الملخص العربي

تأثير مستوى الماء الأرضى على المحاصيل البقولية بمحافظة الفيوم :
٤ ـ تنفس التربة ونشاط أنزيماتها التى تصاحب الفول البلدى ٠

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قدر تصاعد غاز ك ا ٢ ونشاط أنزيمات نيتروجينيز ، د يهيد روجينيز ، كتاليز ، سيلولـــيز ، أميليز ، أنفرتيز ، بروتينيز فى عينات تربة أخذت من منطقة الجذور أو بعيدا عنها تحت نباتات فول بلدى فى مرحلة أقصى ازهار منزرعة فى ظروف حقلية تحت معاملات من عمق مستوى الماء الأرضى هى : ٨ر٢٦ ± ١ر٦ ، ٢ر٤٨ ± ٢ر٤ ، ١ر٧٢ ± ٣ر٠ ٤ر١٠١ ± ٢ر٤ ، ٧ر١١٢ ± ٦ر٤ سم تحت سطح التربة ٠

ويستدل من النتائج على أن اقصى تصاعد لغاز ثانى أكسيد الكربون ونشاط انزيمات نيتروجينيز ، د يهيد روجينيز ، كتاليز ، سيلوليز ، أميليز ، أنفرتيز فى عينات التربة المأخوذة من منطقة جذور الفول البلدى أو بعيدا عنها كان يحدث فى المعاملة ذات عمق ماء أرضـى مقداره ٤ر١٠٤ ± ٢ر٤ سم تحت سطح التربة ٠ وفى هذه المعاملة كانت الزيادة فى نشاط أنزيمات أميليز ، د يهيد روجينيز ، سيلوليز ، أنفرتيز فى عينات التربة المأخوذة من منطقـــة الجذور تزيد عن تصاعد غاز ك ا ٢ أو عن نشاط أنزيم النيتروجينيز فيها بنسبة ٥٤ ، ٢١ ، ١١ ، ٣٪ على التوالى ٠ واستنتج من ذلك تزايد حاجة النباتات الى مصادر كربونية تحصل عليها من تحلل المواد العضوية فى التربة ٠ كما لوحظ أن تنفس التربة ونشاط الأنزيمات كانت فى عينات التربة بمنطقة الجذور أعلى منها فى عينات التربة بعيدا عن الجذور ٠ كما كانت أعلى فى طبقة التربة السطحية ٠ (صفر ـ ١٥ سم) بمقارنتها بطبقات التربة السفلى ٠

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EFFECT OF GROUND WATER LEVEL ON LEGUME CROPS IN FAYOUM GOVERNORATE: 4- SOIL RESPIRATION AND ENZYMES ACTIVITIES ASSOCITED WITH FABA BEAN.

BY

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SUMMARY

For ground water levels 26.8±1.6, 48.2±2.4, 72.1±3.0, 101.4±4.2 and 112.4±6.4 cm. from the surface under field conditions; carbon dioxide evolution and activities of nitrogenase, dehydrogenase, catalase, cellulase, amylase, invertase and proteinase were determined in nonrhizosphere and rhizoshere soils under faba bean (Vicia faba L) plants at maximum flowering age.

At the ground water depth of 101.4±4.2 cm, maximum CO_2 evolution and activities of N_2-ase, dehydrogenase, catalase, cellulase, amylase and invertase activities had taken place in both rhizosphere and nonrhizosphere soil. At this depth, the increase in amylase, dehydrogenase, cellulase and invertase of the rhizosphere soil exceeded that of CO_2 evolution or that of soil nitrogenase by 54, 21, 11 and 3% respectively which indicates higher needs to decomposeable carbon energy sources at this depth. Lower activities were obtained in the nonrhizosphere soil as compared to that of the rhizosphere. Also, the activities were of higher values at soil surface (0-15 cm).

INTRODUCTION

Shalow ground waetr table is a problem which faces irrigated agriculture in different countries (Varallyay 1981 and Balba 1984). This causes the soil moisture/air ratio to be unfavourable for biological nitrogen fixation of legume crops (Child 1981). Also, the effects of the shallow ground water may be extended to the decomposition and transformations of carbon-and nitrogen-containing organic molecules(Kononova 1966 and Harigitai 1972) and to delay the activities of soil enzymes (Ross 1966, Pancholy and Rice 1973 and Skujins 1973).

