RESEARCH PAPER:

Potentiality screening of FYM and vermicompost in disease resistance of mulberry

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SUMMARY

Root rot is one of the most serious diseases of mulberry and has been reported from almost all mulberry growing areas in South India. It is caused by a soil borne micro-organism. Addition of organic nutrients to the soil reduces the inoculum density of the pathogen through changes in the general microbial balance. Therefore, in this experiment different organic nutrients were tested against the root rot disease in mulberry crop. The present investigation was made to find out the efficiency of organic manure in the management of root rot disease. The study revealed that the farmyard manure (T_2) and vermicompost (T_1) exhibited better results in managing the disease than the other amendments like panchagavya, neem cake and biocompost. Better growth of plants, higher chlorophyll content, soluble protein, carbohydrate and total phenolics compounds were recorded in farmyard manure and vermicompost. This may be due to the fact that farmyard manure and vermicompost contain more amounts of organic nutrients essential for microbes, plant growth and resistance against fungal diseases.

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Key Words :
Mulberry, Disease resistance, Organic amendments, Farmyard manure, Vermicompost, Root rot disease

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The negligence on the use of organic sources of nutrients has not only caused the exhaustion of soil fertility and nutrient reserves, but also resulted in soil health problems. Moreover, soil organic matter plays vital role in enhancing soil fertility and productivity. In the absence of organic matter, the soil is a mixture of sand, silt and clay. Many chemical pesticides and fungicides are used to control the pest, which have unfavourable environmental impact and hence, there is a pressure for diseased reliance on such agents and greater regulatory control of their use.

Excessive use of chemical fertilizer and other agrochemicals creates depletion in soil fertility, pollution in surface water bodies, nutrient and increases the soil acidity with nitrification (Dhar, 1962).

Importance of organic manure in present agriculture is increasing day by day because of its utility not only in improving the physical, chemical and biological properties of soil but also in maintaining the soil health without pollution. Addition of organic manure in any form helps in maintaining the organic matter and fertility level in soil (Swati *et al.,* 2005).

EXPERIMENTAL METHODOLOGY

Crop-Mulberry (*Morus alba*), T_1-Vermicompost, T_2-FYM, T_3-Neem cake, T_4-Panchagavya, T_5 –Biocompost, T_6 - Control.

Experiment details:

For this experiment, the pot mixture was prepared using sand, red earth, FYM in 1:2:1 ratio and filled in the pot. The root rot affected roots were mixed in pot mixture as a disease agent for mulberry plants. Then as per the treatment, the treatment materials were mixed in each pot. The single budded cuttings were planted after the above processes to study the effect of various organic amendments on the control of root rot in *Morus alba.*

Measurement of physical parameters:

Plant height (cm), size of leaves (cm^2),

weight of leaves (g), number of leaves ,internode length (cm).

Bio-chemical parameters:

Estimation of

– Chlorophyll content by Arnon 1940 and Witham 1971,
– Total phenols by Bray and Thorpe, (1954).
– Mineralizable nitrogen by Alkaline permanganate method.
– Available phosphorus by Olsen's method (Olsen *et al.,* 1954).
– Available potassium by Hanway and Heidal method (1952).

Determination of :

– pH and electrical conductivity.
– Soluble protein by the mothed of Lowry *et al.,* 1951.
– Carbohydrate by Anthrone method.
– Specific Proteins from Leaf by SDS-PAGE method

EXPERIMENTAL FINDINGS AND DISCUSSION

The results obtained from the present investigation are summarized below:

Microbial parameters:

The micro-organisms (bacteria, fungi, and actinomycetes) count was enumerated in different organic manure treated soils during the experimental period. The bacterial density ranged from 31 to 34 x 10^6 CFU ml^{-1}. The decreased count was observed when compared to control (45 x 10^7). Low bacterial count was recorded in Neemcake applied soil.

In the case fungal population, absence of fungal strain was observed in vermicompost and farmyard manure.

Actinomycetes count was determined during the study period. The higher population density (20 x 10^4) was recorded in farmyard manure. Decreased level of population 19, 18, 18 and 17 was observed in vermicompost, biocompost, neemcake and panchagavya organic manures.

Biochemical parameters :

Estimation of chlorophyll :

After 45, 60and 90 days, the chlorophyll content was measured. The chlorophyll 'a' ranged from 0.335 to 0.425 mgg-1, chlorophyll 'b' ranged from 0.665 to 0.765 mgg-1 and total chlorophyll content gradually increased 0.704 to 0.800 mgg-1 in farmyard manures treated plants. Followed by vermicompost, biocompost and panchagavya and neemcake treatment. The chlorophyll content lower in neem-cake treated plants (Table 3).

