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Influence of Soil Moisture Regimes and Sources of Organic Manures on Urease Activities in Inceptisols

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Abstract: In order to study the influence of moisture regimes and sources of organic manures on soil urease enzymes in inceptisol soil, an incubation study was conducted under laboratory conditions at the Department of Soil Science and Agricultural Chemistry, College of Agriculture Dhule, during 2012. The results revealed that the activity of soil urease enzyme increased significantly with increasing moisture levels up to field capacity. The moisture levels above or below the field capacity reduced the activity of soil urease. Among the sources of organic manures vermicompost increased the activity of urease enzyme in soil. The interaction effect of moisture levels and organic manures on soil urease enzymes was found to be significant during 0^{th}, 15^{th}, 30^{th}, 60^{th} and 120^{th} days of incubation period. The highest urease activity (0.134 mg NH_4^+ –N g^{-1} soil 24 hr^{-1}) was recorded in moisture at field capacity with vermicompost on 30^{th} days of incubation.

Key words: Soil Moisture · Vermicompost · Farm Yard Manure and Urease

INTRODUCTION

A major agriculture research priority is to sustain soil productivity and to develop better methods to monitor changes in soil physical, chemical and biological properties as influenced by the management practices. The productivity and stability of soil as a medium for plant growth depends greatly on the balance between living and non living microorganisms[1].

In the intensity of the biological processes and soil enzymes the activity of soil enzymes is important for nutrient availability for plants. The enzyme is a substance composed of protein that is capable of lowering the activation energy of selected other compound enough to allow the breaking of particular bond under a particular environment, such enzymes which influence the reaction are called biological action [2]. Enzymes and microbial activity to be a sensitive indicator of soil health. Soil microbial population, a living phase of soil is predominantly influenced by the magnitude of soil organic matter and hence, quantification of their abundance and the species prevailing determine the overall biological process and soil health at large [3].

Soil enzymes help soil organisms in their effort to satisfy their nutritional need. Soil enzymes are participatory in and assuring the correct sequence of all biochemical cycle. Hence, it is pertinent to study the activity of soil enzyme. Soil enzymes activity may provide useful index of changes in soil quality. Urease is responsible for hydrolysis of urea to ammonium carbonate in most of the soil and also involved in estimation of urea hydrolysis in soil. The activity of soil enzymes is also affected by different abiotic factors such as temperature, moisture, soil pH and oxygen content. Pavel *et al*. [4] reported that temperature and moisture influence enzyme activities indirectly through microbial growth and substrate availability. Urease catalyses the hydrolysis of urea to CO_2 and NH_3, which is of particular interest because urea is an important N fertilizer. Urease is released from living and disintegrated microbial cells and in the soil, it can exist as an extracellular enzyme absorbed on clay particles or encapsulated in humic complexes [5]. Therefore, the experiment was laid out for the better understanding of soil enzyme activities as influenced by soil moisture regimes and sources of organic manures in inceptisol.

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Table 1: Physical and chemical properties of experimental site

Sr. No.	Particulars	Value
A)	Physical properties	
I	Soil moisture at,	
i.	0 bar	100 %
ii.	1/3 bar	52.25 %
iii.	5 bar	41.82 %
iv.	10 bar	22.38 %
v.	15 bar	8.0 %
B)	Chemical properties	
1	pH (1:2.5)	8.8
2	EC (dSm^{-1})	0.95
3	Calcium carbonate (%)	2.62
4	Organic carbon (%)	0.33
5	Available Nitrogen ($Kg\ ha^{-1}$)	135.60
6	Available Phosphorus ($Kg\ ha^{-1}$)	9.33
7	Available Potassium ($Kg\ ha^{-1}$)	435.10

Table 2: Chemical composition of FYM and vermicompost

Sr. No.	Particulars	FYM	Vermicompost
1	pH	7.9	8.0
2	EC (dSm^{-1})	2.66	4.69
3	Ca (%)	20.0	18.0
4	Mg (%)	3.6	8.0
5	Total nitrogen (%)	0.61	1.2
6	Total phosphorous (%)	0.39	0.42
7	Total potassium (%)	0.79	0.99
8	Organic Carbon (%)	12.0	15.0
9	C/N Ratio	19.67	12.50

