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IMPACT OF CERTAIN GEL SOIL CONDITIONERS ON *Rotylenchulus reniformis* INFECTING OKRA PLANT

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ABSTRACT

A greenhouse study was conducted to investigate the effect of certain gel soil conditioners on the pathogenicity of the reniform nematode, *Rotylenchulus reniformis* infecting okra plant roots (*Abelmoschus esculentus* L) For this aim two gel soil conditioners were used i.e., Evergreen 500 (EG) and Broad Leaf P4 (BL) at four concentrations; 0 (control treatment), 0.2, 0 4 and 0.6 % Results indicated that the increment of EG concentrations highly significant increased the final nematode population with polynomial relationship. On the contrary, a significant polynomial negative correlation occurred between BL concentrations and final nematode population. The concentration 0.2 % of BL caused encouragement for *R. reniformis* final population that reached to 4679 individuals with reproduction factor of 2.34. Generally, the tested soil conditioners increased the plant growth in spite of nematode infection.

Keywords: *Rotylenchulus reniformis*, plant parasitic nematodes, gel soil conditioners, okra, *Abelmoschus esculentus* L.

INTRODUCTION

Synthetic gel soil conditioners have been regarded as a successful mean for improving soil structure. They also often described as super absorbent of water, so they increase water holding capacity, reduce evaporation losses and significantly increase water use efficiency with decreasing nutrient leaching. These previous effects were translated into stronger, larger plants with extensive root systems, and more response to fertilizers (Wallace and Terry, 1998).

On the other hand, there is rare information about the effectiveness of gel soil conditioners on plant parasitic nematodes. Ponchillia (1972) demonstrated that soils with small amounts of air-filled space, extremes in pore size, are deleterious to the migration and survival of *Xiphinema. americanum*. Fortnum *et al.* (1987) revealed that water absorbent polymer (Terro-sorb) can be used as carrier media in satisfactory infestation of several field sites with *Meloidogyne spp.*

McDonald and Den Berg (1993) cleared that soil water is a dynamic phenomenon depends on many aspects of soil physics including in – and out flow of water from soil. The interaction of water and other factors of O_2 concentration, tolerance of host plant, other climatic and epidalphic factors may govern the pathogenicity of the nematodes. Koening *et al.* (1996) noted that soil moisture affect the porosity of the soil and consequently O_2 concentration that limited nematode population density.

The main objective of this study was to investigate the effect of gel soil conditioners on the development and reproduction of *Rotylenchulus reniformis* infecting okra plant.

MATERIALS AND METHODS

Two kinds of synthetic gel soil conditioners were chosen to investigate the effect of soil conditioners on *Rotylenchulus reniformis* Linford and Oliveira. Their commercial names are; Evergreen 500 (EG) and Broad Leaf P4 (BL), Table (1). The conditioners were used with concentrations of 0 (control treatment), 0.2, 0.4 and 0.6 % on dry weight basis. Plastic pots of 15 cm diameter were filled with sterilized sandy loam soil (60.91 % sand, 19.46 % silt and 19.62 % clay) previously mixed with the different concentrations of soil conditioners. Okra, *Abelmoschus esculentus* L., seeds were grown as one seed per pot. The pots were arranged in the greenhouse in a complete randomized design, with three replicates for each treatment. Fifteen days after germination, each plant was inoculated with 2000 fresh immature females of *R. reniformis*.

Table (1): Some properties of the used gel soil conditioners as reported by the manufacturer.

Criterion	Substance	
	Evergreen 500	Broad Leaf P_4
Manufacture name	Chemie - Linz/ Austria	Agricultural polymer, LTD, Gluoucester G15RG UK.
Trade name	Evergreen 500	Broad leaf P4
Chemical composition	Propenamide polymer with hydrophilic groups (sulphonate)	Polyacrylamide co- polymer
Standard particle size	0.25 - 4.00 mm	0.5 - 1.5 mm
Dry bulk density	Approx. 0.6 g/cm^3	Approx. 0.66 g/cm^3
pH of the absorbed water	7.0 ± 0.5	7.0±0.5
Absorption capacity in deionized water*	700 g/g	400 g/g
Absorption capacity in deionized water**	65 g/g	218 g/g

