MICROBIAL COUNTS IN THE SOIL AND RHIZOSPHERE OF TWO BROAD BEAN VARIETIES GIZA 2 AND REBAYA 40, AT DIFFERENT STAGES OF PLANT GROWTH.

by

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ABSTRACT

The microbial density in soil and rhizosphere of two broad bean varieties Giza 2 and Rebaya 40 was estimated at the different stages of plant growth. The results of the investigation showed the following :

1. The total microbial counts, actinomycete and fungi counts were found to be higher in the rhizosphere than in soil apart in all investigated samples at different stages of plant growth for the two broad bean varieties.

2. The rhizospheric total microbial counts increased with the increase of plant age till the flowering stage, where maximum counts were attained, then decreased. This was true for both broad bean varieties.

3. The rhizosphere effect (R/S ratio) on the total microbial counts and the R/S ratio of Fungi counts were higher in Rebaya 40 than Giza 2 in the early stages of plant growth

up to the flowering stage. The opposite was found in the later stages of plant growth.

4- The R/S ratio of actinomycets counts was found to be positive, but not very high, for both the two broad bean varieties.

5- The number of nodules and their dry weight increased with the increase of plant age up to the late pod-formation stage then decreased. Both the broad bean varieties showed the same trend.

INTRODUCTION

The rhizosphere of the growing plants was found to affect the quantity and quality of soil microflora by many earlier investigators including Micer (1956), Naim et al., (1957), Lauw and Webley (1959), Mahmoud et al. (1964), Abdel-Hafez (1966), El-Mofty (1970), Hanafy (1972) and El-Said (1976).

Microbial differences in the rhizosphere of different crop varieties were recorded by many investigators including

Adati (1939), Timonin (1940), Clark (1940), Zukovskaya (1941), Naim et al. (1957).

Stage of plant growth was found to affect the rhizospheric populations by many investigators including Katznelson (1946), Katznelson et al. (1948), Micer (1956), Rovira (1956a) Peterson (1958), Federow and Georgiv (1958), Lauw and Webley (1959), Rema Devi and Sam Raj (1966), Abdel-Hafez (1966), Salem (1969), Shata (1969), El-Mofty (1970), Hanafy (1972) and El-Said (1976).

This investigation was carried out to study the total microbial count, actinomycete and fungi counts in the rhizosphere and soil apart from roots of two broad bean varieties Giza 2 and Rebaya 40 at different stages of plant growth. Studying nodulation of the two broad bean varieties was of the interest of the investigators. In addition, a main target of this investigation was to obtain rhizospheric isolates of bacteria, actinomycetes and fungi to be used in further studies concerned with testing the antagonistic efficiency of these isolates against certain root-rot pathogens.

MATERIAL AND METHODS

Two broad bean varieties namely Giza 2 and Rebaya 40 were sown in the field at the Faculty of Agriculture (Moshtohor) during the season 1979/1980.

Samples of the up-rooted plants and soil apart from roots were obtained from the field experiment at the different stages of plant growth for microbiological determinations. The plate count procedure (Allen, 1949) was used for microbial enumeration. Soil extract agar (Mahmoud, 1955) was used for total microbial count. Jensen's agar medium (Jensen, 1930) was used for Actinomycetes count. Martin's agar medium (Martin, 1950) was used for fungi count.

The number of nodules and their dry weight, were estimated at the different stages of plant growth for both the two broad bean varieties. The dry weight of nodules was determined after exposing to 70°C for 48 hours.

RESULTS AND DISCUSSION

Total microbial count in soil and rhizosphere of two broad bean varieties Giza 2 and Rebaya 40 at different stages of plant growth:

The average plate count of the total microbial flora per gram dry weight, of the rhizosphere soil of the two broad

bean varieties and soil apart at the different stages of plant growth is recorded in Table (1).

Data in Table (1) show that the total microbial count of the soil apart in seven successive determinations which coincided with the different stages of plant growth from seedling up to maturity was 70.46, 38.62, 21.06, 58.26, 39.73, 35.5 and 19.55 millions per gram dry weight of soils. These counts were lower than that of rhizosphere counts, which were found to be in Giza 2 in the order of 104.55, 82.55, 52.36, 239.32, 189.87, 73.17 and 83.30 and for Rebaya 40 were 141.16, 158.55, 89.51, 237.96, 132.47, 69.15 and 34.35 millions per gram dry weight. This indicate the effect of the plant roots on the proliferation of soil microorganisms. Root exudations and plant debris provide soil microorganisms with additional nutrients which acts as source of energy and constituents required for building new microbial cells.

