

Original Research Article

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Efficacy of Organic Manures and Biofertilizers on Soil Microbial Count and Yield of Black Nightshade (*Solanum nigrum* L.)

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ABSTRACT

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Black night shade (*Solanum nigrum* L.) belongs to the family 'Solanaceae' is an important medicinal plant which has tremendous medicinal value. The plant contains alkaloids like solamargine, solanigrine and solasonine. The herb is credited with emollient, antiseptic, leucoderma, piles, ulcer, *asthma* and eye troubles. *Makoi* leaves are also known to suppress carcinogenesis and have high market value. Farmers growing this crop will also get high net return. A field experiment was carried out at HC&RI, TNAU, Coimbatore during 2012-13 to study the effect of organic manures and biofertilizers on Black night shade on quality parameters. Soil application of different graded levels of organic manures and biofertilizers was applied *i.e.*, T1- FYM @ 8t/ha + foliar spray of 1% PPFM, T2- T1+Azophos @ 2kg/ha, T3- T1+Azophosmet @ 2kg/ha, T4- Vermicompost @ 6t/ha + foliar spray of 1% PPFM, T5- T4+Azophos @ 2kg/ha, T6- T4+Azophosmet@ 2kg/ha, T7- Poultry manure @ 4t/ha + foliar spray of 1% PPFM, T8- T7+Azophos @ 2kg/ha and T9- T7+Azophosmet@ 2kg/ha was carried with three replications. Foliar spraying of 1% PPFM was taken up at 45th day after sowing and later at 15 days after first and second harvest *i.e.*, 75 and 105 DAS. The highest Solasodine content (0.4%) was observed in the treatment T₆. The increase may be due to synergistic and compatible effect of organic manures and biofertilizers application.

Introduction

Solanum nigrum L. (commonly known as 'Black night shade' in English and '*Makoi*' in Hindi) belongs to the family 'Solanaceae' is an important medicinal plant which has tremendous medicinal value. The economic parts of the plant are leaves, berries and even the whole herb. The plant contains alkaloids like solamargine, solanigrine and solasonine. The herb has antiseptic, anti-dysenteric properties and used against abdominal upsets. The plant is also credited with emollient, diuretic, anti-spasmodic and laxative properties. It is used in heart diseases, fever,

pain, leucoderma, piles, ulcer, vomiting, *asthma* and eye troubles. The berries and leaves are mainly used for medicinal purposes, besides the other parts of the whole plant. The leaves are used as poultice for rheumatic and gouty joints, dropsy, nausea and nervous disorders. The decoction of the berries and flowers are useful in cough, erysipelas (specific, acute, cutaneous inflammatory disease caused by a haemolytic streptococcus and are characterized by redhot). *Makoi* leaves are also known to suppress carcinogenesis. These are remedy

for pulmonary tuberculosis and Bronchitis, diuretic. The juice of the berries used as an antidiarrhoea, ophthalmopathy and hydrophobia. It is also used in anasarca and heart disease. Berries are used to possess tonic, diuretic and cathartic properties. Seeds are useful in giddiness and dipsia. They are also useful in inflammations and skin diseases. The roots are useful in otopathy, ophthalmopathy, rhinopathy and hepatitis. The whole plant used as antiseptic, anti-inflammatory, expectorant, cardiogenic, digestive, diuretic, laxative, diaphoretic, sedative, swelling, cough, asthma. The plant is also effective in curing cardiopathy, leprosy, haemorrhoids, nephropathy, ophthalmopathy, dropsy and general debility.

Decoction of the plant depresses the Central Nervous System and reflexes of the spinal cord (Saleem *et al.*, 2010). Cultural practices such as cultivation, intercropping, rotation, drainage use of pesticides, and fertilizers have vital implications for the microorganisms, number of fungi, bacteria, actinomycetes, yeast, and protozoa present in the soil (Hengeveld, 1996). Soil microbiology traditionally deals with the study of microorganisms and their processes in soil. The interaction among organisms and their environments involves soil ecology (Paul, 2007). Soil is a heterogeneous medium of solid, liquid and gaseous phases varying in its properties both across the landscape and in depth (Luo and Zhou, 2006).

Soil microorganisms significantly contribute to the maintenance of the matter and energy turnover in terrestrial environment. Soil represents one of the most significant places for biogeochemical processes, in which mineralization has a very important role. Soil respiration is an ecosystem process that releases carbon dioxide (CO₂) from soil root respiration, microbial decomposition of litter and soil organic matter and fauna respiration.

Since the global carbon regulates climate change, soil respiration also becomes relevant to climate change, carbon trading and environmental policy. Soil respiration plays a crucial role in regulating atmospheric CO₂ concentration and in climate regulation. The carbon cycle on the global scale involves exchanges of CO₂ among the land biosphere, atmosphere, oceans and the earth crust (Luo and Zhou, 2006). PPFMs influence seed germination and seedling growth by producing the plant growth regulator zeatin and related cytokinins, due to the production of plant hormone and vitamins by pink pigmented facultative methylotrophic bacteria colonizing on the phyllosphere regions of maize (Sundaram *et al.*, 2002). Mineralization tests are very often used for testing the soil microbial activity. CO₂ production enables to evaluate both mineralization activity of native soil organic matter and potential activity of soil after addition of nutrients.

