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Short Communication

Evaluation of severity of foliar diseases of mulberry under organic *versus* conventional farming systems

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Mulberry (*Morus* sp.), the sole food plant of silkworm (*Bombyx mori*) is prone to several foliar diseases caused by fungi, bacteria, virus and mycoplasma. Among them, powdery mildew (*Phyllactinia corylea*), leaf rust (*Peridiopsora mori*), *Pseudocercospora* leaf spot (*Pseudocercospora mori*), *Myrothecium* leaf spot (*Myrothecium roridum*) and sooty mold (Ascomycetes and Deutoromycetes fungi) are major foliar diseases of mulberry in the eastern and north eastern India (7,8). About 10-15% leaf yield loss occurs due to powdery mildew, leaf rust and leaf spot diseases (3,9). Besides, these diseases also reduce leaf quality drastically leading to poor silkworm rearing. Qadri *et al*. (11, 12) reported crop loss up to 54.56% and 55.59% at maximum disease severity of leaf spot and powdery mildew, respectively.

Farmers generally depend on chemical fertilizers for maintenances of mulberry gardens. Uses of chemical fertilizers have several limitations *i.e.* residual toxicity on silkworm, being costly and hazardous to environment. Moreover, overuse of chemical fertilizer eliminates natural soil microbial flora. Increasing conscious about conservation of environment as well as health hazards caused by agrochemicals, switching over from chemical to organic farming is urgently needed for sustainability of the sericulture industry. Synthetic fertilizers and pesticides increase crop susceptibility to pests (18). Soil borne root diseases are generally less severe on organic farms than conventional farm, however, there were no consistent differences observed in foliar diseases (13). Reports of foliar diseases occurring in the Gangetic plains of mulberry under organic farming are lacking. Therefore, the present study was carried out with an object to evaluate foliar disease response of S-1635 under organic versus conventional farming system.

The experiment was conducted with popular high yielding mulberry variety S-1635 at Central Sericultural Research and Training Institute, Berhampore, West Bengal during the year 2007- 2009. The experiment was laid out in randomized block design with three replications. In each replication 81 nos. of plants was raised in 2´x 2´ spacing under irrigated condition. There were seven treatments *viz.,* T1 - control (No input), T2- FYM (20t/ha/ year) and NPK 336:180:112kg/ha/yr in five split doses (Recommended package), T3 - Vermicompost (30t /ha/ year) in five split doses, T4 - Vermicompost (30t/ha/year in five split doses) + twice foliar spray of vermiwash

@600L/ha/crop, T5 - Vermicompost (25t/ha/year in five split doses) + green manure (*Crotalaria juncea*), T6 - Vermicompost (20t/ha/year) + green manure + recommended dose of bacterial and fungal biofertilizer (*Azotobacter chroococcum* @ 20kg/ha/yr and Arbuscular Mycorrhizal Fungi (AMF) @ 80kg/ ha/yr), T7 - Vermicompost (15t/ha/yr) + biofertlizers (*A. chroococcum* 20kg /ha/yr and AMF 80kg/ ha/yr) + NPK: 168: 90: 56 in five split doses. Vermicompost was prepared by using sericultural waste (silkworm liters, unused mulberry leaves, weeds of mulberry field) by standard method developed by the Institute. Local strains of *A. chroococcum* and AMF were isolated from mulberry garden and multiplied by standard method developed at the Institute laboratory. *A. chroococcum* was applied after pruning in equal split doses adjacent to root system in furrows followed by irrigation. AMF was applied at the root zone six months after establishment of plantation. FYM was applied every year in two equal split doses once in May-June and another in September-October after pruning and prior to digging. *Crotalaria juncea* was sown in June @30 kg/ha in between rows of mulberry and incorporated the green biomass after 50 days of sowing. Chemical fertilizer NPK was applied 20-25 days after pruning in five equal split doses during March, May, July, September and December. Plants were pruned five times during 4th week of February, 3rd week of April, 3rd week of July, 4th week of September and 1st week of February. Plantation was irrigated at 20 days interval from the month of November to May.

Foliar disease severity data were recorded during 4th week of February, 3rd week of April, 3rd week of July, 4th week of September and 1st week of February from 2nd year onwards for two years (2008 and 2009) by randomly selecting from five plants in each replication representing all the four corners (excluding border row) and one in central location. In each plant, foliar disease severity was assessed from five randomly selected branches using 0-5 visual rating scale. In this scale, 0 = healthy leaf, 1 = 1 - 5 % leaf area infected, 2 = 6 - 10 % leaf area infected, 3 = 11 -25 % leaf area infected, 4 = 26 - 50 % leaf area infected, 5 = 51 and above leaf area infected. Percent of Disease Index (PDI) calculated following the formula (2).

$$PDI = \frac{\text{Sum of all numerical rating}}{\text{Total no. of leaves counted} \times \text{Maximum grade (5)}} \times 100$$

Two years pooled data were subjected to analysis of variance to determine significant differences among the treatments.

