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Wind Erosion as Related to Some Soil Conservation Practices in (NWCZ), Egypt

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NORTHWESTERN coastal zone (NWCZ) of Egypt is subjected to wind erosion hazards. Such region was selected to study the effect of tillage system and land use on quantity and quality of soil loss by wind erosion. Two types of land use and three tillage practices were evaluated. The wind speed and direction were recorded duriug study period. The measured active wind speed between 5m/s to 14.29 m/s, represented 27.77% of the time.

Samples of the eroded materials were collected through 16 intervals during the study period from four heights between 0.1 and 1.0 meter above the soil surface using Big Spring Number Eight samplers. The qualitity of soil loss varied according to sampling period, sampler height, type of land use, and tillage systems.

The intensive tillage treatment couducted by farmer under fig trees, produced the highest annual soil loss (10.63 ton/ha^{-1}). Perpendicular tillage to the erosive wind direction reduced wind erosion losses by 39.09% as compared with parallel tillage with the erosive wind direction. The annual soil loss under olive trees by 92.92%.

Coarse sand enrichment ratio (ER) values were < 1 in all treatments, however, fine sand, silt and clay ER values were > 1. The ER values of fertility constituents varied among treatments, but ranged between 1.01 for CEC to 2,93 for total nitrogen.

It can be coucluded that tillage practices should be coudueted perpendicular with the erosive wind direction. Also olive tree are more efficient for controlling wind erosion than fig trees under NWCZ conditions .

Keywords : Wind erosion Fuka, Northern Coast , Egypt .

The northwestern coastal zone of Egypt (NWCZ) has been subjected to agricultural expansion, especially on rainfall. The region is subjected to wind erosion hazards because of high wind speed, low rate of rainfall and high value of soil erodibility, (FAO / UNDP 1970). The accelerated wind erosion is developed after the land - use which disturbe the natural equilibrium between climate, soil and vegetative environment. Arroug (1994) used the wind erosion equation of Woodruff and Siddowoy (1965) to estimate soil loss by wind in El - Omayed area, NWCZ . He showed that the value reached 100 t. ha $^{-1}$ Y^{-1}. In short - term study, Wassif (1997) showed that the amount of airborne materials expressed as t. 100m $^{-1}$ width was 0.783 for bare soil of south Abou - Lahu (NWCZ) through 93 days . Also, he found that the enrichment ratios for organic matter, total nitrogen, available phosphorus and exchangeable potassium were greater than one .

There are several conservation measures to control wnid erosion. Zobeck *et al.* (1989) indicated that different cropping and tillage methods produced different soil aggregate and wind erosion potentials. Hagen and Armbrust (1992) found that threshold friction velocity and trapping of saltation discharge depended on ridge height and spacing, as well as wind speed and direction. Bilbro and Fryrear (1995) concluded that soil cover and tillage practices are effective in reducing potential of wind erosion.

In Egypt, there are limited information about the long - term quantitative data on soil loss by wind erosion. Therefore, this study was aimed to evaluate the quantity and quality of soil loss due to wind erosion under different tillage systems and land use through thirty month at Fuka area, NWCZ, Egypt .

Methods and Material

The study area was in Fuka area in the NWCZ of Egypt. The area of the selected farm was about 33 hectare (300 x 1100m) and was surrounded by 1.5 m height rubble-stone fencing and stony soil as non-erodible area. The treatments are as follows:

(A) Perpendicular tillage on the mean erosive wind direction under fig trees (*Ficus carica* L.)

(B) Parallel tillage to the mean erosive wind direction under fig trees.

(C) Intensive tillage conducted by farmer (traditional tillage) under fig trees.

(D) Intensive tillage conducted by farmer (traditional tillage) under olive trees (*Olea europea* L.).

The fig trees in A and B treatments were three years old and their average height was 1.5 m. While, the fig and olive trees in C and D treatments were ten years old and their average height was 3m. The soil was plowed by chisel plow to about 15 cm depth for every treatment.

