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Soil Enzyme Activities of Wheat Soil in Response to Metribuzin and Fertilizers in Aligarh Soil

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Abstract: ***The effects of metribuzin on some soil enzyme activities (FDAH (fluorescein diacetate hydrolysis), dehydrogenase, acid and alkaline phosphatase alone or combined with fertilizers (NPK and vermicompost) were investigated in a pot experiment growing wheat as a test crop. Pots were also filled with recommended rates of NPK and vermicompost under wheat plants. Among the soil enzymes dehydrogenase and FDAH were the least tolerant to the effect of the herbicide, whereas alkaline were the most tolerant one. Metribuzin @ 250 gai. proved deleterious for soil enzymes as compared to other two concentrations of metribuzin @ 100 and 175 gai. While the use of vermicompost as compared to NPK proved superior in enhancing enzyme activities, which may have recorded a positive effect on wheat yield also as compared to herbicide (metribuzin) use only.***

Keywords: Metribuzin, fertilizers, enzyme activities, NPK and vermicompost

1. Introduction

Use of plant protection chemicals improve and protect crop yields but they can also have an adverse effect on many ecosystems. In modern agriculture herbicides are considered to be an efficient and economic practice to control weeds. But their effect on soil environment depends mainly on the type of active substance, application rates, oxidation-reduction potential of soil, physicochemical properties of soil etc. (Kucharski and Wyszkowska, 2008). These chemicals may exert an effect upon the enzymes of soil and biological activities of microorganisms in a variety of way as herbicides may have negative effects on the growth of rhizobia, nitrogen fixation, morphology etc. (Nweke et al., 2007). Metribuzin is incorporated as a post-emergent soil applied herbicide to control weeds in wheat, onion, potato, tomato and others. But environmental hazards of these chemicals are of much concern, because the term soil enzyme activity implies to overall metabolic activity of all microorganisms and underpins a number of fundamental soil properties such as fertility and structure. The transformation of nutrients, turnover and mineralization of organic substances and their cycling all are dependent upon these enzymes (Subhani et al., 2001). As FDAH is a measurement of lipases, proteases and estereases activities (Dutta et al., 2010) and thus is a suitable method for accurate measurement of total microbial activity in soil. While dehydrogenase belong to oxydoreductases and catalyse the oxidation of organic compounds and phosphatases catalyse hydrolytic break down of phosphomonoesters, therefore shows a high correlation between content of soil phosphorus in soil (Nowak et al., 2006). All the herbicides get into the soil which is the main reservoir and one of the most precious natural resources. In addition, excessive mineral fertilization and modern cultivation practices are adding to the detereioration of soil fertility status. (Gaind and Nain, 2007). Environmental and soil concern have prompted the agricultural research to look for improved management strategies. Thus the use of organic manures like vermicompost and optimization of suitable herbicide concentration may hold a good promise for improved, sustainable agriculture, safe environment and soil.

2. Materials and Methods

A pot experiment was performed in three replications, in the net house of the Aligarh Muslim University, Aligarh on the sandy loam soil. The soil was collected from the adjacent district of U.P. (Aligarh). The soil had the following properties: pH-8.49, organic carbon- .308 % (Walkley and Black ,1947), CEC (meq/100g)- 2.21 (Ganguly,1951) and % $CaCO_3$ -3.45 (Piper, 1942). Before the start of the experiment earthen pots of 10” diameter were placed in the net house .Each pot was filled with 5Kg soil of Aligarh district. Healthy looking and clean seeds of wheat var. PBW 343 were surface sterilized with 0.01% aqueous solution of mercuric chloride. These were washed with double distilled water (DDW) and dried in shade. Prior to sowing of seeds fertilizers treatment was done according to the treatments. The NPK fertilizers were applied @ 120:60:40 Kg ha $^{-1}$ and vermicompost was added @ 5Kg ha $^{-1}$. These were calculated on the basis of their composition and that one hectare of land contains 2×10-^{6} Kg effective soil (Singh, 1988). The herbicide named metribuzin (a member of triazinone family) was obtained from a local agricultural dealer store in Aligarh. Metribuzin was applied as three different concentrations. Each pot was given 300 ml of water at the alternate days uniformly up to the maturity of crop to maintain the proper moisture within the pots.

Wheat was harvested at the maturity. Five samplings were undertaken at 0, 30, 60, 90 and 120 DAS (days after sowing) for soil enzymatic activities. The dehydrogenase activity was estimated by the method of Casida et al. (1964), alkaline and acid phosphatase by Tabatabai and Bremner (1969) and FDAH (fluourescein diacetate hydrolysis) by Adam and Duncan (2001).