Preresses

Soil biochemical$_x$ in the rhizosphere known to be more active than that of nonrhizosphere (Allison 1973). Accordingly maintaining the biochemical conditions in the rhizosphere at the optimum level is necessary to achieve maximum biological nitrogen fixation and growth of legume plants (Allison 1973 and Child 1981). Because the effects of ground water depth on respiration and enzymes activities in the rhizosphere and nonrhizosphere soil under natural field conditions are still questionable, the present work was carried out,

MATERIALS AND METHODS

Five sites of different ground water depths at the farm of El-Fayoum Faculty of Agriculture (Egypt) were chosen for this study. Soil properties of the sites were very similar and found of clay texture (course sand 3.1 to 3.5%, fine sand 21.4 to 21.8%, silt 33.5 to 33.8% and clay 41.5 to 41.7%) Field capacity ranged from 47.2 to 47.9%, wilting point from 21.2 to 21.7%, organic matter from 1.52 to 1.56%, electrical conductivity of saturated soil-water extract 1.95 to 2.5. mmhos/cm at 25°C and soil pH in the saturated soil-water paste from 7.9 to 8.2. These properties were determined according to Black et al (1965).

In each site, 4 random plots 6X7m^2 each were sown to inoculated seeds of faba bean (Vicia faba L.) variety Giza 2 on 25/10/1983. The mean ground water table depths of the Five sites were found 26.8±1.8, 48.2±2.1, 72.1±3.2, 101.4±4.5 and 112.7±6.0 cm. The electrical conductivity of ground water in the sites was varied between 0.60 and 0.68 mmhos/cm at 25°C.

The crop received superphosphate (15.5% P_2O_5) and potassium sulphate (46.5% K_2O) at a rate of 150 and 100 Kg./acre respectively, but no nitrogen fertilizer was added.

At maximum flowering stage of faba bean plants (89 days old), 10 plant samples were dug out of each plot keeping soil particles around the root system. These particles represent the rhizosphere soil. Rhizosphere soil samples from soil surface to 15 cm deep and from 15 to 30 cm deep were taken separetely. Nonrhizosphere soil samples from 0-15 and 15-30 cm deep were taken from between the rows. Rhizosphere and nonrhizosphere soil samples were subjected to determinations of CO_2 evolution and activities of soil nitrogenase, dehydrogenase, catalase, cellulase, amylase, invertase and proteinase. Methods of determinations were after Black et al (1965) for CO_2 evolution, Hardy et al (1973) for soil nitrogenase, Pancholy and Rice (1973) for amylas and invertase,

Ross (1966) for cellulase and dehydrogenase, Temple and Jonson (1964) as adapted by El-Essawi (1972).for catalase and Skujins (1973) for proteinase. The reducing sugars produced at the determinations of invertase, amylase and cellulase activities were determined according to Nelson-Smogi method as modified by Oser (1965).

RESULTS AND DISCUSSIONS

Carbon dioxide evolution and enzymes activities in the rhizosphere and nonrhizosphere soil samples (0-30) of faba bean are shown in Table (1) and Figures 1 and 2. As seen, the activities of all enzymes and carbon dioxide evolution in the rhizosphere and nonrhizosphere soil were increased with increasing ground awter depth from 26.8±1.6 to 101.4±4.2 then, declined with further incraese in the depth of water table. Carbon dioxide evolution and activities of nitrogenase, dehydrogenase, catalase, cellulase, amylase, invertase and proteinase in rhizosphere soil under ground water depth of 101.4±4.2 cm were 155, 155, 189, 140, 172, 239, 160 and 140% of that obtained under the depth of ground water of 26.8±1.6 cm, respectively. At this depth, the increase in amylase, dehydrogenase, cellulase and invertase activities of the rhizosphere soil exceeded that of N_2-ase by 54, 21, 11 and 3%, respectively. This indicates higher needs to decomposeable carbon energy sources for a successful biological nitrogen fixation process. The importance of an available energy supply for symbiotic nitrogen fixation was emphasized by Hardy and Havelka (1975) and the estimated carbohydrate requirements for nitrogen fixation was found 17 g CHO g^{-1} N (Mahon, 1977). This agrees with conclusion stated by Child (1981) that the basic requirement for the operation of the nitrogenase system was a supply of energy.

It may be of interest to notice in table 1, that soil enzymes activities and CO_2 evolution were greater in the rhizosphere than in the nonrhizosohere soil which is expected. According to Allison (1973), because rhizosphere organisms are known to be more active than those located elsewhere in the soil mass, the soil biochemical processes in the rhizosphere are accelerated.