Samples of the eroded soil particles were collected through 16 intervals from April 1, 1995 to October 8, 1997 using Big Spring Number Eight traps (BSNE) at heights of 0.10, 050, 0.75 and 1.00 meter above the soil surface as described by Fryrear (1986). The traps were positioned in each treatment to collect the eroded materials through the study period. The samples of eroded soil materials were dried at 55° for 72 hour, before weighing then, laboratory analysis were conducted.

Climatcological measurements were obtained from recording automatic weather station placed 3 meters above the soil surface in the mid-point of the study area.

Surface soil samples (0-5 cm) were collected from the study area. Composite soil samples were prepared to represent two locations, *i.e.*, A+B and C +D treatments. The composite soil samples and collected eroded materials were subjected to determine : Particle size distribution using the pipette method, aggregate size distribution percentages of dry non-erodible fractions (> 0.84 mm in diameter) CEC, ex. Na, K, Ca. and Mg, organic matter, total nitrogen, available phosphorus and available potassium. The used methods are described by Page *et al.* (1982), and USDA, SCS (1988). Soil roughness factor K using Woodruff and Siddoway (1965) method was determined

Results and Discussion

Site descriptions

The study was carried out at Fuka area about 215 km west of Alexandria. It occupies a portion of NWCZ. The climatic elements during the experimental period are given in Table 1. The average daily temperature varied from 12.94°C in February, 1997 to 26.45°C July, 1997. The average of wind speed varied from 4.53 ms^{-1} in July, 1996 to 2.19 ms^{-1} in November, 1997, with a monthly mean of 3.68 ms^{-1}during the study period. Therefore, such area is under arid and semi-arid conditions with torric soil moisture region and thermic temperature regime.The dryness prevails through most of the year and the wet periods are comparatively small. Hours number of < 0.5, 0.5-5, 5-10, and > 10ms^{-1} wind speed during study period were 803, 9535, 3899, and 76, respectively . Wind speed as high as 14.29 ms^{-1} was recorded during September, 1997.

TABLE 1. Meterological records at the study area from April 1, 1996 to November 19, 1997.

Month	Average daily temp. (c)	Total monthly rainfall (mm)	Average Wind Speed (ms^{-1})	Periods of wind speed								Max. hourly wind speed (ms^{-1})
				0-0.5 ms^{-1}		0.5-5ms^{-1}		5-10ms^{-1}		Over 10 ms^{-1}		
				Hours	% of time	Hours	% of time	Hours	% of time	Hours	% of time	
April, 1996	16.86	4.60	4.51	6	0.83	448	62.22	258	35.83	8	1.12	12.08
May	21.15	-	3.56	13	1.81	527	73.19	173	24.03	7	0.97	13.96
June	23.59	-	3.78	1	0.14	498	69.17	221	30.69	-	-	9.50
July	25.33	0.20	4.53	2	0.27	393	52.82	348	46.77	1	0.14	10.05
August	26.28	-	3.86	5	0.67	513	68.95	226	30.38	-	-	8.01
September	26.26	-	3.43	9	1.25	554	76.94	157	21.81	-	-	9.21
October	21.19	6.60	3.27	19	2.55	592	79.57	133	17.88	-	-	9.14
November	18.72	9.40	3.35	37	5.14	525	72.92	158	21.94	-	-	7.41
December	14.82	0.20	3.29	21	2.83	590	79.41	125	16.82	7	0.94	11.55
January, 1997	13.69	15.20	3.07	40	5.38	586	78.76	118	15.86	-	-	9.25
February	12.94	14.40	3.82	14	2.08	505	75.15	142	21.13	11	1.64	12.46
March	14.32	14.00	4.17	23	3.09	473	63.58	237	31.85	11	1.48	12.66
April	16.47	-	4.26	8	1.11	450	62.50	255	35.42	7	0.97	11.79
May	20.22	0.04	3.14	128	17.21	436	58.60	178	23.92	2	0.27	10.64
June	24.43	-	4.07	61	8.47	396	55.00	253	35.14	10	1.39	12.39
July	26.45	-	4.33	52	6.99	372	50.00	312	41.94	8	1.07	11.00
August	25.89	-	3.49	76	10.21	446	59.95	222	29.84	-	-	8.42
September	23.94	0.80	3.76	28	3.89	471	65.51	216	30.04	4	0.56	14.29
October	21.60	22.0	3.12	110	14.78	508	68.28	126	16.94	-	-	8.91
November	18.21	2.20	3.19	150	33.86	252	56.88	41	9.26	-	-	9.65
Monthly mean	20.62		3.68									
Total	-	-	-	803	5.61	9535	66.62	3899	27.24	76	0.53	