The total microbial count of the rhizosphere reached the maximum, 239.32 and 237.96 millions per gram dry weight for Giza 2 and Rebaya 40 respectively, during the flowering stage. This result is in agreement with the findings of Rema Devi and Sam Raj (1966), Salem (1969) and Shata (1969). It is well known that during the flowering stage, plants are at their optimum physiological activities, and this may affect

Table (1): Total microbial flora in soil and rhizosphere of two broad bean varieties, Giza 2 and Rebaya 40, at different stages of plant growth during the season 1979/1980.

Date of sampling (Stage of plant growth)	Soil counts x 10^6	Giza 2		Rebaya 40	
		Rhizosphere x 10^6	R/S	Rhizosphere x 10^6	R/S
25/11/79 Seedling	70.46	104.55	1.48	141.16	2.00
8/12/79 Tillering stage	38.62	82.55	2.14	158.55	4.10
12/1/80 Starting of flowering	21.06	52.36	2.49	89.51	4.25
2/2/80 Flowering & start pod-formation	58.26	239.32	4.11	237.96	4.08
23/2/80 Pod-formation	39.73	189.87	4.78	132.47	3.33
3/4/80 Late pod-formation	35.50	73.17	2.06	69.15	1.95
24/4/80 Maturity	19.55	83.30	4.26	34.35	1.76

x Date of sowing. 10/11/1979

the quantity and quality of root exudations that enhance the multiplication of soil microorganisms.

The rhizosphere effect (R/S ratio) was found to be positive (more than 1) in all investigated samples at the different stages of plant growth for both broad bean varieties. This result is in agreement with the findings of many investigators including Micer (1956). Naim et al (1957), Lauw and Webley (1959) Mahmoud et al. (1964), Abdel-Hafez (1966), El Mofty (1970), Hanafy (1972) and many others.

The rhizosphere effect (R/S ratio) was higher in Rebaya 40 than Giza 2 in the early stages of plant growth up to the flowering stage. The opposite was observed in the later stages of plant growth. This may be due to differences in root exudations between the two broad bean varieties at the different stages of plant growth.

The R/S ratio, for both broad bean varities, increased with the increase in plant age up to pod-formation stage in case of Giza 2, and flowering stage in case of Rebaya 40. At the later stages of growth, towards maturity, Rebaya 40 showed a gradual decrease in the R/S ratio, but Giza 2 showed a decrease followed by an increase in the R/S ratio. The differences in the trend of the total microbial R/S ratio for the two broad bean varieties at the later stages of plant growth may be attributed to differences in root exudations of the two broad bean varities at the later stages of plant growth.

Data in Table(1) show that total microbial counts in the rhizosphere of both broad bean varieties differed according to the stage of plant growth . This result is in agreement with the findings of Katznelson (1946), Katznelson et al. (1948). Micer (1956), Rovira (1956 a). Federow and Georgiv (1958), Lauw and Webly (1959), Rema Devi and Sam Raj (1966), Abdel-Hafez (1966), Salem (1969), Shata (1969) , El-Mofty (1970) and Hanafy (1972).

Actinomycetes Count in Soil and Rhizosphere of two Broad bean Varieties, Giza 2 and Rebaya 40 , at Different Stages of Plant Growth:

The average plate count of actinomycetes in the soil and rhizosphere of two broad beam varieties namely Giza 2 and Rebaya 40 at the different stages of plant growth is recorded in Table(2).

Data in Table (2) lead to the following results:

1- High actinomycete counts in the soil apart and the rhizosphere of both broad bean varieties at the different stages of plant growth. This result is in agreement with the

Table (2): Actinomycetes count in soil and rhizosphere of two broad bean varieties, Giza 2 and Rebaya 40, at different stages of plant growth during the season 1979/1980.