*** Reported by manufacturer. ** Determined by Hassan (1994).**

Conventional management practices were followed for all treatments. During the experiment the greenhouse temperature varied from 30-35 °C. Seven weeks after inoculation, infected plants were removed and soaked in water for 5 minutes, then washed gently in running tap water and maintained in lactophenol acid fuchsin (Barker *et al.*, 1985) to estimate the number of nematodes attached to root tissues. Soaked and washed water were used to extract nematodes (Goody, 1957) for counting. Rate of reproduction (R_f) was calculated according to the following formula:

R_f = final population (P_f) / initial population (P_i)

The male percentage was estimated as the following formula:

Male % = (male numbers / total nematode population) X 100

In addition, growth parameters based on plant length, fresh and dry weights of shoot and root were recorded. Data was statistically analyzed by using the Fisher's Least Significant Differences (L.S.D.) according to Gomez and Gomez (1984).

RESULTS AND DISCUSSION

Data recorded in Table (2) and illustrated in Fig. (1 & 2) demonstrate the effect of the two gel soil conditioners at different concentrations on *Rotylenchulus reniformis* nematode development and reproduction. The results indicated that all concentrations of EG enhanced the nematode reproduction compared to the control. As shown from the Table (2), the final nematode population at concentrations of 0.2, 0.4 and 0.6 % were 3614, 3778, and 3845 individuals, respectively, while the control treatment was 3607 individuals. So the gradual increment in EG concentration leads to the increase of final nematode population. Also, a significant positive correlation between the EG concentrations and the nematode population was reported.

Table (2). Reproduction of *Rotylenchulus reniformis* on okra plants affected by certain gel soil conditioners under greenhouse conditions.

Conditioner concentration (%)	Nematode population per plant				Final population (P_f)	Reproduction factor (R_f)
	In soil			On Root		
	Larvae	Immature females	Males number and percentage			
Evergreen 500						
0.0	2180	698	247 (6.85 %)	482	3607	1.80
0.2	2011	755	223 (6.17 %)	625	3614	1.81
0.4	2381	892	185 (4.90 %)	320	3778	1.89
0.6	2480	810	110 (2.68 %)	445	3845	1.92
Broad Leaf P_4						
0.0	2180	698	247 (6.85 %)	482	3607	1.80
0.2	3235	1072	99 (2.12 %)	273	4679	2.34
0.4	2401	840	114 (3.18 %)	230	3585	1.79
0.6	1420	447	578 (20.78 %)	336	2781	1.39

The previous relation was fitted to polynomial equation with highly significant correlation coefficient (r) equal 0.961, Fig. (1).This population enhancement is due to the capability of the EG in maintaining the soil moisture in best phase. It is evident that water films in soil provide the habitat for the most species of plant parasitic nematodes for migration, survival and host invasion (Singh and Sharma 1995). Also, the R_f values had the same trend of the total nematode population whereas they increased with the increasing of EG concentrations.

On the other hand, the BL concentrations exhibited significant inversely polynomial relation (r = 0.913) with the total population, Fig (1). The 0.2 % BL harboured the greatest number of nematodes which amounted to

4679 with R_f 2.34, Table (2). While 0.6 % BL minimized the final population to 2781 with R_f 1.39, Table (2). These results can be explained according to the sorption capacity of BL, which absorb water 3.35 times more over than EG (Hassan 1994). Therefore, the concentration 0.2 % presents the most optimum available soil moisture needed for nematode, but at 0.6% concentration the moisture exceeds the safe edge. Consequently, the inhibition of penetration,development and reproduction of nematode decreased due to reduced oxygen-diffusion rates in soil, accumulation of carbon dioxide and-or production of toxins (Singh and Sharma, 1995). The previous results were confirmed by Koening *et al.* (1996); they demonstrated that soil moisture level influences soil aeration as does soil-pore.