† Indicates results based on hourly climateological data at 3 meter height.

Obviously the measured active wind speed, between 5 to 14.29 ms^{-1} , represented 27.77% of the study period. The frequency of wind speeds exceeded 10 ms^{-1} was the heights during February and March, 1997. The most erosive period occurred from March through July, 1997. The dominant wind direction is from west to north (WWN), represented 23.77% of the total wind direction.

The natural vegetation of the experimental site is mostly composed of scattered desert shrubs. The field surface of the study area is almost flat. The soil of experimental site is calcareous : sandy loam to sandy clay loam in texture (Typic Caleic); poor in organic matter, low in fertility and highly erodible (Table 2).

Soil loss quantities

Eroded soil particles were collected 16 times during the study period from April 1, 1995 to October 8. 1997 at 0.1 0.5, 0.75 and 1 meter heights for the various treatments under consideration (Table 3). For every measurement period, the quantity of eroded soil particles decreased by increasing sampler height, (Fig. 1). Consequently, the bulk of the eroded soil particles was carried close to the soil surface. This phenomenon is verified by the results obtained by Fryrear and Saleh (1993). Moreover, the quantity of soil loss at every height increased by increasing the period of measurement. Also, the differences in the amount of eroded materials were related to hours number of erosive winds, soil surface conditions and the treatments.

The relationships between the amounts of eroded soil particles, Y (gm. cm^{-2}) collected during the study period and height above soil surface, X (meter), were tested using linear logarithmic, exponential and power equation is recommended to be used to describe such relationship (Table 4). The fitted equations were significant at the 0.01 significance level. In this respect, Fryrear and Saleh (1993), and Vories and Fryrear (1991) reported that power equation described the quantity of eroded materials transported by wind above the soil surface.

The total amount of eroded soil particles, Q (gm. cm^{-1} width), was obtained by integrating the fitted regression equations over heights from 0.1 to 10 meter above the soil surface (Table 4). Data show that there were great difference in amount of eroded soil particles according to the type of treatments. The amount of soil loss as affected by the treatments under consideration could be arranged in the descending order as follows : C> B> A > D treatment, respectively.

TABLE 2. Some soil properties of soil surface (0-5 cm) depth for the study area.

Treatment	Texture class	$CaCO_3$ %	OM %	CEC	Na^+	K^+	Ca^{+2}	Mg^{++}	Av.K	T.N. gm kg^{-1}	Av.P. mg.kg^{-1}	Mean Diameter (μm)	Soil dry aggregates (>0.84 mm)	Soil roughness K' (dimensionless)
				(cmol (+) kg^{-1})										
A and B	Sandy clay loam	28.2	0.36	22.6	0.87	1.44	13.3	6.82	1.45	0.60	0.68	260	45.13	0.64
C and D	Sandy loam	27.7	0.30	18.3	0.87	0.77	13.9	2.16	0.79	0.79	0.88	185	78.08	0.81

TABLE 3. Amount of eroded soil particles, gm. 10cm -2 , collected by BSNE samplers for different treatments at 4 heights, 0.1 to 1.0 meter , at Fuka area.

