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EFFECT OF TYPE OF ORGANIC MANURE AND CONCENTRATION ON THE ENZYMATIC ACTIVITIES OFSOME CALCAREOUS SOILS FROM NORTHERN IRAQ

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ABSTRACT

The effect of four sources of organic manures (alfalfa residue, cow, chicken and sheep) and their concentrations (0, 1 and 2%) on the enzymatic activity of three calcareous soils from Northern Iraq have been studied in a 45-day incubation experiment at 28C and 90% of the field capacity. During this period, the activity of urease, asparginase and glutaminase have been measured at a 2-week intervals. Results indicated that the more the concentration of the added manure, the more the activity of the enzymes. Addition of alfalfa residue resulted in more activity, followed by chicken manure, then sheep. The least effect was obtained in soils treated with cow manure.

Keywords: Organic manure, Soil enzyme, Calcareous Soil.

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INTRODUCTION

Enzymes are specific proteins excreted extracellularly (and entracellularly) by soil organisms and plants to break down large organic molecules composing organic manures such as polysaccharides, proteins, lignin and others into smaller molecules to be taken by the decomposing cell, as a source of carbon, nitrogen, and phosphorus(Alexander 1977, Killham 1996). During this process, excess nutrient elements are released to the soil to be used by the growing plants. Among these enzymes are urease, Asparginase, and glutaminase.Urease solubilizes the added urea feltilizer into ammonia and carbon dioxide. Part of the ammonia will be volatilized , while the other part will be used by the growing plant as ammonium or nitrate. Asparginase and glutaminase convert aspargineand glutamine into aspartate and glutamate, respectively making ammonium available to the plant (Zantua and Bremner 1977, Tabatabai 1994).

Since, one of the most important source of soil enzymes are bacteria and fungi, any factor affecting directly their numbers will affect indirectly on the activity of the enzymes excreted by them. Among these factors are, soil type and its organic matter contents, pH, moisture, temperatures, and others (Paul and Clark 1989). Since all soil fungi and most of the genera of soil bacteria are chemoheterotrophs, addition of organic manures of animal and plant origins will affect their numbers and so their enzymes excreted (Bergstorm, et al, 1998) .The objective of this investigation is to study the effect of the source and concentration of different organic manures and the soil types on the activity of enzymes represented by urease, asparginase, and glutaminase.

Part of Ph.D these for the 1st author.

MATERIALS AND METHODS

Soil types: Soil samples were collected from three different locations in Northern Iraq (chilocham (soil 1), college of Agaric & Forestry(soil 2), and Horti culture fied in Rashidia (soil 3)) to represent different properties , as possible, air dried, and grind to pass a 2-mm sieve. Samples of each soil were analyzed physically and chemically,as stated by Page, et al 1982 (table 1).

Table (1): Some of the chemical and physical properties of the soils studied.

Soil Type	pH	Ec($dS.m^{-1}$)	Organic $M.g.kg^{-1}$	$CaCO_3$ $g.kg^{-1}$	Texture
Soil 1	7.13	0.48	4.5	400	Silty clay
Soil 2	7.3	0.84	9.6	280	Silty clay
Soil 3	7.86	1.40	3.4	200	Silty loam

Organic manures: Manures of Chicken, sheep, cow, and alfalfa straw were collected, air dried, and grind to pass a 2-mm sieve. Some of their chemical properties are shown in table 2. (Page et al, 1982)

Table (2) : Some of the chemical properties of the organic manures studied.

Organic source	C%	N%	P%	C/N	Ec($ds.m^{-1}$)	pH
Chicken	35.3	3.5	1.04	10:1	11.6	7.1
Sheep	31.9	2.3	0.68	13:1	9.2	7.6
Cow	29.6	2.1	0.91	14:1	8.3	8.1
Alfalfa	24.8	4.7	0.39	7:1	6.8	6.2

The Experiment: 500 cc plastic containers, each containing 150g of soil, were used as experimental units. The number of containers equal to 72, a result of the combinations of 3 types of soils, (soil 1, 2, and 3), 4 sources of organic manures with 3 concentrations (0, 1%, and 2% w/w). Each replicated 3 times. After adding specific level of each of the organic manures to each of the three soils under study and thoroughly mixed, moisture was added up to 90% of the field capacity of each soil and maintained at this level of moisture by weighing the containers each 4 days. The containers were incubated at 26± 2C° for 42 days during which, the activities of the enzymes urease, asparginase, and glutaminase were measured at (0, 14, 28, and 42) days of incubation according to tabatabai (1994), and expressed as ,micromoleNH_4^+-N g^{-1} h^{-1}. The plastic containers were opened at 3- day intervals for aeration.

