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تأثيرالأعضاء المتحللة بيولوجيا على التربة والمياه الجوفية في الضفة الغربية

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الملخص:

تهدف هذه الدراسة إلى استقصاء تأثير الطلب البيولوجي على الأكسجين على عينات من التربة ومياه الشرب في الضفة الغربية. هذه الدراسة ستعطي خلاصة حول مدى تلوث المياه الجوفية بمياه الصرف الصحي والنفايات الصلبة. تم إجراء هذه الدراسة على نوعين من التربة من أريحا وطولكرم. وقد تم تحليل العناصر الفيزيائية والكيميائية لهذين النوعين من التربة وإجراء التجربة بطريقة المحاكاة الفزيائية باستعمال تقنيات أعمدة تربة مختلفة ومن ثم إجراء التقديرات اعتماداً على كميات مياه الأمطار لكل سنة وأبعاد الأعمدة المختلفة. تم إجراء الدراسة بين شهري أبريل ومايو عام 2009، لقد وجد أن تراكيز الطلب البيولوجي على الأكسجين في المادة المرتشحة تتزايد مع مرور الوقت في كلتا العينتين من التربة، وإن تركيز الطلب البيولوجي في شهر ابريل كان أعلى من تركيزه في شهر مايو في تربة أريحا منه في تربة طولكرم بينما تركيز الطلب البيولوجي على الأكسجين في المادة المرتشحة في شهر مايو كان أعلى في تربة طولكرم مقارنة مع تربة أريحا. وقد لوحظ كذلك أن تركيز الطلب البيولوجي على الأكسجين في المادة المرتشحة من نموذج العمود الفارغ تتناقص مع مرور الوقت وأن الأكسجين الذائب كان يتناقص مع زيادة تركيز الطلب البيولوجي على الأكسجين في كلتا العينتين من التربة. كما أن تركيز مجموع المواد الصلبة الذائبة في المادة المرتشحة كان يتناقص في كلتا العينتين من التربة مع مرور الوقت. وكان تركيز الطلب البيولوجي على الأكسجين يتزايد في طبقات التربة من أعلى إلى أسفل في كلتا عينتي التربة بينما كان تركيز الطلب البيولوجي على الأكسجين أعلى في كل طبقة من طبقات تربة طولكرم مقارنة بتركيزه في كل طبقة من طبقات تربة أريحا. كما أن مجموع المواد الصلبة الذائبة في المادة المرتشحة من طبقات تربة طولكرم كان أعلى منه في طبقات تربة أريحا. بينما كان تركيز النيتروجين الكلي في طبقات التربة يتزايد مع العمق ومع مرور الوقت حين إضافة الماء إلى العمود الفارغ بينما يتناقص في طبقات التربة في الأعمدة التي اضيف إليها ماء له طلب بيولوجي على الأكسجين.

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ORIGINAL ARTICLE

Impacts of biodegradable organics on soils and groundwater in West Bank

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KEYWORDS

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Column

Abstract The purpose of this study was to investigate the impact of biological oxygen demand (BOD) on soil and drinking water in West Bank. This study will give us a conclusion about ground water contamination from solid waste and sewage water.

The study was performed on two soil samples brought from Jericho and Talkarem. The physical and chemical properties of the two soil samples were analyzed. The experiment was studied using physical simulation by using different soil column techniques and making some estimation using the amount of rainfall each year and the dimensions of those columns. The study was conducted between April and May, 2009. The concentration of BOD in the leachate was found to increase with time in both types of soil, in April the BOD concentration was higher in the leachate from Jericho soil than Talkarem soil, but in May the BOD concentration was higher in Talkarem soil than Jericho soil. The concentration of BOD in the leachate collected from blank column was decreasing with time, the dissolved oxygen (DO) was decreasing with increasing BOD concentration in both soils.

The total dissolved solids (TDS) concentration in the leachate was decreasing in both soils with time. The BOD concentration was increasing in the soil layers from top to the bottom in both soils (Talkarem and Jericho), but BOD was higher in Talkarem soil in each layer compared with that in Jericho soil layers. The TDS level in Talkarem soil layers was higher than in Jericho soil layers. The total nitrogen (TN) concentration in soil layers increases with depth and with time during water addition in the blank column but decreases in the soil layers in the columns where BOD was added.