Treatment / Measurement Periods	(A)				(B)				(C)				(D)			
	0.1	0.5	0.75	1.0	0.1	0.5	0.75	1.0	0.1	0.5	0.75	1.0	0.1	0.5	0.75	1.0
	(height, meter)															
1/4-6/5/1995	0.36	0.27	0.23	0.2	0.32	0.16	0.13	0.12	1.4	1.1	0.59	0.11	1.6	0.19	0.18	0.11
6/5-8/6/1995	0.47	0.26	0.2	0.11	0.88	0.34	0.31	0.19	0.21	0.13	0.09	0.07	1.2	0.47	0.17	0.16
8/6-13/7/1995	0.27	0.21	0.17	0.12	0.36	0.22	0.17	0.19	0.74	0.48	0.36	0.30	6.2	0.63	0.44	0.43
13/7-8/8/1995	0.06	0.05	0.04	0.03	0.005	0.003	0.002	0.002	0.4	0.12	0.09	0.07	0.58	0.23	0.20	0.17
8/8-4/10/1995	0.16	0.14	0.12	0.09	0.14	0.12	0.11	0.10	1.6	0.65	0.52	0.37	2.2	0.46	0.43	0.40
4/10-28/10/1995	0.1	0.09	0.05	0.03	0.70	005	0.05	0.04	0.45	0.17	0.17	0.08	0.51	0.15	0.08	0.07
28/10-13/12/1995	0.65	0.45	0.21	0.07	0.070	0.19	0.18	0.15	10.1	1.4	1.0	0.51	7.8	0.96	0.67	0.44
13/12/95-31/3/96	131.8	49.3	39.9	33.5	107	51.8	43.5	41.7	436.7	60.9	35.0	5.3	139.5	25.5	16.0	13.3
31/3-20/5/1996	6.7	4.8	4.6	4.40	7.3	5.4	5.1	4.0	41.1	12.9	9.6	6.8	34.5	10.1	9.9	9.0
20/5-11/7/1996	0.2	0.17	0.11	0.11	0.23	0.2	0.2	0.14	5.5	1.3	1.0	0.72	3.9	0.5	0.4	0.25
11/7-16/9/1996	0.31	0.18	0.17	0.14	0.16	0.16	0.13	0.10	5.0	0.79	0.57	0.40	1.3	0.3	0.22	0.19
16/9-17/10/1996	1.2	0.82	0.79	0.74	1.3	0.95	0.70	0.30	13.9	2.7	1.5	0.24	2.9	0.92	0.57	0.47
17/10-13/12/1996	68.6	41.4	30.2	30.1	67.8	43.5	39.1	17.8	389.2	38.4	24.3	16.2	127.2	12.0	8.4	7.7
13/12/96-4/1/97	102.8	23.6	15.5	9.2	63.4	30.9	22.4	21.8	119.9	11.3	6.5	4.4	38.6	22.1	13.6	2.5
4/1-22/5/1997	150.7	58.8	39.0	35.0	368.5	105.0	67.7	54.8	179.5	23.9	14.4	12.0	124.4	20.9	15.0	10.4
22/5-8/10/97	39.9	29.8	24.6	17.8	40.8	37.6	28.6	21.0	97.6	42.0	31.7	26.1	104.0	62.6	53.1	46.8
Total	504.3	210.3	156.0	131.7	659.0	276.6	208.3	162.4	1303.4	198.3	127.5	73.7	596.4	158	119.4	92.4

TABLE 4. Summary of regressions of the form $y = a\,x^{b}$ calculated between soil loss and sampler height.