Foliar diseases *viz.*, powdery mildew, leaf rust, *Pseudocercospora* leaf spot, *Myrothecium* leaf spot and sooty mold was observed during different seasons. Two years pooled data revealed different intensity of foliar disease severity among the treatments (Table 1). Analysis of variance revealed powdery mildew disease severity was significantly low (PDI ~ 4.07) in the treatment of vermicompost (15t) + biofertilizer + NPK 168:90:56

followed by recommended dose of FYM (20t) + NPK 336:180:112 (4.47 PDI); vermicompost (25t) + green manure (PDI ~5.95); vermicompost (30t) (PDI ~6.28). *Pseudocercospora* leaf spot was significantly low (PDI ~4.40) in recommended dose of FYM and fertilizer. However, there was no significant difference of leaf rust, *Myrothecium* leaf spot and sooty mold disease severity among the treatments. Cumulative disease index was found significantly low in recommended dose of FYM and NPK followed by vermicompost (15t) + NPK 168:90:56 + biofertilizer. Powdery mildew and *Pseudocercospora* leaf spot severity was significantly high in control where no inputs were applied. Significantly low P. mildew disease severity under vermicompost + biofertilizer + NPK may be due to increased levels of soil microbial activity leading to increased competition and antagonism in the rhizosphere may be contributing factors for reduction of P. mildew disease severity. Similarly reduction of P. mildew and *Pseudocercospora* leaf spot disease severity on recommended dose of FYM and NPK may be due application of balanced organic and inorganic fertilizers which helps to enriched soil beneficial mycoflora and supply of nutrient for robust growth of plant which may bring forth resistance to diseases. FYM amended in the soil enriched bacterial population of which 20 percent belongs to *Pseudomonas* sp. (16). Several workers reported that *Pseudomonas* sp. control plant diseases through induction of systemic resistance (1, 5, 17). Reduction of P. mildew disease severity due application of vermicompost alone and also with combination of green manure may be due to enhanced activities of antagonistic microbes (4), increased competition against pathogens for resources that cause fungistatsis (6), release of fungitoxic compounds during organic matter decomposition (14, 15) or induction of systemic resistance in the host plants (10, 19). The finding recommends application of vermicompost along with biofertilizer and half dose of NPK for management of foliar diseases of mulberry and to improve soil health and sustainability of the sericulture industry.

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Table 1.

Incidence of foliar disease on mulberry cultivar S-1635 under different treatments (pooled data of two years)

Treatments	Powdery mildew	Leaf rust	*Myrothecium* leaf spot	*Pseudocercospora* leaf spot	Sooty mold	Cumulative disease Index
Control (No input)	10.06 (12.85)	10.96 (16.36)	2.08 (7.28)	15.22 (18.10)	22.84 (28.08)	63.90 (53.17)
FYM + NPK 336: 180: 112 kg/ha/ yr (Recommended package)	4.47 (7.75)	7.69 (15.90)	3.80 (9.63)	4.40 (8.81)	15.51 (22.54)	35.35 (36.42)
Vermicompost (30t /ha/yr)	6.28 (9.94)	8.59 (15.06)	3.51 (9.32)	7.60 (12.78)	23.84 (29.09)	50.74 (45.42)
Vermicompost (30t /ha/yr) +Vermiwash (600lts/ha/crop)	6.65 (10.45)	8.80 (15.53)	2.61 (7.96)	7.70 (12.52)	21.90 (27.74)	48.50 (44.14)
Vermicompost (25t /ha/yr) + Green manure (*C. juncea*)	5.95 (9.76)	13.42 (20.41)	4.47 (10.16)	9.63 (14.43)	19.95 (26.14)	52.63 (46.55)
Vermicompost (25t /ha/yr) + Green manure(*C. juncea*) + biofer-tilizer (*A. chroococcum* 20kg/ha/ yr; AMF 80kg/ha/yr)	7.28 (11.20)	10.37 (16.69)	2.22 (7.15)	9.72 (14.20)	24.85 (29.52)	56.24 (48.60)
Vermicompost (15t /ha/yr) + bio-fertilizer (*A. chroococcum* 20kg/ha/ yr; AMF 80kg/ha/yr) + NPK 168:90:56	4.07 (7.57)	4.51 (11.58)	3.24 (8.93)	5.93 (11.17)	26.23 (30.42)	44.76 (41.99)
CD (P=0.05)	3.19	NS	NS	2.85	NS	7.22

Figures in parentheses are arc-sine transformed values; NS= Non-significant