Enzymes activities, shown in Table 2, were higher in the topsoil (0-15 cm) but decreased variably and remarkably as soil depth increased. Skujins (1973) reported similar findings in this connection.

Moisture and air regimes in soil were found to affect the

Table 1 : Effect of ground water depth on soil respiration and enzymes activities of rhizosphere and nonrhizosphere under faba bean plants . (Mean of the 0 - 15 and 15 - 30 cm soil samples).

Activity	Soil sample	Depth of ground water table , cm					L S D 0.05
		26.8 ±1.6	48.2 ±2.4	72.1 ±3.0	101.4 ±4.2	112.7 ±6.4	
CO_2 evolution , mg. CO_2-C/ 100 g. soil / 24 hrs.	Rhizosphere	6.3	8.2	9.1	9.8	9.2	0.3
	Nonrhizosphere	3.5	3.4	3.8	4.2	3.6	0.4
Nitrogenase , μmole C_2H_4 / 100 g. soil / hr.	Rhizosphere	2.7	2.9	3.7	4.2	3.8	0.3
	Nonrhizosphere	0.9	0.9	1.1	1.2	1.2	0.2
Dehydrogenase, μliter H_2/ transferred/100g. soil/24 hrs.	Rhizosphere	14.7	16.6	20.8	27.8	26.3	1.4
	Nonrhizosphere	3.0	3.2	3.6	4.4	3.7	1.1
Catalase , μmole H_2O_2 decomposed/g. soil/15 minutes	Rhizosphere	600	657	759	838	761	27
	Nonrhizosphere	239	252	270	312	274	32
Cellulase, μmole reducing sugars prod./100g. soil/24 hrs.	Rhizosphere	22.4	26.6	33.7	38.6	33.8	2.4
	Nonrhizosphere	4.6	5.7	6.3	6.5	6.4	1.0
Amylase, μmole reducing sugars produced/100g. soil/24 hrs.	Rhizosphere	1.6	2.2	3.0	3.8	3.4	0.3
	Nonrhizosphere	0.8	0.9	1.2	1.3	1.3	0.2
Invertase, μmole reducing sugars prod./100g. soil/24 hrs.	Rhizosphere	27.3	31.9	38.2	43.8	41.6	2.1
	Nonrhizosphere	9.7	13.5	17.1	19.1	18.4	2.4
Proteinase , % gelatin hydrolyzed / 20 hrs.	Rhizosphere	1.5	1.9	1.8	2.1	2.1	0.2
	Nonrhizosphere	0.2	0.3	0.3	0.3	0.3	0.1

Each value within the table is a mean of 80 determinations i.e. 10 determinations/replicate x 4 replicates x 2 depths of soil sample .

Table 2 : Effect of soil depth on respiration and enzymes activities of rhizosphere and nonrhizosphere soil under faba bean plants. (Mean of the 5 treatments of ground water depths of the experiment) .

Activity	Soil sample	Depth of soil sample		L S D 0.05
		0-15cm	15-30cm	
CO_2 evolution , mg. CO_2-C / 100 g. soil / 24 hrs.	Rhizosphere	14.9	7.3	0.3
	Nonrhizosphere	4.9	3.8	0.5
Nitrogenase , μ mole C_2H_4 / 100 g. soil / hr.	Rhizosphere	5.5	3.1	0.3
	Nonrhizosphere	1.6	1.1	0.4
Dehydrogenase, μliter H_2 transferred/100g.soil/24 hrs.	Rhizosphere	37.5	15.8	2.3
	Nonrhizosphere	5.9	3.5	1.1
Catalase , μmole H_2O_2 decomposed/ g. soil/ 15 minutes.	Rhizosphere	1005	790	27
	Nonrhizosphere	422	229	52
Cellulase, μmole reducing sugars prod./100g.soil/24 hrs.	Rhizosphere	59.3	25.6	3.0
	Nonrhizosphere	9.6	6.2	2.1
Amylase, μmole reducing sugars produced/100g.soil/24 hrs.	Rhizosphere	3.8	2.5	0.6
	Nonrhizosphere	1.5	1.1	0.4
Invertase, μmole reducing sugars prod./100g.soil/24 hrs.	Rhizosphere	44.8	37.3	3.7
	Nonrhizosphere	18.8	16.0	3.0
Proteinase , % gelatin hydrolyzed / 20 hrs.	Rhizosphere	2.2	1.9	0.5
	Nonrhizosphere	0.3	0.1	0.1

Each value within the table is a mean of 200 determinations i. e. 10 determinations/replicate x 4 replicates x 5 ground water depths.

