

Impact of bio- organic fertilizers on the infestation of major pests & foliar disease, leaf yield in mulberry (*Morus alba* L)

ABSTRACT: Massive utilization of inorganic fertilizers for a prolonged period leads to alteration of the soil textural physico-chemical properties and hamper the nutrients availability and uptake by the plants. Application of organic manures along with biofertilizers not only improves the ecological health of the soil but also help disease and pest management, alongside boosting the productivity of the plants. A field experimental study was conducted during March 2004-February 2007 in lateritic soil condition with limited irrigation support in some areas of Midnapur (West) Districts (having around pH of 5.6). It was revealed that the effect of vermicompost manures in combination with other bio fertilizers supplements with reduced doses of inorganic fertilizers had pronounced impact on growth, leaf yield and incidence of pest and diseases of mulberry plants. Appearance of leaf spot disease and pests on the experimental plot species (variety-S-1635) under different treatments also showed that no other diseases than foliar disease was recorded under different manurial and fertilizer doses (T_1 - T_5). Although the incidence was found to be low in the treatment T_3 (8.43%) in comparison to other treatments (T_1 , T_2 , T_4 and T_5), but such treatment did not have any bearing on the incidence of the diseases. Further, population of the insect pests like white fly and thrips were found to be significantly reduced below the economic threshold level in the experimental plots treated with different organic manures over control.

Key words: Mulberry, Organic manures, Biofertilizers, lateritic belt, Pests, Disease

1. INTRODUCTION

Mulberry being deep rooted perennial crop tends to grow and produce leaves throughout the years in the tropical region and represents the only prime food sources for mulberry silkworms (*Bombyx mori* L). Mulberry leaf is a major economic component in sericulture, since the quality and quantity of leaves produced per unit area have a direct bearing on cocoon harvest (Chandrabu *et al.* 2012). Production of leaves in the tropical countries is largely dependent on the application of inorganic fertilizers. Pests and diseases play significant roles in determining the leaf yield of mulberry per unit area (Sharma, *et al.* 1994). Fertilization with inorganic nitrogen, can often encourage succulent and tender plant growth that may enhance the multiplication rate of pests leading to more damage to plants. The plants having good growth coupled with biomass impart profound influence on insect population (Chatterjee *et al.*, 2013). Moreover to reduce the application of pesticides, some agronomical practices like inter cultural operation, proper plant spacing and pruning are supposed to reduce the infestation of diseases without adversely affecting the ecosystem. Recently, a great attention has been paid towards the bio organic farming to avoid the heavy use of agrochemicals that resulted in numerous environmental troubles (Lampkin 1990). Proponents of organic agriculture have asserted that plants grown with biological sources of nutrients such as manures and composted organic wastes are less susceptible to the attack of the insect pests than other conventionally grown plants. Vermicompost, in an organic manure obtained in the form of casting of ingested biomass by earthworms after undergoing physical, chemical and microbial transformations (Chanda *et al.*). Besides, macro and micronutrients, it also contains humic acids, plant growth promoting substances like auxins, gibberellins, and cytokinins (Krishnamoorthy and Vajrabhiah, 1986). Along with farmyard manures, biofertilizers also play a vital role as organic nutrient sources for sustainable soil health and crop growth (Mali *et al.*, 2005). The present investigation aims at evaluating the impact of bio-organic sources of nutrients on leaf yield, incidence of pest attacks and occurrences of certain diseases (leaf spot) in high yielding mulberry varieties (S-1635) in the lateritic soil of Midnapore (West).

2. MATERIALS & METHODS

Mulberry garden of S-1635 variety was raised in lateritic soil in the campus of Vidyasagar University of Midinapur (West). The plantation was made with 49 plants in each replication with 60cm. x 60cm. spacing and was laid out completely in randomized block design method with five treatments having three replicas. The garden was pruned four times in a year. The soil of the experimental plot was acidic (pH 5.6) in nature having 0.41% organic carbon. Recommended cultural practices for irrigated mulberry and the application of organic manures (Farm yard manure (FYM) @ 20 MT/ha/yr, Vermicompost @10 MT/ha/yr, poultry litter @7MT/ha/yr) were followed. Azotobactors in the form of nitrofert bio- fertilizer was applied @20kg/ha/yr after two to three days of every pruning near mulberry rhizosphere by making small furrows and then covered with soil in 4 equal splits, whereas phosphofert bio fertilizer i.e. Arbuscular michorrhizal fungi (AMF) was applied at the rate of 100kg/ha/4years following the same process. Farm yard manure was applied in the control plot so that it could be enriched with nitrogen @ 336kg/ha/yr, phosphorous @ 180kg/ha/yr and potassium @ 112kg/ha/yr respectively. Rest of the plots were provided with nitrogenous fertilizers @ 168kg/ha/yr, phosphorous fertilizer@ 60kg/ha/yr and potassium in usual dose applied in combination with other organic and microbial manures. Inorganic fertilizers were applied after 20 days of the bio fertilizer. Irrigation was provided as and when required. After 65 days of growth, the observations were recorded during the months of August, November, February and May, 2005-07. The treatments followed are mentioned in the Table-1.

