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EFFECT OF BIOFERTILIZER APPLICATION AND MOISTURE LEVELS ON SOIL DEHYDROGENASE ACTIVITY UNDER SUGARCANE CROPPING SYSTEM

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ABSTRACT:

The objective of the study is to evaluate the effect of biofertilizer application and moisture levels on dehydrogenase activity under sugarcane cropping system by imposing different levels of irrigation(75%, 100%, 125% Recommended dose of irrigation) and fertigation (75% and 100% Recommended dose of fertilizers with different formulations of fertilizers and with or without biofertiliers). Based on the results obtained from the field trial, dehydrogenase activity increased upto 150 days after planting from the initial dehydrogenase activity and there after showed a decreasing trend until harvest. Irrigation regime of 125 percent (I_3) with fertigation level of 75 percent RDF as 50 percent commercial and 50 percent water soluble fertilizer + LBF (F3) recorded the highest dehydrogenase activity (I_3F_3). It is evidently clear that the application of biofertilizers were greatly involved in the accumulation of soil enzymes, which directly reflects the soil fertility index. Soil moisture content may also be played a major role on dehydrogenase activity.

KEYWORDS: *Dehydrogenase; Soil Enzymes; Sugarcane; Biofertilizer*.

INTRODUCTION:

Sugarcane is a tropical plant. Among the several agricultural crops sugarcane is the most remunerative crop and has very high economic biomass to total biomass ratio. It requires more water and fertilizer. India is one of the largest producers of sugar and sugarcane. Biofertilizers have been recognized as a vital component of the integrated nutrient management systems (Jeyabal *et al.*, 1999). Microorganisms are part of such components of soil which directly and indirectly responsible for soil health as well as transformation, availability and uptake of nutrients by plants (Lal *et al.*, 2000).

Soil enzymes activity has been considered as one of the indices for soil fertility (Galstyan, 1963). Quantitative measurement of soil enzyme activities can contribute to our understanding of these biological transformations by allowing us to evaluate the activity present in the soil. Soil enzymes originate from soil microorganisms (Hofmann, 1963; Briggs and Spedding, 1963), soil animals (Kiss, 1957) and soil vegetation (Peterson, 1961).

Biological oxidation of organic compounds is due to dehydrogenation process, which involves highly specific dehydrogenases (enzymes catalyzing dehydrogenation). Dehydrogenase enzymes appear to be linked with microbial activity associated with initial break down of organic matter (Ross, 1971). Dehydrogenase has been widely used to measure catabolic activities in soil, which is correlated with microbial activity (Skujins, 1976.

MATERIALS AND METHODS

The experiments were carried out at central farm of Agricultural College and Research Institute, Madurai with the following treatments in spilt plot design having three main field treatment and six sub plot treatments. 75%, 100% 125% Recommended dose of irrigation as main plot treatments (I_1, I_2, I_3) and fertilizer dose in sub plot treatment (F_1-75% RDF – commercial fertilizer + liquid biofertilizer, F_2-100%RDF – Commercial fertilizer, F_3 -75% RDf - 50% commercial fertilizer and 50% water soluble fertilizer +Liquid biofertilizer , F_4-100%RDF - 50% commercial fertilizer and 50% water soluble fertilizer, F_5-75% RDF - Fully water soluble fertilizer + LBF, F_6-100%RDF - Fully water soluble fertilizer).

Sugarcane variety CO 86032 was used for the research and the spacing used is 165cm. The recommended fertilizer dose of fertilizer followed is 344:94:169 kg NPK ha^{-1}.

Soil samples were collected from the corners and the center of the field at 0-15 cm depth during the cropping period at 30 days interval, samples were combined and then thoroughly mixed to obtain a homogenous mixture. The soil was taken directly for enzyme assay. Portion of soil was dried and taken for soil nutrients analyses.