RESULTS AND DISCUSSION

Activity of the Enzyme Urease : Table (3) shows the effect of incubation period on the activity of the enzyme urease in three soils treated with different concentrations of manures. The data indicate that the activity in the unamended soils at the beginning of

the experiment (time 0) differs from one soil to another.Heigher activity was measured in soil 2, followed by soil 1, while soil 3 was the least (0.52, 0.33, and 0.16 micromole. NH_4^+-N g^{-1} h^{-1}), respectively. This result was in correlation with the organic matter contents of each soil (Table 1). Soil 2 contains the heighest, while, soil 3 the lowest. Microbial biomass is proportional to the organic matter contents of the soil, the more the biomass, the more the enzymatic activity (killham 1996 and Alexander 1977, Dick, et al. 1988). Adding the lowest level of the organic manures (1%) increased that activity and in some cases it was about double of that obtained in the control. Another increases were also noted when the level of the added manures was 2% . Again, the heighest activity was in soil 2 followed by soil 1, then soil 3. the source of these increases in activity at time 0 are the added manures, since animals and plants excrete urease similer to that excreted by bacteria and fungi (Conn &Stumpt, 1975). Table (3) also shows that incubating the unamended and the manures - amended soils for 14 days gave maximum peak of activity, and any further incubation decreased that sharply. This sharp decreases in activity is probably due to the degradation of the most degradable part of the organic nitrogen composing the organic manures within the first fourteen days of incubation due to the favorable conditions of optimum temperature, moisture, and pH (Alexander 1977, Killham 1996).Maximum activity (5.35 micromole NH_4^+-N g^{-1} h^{-1}) was measured in soil 2 when amended with 1% chicken manure, followed by alfalfa straw (3.69 micromole NH_4^+-N g^{-1} h^1), followed by sheep manure (2.85 micromole NH_4^+-N g^{-1} h^1), while cow manure was the least (2.69 micromole NH_4^+-N g^{-1} h^1) . Values for soil 1 were (2.88, 3.24, 2.66, and 1.75 micromole NH_4^+-N g^{-1} h^1) respectively.It was found that, raising the level of the added manures from 1 to 2% increased the activity of the enzyme urease and in some cases, it was double of that measured at the 1% level.The activities obtained in the soilswhen amended with 2% organic manures were (7.29, 7.78, 5.15, and 3.86 micromoleNH_4^+-N g^{-1} h^1)) for soil 2 and (5.64, 7.19, 4.79, and 2.85 micromole NH_4-N g^{-1} h^1) for soil 1.

The genera of bacteria and fungi which excrete this enzyme are chemoheterotrophs and any increase in the source of carbon and energy will increase their biomass which in turn will increase the activities of the enzymes excreted by them. Many investigators have obtained similar results. Zantua&Bremner(1976) found that urease activity in soil can be increased by the addition of glucose , starch, cellulose, animal manures, and plant materials. They concluded that , although, some of the urease activity was produced when treating the soil with organic materials, but , eventually becomes identical to that of the unamended soils. Elder (1993) reported increases in microbial biomass and enzymatic activities after long-term addition of cattle slurry to a grass land. Comparing the effect of organic manures on the activity of the enzyme urease, it was noted that after fourteen days of incubation, alfalfa straw gave the highest activity followed by chicken manure. Sheep and cow manure was the least, respectively. Table (2) showed that the percentage of the total nitrogen content of alfalfa straw and for chicken manure were 4.7% and 3.5%, respectively, while sheep and cow manures were 2.31 and 2.1% respectively, which reflected on the activity of this enzyme. Again soil 2 gave the heighest activity followed by soil 1, while soil 3 was the lowest, regardless of the type or the concentration of the added manures.