T_1 (control) = FYM + N336: P_2O_5 180: K_2O 112 kg /ha /yr (recommended dose)

T_2 = Vermicompost + Azotobacter +AMF + $\frac{1}{2}$ N (50% N) + $\frac{1}{3}$ P_2O_5 and K_2O (33% P_2O_5 and K_2O of the recommended dosage)

T_3 = Poultry-manure + Azotobacter +AMF + $\frac{1}{2}$ N (50% N) + $\frac{1}{3}$ P_2O_5 and K_2O (33% P_2O_5 and K_2O of the recommended dosage)

T_4 = $\frac{1}{2}$ Vermicompost + Azotobacter +AMF + $\frac{1}{2}$ N (50% N) + $\frac{1}{3}$ P_2O_5 and K_2O (33% P_2O_5 and K_2O of the recommended dosage)

T_5 = $\frac{1}{2}$ Poultry-manure + Azotobacter +AMF + $\frac{1}{2}$ N (50% N) + $\frac{1}{3}$ P_2O_5 and K_2O (33% P_2O_5 and K_2O of the recommended dosage)

The incidence of occurrences of diseases and out breaks of pests per plant were recorded for two consecutive years (2005-06 to 2006-07) after 55-60 days of pruning , by randomly taking 10 plants in each replication. Foliar disease such as leaf spot caused by *Myrothecium* was observed during September 2006 and September 2007. During this period, two types of pests populations were recorded (White fly; December-06 and September-07 and Thrips; April-06 and May-07). Leaf Yields from those plots were recorded and calculated in respect of each hectare. All data were processed through statistical analysis.

3. RESULTS AND DISCUSSION

Table-1 showing the nutritional status of different composts has revealed that percentage of N_2 and P_2O_5 was high in poultry litter treated plots followed by the plots treated with vermicompost. In respect of K_2O , FYM treated plots had higher percentage than vermicompost treated ones (1.8% in contrast to vermicompost 1.2%). Poultry litter treated plots had the highest K_2O % among these three.

Leaf Yield showed an increasing trend in different treatments for the three consecutive years (Table-2). Soil productivity of mulberry had been recorded in the tune of 16987.87 kg/ha/yr after application of poultry litter along with biofertilizers (Azotobacter+AMF) and curtailing dose of NPK(T_3). Analysis of three year leaf yields data under different nutrient sources indicated that bio-organic amendments recorded higher leaf yields which were found to be antagonist against diseases and pests attack. Among the treatments, maximum leaf yields was recorded in T_3 in the third year after the establishment of plants (16987.87 kg/ha/yr.), so overall 16.69% increase in leaf yield was recorded. Leaf yields were not hampered due to attack of pests and foliar disease incidence are supposed to be due to effect of organic usage.

Incidence of occurrence of leaf spot disease and pests of mulberry (variety S-1635) under different treatments has revealed that there were no significant differences among the treatments with regard to leaf spot disease and attack of pests like thrips. Regarding infestation of white fly, significant differences were observed among the treatments (CD value (2.265) at 5% level) (Table-) It was also observed that maximum infestation of white fly was recorded in T₁ (control). The infestation in case of T₃ was 17.17% which was followed by T₂ (16.71%), T₅ (16.66%) and T₄ (15.97%). But the infestation in these three (T₂, T₃ and T₄) and T₅ differed significantly from each other. Similarly in foliar disease (leaf spot) the infestation was maximum in control (9.48%) and minimum in T₃ (8.43). Maximum infestation with thrips was noticed in T₂ (14.23%) followed by T₄ (13.10%) and T₅ (12.40%) respectively (Table-3).