1. Introduction

During the last decade, there has been a growing concern about the decrease in usable water resources. Currently, the world is moving toward water crisis; water shortage is an important concern in arid areas such as Africa, southern Asia, and the middle east and in some other parts of the world, which may lead to a war crisis (Jaafarzadeh, 1996; Mohammadi and Kaviani, 2003; Wu and Tan, 2012). Palestine is not like other countries, it has its special situation because of the Israeli occupation.

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Palestinians are forbidden to look or dig for underground water, even inside his/her own land. Not only did the Israelis occupy Palestinian land, but they also controlled its natural resources of water. Palestinian natural sources of ground water and rainwater replenish the ground water. The occupiers (Israelis) control the amount of consumption for each citizen i.e., the occupiers consume 80% of natural water leaving Palestinians with 20%. On the other hand, continued population growth has increased per capital water consumption and increased water requirements, for different uses, although the West Bank in Palestine is a special case (World Bank, 2010).

The Palestinian citizen cannot travel freely from one place to another. Most Palestinians depend on agriculture. Agriculture needs fertile soil and enough pure water, moreover this water is required by both humans and animals to drink.

So, we must protect the ground water from pollution because water treatment is very costly (Simate et al., 2011). In general protection from pollution is more efficient than treatment. Ground water, which is the main source of drinking water in Palestine, may be polluted. Palestinian occupiers may close and segregate main roads, obstructing the restoration of aquifers and lead to aquifer pollution. Such actions can lead to complications of sewage water, solid waste problems and the undesired usage of random and uncontrolled sewage networks, instead of a proper aquifer.

Although some studies (Neralla et al., 2000; Soto et al., 1999; Vymazal, 1999; Merlin et al., 2002) have documented that macrophytes can improve BOD and bacterial removal from wastewaters through sedimentation, mechanical filtration, nutrient assimilation, oxygenation, and microbial attachment mechanisms, others did not detect any significant difference between planted and unplanted systems (Tanner et al., 1995; Baldizon et al., 2002).

Comparisons of different studies are difficult because they utilize diverse substrates, different water flow designs and rates, and variable hydraulic and mass loadings. For example, the role of the substrate and the rhizosphere in surface flow systems is quite negligible compared with the subsurface flow systems, where long residence times allow extensive interaction with the wastewater (Baudoin et al., 2003; Lioussanne et al., 2010).

While resilient, slow growing species with low seasonal biomass turnover, and high root zone aeration capacity may be suitable for surface flow systems, high productivity species, tolerant to high levels of pollutants and hypertrophic waterlogged conditions may be functionally superior in subsurface flow systems (Tanner et al., 1995).

Furthermore, some polyculture species may form floristical and structural vegetation patterns with enhanced ecological, functional and esthetic values, while others may be more efficient in monoculture stands.

1.1. Sewage disposal

The Palestinian villages do not have sewage system to dispose waste water. Village inhabitants are forced to dig sewage wells in their land in close proximity to their drinking wells (which accumulate rainfall in the winter). Therefore, wastewater gradually leaks from the sewage wells into the drinking wells, causing them to be polluted with oxygen consuming BOD, and toxic materials. These consequences pose many dangers to human life and risk of pollution to soil and ground water overall (Colo, 1984; Tsarpali et al., 2012).

In some urban areas, sewage is carried separately in sanitary sewers and runoff from streets, which is carried in storm drains. Access to either of these is typically through a manhole. During high precipitation periods a sanitary sewer overflow can occur, causing potential public health and ecological damage.

Untreated sewage can have serious impacts on the quality of the environment and on people's health. Pathogens can cause a variety of illnesses. Some chemicals pose risks even at very low concentrations and can cause a threat for long period of time because of bioaccumulation in the animal or human tissue (Tchobanoglous et al., 2003).

1.2. Study area

One study sample of soil was collected from the north of Talkarem. It was muddy brown that is suitable for growing olive trees, fruits and vegetables.

The other sample was collected from the east of Jericho, it was sandy yellow, usually used for planting banana and some vegetable.

In Talkarem, the weather is rather hot and dry in summer and rainy in winter, the average rainfall is above 550 mm per year. However, in Jericho the weather is very hot most of the year and the average rainfall is about 150 mm per year.

Due to the mentioned differences in climate and soil physical features (organic content, texture, etc...), we have carried out this study to present the adsorption of BOD in these two distinct soils and to study leachate from both of their wastewaters (Ustin et al., 2009; de Jong et al., 2011).