The results are the mean of the three replicates. Data were subjected to an analysis of variance (ANOVA) using least significance difference test and comparing the difference between specific treatments by Gomez and Gomez(1984).

3. Results and Discussion

Such work on metribuzin with fertilizers on wheat is lacking. The research proves that soil contamination with metribuzin @ 250 gai. disturbed the soil enzyme activities (Table 1- 4). Noteworthy is the fact that the herbicide may also cause changes in these activities even when applied in the recommended dose, although the actual disorders depends on the rate of herbicide . As in our study metribuzin @ 250 gai. affected the phosphatases activity in soil. FDAH and dehydrogenase was negatively correlated to the herbicide concentrations These proved to be the least tolerant to herbicide dose. Our research proves that metribuzin @ 250 gai. + NPK decreased the enzyme activities the most and metribuzin @ 100 gai. + vermicompost increased these all enzymes the most. All four activities were highest in the first month of crop growth. Generally high enzymatic activities in humus rich sources are also reported by others (Gaid and Nain, 2007; Sebiomo et al., 2011,). This could be due to high carbon in these which acts an energy or food source for the soil microorganisms as a result high enzyme activities are seen in such amended soils as also studied in our study. Which later may have exerted a favourable effect on wheat growth and yield as noted by us. Jastrzebska and Kucharaski (2007) also noted that recommended or medium dose positively affected the barley yield.

4. Conclusion

Our experiment concluded that medium and lower concentrations (175 and 100 gai.) respectively of metribuzin herbicide proved effective for soil enzymes as well as for wheat. Which may be due to higher dose of metribuzin that negatively affected the soil microorganisms and enzyme activities by disturbing the soil physicochemical properties like soil acidity etc. as these chemicals are also transported in all plant tissues, cellular structures which may finally lead to yield loss. In Aligarh soil metribuzin did not worked well, which may also be due to soil properties as these affect herbicide degradation also. soil. Use of vermicompost may be a good approach for soil as well from yield point of view. Metribuzin worked negatively much in Aligarh soil it affected the soil as well as yield of wheat, which is the main requirement for providing the food to increasing population in future. So it is not suggesed to use this herbicide for Aligarh for better production of wheat.

5. References

[1] G. Adam and H. Duncan, ‘’ Development of a sensitive and rapid method for the measurement of total microbial activity using fluorescein diacetate (FDA) in a range of soils”, Soils Biol. Biochem., 33, pp 943-951, 2001.

[2] L. E. Casida, D. A. Klein and T. Santaro, ‘’ soil dehydrogenasea ctivity”, Soil Sci., 98, pp 371-376, 1964.

[3] M. Dutta, D. Sardar, R. Pal and R.K. Kole, ‘’Effect of chlorpyrifoson microbial biomass and activities in tropical clay loam soil”, Environ. Monit. Assess., 160, pp 385-391, 2010.

[4] S. Gaind and L. Nain, ‘’ Chemical and biological properties of wheat soil in response to paddy straw incorporation and its biodegradation by fungal inoculants”, Biodegradation, 18, pp 495-678, 2007.

[5] K. Ganguly, “Base exchange capacity of silica and silicates*’’, J. Phys. Colloidal Chem*., 55, pp 1417-1428, 1951 .

[6] K. A. Gomez and A. A. Gomez, *Statistical procedures for agricultural research*, 2nd Edi. John Wiley & Sons, New York, 1984.

[7] E. Jastrzebska and J. Kucharaski,“Dehrogenase, urease and phosphatise activities of soil contaminated with fungicide’’, Pl. Soil Environ, 53, pp 51-57, 2007.

[8] J. kucharaski and J. Wyszkowska,” Biological properties of soil contaminated with the herbicide APYROS 75 WG’’, J. Elementol., 13, pp 357-371, 2008.

[9] C. O. Nweke, C. Ntinugwa, I. F. Oban, S. C. Ike, G. E. Eme, E. C. Opara, J. C. Okolo and C. E. Nwanyanwu, “ In vitro effects of metals and pesticides on dehydrogenase activity in microbial community of cow pea (Vigna unguiculata) rhizoplane’’, African J. Biotech., 6, pp 290-295, 2007.

[10] J. Nowak, A. Telesinski and J. Szymczak, “ Comparison of herbicides containing isoproturon, 2-4 D and dicamba on phosphatase activity in the soil and in spring wheat (*Triticum aestivum* L.)’’, Elec.J. Polish Agric.Uni., 9, pp 1-9, 2006.