In the treatment combination of (T₂-T₅) the treatment T₄ was found consistently effective in reducing the incidence of pests and recorded the lowest whitefly population. The treatments T₅ and T₂ were the next in order of effectiveness in reducing the population of white fly and sustainable yield in mulberry. The result is more or less in conformity with. Ravi *et al.*, (2006) who also recorded significant reduction of the incidence of sucking pests namely whitefly and leaf hoppers under organic manures and biofertilizer treated plots. Similarly in foliar diseases, infestation was maximum in control and minimum in the plot treated with organic composts like poultry litter along with biofertilizers. These findings also corroborates with the study of Ghorbani *et al.*, 2006 who stated that organic composts must have direct anti-disease effects or stimulate competitor micro-organisms and/or induce plant resistance. The use of organic soil amendments can result in a better soil quality and greater plant disease suppressiveness (Bulluck and Ristaino, 2002). Sharma 1994 also concluded that reduction in disease development might be due to the production of various growth substances or hormones by azotobacter, azospirillum and partial application of nitrogen which enables plants to develop resistance power in the plant against certain pathogens. In the present investigation, highest abundance of white fly in control plot (FYM+NPK) has also corroborated the research outcomes of Prestidge and Mc Neill (1983) who found that plants grown with high levels of nitrogen fertilizer resulted in larger infestation of pest. Integration of different sources of nutrients tended to release essential plant nutrients gradually throughout the growth period that might have induced development of resistance which subsequently helped in escaping whitefly infestation in tomato. Panda *et al.*, (2005) highlighted the pest suppressing ability of vermicompost and found that vermicompost based treatments harboured lowest population of sucking pests namely jessids and thrips in the plantation of chilli.

Table:1. Nutrient status of different composts

Different components	pH	Organic carbon %	N%	P%	K%
Farm Yard Manure (FYM)	7.2	39.4	1.1	0.42	1.82
Vermicompost	7.2	15.4	1.65	0.92	1.2
Poultry Litter	7.0	7.7	3.1	2.84	2.70

Table:2. Effect of different treatments on % gain of leaf yield over control (kg/ha/yr)

Treatments	2004-05	2005-06	2006-07	Average leaf Yield of three years	% of increase in yield
T ₁	13149.67	13455.54	14496.60	13700.603	-
T ₂	14710.26	14429.15	15569.70	14903.036	8.77
T ₃	15092.42	15883.32	16987.87	15987.87	16.69
T ₄	14423.83	14487.55	15455.69	14789.023	7.94
T ₅	14024.55	14094.84	15198.85	14439.413	5.39

Table:3. Incidence of disease and pests of Mulberry (variety S-1635) under different treatments (Average of two years pooled data)

Treatments	Disease of Mulberry	Pests of Mulberry (number/leaf)	
	Leaf spot disease incidence(%) (<i>Myrothaium roridum</i>)	White fly (<i>Dialeuropora decempuncta</i>)	Thrips (<i>Pseudodendrothrips mori</i>)
T ₁	9.48	20.02	13.10
T ₂	9.43	16.71	14.23
T ₃	8.43	17.14	11.57
T ₄	8.69	15.97	11.27
T ₅	9.30	16.66	12.40
CD at 5%	NS	2.265	NS
CD at 1%	NS	NS	NS
CV %	4.69	6.953	11.49

The lowest disease incidence was recorded in the plots treated with poultry manure at the dose of 7 MT/ha. The results generated out of the present research studies are in conformity to the findings of Sullivan (2003) who concluded that excessive nitrogen levels may further boost different diseases which are rarely a problem in organic production.

4. CONCLUSION

The present study has revealed that Bio-organic fertilizers appear to be more effective than inorganic fertilizer to induce growth and tolerance to insect pests and diseases. Therefore, these agricultural inputs should be considered in the nutrient schedule of mulberry cultivation. Applications of manures and organic fertilizers have sound effect on the protection of natural enemies under field condition. Bio-organic fertilizers have contributed the higher yield as compared to chemical fertilizers and thereby tend to improve the fertilizer use efficiency and reduce the inorganic pesticide load on soil and ground water leading to the sustainable agriculture.

The present study has also highlighted that in order to reduce the inorganic pesticide load on soil and ground water and ultimately on environment a two-fold measure has to be taken- (1). curtailment of chemical fertilizers through judicious application of inorganic and organic sources of nutrients & (2). Increasing use of vermicompost supplemented with other biofertilizers in the nutrient schedule of mulberry cultivation. The treatment comprising of recommended dose of inorganic fertilizers and vermicompost (5 MT/ha/yr) inoculated with nitrofert and phosphofert biofertilizer may be practiced to minimize white fly population and sustainable yield of mulberry. In addition, by way of reducing 25% doses of chemical fertilizers usage it will also improve the fertilizer use efficiency and subsequently will help sustaining the fertility and productivity of soil.

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