Table(3): Effect of incubationperiod on ureaseactivity (Micromole NH_4^+-N g^1 h^{-1}) in three soils treated with different concentrations of chicken manure (A), Sheep (B), Cow (C), and alfalfa straw (D).

A- Chicken Manure

Soil Type	Organic manure	Time of incubation (day)				Soil × Organic manure	Soil (average)	Organic manure (average)
		0	14	28	42			
Soil 1	0	0.33	0.62	0.39	0.16	0.37		
	1	0.78	2.88	1.46	0.19	1.33		
	2	0.94	5.64	2.20	0.08	2.21		
Soil 2	0	0.52	0.81	0.58	0.32	0.56		
	1	0.78	5.35	1.82	0.26	1.60		
	2	1.10	7.29	2.53	0.10	2.76		
Soil 3	0	0.16	0.52	0.29	0.10	0.95		
	1	0.38	2.11	1.13	0.16	1.93		
	2	0.55	5.02	1.72	0.42			
Soil×Time of incubation	1	0.68	3.05	1.35	0.14		1.30	
	2	0.80	3.88	1.64	0.23		1.64	
	3	0.37	2.55	1.05	0.23		1.05	
Organic manure×Time of incubation	0	0.33	0.65	0.42	0.20			0.40
	1	0.65	2.84	1.47	0.20			1.29
	2	0.86	5.99	2.15	0.20			2.30
Average (time of incubation)		0.62	3.16	1.35	0.20			

L.S.D 5% (Soil): 0.039, Organic manure: 0.039, Time incubation: 0.045 (Soil × Organic): 0.068 (Soil × Time incubation): 0.079 (Organic manure × Time incubation): 0.079 (Time incubation × Organic manure × Soil): 0.136

B- Sheep Manure

Soil Type	Organic manure	Time of incubation (day)				Soil × Organic manure	Soil (average)	Organic manure (average)
		0						
Soil 1	0	0.33	0.62	0.39	0.16	0.37		
	1	0.52	2.66	1.17	0.06	1.10		
	2	0.64	4.79	1.98	0.58	2.03		
Soil 2	0	0.52	0.81	0.58	0.32	0.56		
	1	0.52	2.85	1.59	0.49	1.37		
	2	0.84	5.15	2.33	0.25	2.15		
Soil 3	0	0.16	0.52	0.29	0.10	0.27		
	1	0.26	1.91	0.88	0.23	0.82		
	2	0.46	4.44	1.42	0.45	1.70		
Soil×Time of incubation	1	0.54	2.69	1.18	0.27		1.17	
	2	0.64	2.94	1.50	0.36		1.36	
	3	0.30	2.29	0.87	0.26		0.93	
Organic manure×Time of incubation	0	0.33	0.65	0.42	0.20	0.40		
	1	0.44	2.47	1.21	0.26	1.10		
	2	0.71	4.79	1.91	0.43	1.96		
Average (time of incubation)		0.49	2.64	1.18	0.30			

L.S.D 5% (Soil): 0.048, Organic manure: 0.048, Time incubation: 0.055 (Soil × Organic): 0.082 (Soil × Time incubation): 0.095 (Organic manure × L.S.D × Time incubation): 0.095 (Time incubation × Organic manure × Soil): 0.165

C- Cow Manure

Soil Type	Organic manure	Time of incubation (day)				Soil × Organic manure	Soil (average)	Organic manure (average)
		0	14	28	42			
Soil 1	0	0.33	0.62	0.39	0.16	0.37		
	1	0.46	2.53	0.97	0.03	1.00		
	2	0.58	2.85	1.59	0.00	1.26		
Soil 2	0	0.52	0.81	0.58	0.32	0.56		
	1	0.45	2.69	1.23	0.26	1.13		
	2	0.68	3.86	1.72	0.19	1.61		
Soil 3	0	0.16	0.51	0.29	0.10	0.27		
	1	0.10	1.75	0.55	0.13	0.63		
	2	0.23	2.53	1.17	0.23	1.05		
Soil × Time of incubation	1	0.45	2.00	0.98	0.06		0.88	
	2	0.55	2.45	1.18	0.22		1.10	
	3	0.17	1.60	0.67	0.15		0.65	
Organic manure × Time of incubation	0	0.33	0.65	0.42	0.20			0.4
	1	0.34	2.32	0.92	0.10			0.92
	2	0.51	3.08	1.49	0.14			1.30
Average (time of incubation)		0.39	2.02	0.94	0.14			