The main sources of ground water pollutions are human waste, solid waste, agricultural waste, including nitrate and phosphate which are used in fertilizers and industrial waste. The toxic waste dumped in the West Bank ranges from the by-products of the Israeli military industry, some of which are radioactive, to chemical substances that are highly damaging to the environment. Some are so toxic that they are capable of causing cancer on a massive scale (Reis, 2011).

This study aimed to see the effect of biological oxygen demand (BOD) on drinking water by studying the kinetics of BOD leachate from two soil samples taken from different areas in Palestine and also it's worthwhile to see if there is an impact of BOD on total dissolved solids (TDS).

The main sources of ground water pollution are the human waste, solid waste, agricultural waste, including nitrate and phosphate which are used in fertilizers and industrial waste as shown in Fig. 1.

2. Methods and materials

2.1. Soil parameters and area description

Two agricultural soils were obtained one from Jericho city, where the total yearly rainfall is about 150 mm with yellow to white soil color and the other from the Talkarem city where the total yearly rainfall is about 600 mm with red to brown soil color. The two samples were collected from an agricultural area of about 1000 m^2. The first 10 cm of depth was ignored and then representative samples from different locations of the 1000 m^2 were collected and mixed to end up with a representative sample for each area.

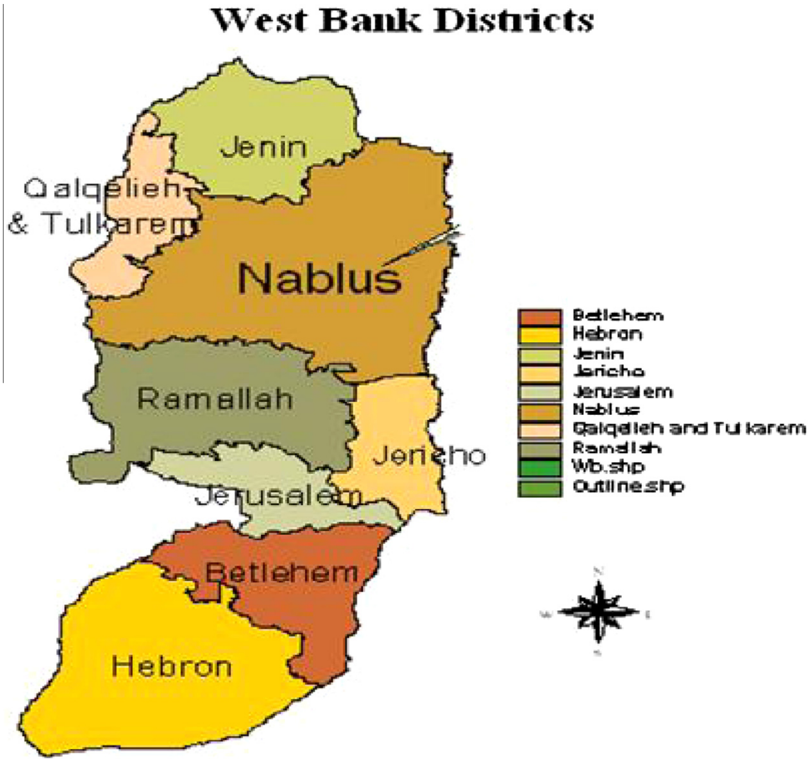

Figure 1 The map for the study area.

Table 1 Presents chemical properties for the two soil samples studied.

Parameter	Talkarem soil	Jericho soil
pH	7.8	8.61
Moisture content (%)	19.57	3.73
Organic carbon (%)	3.38	3.74
Organic matter (%)	5.82	6.43
Nitrogen (%)	0.40	0.37
Phosphorous (%)	0.16	0.19
TDS (mg/L)	185	65
BOD (mg/L)	237	216

Table 2 The soil texture of the two samples.

Soil texture	Talkarem (%)	Jericho (%)
Gravel	0	23.5
Sand	9.56	60.50
Slit	66.92	11.20
Clay	23.52	4.80

Moisture content (organic matter) (ASMD-2216, xxxx), nitrogen percent (Broadbent and Carlton, 1978), and soil texture of both soils were determined and the results are summarized in Table 1.

2.2. Soil texture

The soil texture refers to the size distribution of the mineral particles found in soil. Particles are normally classified into three main classes: sand, silt and clay. The soil texture was determined by ASTM 125-hydrometer (ASTM D4221-11, xxxx). The results are summarized in Table 2.