[11] C. S. Piper, ’’ The determination of calcium carbonate by rapid titration method”, *Soil and Plant Analysis.* Hans Publishers, Nicol Road, Bombay I , 1942 (reprinted in 1966).

[12] Sebiomo, V. W. Ogundero and S. A. Bankole, “ Effect of four herbicides on microbial population, soil organic matter and dehydrogenase activity’’, African J. Biotech., 10, pp 770- 778, 2011

[13] L. Singh, “*Practical Agricultural Chemistry and Soil Science*’’, Pub. Bishen Singh Mahindra Pal Singh, Dehradun, India, 1988.

[14] Subhani, H. C.hangyong, X. Zhengmiao, L. Min and EL- Ghamry, ‘ Impact of soil environment and agronomic practices on microbial/dehydrogenase enzyme activity in soil’’, A. Review, Pak J. Biol. Sci., 4, pp 33-338, 2001.

[15] M. A. Tabatabai and J. M. Bremner , ” Use of P-nitrophenyl phosphate for assay of soil phosphatase activity ‘’, Soil Biol. Biochem., 1, pp 301-307, 1969.

[16] Walkley and I. A. Black, “ A critical examination of a rapid method for determining organic carbon in soils’’, Soil Sci., 63, pp 251-64, 1947.

Author Profile

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Table 1: Effect of herbicide doses on fluorescein diacetate hydrolysis (FDAH) activity of wheat (*Triticum aestivum* L.) grown under NPK and vermicompost fertilizers.

Herbicide concentrations (gai.)	FDAH activity (µg g^{-1})							
	0 DAS				30 DAS			
	Herbicide	NPK	Vermi compost	Mean	Herbicide	NPK	Vermi compost	Mean
Control	9.50	8.00	11.50	9.67	19.50	19.00	21.00	19.83
100	9.50	8.00	11.50	9.67	21.00	20.50	24.00	21.83
175	9.50	8.00	11.50	9.67	24.00	21.70	26.00	23.90
250	9.50	8.00	11.50	9.67	16.00	15.00	18.00	16.33
Mean	9.50	8.00	11.50		20.13	19.05	22.25	
	60 DAS				90 DAS			
	Herbicide	NPK	Vermi compost	Mean	Herbicide	NPK	Vermi compost	Mean
Control	19.00	18.00	20.50	19.17	10.40	10.00	13.50	11.30
100	20.50	19.00	22.50	20.67	14.40	10.40	16.50	13.77
175	17.00	16.00	18.00	17.00	9.00	8.00	13.00	10.00
250	14.50	14.00	15.00	14.50	8.00	6.00	9.50	7.83
Mean	17.75	16.75	19.00		10.45	8.60	13.13	
	120 DAS							
	Herbicide	NPK	Vermi compost	Mean				
Control	11.50	11.00	16.00	12.83				
100	15.00	13.00	22.00	16.67				
175	10.00	9.50	14.00	11.17				
250	8.30	7.80	13.00	9.70				
Mean	11.20	10.33	16.25					
			C.D. at 5%					
DAS		Fertilizer		Herbicide		Interaction		
0		NS		0.435		NS		
30		0.799		0.923		NS		
60		0.469		0.542		0.914		
90		0.444		0.513		0.865		
120		0.522		0.602		1.017		

Table 2: Effect of herbicide doses on dehydrogenase activity of wheat (*Triticum aestivum* L.) grown under NPK and vermicompost fertilizers.

Herbicide concentratins (gai.)	Dehydrogenase activity (µg g^{-1})							
	0 DAS				30 DAS			
	Herbicide	NPK	Vermi compost	Mean	Herbicide	NPK	Vermi compost	Mean
Control	2.68	1.34	3.89	2.64	10.92	5.94	11.73	9.53
100	2.68	1.34	3.89	2.64	9.52	5.51	9.70	8.24
175	2.68	1.34	3.89	2.64	8.45	4.31	7.84	6.87
250	2.68	1.34	3.89	2.64	7.72	2.26	6.77	5.58
Mean	2.68	1.34	3.89		9.15	4.51	9.01	
	60 DAS				90 DAS			
	Herbicide	NPK	Vermi compost	Mean	Herbicide	NPK	Vermi	Mean
Control	9.52	4.81	9.94	8.09	3.44	2.85	4.35	3.55
100	7.72	3.71	9.54	6.99	3.02	2.21	3.48	2.90
175	6.48	2.23	7.98	5.56	2.86	1.98	3.14	2.66
250	3.08	2.12	5.18	3.46	2.75	1.39	3.00	2.38
Mean	6.70	3.22	8.16		3.02	2.11	3.49	
	120 DAS							
	Herbicide	NPK	Vermi compost	Mean				
Control	5.03	3.80	5.52	4.78				
100	3.92	2.41	5.32	3.88				
175	3.32	2.23	4.12	3.22				
250	2.77	1.95	3.16	2.63				
Mean	3.76	2.60	4.53					