L.S.D 5% (Soil): 0.034, Organic manure: 0.034, Time incubation: 0.039 (Soil × Organic): 0.059 (Soil × Time incubation): 0.069 (Organic manure × L.S.D × Time incubation): 0.069 (Time incubation × Organic manure × Soil): 0.119

D- Alfalfa Straw

Soil Type	Organic manure	Time of incubation (day)				Soil × Organic manure	Soil (average)	Organic manure (average)
		0	14	28	42			
Soil 1	0	0.33	0.62	0.39	0.16	0.37		
	1	0.84	3.24	1.85	0.19	1.53		
	2	1.13	7.19	2.30	0.39	2.75		
Soil 2	0	0.52	0.81	0.58	0.32	0.56		
	1	0.97	3.69	2.01	0.74	1.85		
	2	1.33	7.78	2.63	0.10	2.95		
Soil 3	0	0.16	0.51	0.29	0.10	0.27		
	1	0.45	2.69	1.46	0.36	1.24		
	2	0.88	5.61	2.01	0.62	2.28		
Soil×Time of incubation		0.77	3.68	1.51	0.25		1.55	
		0.94	4.10	1.74	0.38		1.79	
		0.50	2.94	1.25	0.36		1.26	
Organic manure×Time of incubation		0.33	0.65	0.42	0.20			0.40
		0.76	3.21	1.77	0.43			1.54
		1.11	6.86	2.31	0.36			2.66
Average (time of incubation)		0.74	3.57	1.50	0.33			

L.S.D 5% (Soil): 0.038, Organic manure: 0.038, Time incubation: 0.044 (Soil × Organic): 0.067 (Soil × Time incubation): 0.077 (Organic manure × L.S.D × Time incubation): 0.077 (Time incubation × Organic manure × Soil): 0.133

Statistical analysis (table 3) indicated that there were significant differences between soil type and incubation periods, (14 days). Soil 2 at 14 days of incubation gavetheheighst activity. Also significant differences were noted between the concentrations of the added organic manure and the incubation period (14 days), since at this period of incubation addition of 2% of the different organic manure gave maximum activity.

Activity of the enzymes asparginase and glutaminase : Tables (4 and 5) show the effect of incubation periods on the activity of the enzyme asparginase (table 4) and Glutaminase (table 5) in three soils treated with different concentrations of manures. The data also indicate that at time 0 the heighest activity was registered in the unamendedsoil2 followed by soil 1, and soil 3 was the least, probably for the same reason mentioned previously. Again. incubating both unamended and manures-amended soils for 14 days gave maximum activity, which decreased after that to reach the activity measured at the control. Quiquampoix et al, 2002 , Yang et al 2006, Laxman and Raman 1999 mentioned that the decrease in the activity may be due to the formation of clay- enzyme or metal – enzyme complexes. Complexation of the enzymes by the clay contents of the soil or metals may affect positively or negatively on the activity of enzymes and sometime have no effect.The data of table 4 and 5 indicated that, similar findings to that of urease activity were obtained with regards to the effect of the concentration of the added manures on the activity of both enzymes (asparginase and glutaminase),the heigher the level of the added manure, the higher the activity,Hojati and nourbakhsh (2006) studied the effect of cow manure and sewage sludge (25 and 100 Tons h^{-1}) on microbial biomas and enzyme activities in a calcareos soil cropped to corn and found that both organic amendments increased the enzymatic activities of glutaminase, alkaline phosphatase, and B-glucosidase compared to the control, and their activities increased with the increases in the rate of application. Generally, the activity of the enzyme asparginase was more than the activity of the enzyme glutaminase for all the manures tested, except when sheep manure was used, where the opposite was found. Most of the organic N in the organic manures is protein with different sequences of amino acids, among them the amino acids aspargine and glutamine, substrates of the enzyme asparginase and glutaminase, respectively, and probably the concentration of aspargine is more than glutamine (substrate of these enzymes) in all of the manure tested except for sheep manure, which we expect the opposite**.**

Statistical analysis (table 4 & 5) indicated that there were significant differences between soil type and incubation periods (14 days). Soil 2 at 14 days of incubation gave the heighst activity. Also significant differences were noted between the concentrations of the added organic manure and the incubation period (14 days), since at this period of incubation addition of 2% of the different organic manure gave maximum activity.