2.3. Soil column experiment

In this study, twelve plastic soil columns with a diameter of 15 cm and 200 cm height were used. These columns were used to study the main parameters' (BOD, DO, TDS, TN, and TP) concentration.

They were filled with two different types of soil (i.e.), 6 columns with soil from Jericho city in the east of Palestine and the other columns with Talkarem soil sample in the west of Palestine.

The columns were divided into three groups (a, b, and c): Group (a) contained (1–4) columns, two of them contained soil from Jericho and the others with soil from from Talkarem. One of the two columns of each city received only tap water (as a blank), and the other column of each city received water containing BOD from the soil. The BOD containing columns represented the effects of one year's rainfall.

Group (b) contains (5–8) columns divided as in group (a), to present the effect of rainfall at 10 years. Group (c) contains (9–12) columns divided also as in groups (a and b), to present the effect of rainfall at 25 years. Here is a description of the columns (Cordy et al., 2004).

Column 1: Soil Of Jericho BOD One Year Effect. Column 2: Soil Of Jericho Water One Year Effect. Column 3: Soil Of Jericho BOD 10 Year Effect. Column 4: Soil Of Jericho Water

Figure 2 Experimental setup for the soil columns.

Table 3 Volume of water and BOD (600 mg/L) was added every time in the columns.

Time (year)	Jericho (cm^3)	Talkarem (cm^3)
One	132	324
10	1320	3240
25	3314	8102

10 Year Effect. Column 5: Soil Of Jericho BOD 25 Year Effect. Column 6: Soil Of Jericho Water 25 Year Effect. Column 7: Soil Of Talkarem BOD 1 Year Effect. Column 8: Soil Of Talkarem Water 1 Year Effect. Column 9: Soil Of Talkarem BOD 10 Year Effect. Column 10: Soil Of Talkarem Water 10 Year Effect. Column 11: Soil Of Talkarem BOD 25 Year Effect. Column 12: Soil Of Talkarem Water 25 Year Effect. A summary of the columns are shown in Fig. 2.

2.4. Sample preparation for blank and leachate (BOD) analysis

Sample 1: Tap water was taken for blank addition. Sample 2: The standard concentration of BOD was prepared by mixing 250 g of dry sheep compost with 12 l of water for 5 days. The concentration of BOD becomes about 605 ppm. This concentration is not stable and may decrease or increase. (see Table 3).

2.5. Amount of water and BOD added

The amount of water and BOD added were calculated in comparison to the Palestinian weather forecast department.

The annual average rainfall in Talkarem is about 550 mm in 365 days (yearly). The volume of BOD dissolved in the water that was added to each column for the year was calculated using the following equation ($V(\text{ml}) = Pr^2d/10$).

where r is the radius of the tube and d is the amount of rainfall yearly.

3. Results and discussion

After each time we added BOD and water the leachate was collected from each column, and analyzed to test the concentration of BOD, TDS, and DO, for each sample. The results are shown in Tables 4–7 and Figs. 3 and 4.

Table 4 Concentration of (BOD, TDS, and DO) in (mg/L) of leachated sample from column soils of Talkarem representing 25 year effect.

Date	*25 year Talkarem BOD			+25 year Talkarem water		
	BOD	TDS	DO	BOD	TDS	DO
2/4/2009	118	1380	2.1	91	760	5.7
3/4	129	1260	3.2	100	800	4.9
5/4	189	1320	1.1	96	666	7.8
7/4	594	1010	1.8	120	710	3
12/4	320	1120	4.3	65	450	2.6
14/4	139	1030	7	113	511	9.6
22/4	188	733	5.2	86	437	9.8
24/4	118	892	3.8	16	360	8.6
29/4	380	844	1	32	378	6.4
1/5	307	828	3	48	340	6.2
10/5	81	1251	2	10	202	7.8
14/5	267	1130	1.2	130	345	1.8
16/5	270	992	2.2	104	372	8
20/5	343	1163	1.6	102	260	8.6
27/5	42	1138	4.2	88	333	7.7
30/5	556	1210	1.6	67	445	8.3

The columns (1–4) show the effect of one year, and the amount which leached was very small due to the amount of water which was added to each column.

3.1. Leachate analysis results

Due to limitations, on available laboratory analysis, only the chemical analysis is related to leachate coming out of soil columns (with depth 2.0 m) to study the impact of 25 year, 10 year and one year effect when soil was treated with standard solution of BOD with 600 mg/L. The blank columns, contain only soil from each are and tap water only.