	C.D. at 5%		
DAS	Fertilizer	Herbicide	Interaction
0	NS	0.052	NS
30	0.129	0.149	0.252
60	0.107	0.124	0.209
90	0.047	0.054	0.091
120	0.060	0.069	0.117

Table 3: Effect of herbicide doses on alkaline phosphatase activity of wheat (*Triticum aestivum* L.) grown under NPK and vermicompost fertilizers.

Herbicide concentrations (gai.)	Alikaline phosphatase activity (μg g^{-1})							
	0 DAS				30 DAS			
	Herbicide	NPK	Vermi compost	Mean	Herbicide	NPK	Vermi compost	Mean
Control	84.00	79.00	88.30	83.77	90.30	83.30	114.00	95.87
100	84.00	79.00	88.30	83.77	94.00	84.00	116.50	98.17
175	84.00	79.00	88.30	83.77	96.00	86.00	117.00	99.67
250	84.00	79.00	88.30	83.77	88.70	82.30	113.00	94.67
Mean	84.00	79.00	88.30		92.25	83.90	115.13	
	60 DAS				90 DAS			
	Herbicide	NPK	Vermi compost	Mean	Herbicide	NPK	Vermi compost	Mean
Control	85.00	80.60	107.00	90.87	82.60	73.00	92.30	82.63
100	84.00	79.00	106.00	89.67	81.00	69.30	90.60	80.30
175	83.30	78.00	100.50	87.27	78.00	67.00	88.00	77.67
250	80.30	72.60	98.50	83.80	77.00	64.30	85.00	75.43
Mean	83.15	77.55	103.00		79.65	68.40	88.98	
	120 DAS							
	Herbicide	NPK	Vermi compost	Mean				
Control	84.00	79.00	103.50	88.83				
100	83.30	78.60	99.50	87.13				
175	81.30	75.30	98.00	84.87				
250	80.00	72.00	96.00	82.67				
Mean	82.15	76.23	99.25					

	C. D. at 5 %		
DAS	Fertilizer	Herbicide	Interaction
0	NS	3.72	NS
30	3.01	3.48	NS
60	3.40	3.93	NS
90	3.07	3.54	NS
120	3.32	3.83	NS

Table 4: Effect of herbicide doses on acid phosphatase activity of wheat (*Triticum aestivum* L.) grown under NPK and vermicompost fertilizers.

Herbicide concentrations (gai.)	Acid phosphatase activity (μg g^{-1})							
	0 DAS				30 DAS			
	Herbicide	NPK	Vermi compost	Mean	Herbicide	NPK	Vermi compost	Mean
Control	16.00	7.75	18.50	14.08	62.63	60.48	64.79	62.63
100	16.00	7.75	18.50	14.08	64.79	63.71	65.87	64.79
175	16.00	7.75	18.50	14.08	68.00	66.95	77.75	70.90
250	16.00	7.75	18.50	14.08	61.56	59.40	62.63	61.20
Mean	16.00	7.75	18.50		64.25	62.64	67.76	
	60 DAS				90 DAS			
	Herbicide	NPK	Vermi compost	Mean	Herbicide	NPK	Vermi compost	Mean
Control	37.58	35.40	38.12	37.03	23.45	23.01	24.62	23.69
100	32.67	31.59	33.22	32.49	20.34	20.30	20.87	20.50
175	31.50	30.83	32.67	31.67	17.66	14.45	19.27	17.13
250	29.95	21.24	31.04	27.41	11.77	11.24	12.84	11.95

Mean	32.93	29.77	33.76		18.31	17.25	19.40	
	120 DAS							
	Herbicide	NPK	Vermi compost	Mean				
Control	28.02	26.37	28.57	27.65				
100	26.92	24.73	27.70	26.45				
175	23.63	22.53	25.27	23.81				
250	22.53	21.98	23.63	22.71				
Mean	25.28	23.90	26.29					
			C.D. at 5%					
DAS		Fertilizer		Herbicide		Interaction		
0		1.66		1.92		3.23		
30		1.99		2.30		3.88		
60		1.25		1.44		2.44		
90		0.736		0.850		1.435		
120		0.976		1.127		NS		