MATERIALS AND METHODS

An incubation experiment was conducted under laboratory condition. The plastic pots were filled with 1 kg soil. The soil moisture at different bars 0 bar (M_1), 1/3 bar (M_2), 5 bar (M_3), 10 bar (M_4) and 15 bar (M_5) and sources of organic manure vermicompost (O_3), FYM (O_2) and control (O_1) were added in soil as per treatment. The sources of organic manure were added in soil @ 1% of organic carbon content and soil moisture levels maintained as per the treatment during incubation period. The soil properties and chemical composition of organic manures were presented in Tables 1 and 2. The fifteen treatment combinations were replicated thrice in a complete randomized design (factorial). The soil samples were drawn periodically from the pots at an interval of 0^{th} days, 15^{th} days, 30^{th} days, 60^{th} days and 120^{th} days of incubation. The urease enzyme assay was carried out according to the method described by Tabatabai and Bremner [6].

RESULTS AND DISCUSSION

Urease Activity: The data given in Table 3 and Fig. 1 indicated that the level of moisture in soil increased the urease activity over control during all incubation period. The application of moisture at field capacity (M_2) significantly increases the urease activity over other moisture levels in different days of incubation period. The increased urease activity in soil with increased levels of moisture might be due to the activation in growth of urease producing micro organisums. It is generally assumed that the urease in soil is essentially a microbial extracellular enzymes accumulated through release of urease from living and disintegrated microbial cells. The increase in urease activity with moisture levels was also reported by Sahrawat [7].

The observation on urease in relation to moisture levels is in close conformity with results reported by Zhang *et al.* [8], Sardans and Penuelas [9].

The additions of organic manures increased the activity of urease enzyme in soil over control throughout the incubation period. The application of vermicompost (O_3) was found significantly superior over FYM (O_2) at all incubation period. The urease activity was increased in different incubation days, but decreased at 60^{th} and 120^{th} day of incubation. The soil urease activity increased with increasing levels of organic manures indicating that some quantity of extracellular urease enzyme adsorbed on organic colloids[10]. Soil contains urea producing micro organism and urease activity in soil can be increased by addition of organic manures like vermicompost and FYM. Increased urease activity upon addition of organic manure was also reported by Saini *et al.* [11], Serra *et al.* [12], Lal *et al.* [13] and Gill *et al.* [14].

The observation on activity of urease in relation to organic manures in soil is close conformity with results reported by Kadlag *et al.* [15] and Manna *et al.* [16]. They reported that the addition of FYM and vermicompost increased the activity of urease enzyme in soil. The activity of urease enzyme in soil increased with an advance in incubation period, it was more on 30^{th} day of incubation. However, the increase was not consistent.

The interaction effect between levels of moisture and organic manures was found to be significant at all incubation period. The interaction (M_2O_3) showed the highest value (0.134 mg NH_4^+ –N g^{-1} soil 24 hr^{-1}) of urease activity on 30^{th} days of incubation. The level of moisture with vermicompost showed the higher urease activity as compared with other moisture levels and FYM. These results indicated that moisture levels had significant role in enhancing soil urease activity.

Table 3: Effect of moisture regimes and organic manures on urease activity ($mgNH_4^+$ –N g^{-1} soil 24 hr^{-1}) in soil