The concentration of the leachate collected from the twelve columns (six for soil collected from Jericho, the other soil from Talkarem), was analyzed as a function of time (rain water application) and the results of BOD elevation are presented in Tables 4–7 and Figs. 3 and 4.

The results in Table 4 represent the leachate for 25 years for the soil from Talkarem with standard polluted solution with 600 mg/L of BOD, and blank treatment of soil with tap water, to make comparison with Jericho soil, while the results in Table 5, represent the concentration of BOD, TDS, and DO, for Jericho soil sample for 25 years. The result in Tables 6 and 7, represents the study for the two soil samples for 10 years.

The water used in the experiment was tap water from the Municipality of Jenin with the following chemical analysis results: TDS of 310 mg/L, Ca 60 mg/L, Mg 11.8 mg/L, Na 31.9 mg/L, K 2.5 mg/L, PO_4 0.02 mg/L and NO_3 18.2 mg/L.

3.1.1. Distribution of BOD

The data in Tables 4–7 and Figs. 3 and 4 , show that in April the BOD concentration of the leachate collected from columns was increasing with time, the concentration of BOD in the blank column was decreasing with time. This BOD was found in the soil which was filled in each column. This decrease was due to the rinse of water and was referred as blank column. By looking at Tables 4 and 5 which represent the concentration of

Table 5 Concentration of BOD, TDS, and DO, in (mg/L) of leachated sample from column soils of Jericho representing 25 year effect.

Column type	*25 year Jericho BOD			+25 year Jericho water		
Date	BOD (mg/L)	TDS (mg/L)	DO (mg/L)	BOD (mg/L)	TDS (mg/L)	DO (mg/L)
3/4/2009	140	1310	3.4	91	680	7.9
5/4	97	1160	4.8	43	720	9.2
7/4	86	1210	4.1	27	500	9.4
12/4	96	1180	1.7	59	610	6.7
14/4	86	1015	5.8	91	580	8.6
17/4	159	1111	1.5	51	565	5.9
22/4	140	995	3.1	56	541	9.5
24/4	220	808	8.3	15	349	9.7
29/4	160	1016	6.7	16	389	6.0
1/5	235	943	8.3	11	368	8.5
10/5	200	801	1.0	10	322	6.9
17/5	306	710	5.2	7	211	7.1

* BOD refers to solution that has 600 ppm of BOD.
+ Water refers to the blank column (no BOD in water just from the soil).

Table 6 Concentration of BOD, TDS, and DO, in ppm of leachated sample from column soils of Talkarem representing 10 year effect.

Column type	*10 year Talkarem BOD			+10 year Talkarem water		
Date	BOD (mg/L)	TDS (mg/L)	DO (mg/L)	BOD (mg/L)	TDS (mg/L)	DO (mg/L)
3/4/2009	140	967	6.3	120	410	3.6
5/4	237	789	Low range	151	348	6.1
7/4	202	890	2.8	115	290	7.8
12/4	181	880	3.8	5	380	Up range
14/4	90	870	6.8	71	312	7.4
19/4	102	770	3.7	53	273	4.3
22/4	75	844	5.5	54	373	7.1
24/4	178	795	6.9	21	305	Up range
29/4	21	883	5.8	5	307	7.3
1/5	100	1013	7	20	262	5.5
14/5	65	845	2.8	12	243	3.6
16/5	512	850	Low range	160	375	3.6
20/5	205	835	3.2	80	365	5.4
22/5	218	785	4.6	70	289	6.
27/5	195	780	3.1	108	308	7.2
30/5	178	883	6.2	91	352	7.6

* BOD refers to solution that has 600 ppm of BOD.
+ Water refers to the blank column (no BOD in water just from the soil).

Table 7 Concentration of BOD, TDS, and DO, in (mg/L) of leachated sample from column soils of Jericho representing 10 year effect.

Column type	*10 year Jericho BOD			+10 year Jericho water		
Date	BOD (mg/L)	TDS (mg/L)	DO (mg/L)	BOD (mg/L)	TDS (mg/L)	DO (mg/L)
5/5	102	963	4.2	48	841	5.6
10/5	170	778	2.1	81	625	3.6
13/5	160	820	3.6	32	510	6
14/5	178	760	6.1	19	485	6.3

* BOD refers to solution that has 600 ppm of BOD.
+ Water refers to the blank column (no BOD in water just from the soil).