Dehydrogenase activity in soil was determined by following the method described by Casida *et al.* (1964). Six gram of soil was taken in 100 ml Erlenmeyer flask. In the flask, 120 mg of $CaCO_3$, 1 ml of 3%. Triphenyl tetrazolium chloride (TTC) and 2-4 ml of distilled water were added. The flasks were tightly stoppered and swirled for a few seconds. A small amount of free liquid was present at the surface of the soil. The soil samples were incubated for 20h at 30^{o}C. The product was extracted with 94% methanol for 60 min, immediately filtered through filter paper and assayed at 485 nm. The unknowns were calculated from the standard with triphenyl formazan (TPZ).

Triphenyl formazan, 100 mg was dissolved in about 80 ml of methanol adjusted the volume to 100 ml with methanol and mixed thoroughly. To prepare the standard graph, diluted 10ml of TPF standard solution to 100ml with methanol (100 mg of TPF ml^{-1}). Pipetted out 5,10, 15,20 and 25 ml aliquots of this solution into 100 ml volumetric flasks (500, 1000, 1500, 2000 and 25000 mg of TPF 100 ml^{-1}) and the volumes were made up with methanol and mixed thoroughly. The intensity of the red colour of TPF was determined by measuring the absorbance at 485 nm.

RESULTS:

The data on dehydrogenase activity shows significant increase at all intervals up to 150 DAP from the initial dehydrogenase activity of 0.043 x µg TPF g^{-1} hr^{-1}. Then the activity had decreased till harvest of the crop. Irrigation regime of 100 percent (I_3) recorded the maximum dehydrogenase activity (0.173 µg TPF g^{-1} hr^{-1}) at 150 DAP. The lowest was recorded in 75 percent (I_1) (0.143 µg TPF g^{-1} hr^{-1}). Among the fertigation levels 75 percent RDF as 50 percent commercial and 50 percent water soluble fertilizer + LBF (F3) recorded the highest dehydrogenase activity (0.210 µg TPF g-1 hr-1) during 150 DAP. The lowest was recorded in
100 percent RDF as fully water soluble fertilizer (F6) (0.107µg TPF g-1 hr-1).

Interaction effect of 125 percent irrigation with 75 percent RDF as 50 percent commercial and 50 percent water soluble fertilizer + LBF (I_3F_3) recorded the highest dehydrogenase activity (0.240 µg TPF g^{-1} hr^{-1}) at 150 DAP followed by 100 percent irrigation with 75 percent RDF as fully water soluble fertilizer + LBF (I_2F_5) . The lowest dehydrogenase activity occurred at 125 percent irrigation with 100 percent RDF as fully water soluble fertilizer (I_3F_6) (0.070 µg TPF g^{-1} hr^{-1}) at 150 DAP.

DISCUSSION:

This study showed that higher dehydrogenase activity was observed in 125 percent irrigation with 75 percent RDF as 50 percent commercial and 50 percent water soluble fertilizer + LBF (I_3F_3) The dehydrogenase activity was higher in early stages of crop growth and it declined towards the harvest stage may be due to the changes in soil pH, which can significantly affect microbial activities in soil. Due to the higher microbial population, the biofertilizer applied treatments showed the higher dehydrogenase activity. It is evidently clear that the application of biofertilizers were greatly involved in the accumulation of soil enzymes, which directly reflects the soil fertility index (Kannaiyan, 2000). Soil moisture content may also be played a major role on dehydrogenase activity.

CONCLUSION:

Soil enzymatic activities are the direct expression of the soil community to metabolic requirements and available nutrients. Dehydrogenase activity is directly correlated with the applied microbial load and also the moisture content. Higher the moisture content increases the dehydrogenase activity up to saturation point of the soil. Because the moisture content is one among the important factors of organic matter degradation. Increased microbial load may facilitates the organic matter degradation process in soil and there by the dehydrogenase activity.