Land use	Treatments	Equation Statistics*			Amount of eroded materials (Q) (gm.cm^{-1} width)	
		a	b	r^2	From 1/4/95 to 8/10/97	Per year
Fig trees (3 years old, 1.5 m average height)	(A) *Perpendicular tillage* (B) *Parallel tillage*	13.42 17.25	-0.58 -0.59	0.998** 0.992**	1978.52 2572.30	791.41 1028.92
Fig trees (10 years old)	(C) Intensive tillage	8.22	-1.21	0.996**	2658.51	1063.40
Olive trees (10 years old)	(D) Intensive tillage	9.26	-0.81	0.999**	1376.75	550.70

\+ a and b are regression coefficients and r^2 is correlation coefficient of determination.
** significant at 0.01 level.

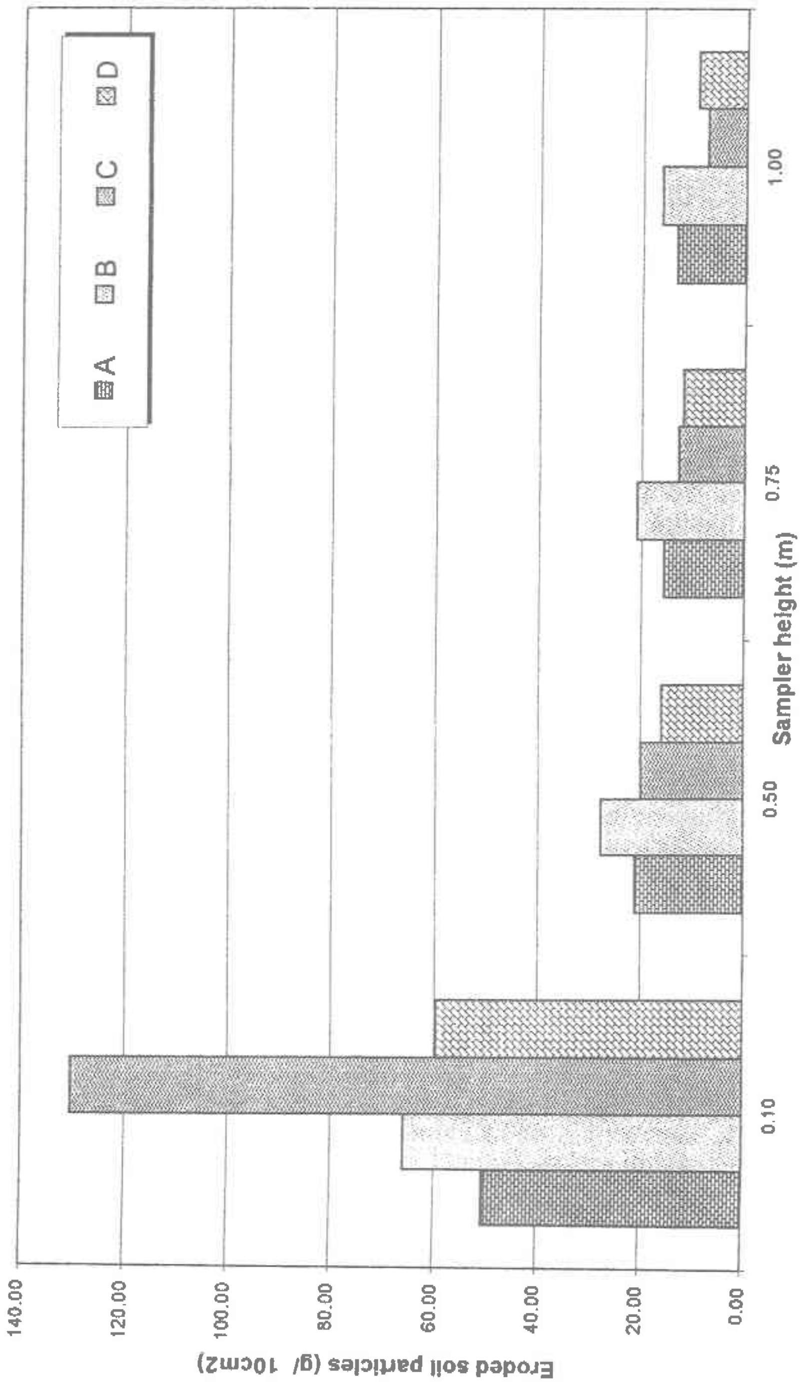

Fig . 1. Total amount of eroded soil particles collected by BSNE samplers at different heights at Fuka area.