BOD for 25 years in both Talkarem and Jericho we found that the concentration of BOD was higher in Jericho soil (Table 5). This difference was due to the nature of the soil of Jericho than Talkarem (see physical properties of soil analysis in Table 2. Jericho soil is described as sandy soil with large holes and pores which increase the permeability of the soil due to the sand fraction of 60.5% which is much higher than in Talkarem soil (9.65%).

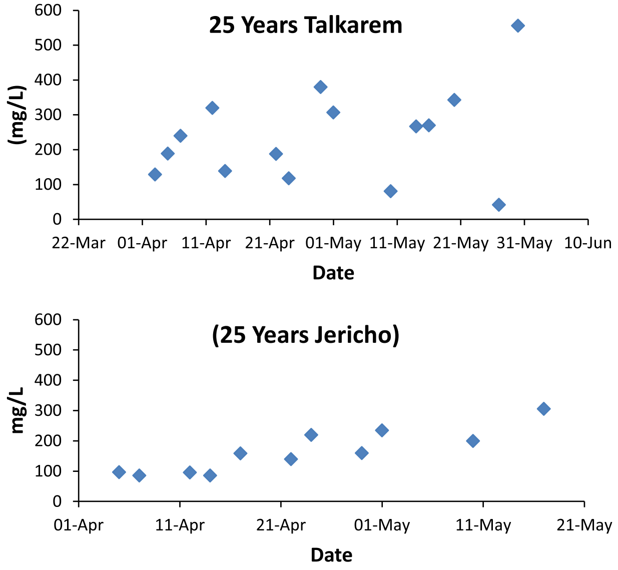

Figure 3 The concentration of BOD (mg/L) in (a) Talkarem (b) Jericho soil within 25 year expectations.

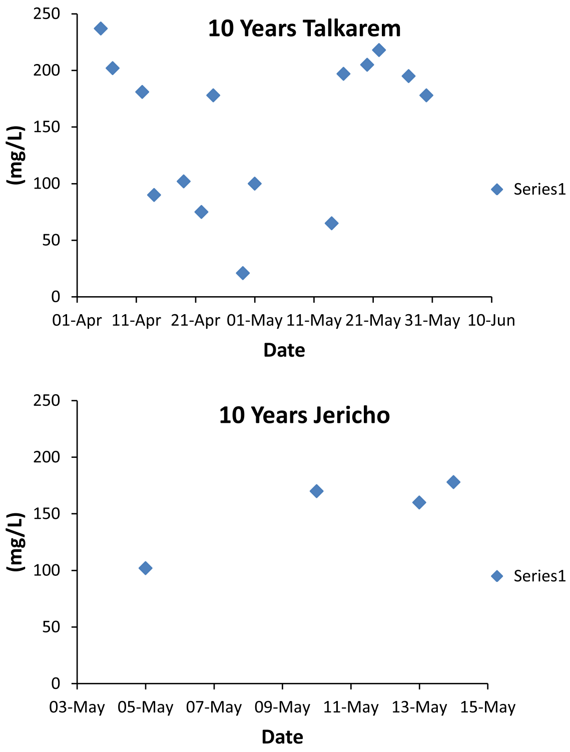

Figure 4 The concentration of BOD (mg/L) in (a) Talkarem (b) Jericho soil within 10 year expectations.

In May the concentration of BOD in leachate increases in Talkarem soil more than Jericho, this difference is due to the large amount of solution of BOD added each time in Talkarem which is four times higher than the one added to Jericho, due to the amount of rainfall yearly. So, the soil becomes saturated in the columns of Talkarem more than Jericho. About 30 times of BOD were added to the column representing Talkarem soil. On the other hand 20 times were added to Jericho columns.

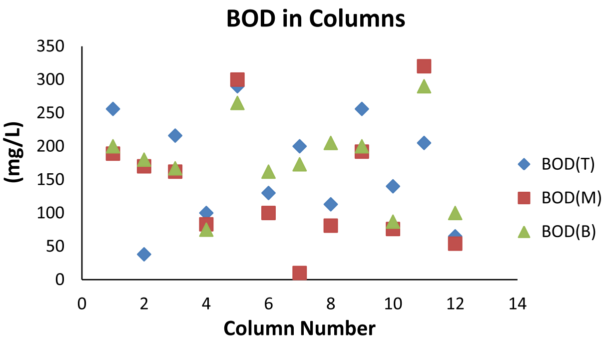

Figure 5 Distribution of BOD (mg/L) in columns after cutting the columns and measuring the distribution between the top, middle and bottom part in each column.