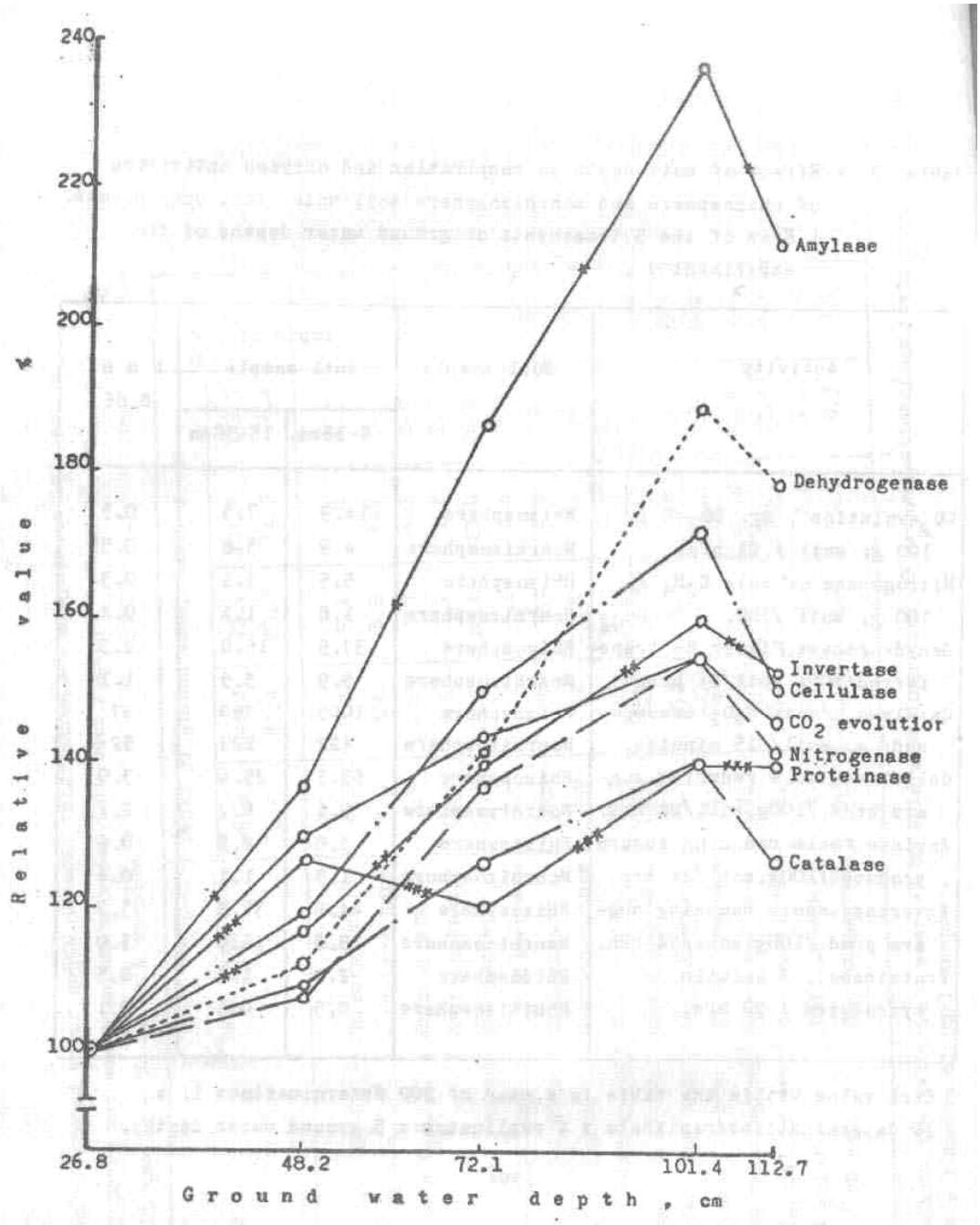

Figure 1 : Relative values of soil respiration and enzymes activities in rhizosphere under faba bean plants at maximum flowering age as affected by ground water depth .