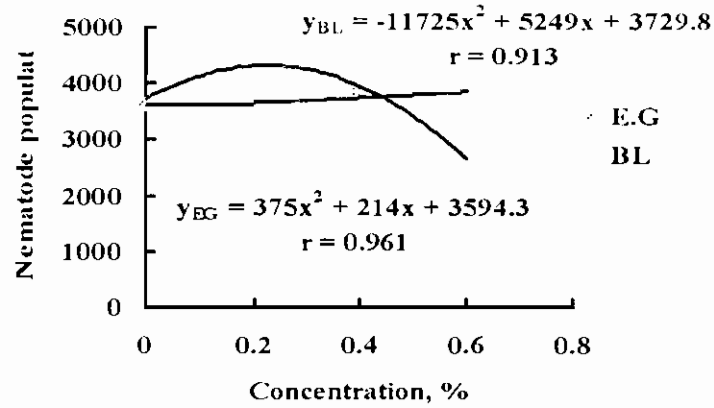

Fig. (1). The relationships between nematode population of *R. reniformis* and gel soil conditioners concentrations.

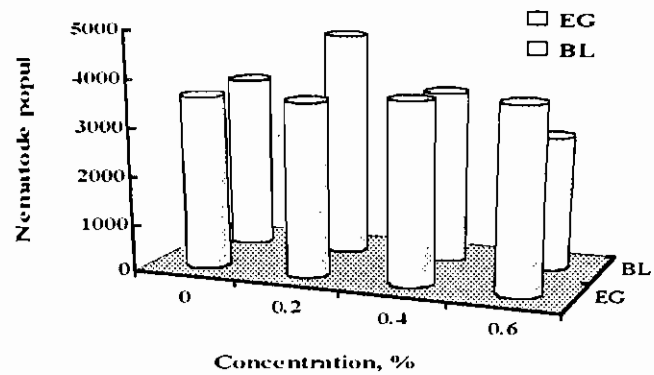

Fig. (2). Total nematode population of *R. reniformis* as affected by gel soil conditioners concentrations.

As far as the male percentage is concerned, it was found that the highest percentage was obtained at 0.6 % BL and the lowest percentage was at 0.2 %BL, Table (2). While the percentage of the male varied among the EG concentration and still less than the control, Table (2). It is evident that males presence is correlated with the adverse conditions as reported by Davide & Triantaphyllou (1967), Zuckerman, *et al.* (1971) and Ashoub (1984).

The results obtained from Table (3) and illustrated in Fig. (3) show that the addition of soil conditioners increased the vegetative growth of okra plants in spite of nematode infection. This increase may be attributed to the using of soil conditioners which improved the plant's ability to tolerate the nematode damage (Wallace, 1983). The highest growth obtained was at 0.6 % for EG and BL concentrations compared with lower concentrations. This increasing may be occur as a result of the retained moisture in the root zone that indicated by the water stored in the soil at the end of plant (Al-Harbi *et al.*, 1994) . Also, the results revealed that the effectiveness of BL at 0.4 and 0.6 % concentrations on plant growth was more pronounced than with EG. This effect may be due to the high water absorption capacity of BL. While, the plants at 0.2 % BL concentration had less vegetative growth than 0.2 % EG concentration. This result may be attributed to the high nematode population at this concentration (Table 2).

It is concluded that the effect of soil gel conditioners on the different phytonematodes genera must be evaluated before the additional to the soil.

Table (3): Effect of certain gel soil conditioners on okra plant growth infected by *Rotylenchulus reniformis*.

Concentration conditioner (%)	Growth parameters				
	Shoot			Root	
	Length, cm	Fresh weight, g	Dry weight, g	Fresh weight, g	Dry weight, g
			Evergreen 500		
0.0	37.28	31.25	7.26	12.19	5.11
0.2	40.19	34.22	7.38	15.03	5.65
0.4	42.69	35.7	7.63	15.75	5.75
0.6	45.55	38.86	9.41	16.27	5.81
$LSD_{0.05}$	Non-significant	4.39	1.10	2.10	0.38
			Broad Leaf P_4		
0.0	37.28	31.25	7.26	12.19	5.11
0.2	39.83	33.85	7.62	12.85	5.17
0.4	47.22	41.89	9.95	17.53	5.83
0.6	49.55	46.55	12.03	17.51	5.98
$LSD_{0.05}$	4.57	6.80	0.80	2.45	0.33