As there is a growing demand for organically grown herbal products in national and international markets, an attempt has been made to assess the effect of different organic manures and biofertilizers on the soil microbial count and yield of *Solanum nigrum* L. with the following objectives.

To study the effect of organic manures and biofertilizers on soil microbial count and to study the effect of organic manures and biofertilizers on yield of *Solanum nigrum* L.

Materials and Methods

A field experiment was carried out at the Department of Medicinal and Aromatic Crops, Horticultural College and Research Institute, Tamil Nadu Agricultural University, Coimbatore during 2012-13 in randomized block design which was replicated thrice to study the effect of organic manures and biofertilizers on Black night shade soil

microbial count and yield characteristics in sandy clay loam soils in spacing of 60 x 30 cm.

Soil application of different graded levels of organic manures and biofertilizers was applied *i.e.*, T1- FYM @ 8t/ha + foliar spray of 1% PPFM, T2- FYM @ 8t/ha + Azophos @ 2kg/ha + foliar spray of 1% PPFM, T3- FYM @ 8t/ha + Azophosmet @ 2kg/ha + foliar spray of 1% PPFM, T4- Vermicompost @ 6t/ha + foliar spray of 1% PPFM, T5- Vermicompost @ 6t/ha + Azophos @ 2kg/ha + foliar spray of 1% PPFM, T6- Vermicompost @ 6t/ha + Azophosmet @ 2kg/ha + foliar spray of 1% PPFM, T7- Poultry manure @ 4t/ha + foliar spray of 1% PPFM, T8- Poultry manure @ 4t/ha + Azophos @ 2kg/ha + foliar spray of 1% PPFM and T9- Poultry manure @ 4t/ha + Azophosmet @ 2kg/ha + foliar spray of 1% PPFM was carried with three replications. Foliar spraying of 1% PPFM was taken up at 45th day after sowing and later at 15 days after first and second harvest *i.e.*, 75 and 105 DAS.

Estimation of total microbial population

Ten grams of rhizosphere soil sample was transferred to 90 ml of sterile distilled water to get 10^{-1} dilution. After thoroughly mixing it, one ml of this dilution was transferred to 9 ml water blank to get 10^{-2} dilution. Likewise, sample was diluted serially with 9 ml water blanks till appropriate dilution was obtained (Parkinson *et al.*, 1971).

Bacteria ($\times 10^6$ CFU g^{-1} soil)

The total bacterial population was enumerated by plating one ml of 10^{-6} dilution in sterile Petri plates using soil extract agar medium. The bacterial colonies appearing on the plates after 48 h of incubation at $30 \pm 1^\circ C$ were counted and expressed in colony forming units (CFU) per g dry weight of the soil.

Fungi ($\times 10^3$ CFU g^{-1} soil)

For the enumeration of fungal population, one ml of 10^{-3} dilution of the soil sample was plated in sterile plate with Rose Bengal agar medium. After 72 h of incubation, the fungal colonies were counted and expressed in CFU per g dry weight of soil.

Actinomycetes ($\times 10^4$ CFU g^{-1} soil)

The total actinomycetes population was enumerated by plating 1 ml of 10^{-4} dilution with Kenknights agar medium. The powdery colonies of actinomycetes appearing after 5 days were counted and expressed in CFU per g dry weight of soil.

Results and Discussion

The ultimate goal to be achieved in any crop production programme is maximization of yield. The yield is a complex phenomenon, which can be engineered both by morphological and physiological parameters. The highest herbage yield per hectare was observed in the treatment T₆ (Vermicompost 6 tha^{-1} + Azophosmet 2 $kg\ ha^{-1}$ + Foliar spray of 1% PPFM). The increased yield may be due to synergistic and compatible effect of organic manures and biofertilizers application. The effect of vermicompost on germination, growth and yield of tomato plants were evaluated under glass house conditions by Atiyeh *et al.*, (2000) and Somasundaram *et al.*, (2003) in green gram who found that highest yield attributes were due to the highest mineral nitrogen concentration of vermicompost.

The increase in yield due to the application of vermicompost might be due to the fact that it is originated from organically digested plant materials which have loosely packed granular particles. It is rich in organic matter content and essential nutrients which are present in

easily available or mineralizable form. Hence, the addition of vermicompost to the soil enhanced the microbial activity of soil and provided more macro and micro nutrients to the plants for better growth. Vermicompost also stimulate the nitrate reductase activity,

which regulates the nitrogen availability to the plant. Humic substance present in the vermicompost stimulates the respiration enzyme which could have resulted in increased respiration and increased yield.