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Effect of moisture levels and liquid biofertilizers on dehydrogenase activity under sugarcane cropping system (µg TPF g^{-1} hr^{-1})

Treatments	Dehydrogenase (µg TPF g^{-1} hr^{-1})															
	30 DAP				60 DAP				90 DAP				120 DAP			
	I_1	I_2	I_3	MEAN	I_1	I_2	I_3	MEAN	I_1	I_2	I_3	MEAN	I_1	I_2	I_3	MEAN
F_1	0.090	0.130	0.100	**0.107**	0.110	0.150	0.130	**0.130**	0.110	0.150	0.130	**0.130**	0.130	0.180	0.160	**0.157**
F_2	0.070	0.110	0.070	**0.083**	0.090	0.090	0.090	**0.090**	0.100	0.100	0.070	**0.090**	0.110	0.120	0.100	**0.110**
F_3	0.130	0.090	0.070	**0.097**	0.150	0.130	0.100	**0.127**	0.150	0.150	0.150	**0.150**	0.170	0.160	0.190	**0.173**
F_4	0.100	0.090	0.050	**0.080**	0.100	0.090	0.070	**0.087**	0.090	0.100	0.080	**0.090**	0.100	0.110	0.100	**0.103**
F_5	0.090	0.110	0.070	**0.090**	0.130	0.100	0.130	**0.120**	0.150	0.130	0.130	**0.137**	0.180	0.170	0.180	**0.177**
F_6	0.070	0.090	0.050	**0.070**	0.090	0.130	0.070	**0.097**	0.110	0.110	0.070	**0.097**	0.140	0.090	0.060	**0.097**
MEAN	**0.092**	**0.103**	**0.068**		**0.112**	**0.115**	**0.098**		**0.118**	**0.123**	**0.105**		**0.138**	**0.138**	**0.132**	
	I	F	I x F	F x I	I	F	I x F	F x I	I	F	I x F	F x I	I	F	I x F	F x I
SEd	0.001	0.001	0.002	0.002	0.001	0.001	0.002	0.002	0.001	0.001	0.002	0.002	0.0003	0.002	0.003	0.0034
CD (0.05)	0.002	0.002	0.004	0.004	0.002	0.003	0.005	0.004	0.002	0.003	0.005	0.005	0.001	0.004	0.006	0.0069

Treatments	150 DAP				180 DAP				210 DAP				AT HARVEST			
	I_1	I_2	I_3	MEAN	I_1	I_2	I_3	MEAN	I_1	I_2	I_3	MEAN	I_1	I_2	I_3	MEAN
F_1	0.150	0.210	0.190	**0.183**	0.100	0.130	0.110	**0.113**	0.060	0.090	0.060	**0.070**	0.050	0.070	0.050	**0.057**
F_2	0.090	0.140	0.120	**0.117**	0.070	0.090	0.080	**0.080**	0.040	0.060	0.070	**0.057**	0.030	0.050	0.060	**0.047**
F_3	0.190	0.200	0.240	**0.210**	0.160	0.180	0.150	**0.163**	0.090	0.130	0.130	**0.117**	0.070	0.100	0.100	**0.090**
F_4	0.100	0.150	0.110	**0.120**	0.060	0.110	0.090	**0.087**	0.040	0.070	0.060	**0.057**	0.030	0.060	0.050	**0.047**
F_5	0.200	0.220	0.200	**0.207**	0.120	0.160	0.160	**0.147**	0.100	0.110	0.110	**0.107**	0.080	0.090	0.090	**0.087**
F_6	0.130	0.120	0.070	**0.107**	0.080	0.070	0.050	**0.067**	0.050	0.040	0.030	**0.040**	0.040	0.030	0.020	**0.030**
MEAN	**0.143**	**0.173**	**0.155**		**0.098**	**0.123**	**0.107**		**0.063**	**0.083**	**0.077**		**0.050**	**0.067**	**0.062**	
	I	F	I x F	F x I	I	F	I x F	F x I	I	F	I x F	F x I	I	F	I x F	F x I
SEd	0.001	0.002	0.004	0.0042	0.001	0.002	0.003	0.0033	0.001	0.002	0.003	0.0026	0.001	0.001	0.002	0.0021
CD (0.05)	0.003	0.005	0.009	0.0086	0.002	0.003	0.005	0.0067	0.002	0.003	0.005	0.0054	0.002	0.003	0.004	0.0043

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