Table (4): Effect of incubation period on asparginase activity (Micromole NH_4^+-N g^{-1} h^{-1}) in three soils treated with different concentrations of four types of organic manures chicken (A), Sheep (B), Cow (C), and alfalfa straw (D).

A- Chicken Manure

Soil Type	Organic manure	Time of incubation (day)				Soil × Organic manure	Soil (average)	Organic manure (average)
		0	14	28	42			
Soil 1	0	0.16	0.42	0.16	0.00	0.19		
	1	0.41	2.64	0.12	0.19	1.13		
	2	0.84	5.12	1.62	0.10	1.92		
Soil 2	0	0.42	0.62	0.19	0.10	0.32		
	1	0.62	3.27	1.26	0.06	1.43		
	2	0.91	6.29	1.78	0.87	2.47		
Soil 3	0	0.10	0.29	0.10	0.00	0.11		
	1	0.26	1.72	0.55	0.10	0.66		
	2	0.45	3.85	1.46	0.36	1.53		
Soil×Time of incubation	1	0.49	2.74	0.98	0.10		1.08	
	2	0.65	3.39	1.08	0.51		1.41	
	3	0.25	1.95	0.70	0.15		0.76	
Organic manure×Time of incubation	0	0.21	0.44	0.15	0.02			0.21
	1	0.44	2.56	0.99	0.29			1.07
	2	0.74	5.09	1.62	0.44			1.97
Average (time of incubation)		0.46	2.70	0.92	0.25			

L.S.D 5% (Soil): 0.022, Organic manure: 0.025, Time incubation: 0.038 (Soil × Organic): 0.044 (Soil × Time incubation): 0.044 (Organic manure × L.S.D × Time incubation): 0.044 (Time incubation × Organic manure × Soil): 0.076

B- Sheep Manure

Soil Type	Organic manure	Time of incubation (day)				Soil × Organic manure	Soil (average)	Organic manure (average)
		0	14	28	42			
Soil 1	0	0.16	0.42	0.16	0.00	0.19		
	1	0.39	2.09	0.88	0.00	0.84		
	2	0.38	4.12	1.13	0.19	1.46		
Soil 2	0	0.42	0.62	0.19	0.10	0.32		
	1	0.49	2.39	1.03	0.22	1.01		
	2	0.19	4.51	1.46	0.19	1.64		
Soil 3	0	0.10	0.29	0.10	0.00	0.11		
	1	0.10	1.42	0.38	0.00	0.47		
	2	0.29	3.66	1.12	0.19	1.32		
Soil×Time of incubation	1	0.31	2.22	0.73	0.06		0.83	
	2	0.43	2.50	0.90	0.12		0.99	
	3	0.13	1.79	0.54	0.06		0.63	
Organic manure×Time of incubation	0	0.21	0.44	0.15	0.02			0.21
	1	0.32	1.98	0.77	0.03			0.77
	2	0.36	4.09	1.24	0.19			1.47
Average (time of incubation)		0.29	2.17	0.72	0.08			

L.S.D 5% (Soil): 0.046, Organic manure: 0.046, Time incubation: 0.054 (Soil × Organic): 0.080 (Soil × Time incubation): 0.093 (Organic manure × L.S.D × Time incubation): 0.093 (Time incubation × Organic manure × Soil): 0.161

C- Cow Manure

Soil Type	Organic manure	Time of incubation (day)				Soil × Organic manure	Soil (average)	Organic manure (average)
		0	14	28	42			
Soil 1	0	0.16	0.42	0.16	0.00	0.19		
	1	0.26	1.81	0.68	0.10	0.71		
	2	0.36	2.43	0.94	0.03	0.94		
Soil 2	0	0.42	0.62	0.19	0.10	0.32		
	1	0.42	2.07	0.91	0.19	0.90		
	2	0.36	3.69	1.17	0.10	1.33		
Soil 3	0	0.10	0.29	0.10	0.00	0.11		
	1	0.13	1.13	0.29	0.00	0.39		
	2	0.19	1.72	0.84	0.10	0.71		
Soil×Time of incubation	1	0.26	1.56	0.59	0.04		0.61	
	2	0.40	2.13	0.76	0.12		0.85	
	3	0.12	1.05	0.41	0.03		0.40	
Organic manure×Time of incubation	0	0.21	0.44	0.15	0.02			0.21
	1	0.27	1.68	0.63	0.10			0.67
	2	0.30	2.61	0.99	0.08			0.99
Average (time of incubation)		0.26	1.58	0.59	0.07			