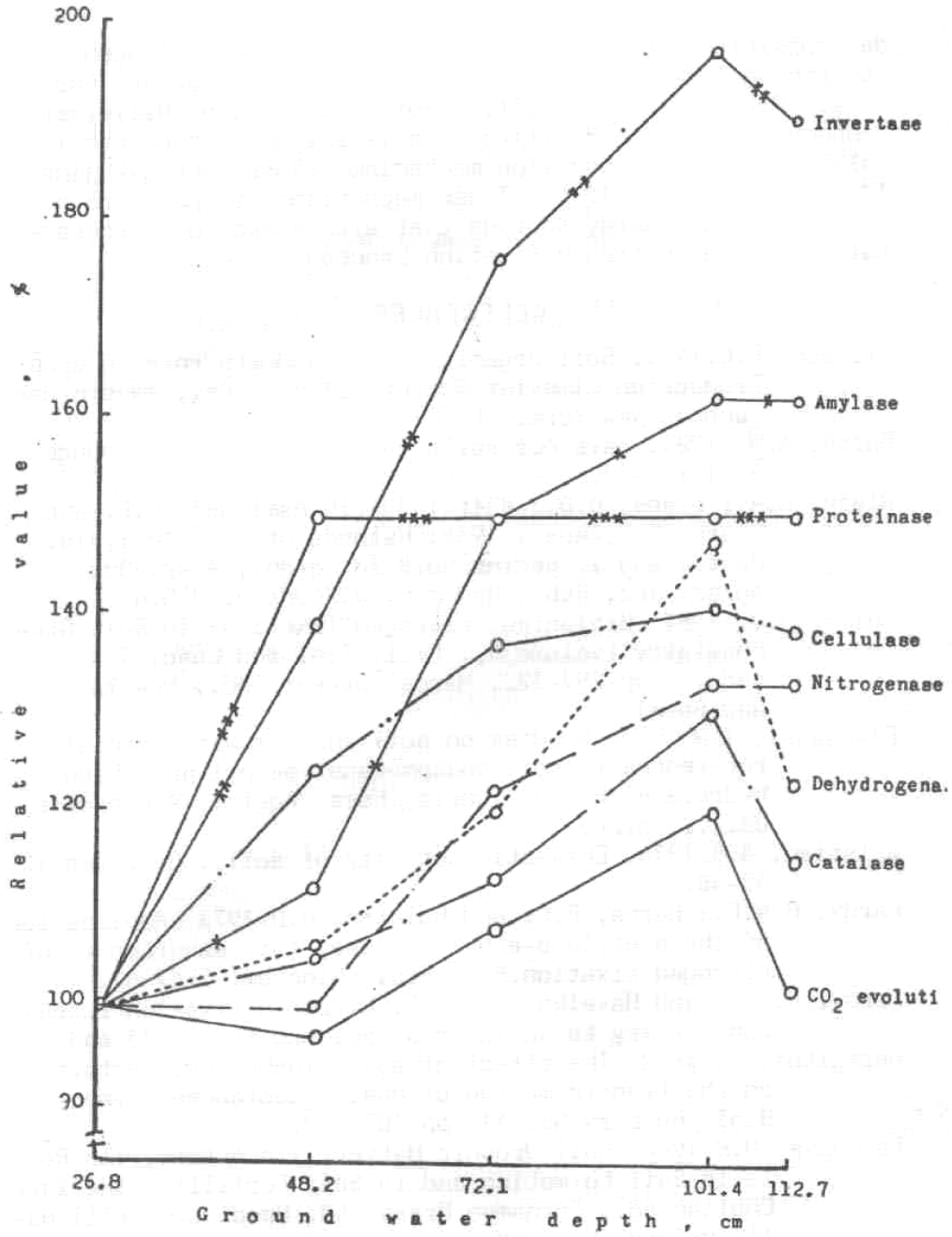

Figure 2 : Relative values of soil respiration and enzymes activities in nonrhizosphere under faba bean plants at maximum flowering age as affected by ground water depth .

decomposition and transformation of carbon-and nitrogen-containing organic molecules in soil (Konova 1966 and Harigitai 1972). This would affect soil respiration (Miller and Johnson 1964) and activities of soil enzymes, which are involved in the decomposition mechanisms (Ross 1966, Skujins 1973 and Calastain 1974). These mechanisms products are potential carbon energy sources that are needed to a successful biological nitrogen fixation process.

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