M/O	O_1	O_2	O_3	Mean
		0 Days Incubation		
M_1	0.028	0.029	0.030	0.029
M_2	0.048	0.050	0.052	0.050
M_3	0.043	0.045	0.046	0.046
M_4	0.032	0.034	0.035	0.036
M_5	0.027	0.028	0.029	0.028
Mean	0.036	0.032	0.034	
Interaction		S.E ±		C. D at 5%
M		0.469		1.295
O		0.363		1.002
M x O		0.813		2.246
		15^{th} Days Incubation		
M_1	0.038	0.040	0.041	0.036
M_2	0.062	0.064	0.065	0.066
M_3	0.051	0.052	0.054	0.053
M_4	0.042	0.043	0.045	0.043
M_5	0.037	0.038	0.039	0.038
Mean	0.046	0.044	0.048	
Interaction		S.E ±		C. D at 5%
M		0.575		1.588
O		0.445		1.229
M x O		0.998		2.757
		30^{th} Days Incubation		
M_1	0.045	0.046	0.043	0.041
M_2	0.130	0.132	0.134	0.132
M_3	0.112	0.113	0.115	0.113
M_4	0.081	0.082	0.083	0.082
M_5	0.062	0.063	0.064	0.063
Mean	0.086	0.082	0.086	
Interaction		S.E ±		C. D at 5%
M		0.496		1.370
O		0.384		1.060
M x O		0.860		2.376
		60^{th} Days Incubation		
M_1	0.040	0.043	0.045	0.046
M_2	0.082	0.084	0.085	0.086
M_3	0.072	0.073	0.074	0.073
M_4	0.052	0.053	0.054	0.053
M_5	0.042	0.043	0.044	0.043
Mean	0.056	0.052	0.064	
Interaction		S.E ±		C. D at 5%
M		0.741		2.047
O		0.574		1.585
M x O		1.284		3.547
		120^{th} Days Incubation		
M_1	0.032	0.034	0.035	0.036
M_2	0.052	0.053	0.054	0.053
M_3	0.047	0.048	0.049	0.048
M_4	0.036	0.037	0.038	0.037
M_5	0.032	0.034	0.035	0.036
Mean	0.038	0.042	0.042	
Interaction		S.E ±		C. D at 5%
M		0.741		2.047
O		0.574		1.585
M x O		1.284		3.547

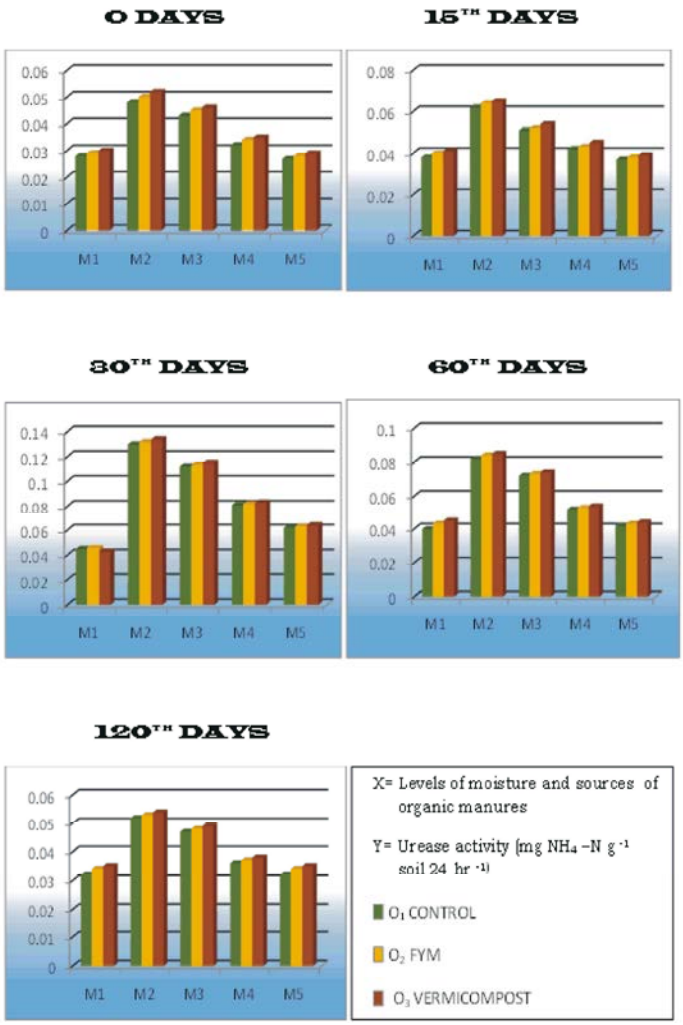

Fig. 1: Effect of moisture levels and sources of organic manures on urease avtivity

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