L.S.D 5% (Soil): 0.035, Organic manure: 0.035, Time incubation: 0.041 (Soil × Organic): 0.061 (Soil × Time incubation): 0.070 (Organic manure × L.S.D × Time incubation): 0.070 (Time incubation × Organic manure × Soil): 0.122

D- Alfalfa Straw

Soil Type	Organic manure	Time of incubation (day)				Soil × Organic manure	Soil (average)	Organic manure (average)
		0	14	28	42			
Soil 1	0	0.16	0.42	0.16	0.00	0.19		
	1	058	3.21	1.13	1.29	1.26		
	2	0.94	6.71	1.98	0.07	2.42		
Soil 2	0	0.42	0.62	0.19	0.10	0.32		
	1	0.78	3.44	1.65	0.38	1.56		
	2	1.03	6.32	2.14	1.04	2.63		
Soil 3	0	0.10	0.29	0.10	0.00	0.11		
	1	0.36	1.91	0.88	0.23	0.84		
	2	0.62	4.18	1.72	0.24	1.71		
Soil×Time of incubation	1	0.56	3.45	1.09	0.06		1.29	
	2	0.75	3.46	1.33	0.50		1.51	
	3	0.33	2.13	0.90	0.18		0.89	
Organic manure×Time of incubation	0	0.21	0.44	0.15	0.02			0.21
	1	0.57	2.85	1.22	0.25			1.22
	2	0.86	5.74	1.94	0.47			2.25
Average (time of incubation)		0.55	3.01	1.11	0.25			

L.S.D 5% (Soil): 0.042, Organic manure: 0.042 Time incubation: 0.049 (Soil × Organic): 0.073 (Soil × Time incubation): 0.084 (Organic manure × L.S.D × Time incubation): 0.084 (Time incubation × Organic manure × Soil): 0.146

Table (5): Effect of incubation period on glutaminase activity (Micromole NH_4^+-N g^{-1} h^{-1}) in three soils treated with different concentrations of four types of organic manureschicken (A), Sheep (B), Cow (C), and alfalfa straw (D).

A- Chicken Manure

Soil Type	Organic manure	Time of incubation (day)				Soil × Organic manure	Soil (average)	Organic manure (average)
		0	14	28	42			
Soil 1	0	0.19	0.26	0.10	0.00	0.14		
	1	0.36	2.63	0.91	0.19	0.79		
	2	0.55	4.76	1.43	0.29	1.73		
Soil 2	0	0.19	0.52	0.19	0.10	0.24		
	1	0.49	3.44	0.94	0.25	1.28		
	2	0.57	5.83	1.46	0.00	1.93		
Soil 3	0	0.06	0.19	0.13	0.00	0.10		
	1	0.19	1.13	0.45	0.04	0.45		
	2	0.36	3.31	1.13	0.29	1.25		
Soil×Time of incubation	1	0.37	2.26	0.81	0.11		0.89	
	2	0.37	3.26	0.86	0.11		1.15	
	3	0.20	1.55	0.57	0.08		0.60	
Organic manure×Time of incubation	0	0.15	0.32	0.14	0.02			0.16
	1	0.35	2.11	0.77	0.14			0.84
	2	0.44	4.63	1.34	0.13			1.64
Average (time of incubation)		0.31	2.36	0.75	0.10			

L.S.D 5% (Soil): 0.127, Organic manure: 0.127 Time incubation: 0.147 (Soil × Organic): 0.221 (Soil × Time incubation): 0. 255 (Organic manure × L.S.D × Time incubation): 0.255 (Time incubation × Organic manure × Soil): 0.441