Estimation of soluble protein:

The soluble protein level was estimated in various compost treated plants. The highest soluble protein level 0.058, 0.064 and 0.077 mgg^{-1} was recorded in farmyard manure treated plants. In the case of vermicompost applied plants, soluble protein level was 0.026, 0.065 and 0.070 mgg^{-1}. Biocompost, neemcake and panchagavya applied plants were having lower level of soluble proteins (Table 2).

Estimation of carbohydrate:

The carbohydrate level 0.174, 0.246 and 0.255 mgg^{1} was slightly increased in 45, 60 and 90 days treatment with farmyard manure. Similarly in vermicompost, the carbohydrate level was estimated between 0.164 and 0.236 mgg^{-1}. In other organic manure treated plants, *viz.,* biocompost, neemcake and panchagavya the reduced amount of carbohydrate content was noticed (Table 2).

Estimation of total phenol:

The phenol content in root and shoot was more (0.262, 0.266, 0.276 and 0.278, 0.279 and 0.288 mgg^{-1}) in farmyard manure. In vermicompost the phenol level was somewhat lesser than farmyard manure treated method. The range

Table 1: Measurement of physical parameter in different treatments

Treatments	No. of leaves			Area of leaves (cm^2)			Internode length (cm)			Weight of leaves(g)			Height of plant (cm)		
	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
T_1	48.0	49.0	51.0	145.6	152.1	155.1	2.2	3.7	4.1	1.9	2.0	2.3	86.8	88.5	98.3
T_2	67.0	70.0	79.0	165.0	170.4	173.3	2.6	3.1	5.0	2.1	2.3	3.1	86.0	92.0	102.0
T_3	47.0	50.0	58.0	83.3	89.7	151.8	3.4	3.8	4.0	1.0	1.8	2.8	77.3	83.3	83.8
T_4	28.0	34.0	45.0	139.5	147.1	150.1	3.9	4.1	4.1	1.7	1.8	2.3	57.6	67.1	104.0
T_5	36.0	40.0	51.0	143.8	144.2	156.4	2.8	4.6	4.7	1.8	1.8	2.9	70.4	73.8	96.6
Control	19.0	30.0	32.0	130.5	130.8	134.4	3.8	4.1	5.1	1.3	1.7	2.2	56.6	62.6	80.6

A – 45 days; B- 60 days; C- 90 days; T - treatments

Table: 2 Biochemical parameter analysis on samples of different treatments

Treatments	45th Day chlorophyll level mg/g-1			60th Day chlorophyll level mg/g-1			90th Day chlorophyll level mg/g-1		
	Soluble protein	Carbohydrate	Total phenol	Soluble protein	Carbohydrate	Total phenol	Soluble protein	Carbohydrate	Total phenol
T_1	0.026	0.164	0.248	0.065	0.226	0.254	0.070	0.236	0.264
T_2	0.058	0.174	0.262	0.064	0.246	0.266	0.077	0.255	0.276
T_3	0.048	0.106	0.201	0.062	0.172	0.210	0.076	0.182	0.221
T_4	0.048	0.114	0.193	0.054	0.178	0.200	0.070	0.187	0.210
T_5	0.046	0.118	0.244	0.067	0.182	0.254	0.064	0.193	0.259
T_6	0.046	0.112	0.210	0.065	0.188	0.229	0.070	0.198	0.238
Control	0.047	0.164	0.220	0.061	0.226	0.235	0.071	0.236	0.244

varied from 0.248, 0.254 to 0.264 in root. But in biocompost, neemcake and panchagavya induced plants phenol level was slowly increased from 0.193 to 0.259 mgg^{-1} (Table 2).

Macronutrients (NPK):

The macronutrient level was tested in organic manure treated soil. NPK level was higher in farmyard manure applied soil 114.6, 65 and 403 kg/ha and organic carbon level as 0.85 per cent. Vermicompost applied soil NPK level and organic carbon level recorded was 113.6, 56 and 269 kg/ha and this value was higher when compared to other compost.

Level of NPK in different organic manure treated soil.

The chemical analysis of the vermicompost revealed 1.875 per cent nitrogen, 0.6 per cent phosphorus and 1.0 per cent potassium. Farmyard manure contains 0.3 per cent nitrogen,0.2 per cent phosphorus and 0.3 per cent potash besides 14.5 per cent ppm zinc,1465 ppm iron,69 ppm manganese and 28 ppm copper.

The application of vermicompost at different rates along with the farmyard manure significantly increased the concentration of major nutrients at all stages of crop growth. The concentration of NPK increased with the age of crop up to 45th day which might be due to solubility effect of certain organic acids released during the decomposition of the organic matter present in vermicompost and farmyard manure. The application of farmyard manure and vermicompost resulting in higher content of nutrients, in mulberry leaves (Dahiya *et al*., 1987). Similar trends were observed in present studies.

