT/ha./year & poultry manures @ 7 MT/ha./year and pig manure @8 MT/ha/year was applied. *Azotobactor* bio fertilizer was applied @20kg./ha./year 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 five different treatments viz., T_1 = 10 MT/ha/yr FYM + (150 kg N+50 kg P_2O_5+ 50 kg K_2O) /ha /yr), T_2 = 10 MT/ha/ha weed composts + (Azotobacter 20kg + 75kg N + 20 kg P_2O_5 and 50kg K_2O) /ha /yr of T_1, T_3 = 10 MT/ha/yr silkworm rearing waste composts + (Azotobacter 20kg + 75kg N + 20kg P_2O_5 and 50K_2O) /ha /yr of T_1, T_4 = 7 MT/ha/yr poultry-manure + (Azotobacter 20kg + 75kg N + 20kg P_2O_5 and 50kgK_2O) /ha /yr of T_1, T_5 =8 MT/ha/yr pig manure + (Azotobacter 20kg + 75kg N + 20kg P_2O_5 and 50kg K_2O) /ha /yr of T_1.

Data on plant height, number of leaves per plant, leaf area, leaf moisture%, leaf moisture retention capacity & protein content of leaves were recorded for four harvesting seasons namely August, November, February and May.. The plant height was taken as the height of the tallest shoots from the ground level. Total numbers of leaves were recorded as rearable leaves and leaf yield was taken as all leaves of plats in a plot except the border line effect. Leaf area was calculated by following the method of 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 following formula

$$\text{Leaf Moisture\%} = \frac{\text{Fresh weight} - \text{Dry weight}}{\text{Fresh weight}} \times 100$$

To determine moisture retention capacity, fresh leaves were weighed (WI) and incubated at $27^0c \pm 1^0c$ with a relative humidity of 45-50% for 12 hours in a BOD incubator and weighed (WF) again. Further, leaves were dried in an oven and weighed.

$$\text{MRC (\%)} = \frac{\text{Moisture content after 12 hr of incubation}}{\text{Moisture content}} \times 100$$

Total Soluble Protein content in leaves was estimated by the method of Lowry *et al*., (1951). 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	1.1	0.40	1.80
Silk worm rearing waste	1.60	1.00	1.50
Pig Manure	0.80	0.70	0.50
Poultry manure	1.60	1.0	.60

pH was estimated following the method of Jackson (1967). Organic carbon was determined by Walkley and Black method (1934) and estimation of nitrogen by 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.