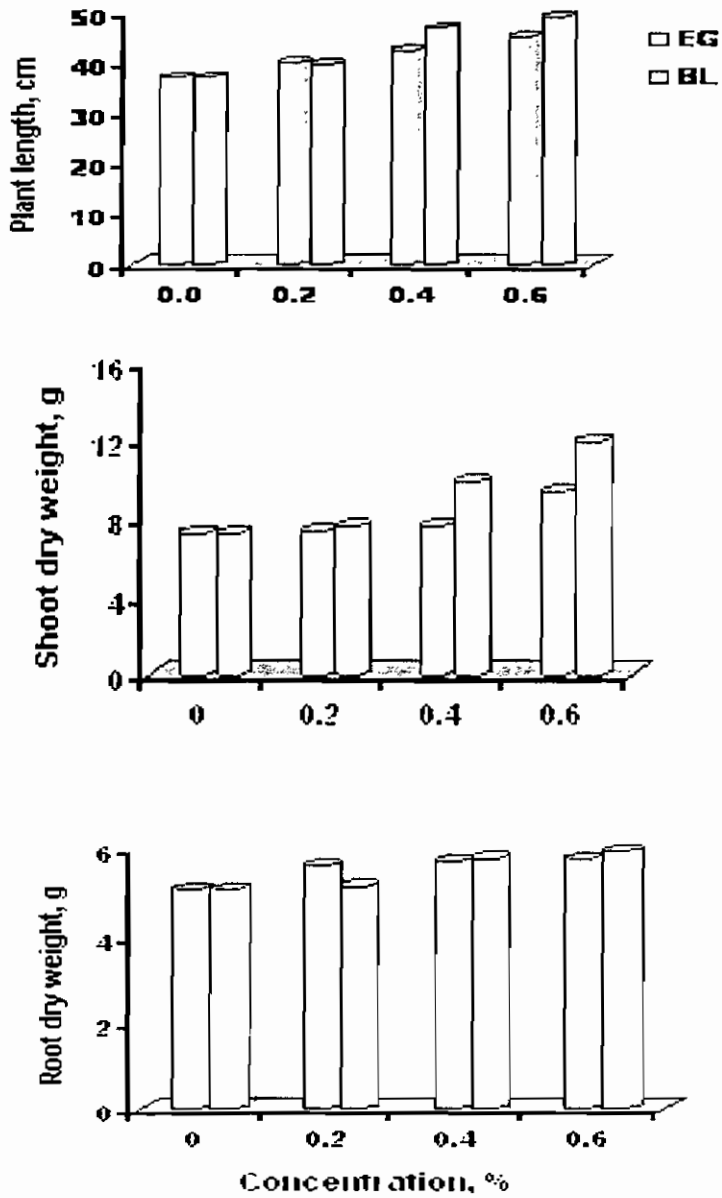

Fig. (3). The effect of gel soil conditioners on growth parameters of infected okra plant by *R. reniformis*.

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تأثير بعض محسنات التربة الجيلاتينية على نيماتودا *Rotylenchulus reniformis* التي تصيب نبات البامية

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أجريت دراسة في الصوبة لتحديد تأثير بعض محسنات التربة على القدرة المرضية لنيماتودا *Rotylenchulus reniformis* التي تصيب نبات البامية. تم اختيار نوعين من محسنات التربة هما Evergreen – 500 و Broad Leaf P4 بتركيزات صفر (معاملة المقارنة) ٠,٢ - ٠,٤و٠,٦ %. أظهرت النتائج أن تركيزات المحسن Evergreen 500 زادت من تكاثر النيماتودا بعلاقة موجبة متعددة الحدود بمعامل انحدار يساوي ٠,٩٦١. بينما تركيزات المحسن Broad Leaf P4 أظهرت علاقة سالبة متعددة الحدود مع تعداد النيماتودا بمعامل انحدار يساوي ٠,٩١٣. ومن ناحية أخرى التركيز ٠,٢ % من المحسن Broad Leaf P4 أدى إلى زيادة معنوية في تعداد النيماتودا حيث بلغ ٤٦٧٩ مقارنة بمعاملة المقارنة و بمعامل تكاثر ٢,٣٤ وكانت نسبة الذكور ٢,١٢ %. كذلك أوضحت النتائج أن محسنات التربة أدت إلى زيادة نمو النباتات على الرغم من إصابتها بالنيماتودا.