B- Sheep Manure

Soil Type	Organic manure	Time of incubation (day)				Soil × Organic manure	Soil (average)	Organic manure (average)
		0	14	28	42			
Soil 1	0	0.19	0.26	0.10	0.00	0.14		
	1	0.26	1.85	0.65	0.10	0.71		
	2	0.38	3.74	0.98	0.00	1.24		
Soil 2	0	0.19	0.52	0.19	0.10	0.24		
	1	0.23	2.92	0.74	0.17	1.02		
	2	0.49	4.61	1.17	0.17	1.57		
Soil 3	0	0.06	0.19	0.13	0.00	0.10		
	1	0.10	0.91	0.19	0.00	0.29		
	2	0.19	2.82	0.97	0.10	1.01		
Soil×Time of incubation	1	0.24	1.94	0.57	0.02		0.69	
	2	0.31	2.64	0.70	0.13		0.95	
	3	0.11	1.31	0.43	0.02		0.47	
Organic manure×Time of incubation	0	0.15	0.32	0.14	0.02			0.16
	1	0.19	1.89	0.53	0.08			0.67
	2	0.31	3.67	1.04	0.08			1.27
Average (time of incubation)		0.22	1.96	0.57	0.06			

L.S.D 5% (Soil): 0.037, Organic manure: 0.037 Time incubation: 0.043 (Soil × Organic): 0.064 (Soil × Time incubation): 0.074 (Organic manure × L.S.D × Time incubation): 0.074 (Time incubation × Organic manure × Soil): 0.129

C- Cow Manure

Soil Type	Organic manure	Time of incubation (day)				Soil × Organic manure	Soil (average)	Organic manure (average)
		0	14	28	42			
Soil 1	0	0.19	0.26	0.10	0.00	0.14		
	1	0.13	1.43	0.49	0.10	0.52		
	2	0.26	2.11	0.62	0.00	0.75		
Soil 2	0	0.19	0.52	0.19	0.10	0.24		
	1	0.13	2.56	0.55	0.10	0.81		
	2	0.36	3.08	1.04	0.19	1.17		
Soil 3	0	0.06	0.19	0.13	0.00	0.10		
	1	0.00	0.55	0.19	0.00	0.19		
	2	0.10	1.62	0.74	0.06	0.62		
Soil×Time of incubation	1	0.19	1.26	0.40	0.01		0.47	
	2	0.22	2.05	0.59	0.10		0.74	
	3	0.04	0.79	0.35	0.01		0.30	
Organic manure×Time of incubation	0	0.15	0.32	0.14	0.02			0.16
	1	0.07	1.51	0.41	0.02			0.51
	2	0.23	2.27	0.80	0.08			0.84
Average (time of incubation)		0.15	1.37	0.45	0.04			

L.S.D 5% (Soil): 0.034, Organic manure: 0.034 Time incubation: 0.039 (Soil × Organic): 0.059 (Soil × Time incubation): 0.068 (Organic manure × L.S.D × Time incubation): 0.068 (Time incubation × Organic manure × Soil): 0.118

D- Alfalfa Straw

Soil Type	Organic manure	Time of incubation (day)				Soil × Organic manure	Soil (average)	Organic manure (average)
		0	14	28	42			
Soil 1	0	0.19	0.26	0.10	0.00	0.14		
	1	0.25	2.82	0.91	0.22	1.05		
	2	0.74	5.83	1.65	0.17	1.96		
Soil 2	0	0.19	0.52	0.19	0.10	0.24		
	1	0.58	4.31	1.17	0.19	1.56		
	2	0.91	6.81	1.81	0.19	2.43		
Soil 3	0	0.06	0.19	0.13	0.00	0.10		
	1	0.36	1.42	0.58	0.10	0.59		
	2	0.45	3.47	1.46	0.36	1.44		
Soil×Time of incubation	1	0.40	2.98	0.70	0.11		1.05	
	2	0.56	3.88	1.06	0.15		1.41	
	3	0.27	1.69	0.72	0.14		0.71	
Organic manure×Time of incubation	0	0.15	0.32	0.14	0.02			0.16
	1	0.38	2.86	0.89	0.14			1.07
	2	0.70	5.37	1.46	0.24			1.94
Average (time of incubation)		0.41	2.85	0.83	0.13			