Table 3: Physical parameters and macronutrients analysis on samples of different treatments

Treatments	45th Day chlorophyll level mg/g-1			60th Day chlorophyll level mg/g-1			90th Day chlorophyll level mg/g-1		
	Chloro (a) mg/g-1	Chloro (b) mg/g-1	Total chloro mg/g-1	Chloro (a) mg/g-1	Chloro (b) mg/g-1	Total chloro mg/g-1	Chloro (a) mg/g-1	Chloro (b) mg/g-1	Total chloro mg/g-1
T_1	0.299	0.663	0.730`	0.311	0.555	0.710	0.315	0.565	0.830
T_2	0.335	0.665	0.704	0.370	0.730	0.789	0.425	0.765	0.800
T_3	0.121	0.251	0.302	0.129	0.275	0.360	0.165	0.305	0.369
T_4	0.225	0.450	0.543	0.185	0.435	0.534	0.207	0.540	0.645
T_5	0.265	0.521	0.573	0.314	0.565	0.650	0.340	0.617	0.693
T_6	0.112	0.232	0.281	0.131	0.382	0.381	0.197	0.404	0.499
Control	0.164	0.310	0.356	0.192	0.334	0.371	0.194	0.382	0.441

	Macro nutrients				
Treatments	N kg/ha	P kg/ha	K kg/ha	OC %	$_PH$	EC (mmg/cm$^{3)}$
T_1	113.6	56	269	0.87	8.1	0.164
T_2	114.6	65	403	0.85	8.2	0.167
T_3	109	40	358	0.22	8.0	0.199
T_4	111	40	209	0.78	8.1	0.142
T_5	112	40	358	0.72	8.0	0.205
Control	108	40	224	0.60	8.2	0.176

In farmyard manure applied mulberry plants the total chlorophyll content was high it increases the nutrient value of *Morus alba* leaves.

Mulberry plants responded significantly to organic manure (vermicompost and farmyard manure) and NPK fertilizers. Vermicompost application produced marked effect in foliage yield of mulberry which increased with the successive increase in the levels of vermicompost. The maximum yield was 40.63q ha^{-1} recorded in the treatment farmyard manure followed by the application of vermicompost at 25 t ha^{-1} vermicompost at 5 to 25 ha^{-1} significantly improved the foliage yield of mulberry, 11.91,21.86,26.26,28.27,29.71 per cent higher over control (Sengupta *et al.,* 1972 and Tikader *et al.,* 1993). These results were correlated with present investigation. The yield of foliage increased from 36.0 per cent, 41.0 per cent and 44.5 per cent in farmyard manure applied mulberry plant and in vermicompost 31.0 per cent, 36.0 per cent and 41.0 per cent.

Reduced number of fungus population was recorded in farmyard manure and vermicompost treated soil. The incidence of fungus population was effectively controlled by the soil application with farmyard manure. There by in present study it reveals the inhibition of fungal root rot disease and increased the growth rate of mulberry plants.

The leaves weight and leaf area increased in the farmyard manure treated mulberry plants. The leaves weight was positively correlated with the farmyard manure dose (1.98g to 2.98 g). The weight of leaves varied from 2.1g to 3.0g in farmyard manure. This shows similar pattern of results with the studies of Shi and Nortan (2000).

The observation was made of chemical composition of the mulberry leaves at various stages of maturity. The difference was observed in farmyard manure treated plants 70 per cent to 81.6 per cent of soluble protein and 46.0 per cent to 58.0 per cent of carbohydrate was available. Similar results were observed in the present studies in which Farmyard manure treated plants, 58.0 per cent to 67 per cent of soluble protein and 39.0 per cent to 48.0 per cent of carbohydrate level increased.

On dry matter basis, the leaves contained 15.0 to 27.6 per cent soluble protein and 63.3 per cent total carbohydrate present in vermicompost treated plants (Jayal and Kehar, 1962). Similar trend was observed in present study in which 14.2 per cent to 25.6 per cent soluble proteins and 58.3 per cent total carbohydrate were present in farmyard manure treated plant and 12.0 per cent to 24.0 per cent soluble protein and 56.3 per cent total carbohydrate was present in vermicompost plant.

Treatment of farmyard manure with soil showed substantial changes in microbial population. After treatment the soil was found to be rich in Actinomycetes which was followed by bacteria and fungi (Finstein and Morris, 1975). In present work the Actinomycetes population was found high in farmyard manure and vermicompost treatment soils.

The increased population of Actinomycetes and bacteria produced antifungal agents. The growth of Actinomycetes was influenced by organic manure. From the present study, it presumed that, the organic manure especially farmyard manure and vermicompost improved the soil fertility, growth rate of mulberry plant, beneficial microbes population, chlorophyll content and also it helps to prevent mulberry plants from phytopathogenic fungi which cause root rot disease.

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