III. RESULTS:

It is evident from Table- 2 that direct application of bio-inoculants along with organic manures and reduced doses of inorganic fertilizers in combination to the soil exhibited significantly different results with respect of morphological parameters of mulberry viz. plant height, number of shoots per plants,, leaf area, number of leaves per plant. Pooled data recorded for two years with respect of morphological parameters showed that the application of poultry manure along with *Azotobactor* biofertilizer with reduced dose of inorganic fertilizers(T4) for rainfed condition significantly increased the plant height from 62.30 cm. in control to 76.20cm, leaf area from 132.31sq.cm. to 165.30 sq.cm. . It was also observed that contribution of T4 in respect of the number of leaves/plant was highly encouraging as it yielded 112.42kg/ha./year leaves per plant over control which was only 90.10 kg/ha./yr.However increasing number of shoots(7.8) showed that application poultry manure along with biofertilizers exhibited better results.Above all, the impression in respect of different morphological characters like number of leaves per plant and leaf area T4 (Poultry manure+ AZB + 50% N +40%P +100%K)) influenced more than any other treatment which was significantly higher over control. Chemo-assay of leaf also indicated superior quality due to application of the compost and or manure with reduced dose of chemical fertilizers. Effect of organic manures and bio fertilizers on leaf moisture (%) of mulberry variety S1 revealed that T4 resulted 77.60 % which was the highest leaf moisture percentage over control (72.23) (Table-3). However, among the rest of the leaf quality parameter moisture retention capacity showed highest(92.53) in the treatment T5 (Pig manure+ AZB + 50% N +40%P +100%K) over control (82.89). Significant increase in protein content (22.01mg./gm. Fresh weight) of the leaves were obtained by the treatment T4 over control which was only 17.00 mg./gm. Fresh weight.Since mulberry needs more nitrogenous fertilizers in comparison with other agriculture crops, the needs for its economization is evident and so the scope for biofertilizer is well appreciated (Bongale and Dandin 1993). According to Senapati *et al* (2004) it was observed that the incorporation of FYM, bio fertilizers along with chemical fertilizers improved soil structure reduced bulk density, particle density and percent spore space. Naramabuye *et al* (2008) confirmed that animal manure had increased both soil nutrient status and pH of soil. The present observation on poultry litter (T4) and pig manure (T5) applications was also in same agreement. (Table-1). The study of Kerenhap *et al* (2007) in respect of total soluble protein content in mulberry leaves with the application of poultry manures and Chakraborty *et al* (2008) in respect of the soluble protein with the application of poultry manure with biofertilizers also confirmed the present findings. Akinrinde *et al* (2006) reported through their research findings that chicken manure produced significantly higher leaf area in maize plant. More or less similar types of findings were achieved in the present study as application of poultry manure along with biofertilizers and reduced dose of inorganic fertilizers was shown to contribute towards the development of increased leaf area. Hence a combined application of organic manure and bio fertilizers not only improving the soil fertility level but also effective in respect of overall growth and biochemical constituents of leaf of the plant. Thus from the present study it was inferred that application of organic manures along with bio fertilizer and reduced dose of chemical fertilizer is highly beneficial for mulberry cultivation and is eco friendly. Thus this improved package is recommended for mulberry plantation under rain-fed lateritic soil conditions of West Midnapore.

Table 2: Effect of bio-fertilizer in combination with organic manures on morphological parameters of mulberry

Treatment	**Plant height(cm.)**	**Number of shoots/plant**	**Number of leaves/plant**	**Leaf area (sq.cm.)**
T1 (FYM +NPK) Control	62.30± 1.36	5.13± 1.13	90.10± 2.53	132.31± 4.28
T2 (Weed compost +AZB + 50% N +40%P +100%K)	67.21± 2.22	5.25± 1.28	92.33± 3.26	138.39± 3.91
T3 (Silkworm rearing waste compost + AZB + 50% N +40%P +100%K)	71.58± 2.91	6.3± 2.39	95.61± 3.21	142.32± 4.74
T4 (Poultry manure + AZB + 50% N +40%P +100%K)	76.20± 3.50	7.8± 2.89	112.42± 4.78	165.30± 5.39
T5 (Pig manure+ AZB + 50% N +40%P +100%K)	73.13± 3.18	6.52± 2.61	100.32± 3.49	162.20± 5.12

** All the values are mean of six samples
** All values are significant at 5% and 1% level
** ± = Standard Error.

Table 3: Effect of biofertilizers in combination with organic manures on quality of leaf in mulberry

Treatment	Leaf moisture%	Leaf moisture retention capacity%	Leaf protein (mg./gm fresh weight)
T1 (FYM +NPK) Control	72.23± 2.15	82.89± 3.19	17.00± 2.62
T2 (Weed compost +AZB + 50% N +40%P +100%K)	72.3± 2.18	86.70± 3.46	17.33± 2.11
T3 (Silkworm rearing waste compost + AZB + 50% N +40%P +100%K)	72.31± 2.11	88.83± 3.52	17.96± 2.32
T4 (Poultry manure + AZB + 50% N +40%P +100%K)	77.60± 3.13	92.01±4.03	22.01± 4.21
T5 (Pig manure+ AZB + 50% N +40%P +100%K)	74.69± 2.33	92.53± 4.32	19.30± 3.18

** All the values are mean of six samples
** All values are significant at 5% and 1% level
** ± = Standard Error.

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