Date of sampling (Stage of plant growth	Soil x 10^6	Giza 2		Rebaya 40	
		Rhizosphere x 10^6	R/S ratio	Rhizosphere x 10^6	R/S ratio
25/11/79 Seedling stage	10.06	11.20	1.11	12.54	1.18
8/12/79 Tillering stage	7.47	9.38	1.25	8.19	1.10
12/1/80 Starting of flowering	9.10	12.10	1.33	18.40	2.02
2/2/80 Flowering & start of pod-formation	8.08	10.32	1.28	9.17	1.13
23/2/80 Pod-formation	9.17	16.40	1.79	15.83	1.73
3/4/80 Late pod-formation	10.97	15.30	1.39	11.49	1.05
24/4/80 Maturity	4.94	14.78	2.99	9.75	1.97

x Date of sowing 10/11/1979

results of Abdel-Hafez (1962), Ibrahim (1964) and Shata (1969) who recorded high densities of actinomycetes either in fertile or deteriorated Egyptian soil.

2- The rhizosphere effect on the actinomycete counts(R/S ratio) was found to be positive in all investigated samples at different stages of plant growth for both broad bean varieties. The actinomycetes R/S ratio at different stages of plant growth for Giza 2 were 1.11, 1.25; 1.33, 1.28 , 1.79, 1.39 and 2.99 and for Rebaya 40 were 1.18, 1.10, 2.02, 1.13, 1.73, 1.05 and 1.97. The positive R/S ratio obtained with the actinomycete counts is in agreement with many earlier investigators including Rouatt et al. (1960), and Shata (1969).

3- The actinomycetes R/S ratio for both the two broad bean varieties were not very high. This may be due to the fertility of soil which supplied the actinomycetes with their necessary nutrional requirements needed for growth. Hence, additional nutrients from roots did not show high increment is actinomycete R/S ratio.

Fungi counts in soil and rhizosphere of two broad bean varieties Giza 2 and Rabaya 40, at different stages of plant growth :

The average plate count of fungi in the soil and rhizosphere of two broad bean varieties namely Giza 2 and Rebaya 40 at different stages of plant growth is recorded in Table (3).

Data in Table (3) Lead to the following results :

1. The rhizosphere effect on the fungi counts (R/S ratio) was found to be positive in all investigated samples at the different stages of plant growth for both broad bean varieties. The fungi R/S ratios for Giza 2 were 2.83, 2.96, 3.72, 1.95, 1.36, 4.04 and 2.36 and for Rebaya 40 were 3.62, 3.45, 5.32, 2.23, 1.06, 1.33 and 1.21 at different stages of plant growth.

2. The rhizosphere effect on fungi counts (R/S ratio) was found to be higher in the early stages of plant growth in Rebaya 40 than Giza 2. The opposite was observed in the later stages of plant growth. This may be due to differences in root exudations of the two broad bean varieties at different stages of plant growth.

3. Fungi counts in the rhizosphere and soil apart, were found to be very low as compared to actinomycetes count, This may be due to the fact that Egyptian soil fall in the alkaline range (pH 8) which is not suitable for high rate of fungi multiplication.

Table (3) : Fungi count in soil and rhizosphere of two broad bean varieties Giza 2 and Rebaya 40, at different stages of plant growth during the season 1979/1980.

Date of sampling (Stage of growth)	Soil x 10^3	Giza 2		Rebaya 40	
		Rhizosphere x 10^3	R/S ratio	Rhizosphere x 10^3	R/S
25/11/79 Seedling stage	23.43	66.19	2.83	84.70	3.62
8/12/79 Tillering stage	27.78	82.17	2.96	95.78	3.45
12/1/80 Start of flowering	19.79	73.58	3.72	105.24	5.32
2/2/80 Flowering & start pod-formation	34.27	66.94	1.95	76.45	2.23
23/2/80 Pod-formation	43.88	59.71	1.36	46.68	1.06
3/4/80 Late pod-formation	37.87	153.00	4.04	50.54	1.33
24/4/80 Maturity stage	19.89	46.93	2.36	23.97	1.21

The rhizospheric fungi counts during the different stages of plant growth for Giza 2 were 66.19, 82.17, 73.58, 66.94, 59.71; 153.00 and 46.93 and for Rebaya 40 were 84.70, 95.78, 105.24, 76.45, 46.68, 50.54 and 23.97 thousands per gram dry weight of rhizospheric soil, as compared to that of soil apart which were 23.43, 27.78, 19.79; 34.27, 43.88, 37.87 and 19.89 thousands per gram dry weight of soil.