L.S.D 5% (Soil): 0.096, Organic manure: 0.096 Time incubation: 0.110 (Soil × Organic): 0.166 (Soil × Time incubation): 0.191 (Organic manure × L.S.D × Time incubation): 0.191 (Time incubation × Organic manure × Soil): 0.331

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تأثير نوع السماد العضوي وتركيزه في النشاط الأنزيمي لترب كلسية من شمال العراق

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الخلاصة

في هذا البحث تم دراسة تأثير أربعة مصادر من الأسمدة العضوية (سماد دواجن، أبقار، أغنام وسماد بقايا الجت) وتركيزها المضاف (صفر، 1% و 2%) في النشاط الأنزيمي لثلاث ترب كلسية من شمال العراق في تجربة تحضين مدتها 45 يوماً على درجة حرارة 28°م ورطوبة تعادل 90% من السعة الحقلية. خلال هذه المدة تم دراسة نشاط كل من أنزيمات اليوريز، الكلوتامينيزوالأسبرجينيز كل أسبوعين، أشارت النتائج إلى أنه كلما زاد تركيز السماد العضوي المضاف كلما زاد نشاط هذه الأنزيمات. كذلك وجدنا أن إضافة بقايا الجت نتج عنها زيادة في النشاط الأنزيمي، تبع ذلك سماد مخلفات الدواجن ثم مخلفات الأغنام، وكان لإضافة مخلفات الأبقار التأثير الأقل.

الكلمات الدالة: السماد العضوي، أنزيمات التربة، الترب الكلسية.

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REFERENCES

Alexander, M. (1977). Introduction To Soil Microbiology. John Willey and Sons Inc. New York and London.

Bergstorm, D.W. and C.M. Monreal (1998). Increased soil enzyme activities under two row crops. *Soil Science Society of American Journal 62: 1295-1301*.

Conn, E.E. and Stumpt, P.K. (1976). Outlines of Biochemistry 4th Ed. John Wiley and Sons Inc. New York, London , Toronto.PP : 157-194.

Dick, R.P., D.D. Myrold, and E.A.Kerle (1988) Microbial biomass and soil enzyme activities in compacted and rehabilitated skid trail soils. *Soil Science Society of American Journal 52: 512-516.*

Hojati and F. Nourbakhsh (2006). Enzyme activities and microbial biomass carbon in a soil amended with organic and inorganic fertilizers. *Journal of Agronomy 5(4): 563- 579.*

Kandeder, E. and G. Eder (1993). Effect of cattle slurry in grassland on microbial biomass and on activities of various enzymes. *Biology Fertilizer Soils 16: 249-254.*

Killham, K. (1996). Soil Ecology. University Press, Cambridge.

Laxman, R. and S. Raman (1999). Effect of moisture and heavy metals on the activity of L-asparginase in alfisols and vertisols. *Journal of the Indian Society of Soil Science 47: 58-62*.

Page, A.L., R.H. Miller, and D.R. Keeney (1982). Methods Of Soil AnalysisPart (2). Chemical and Microbiological properties. 2nd Ed. Agronomy 9 *American Society Agronomy* Madison, Wisconsin.

Paul, E.A. and E.E. Clark (1989). Soil Microbiology and Biochemistry. Academic Press.

Quiquampoix, H, Noinville, S.S. and M.H. Baron, (2002). Enzyme adsorption on soil mineral surfaces and consequences for the catalytic activity. In Enzyme in the Environment. Burns R.G. and Dick, R.P. (Eds). Marcel Dekker Inc. Switzerland.

Tabatabai, M.A. (1994) Soil enzymes. In Methods of Soil Analysis, Part 2 : Microbiological and Biochemical Properties. weaver, R.W., J.S. Angle, and P.S. Botomly. EdsSSSA Book, *Series No.5. Soil Science Society of American Journal, Madison , WI., pp: 775-833.*

Yang Z., S. zheng, and S. Feng . (2006). Effects of cademium, Zinc and lead on soil enzyme activities. *Journal of Environmental Science 18(6) : 1135-1141.*

Zantua, M. and J.M. Bremner (1997). Stability of urease in soils. *Soil Biology Biochemistry 9: 135- 140.*