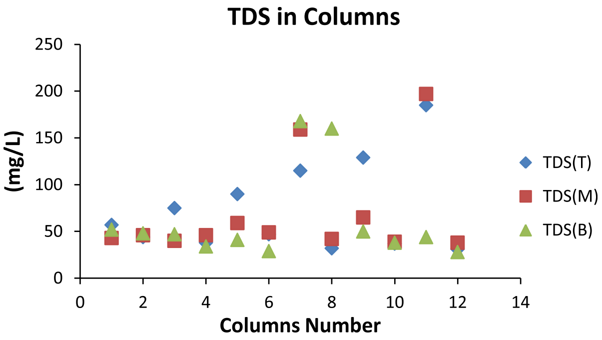

Figure 6 Distribution of TDS (mg/L) in columns after cutting the columns and measuring the distribution between the top, middle and bottom part in each column.

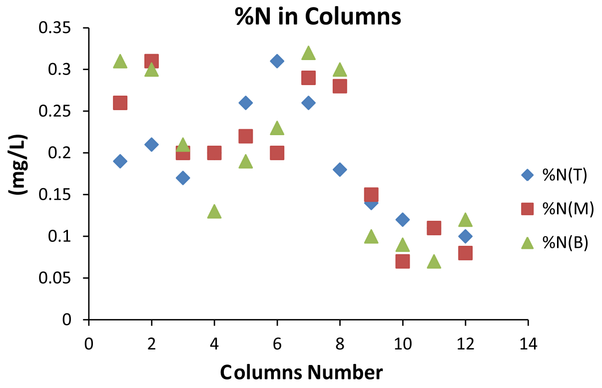

Figure 7 Distribution of Nitrogen (%) in columns after cutting the columns and measuring the distribution between the top, middle and bottom part in each column.

The data in Tables 6 and 7 represent the leachate concentration for both Talkarem and Jericho for a 10 year study. The concentration of BOD in Talkarem soil (Table 6) was higher than in Jericho (Table 7). This was due to the reason mentioned above plus in May, Jericho soil has a higher temperature than in Talkarem and this will lead to some evaporation of solution from the column of Jericho soil. This conclusion was also observed in the blank columns.

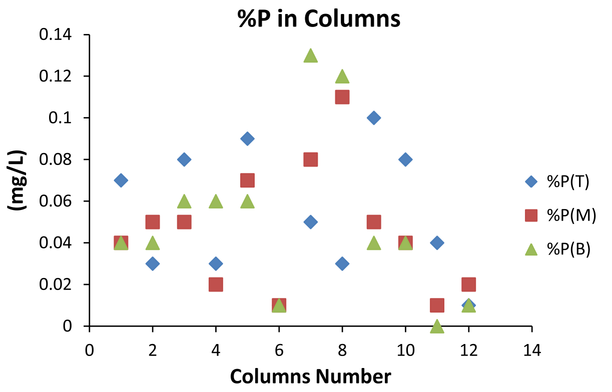

Figure 8 Distribution of phosphorous (mg/L) in columns after cutting the columns and measuring the distribution between the top, middle and bottom part in each column.

The study of leachate effects of BOD in soil for one year study showed no effects of the leachate on ground water. This is due to the small amount of rainfall in one year. This study was represented for columns (1, 2, 7, and 8). The only study was done on the analysis of their soil after the leachate. These studies were both BOD, TDS, TN, TP. The results are shown in Figs. 5–8 and Table 8.

In general the concentration of both BOD and COD was decreasing from the original added concentration (600 ppm), due to the bacterial effects in the soil.

3.1.2. Changes in dissolved oxygen (DO)

The concentration of dissolved oxygen (DO) in leachate decreases with time in all columns when BOD was added. This decrease is due to the increase in BOD concentration. The bacteria consume dissolved oxygen in the soil. This decrease in DO in soil and water will affect negatively on the crops in both soils of Jericho and Talkarem.

3.1.3. Total dissolved solids (TDS)

Generally, TDS in leachate was decreasing in both soils Table 4–7. This was due to several factors:

First, the BOD activities in soils consumed specific amount of salts from soil. Secondly, the presence of large cations like Mg, Fe, etc. absorbed in soil and the small cations like Na, K, are adsorbed on soil surfaces, this will affect the TDS in leachate and decrease it.