The increase in fungi population in the rhizosphere than in the soil apart from plant roots could be attributed to the rhizosphere effect. Plant roots supply the rhizosphere area with organic excretion and sloughed off portions both are organic matter needed for fungal multiplication. In addition, the carbon dioxide evoluted during the respiration of plant and microorganisms lower the pH of the rhizosphere area to be more suitable for fungal multiplication.

The number of nodules on the root of two broad bean varieties Giza 2 and Rebaya 40 at different stages of plant growth:

The number of nodules and their dry weight of the two broad bean varieties Giza 2 and Rebaya 40 at different stages of plant growth is recorded in Table(4).

Table (4) : The number of nodules on the root of the two broad bean varieties Giza 2 and Rebaya 40, at the different stages of plant growth.

Date of sampling	Giza 2					Rebaya 40				
	Mean number of nodules per plant				Dry weight of nodules mg/plant	Mean number of nodules per plant				Dry weight of nodules mg/plant
	Big	Medium	Small	Total		Big	Medium	Small	Total	
22/12/1979	2.75	5.50	6.50	14.75	126.49	2.50	3.75	6.75	13.00	105.93
12/1/1980	4.50	4.25	14.00	22.75	174.98	4.25	5.00	7.75	17.00	153.33
2 / 2/1980	5.50	5.50	12.00	23.00	196.88	5.00	6.50	12.00	23.50	197.50
23/2/1980	5.50	8.00	30.00	43.50	290.63	5.25	10.75	42.00	58.00	358.95
15/3/1980	15.00	19.25	65.00	99.25	676.90	16.25	21.25	68.50	106.00	757.70
3/4/1980	4.25	6.50	24.50	35.35	233.73	4.5	8.00	19.25	31.75	230.99

Date of sowing 10/11/1979.

Data in Table (4) show that the number of noduless and their dry weight increased with the increase of plant age up to the stage of Late pod-formation after which both the number of nodules and their dry weight decreased. This was true for both broad bean varieties.

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دراسة أعداد الميكروبات فى التربة وريزوسفير نباتات الفول البلدى لصنفى جيزة ٢ وربايـة ٤٠ على مراحل النمو المختلفة

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فى هذه الدراسة تم تقدير اعداد الميكروبات فى التربة البعيدة عن الجذور وفـــى ريزوسفير جذور نباتات الفول البلدى صنفى جيزة ٢ وربايـة ٤٠ ، كذلك قدرت أعداد العقـد الجذرية والوزن الجاف للعقد وذلك على مراحل النمو المختلفة ، وأسفرت الدراسة عـــن النتائج التالية :

١ ـ وجد أن العدد الكلى للميكروبات وعدد الاكتينوميسيتات وعدد الفطريات فى الريزوسفير كانت أعلى من اعدادها المقابلة فى التربة البعيدة وذلك على مراحل النمو المختلفـة فى كل من صنفى الفول .

٢ ـ زاد العدد الكلى للميكروبات فى الريزوسفير بزيادة عمر النبات حتى مرحلة الازهار ، ثم بدأت تتناقص اعداد الميكروبات بزيادة عمر النبات . ووجد هذا الاتجاه فى كل مـــن صنفى الفول .

٣ ـ تأثير الريزوسفير على العـدد الكلى للميكروبات وعدد الفطريات كان أكبر فى صـــنف ربايـة ٤٠ عن جيزة ٢ فى المراحل الاولى من عمر النبات حتى مرحلة الازهار . بينمـــا وجد العكس فى المراحل الاخيرة لنمو النباتات .

٤ ـ تأثير الريزوسفير على اعداد الاكتينوميسيتات كان موجبا ولكن لم يكن كبيرا فى كل مـــن صنفى الفول .

٥ ـ وجد أن كل من اعداد العقد الجذرية والوزن الجاف للعقد على النبات زاد بزيـــادة عمر النبات حتى وصلت الى حدها الاقصى فى المراحل الاخيرة من تكوين القرون ، ثـــم قل عدد العقد والوزن الجاف للعقد على النبات فى مرحلة النضج .