Table.1 Effect of organic manures and biofertilizers on fresh herbage yield per plot (kg plot⁻¹) of Black nightshade

Treatments	Fresh herbage yield per plot (kg plot ⁻¹)		
	60 DAS	90 DAS	120 DAS
T1	2.14	3.27	4.23
T2	2.23	3.39	4.11
T3	3.91	4.35	5.12
T4	3.07	3.21	4.25
T5	3.17	3.43	4.27
T6	5.99	6.97	7.91
T7	2.03	2.29	2.38
T8	2.81	2.92	2.82
T9	3.03	4.02	4.27
SEd	0.09	0.10	0.11
CD (P=0.05)	0.18	0.21	0.24

Treatment details:

T1- FYM @ 8t/ha + foliar spray of 1% PPFM

T2- FYM @ 8t/ha+Azophos @ 2kg/ha+ foliar spray of 1% PPFM

T3- FYM @ 8t/ha+Azophosmet @ 2kg/ha+ foliar spray of 1% PPFM

T4- Vermicompost @ 6t/ha + foliar spray of 1% PPFM

T5- Vermicompost @ 6t/ha+Azophos @ 2kg/ha+ foliar spray of 1% PPFM

T6- Vermicompost @ 6t/ha+Azophosmet@ 2kg/ha+ foliar spray of 1% PPFM

T7- Poultry manure@ 4t/ha + foliar spray of 1% PPFM

T8- Poultry manure@ 4t/ha +Azophos @ 2kg/ha+ foliar spray of 1% PPFM

T9- Poultry manure@ 4t/ha +Azophosmet@ 2kg/ha+ foliar spray of 1% PPFM

Table.2 Effect of organic manures and biofertilizers on soil microbial population (Bacteria, Fungi, Actinomycetes) at initial and final stage of Black nightshade crop growth

Treatments	Bacteria (x 10 ⁶ CFU g ⁻¹ soil)	Fungi (x 10 ³ CFU g ⁻¹ soil)	Actinomycetes (x 10 ⁴ CFU g ⁻¹ soil)
Initial population	10.2	9.3	6.02
Final stage			
T1	47.66	24.33	35.33
T2	88.25	27.66	45.66
T3	91.30	42.96	81.33
T4	42.66	30.33	59.70
T5	66.50	22.33	68.64
T6	96.76	52.46	94.66
T7	31.33	19.54	15.37
T8	41.86	21.56	24.19
T9	89.46	31.95	65.37
SEd	1.79	0.81	1.49
CD (P=0.05)	3.80	1.71	3.15

Treatment details:

T1- FYM @ 8t/ha + foliar spray of 1% PPFM

T2- FYM @ 8t/ha+Azophos @ 2kg/ha+ foliar spray of 1% PPFM

T3- FYM @ 8t/ha+Azophosmet @ 2kg/ha+ foliar spray of 1% PPFM

T4- Vermicompost @ 6t/ha + foliar spray of 1% PPFM

T5- Vermicompost @ 6t/ha+Azophos @ 2kg/ha+ foliar spray of 1% PPFM

T6- Vermicompost @ 6t/ha+Azophosmet@ 2kg/ha+ foliar spray of 1% PPFM

T7- Poultry manure@ 4t/ha + foliar spray of 1% PPFM

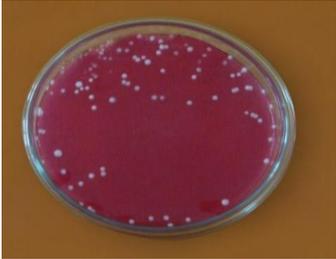
T8- Poultry manure@ 4t/ha +Azophos @ 2kg/ha+ foliar spray of 1% PPFM

T9- Poultry manure@ 4t/ha +Azophosmet@ 2kg/ha+ foliar spray of 1% PPFM

Fig.1 Best Treatment (T6)



Fig.2

Soil microbial population at initial stage	Soil microbial population at final stage
Bacteria 	Bacteria (T6) 
Fungi 	Fungi (T6) 
Actinomycetes 	Actinomycetes (T6) 

Thus application of vermicompost have stimulated the microorganisms by serving as a

source of N and other nutrients essential for its growth and multiplication resulting in increased

yield in *Solanum nigrum*. Similar report was also stated by Somasundaram *et al.*, (2003) in green gram.

The increased yield ascribed might be due to better soil condition, availability of nutrients, continuous and steady supply of nutrition and greater soil microbial activity thus enhancing the production of phytohormones by the application of organic manures. Presence of bioactive principles like auxin, gibberellin, cytokinin, vitamins and amino acids in biostimulants could have influenced more number of side shoots and yield. The growth promoting activity (and it leads to greater movement and availability of phosphorus and micronutrients to the plant) of PPFM is also a possible reason for higher yield. The results are in corroboration with earlier findings of Thanuja (2002) in black pepper.

In conclusion, in the present study, combined use of organic manures with biofertilizers (Vermicompost 6 t ha⁻¹ + Azophosmet 2 kg ha⁻¹ + Foliar spray of 1% PPFM) might have improved the microbial load of the soil, thus increasing the microbial population *viz.*, bacteria, fungi and actinomycetes conspicuously with the application of different organic N sources. The results obtained in this study are supported by the report of Aira *et al.*, 2002. The attributed reason could be the organic manure addition *viz.*, vermicompost would have resulted in increased secondary and micronutrients in the soil which might have helped to increase the microbial population. Application of vermicompost to the soil could have stimulated actinomycetes and bacteria.

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