3.2. Soil analysis

After the addition of BOD and water each column was cut into three parts (top, middle and bottom). The soil sample was collected from each part to measure the concentration of (BOD, TDS, %P, %N) and the results are shown in Figs. 5–8.

3.2.1. BOD analysis in soil layers

Looking at Figs. 5–8, the concentration of BOD was increasing in the soil layers from top to bottom due to the daily addition of BOD in both soils (Talkarem and Jericho).

The increase of BOD concentration in Talkarem soil in each layer compared with Jericho soil was due to the higher amounts of BOD added to Talkarem soil (more rain). Other reason leading to the increase of BOD in bottom layer is the shortage of TDS.

On the other hand, the BOD concentration in the blank column soil decreases with time in both blank Jericho and Talkarem, with depth (top to bottom).

3.2.2. TDS in soil layers

The TDS concentration level in Talkarem layers was higher than in Jericho soil levels, this was due to the accumulation of most of the salts in Talkarem soil. Other observation was that the TDS in the bottom layer of Talkarem soil was higher than in Talkarem soil. Other observation was that the TDS in the bottom layer of Talkarem soil was higher than the top layer due to the accumulation of salts in the bottom layer. This indicates that Jericho soil is more active to leachate ions due to the permeability of sandy soil of Jericho.

Some variations in results of TDS were due to different amounts of rainfall in Talkarem than in Jericho, which was applied and taken into consideration during our study.

3.2.3. Total nitrogen (TN) and total phosphorous (TP)

The concentration of total nitrogen in the soil layer found to increase with depth and with time in the columns, during water addition in the blank, was due to nitrate ions (NO_3^-) which pair with base cations and this leads to accumulation in or within soil layers (Ward and Zafiriou, 1988).

Table 8 Concentration of BOD (mg/L), TDS (mg/L), %N and %P at different depths.

Column	Top				Middle (1 m)				Bottom (2 m)			
	BOD	TDS	% *N*	% *P*	BOD	TDS	% *N*	% *P*	BOD	TDS	% *N*	% *P*
1	256	57	0.19	0.07	189	43	0.26	0.04	200	52	0.31	0.04
2	38	44	0.21	0.03	–	46	0.31	0.05	180	48	0.30	0.04
3	216	75	0.17	0.08	162	40	0.20	0.05	167	47	0.21	0.06
4	100	38	0.20	0.03	83	46	0.20	0.02	75	34	0.13	0.06
5	290	90	0.26	0.09	300	59	0.22	0.07	265	41	0.19	0.06
6	130	47	0.31	0.01	100	49	0.20	0.01	162	29	0.23	0.01
7	200	115	0.26	0.05	10	159	0.29	0.08	173	168	0.32	0.13
8	113	32	0.18	0.03	81	42	0.28	0.11	205	160	0.30	0.12
9	256	129	0.14	0.10	192	65	0.15	0.05	200	50	0.10	0.04
10	140	37	0.12	0.08	76	39	0.07	0.04	87	38	0.09	0.04
11	205	185	0.11	0.04	320	197	0.11	0.01	290	44	0.07	0.00
12	65	31	0.10	0.01	54	38	0.08	0.02	100	28	0.12	0.01

The concentration of total nitrogen and Phosphorous in the soil layers in columns where BOD was added, decreases with time (increase in the volume of BOD added comparing with water addition due to bacterial activity) (Khan and Ansari, 2005) (see Table 8).

4. Conclusions

During the study of BOD leachate, the study showed that BOD leachate was increasing with time when more volume of BOD solution is added, which has a concentration of 600 ppm and decreasing in column of blank when water is added in both soils. The BOD in Jericho soil showed more BOD concentration due to the reasons mentioned in the results and discussion.

- TDS of leachate from columns when BOD solution was added decreased with time.
- The dissolved oxygen (DO) decreases with increasing of BOD concentration. The BOD concentration in the layers of soil (Top, Middle and Bottom) increases with depth and time and decreases in the layers of soil of the blank columns where water was added in both types of soil.
- The TDS in the soil decreased with depth but in Talkarem soil, TDS concentration was more than that found in Jericho soil which indicated that the Jericho soil is more active to leachate TDS.
- The total nitrogen present in the soil layers increases with depth in blank columns, but decreases with depth (soil layers) and time when BOD solution is added.

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