Concerning the annual soil loss, data reveal that the perpendicular tillage with the erosive wind direction reduced soil loss due to wind erosion as compared to parallel tillage with erosive wind direction. It is elear that the annual soil loss from B treatment was higher than A treatment by 30.09% Consequently, perpendicular tillage with the erosive wind direction was more effective than parallel tillage to the erosive wind direction in reducing annual soil loss at Fuka area. This may be due to the fact that the effect of ridges varies as the wind direction changes (USDA/SCS, 1988), where soil roughness factors (K') were 0.5 and 1 for perpendicular and parallel tillage, respectively. Also the annual soil loss from C treatment was greater than that from A and B treatments by 34.39 and 3.30%, respectively. The value of soil roughness factor varied between treatments depending upon the intensity of tillage operations (Table 2). Therefore, the soil of C treatment is very susceptible to wind erosion. In this respect, Saleh (1994) stated that the differences in measured erosion reflects the combined effects of soil roughness and soil structure. He concluded that surface roughness significantly reduces soil erosion by wind.

Concerning the relation between soil loss and land use system the annual soil loss under old fig trees (C treatment) was greater than that from under olive trees (D treatment) by 92.92% (Fig. 2). This is due to the fact that olive trees provide a dense cover all over the year. Also, the annual soil loss from A and B treatments were higher than that from D treatment by 43.71 and 86.84%, respectively. This may be due to the effect of tree height in reducing soil loss by wind. Therefore, plant cover did provide suitable protection to the soil from wind erosion.

Soil loss qualities

The eroded materials for each height was mixed to represent composite sample for every treatments.

Concerning dry sieving of the soil surface layer (0-5cm). the particles size < 100 µm was 29.0 and 37.6% for both sites of the treatments, (Table 5). It was almost higher for A and B treatments than C and D treatments. Moreover, mean diameter of particles (MD) was obtained from the size distribution curves as suggested by Chepil (1957). Soils of C and D treatments has lower MD value (175 µm) probably due to excessive tillage for big fig and olive orchards to conserve the water in the soil. In this respect, Chepil and Woodruff (1963) reported that excessive and improper tillage often causes excessive soil loosening and pulverization. Data given in Table 5 show that wind blown materials moved in 3 different ways, *i.e.*, surface creeping, saltation and suspension. The values of each type varied considerably with increasing the height of BSNE sampler. Percent of suspended partieles (<100µm) increased with inereasing BSNE sampler height and varied according to the treatment 96.90%. In general, movement of particles by saltation was the same for all treatments, but some variation was found in the proportion of particles carried at different heights. It was also found that their amounts decreased rapidly with height above the soil surface. Eroded materials carried by surface creep, widely varied according to the treatments. Their values were particularly high for C and D treatments and least for the other treatments. This may be due to the effect of ridges which affects lowering the total rate of soil flow and virtually eliminated surface creep. Inereasing the roughness of soil surface for A and B treatments redueed the rate of movement by surface creep. A rough soil surface trapped most of the surface ereep but failed to reduce the movement in salatation and suspension by the same degree. Consequently the relative proportion of each type of movement varied greatly for different treatments . The greatest proportion of the movement in all cases examined was partieles in suspension .

The (MD) values decreased with inereasing sampler height (Table 5) . The values decreased about 39 and 50%, respectively with increasing BSNE sampler height. This variation may be due to the mode of particles transportation, where the large particles moved by saltation at a sampler height of 0.1 meter. The MD values for the soil surface layer was greater than for the wind blown materials. Therefore, loss of fine particles was greater than the loss of coarse ones, because suspended materials (<100 µm) contained silt and clay particles which were easily transported by wind. In this respect, Zobeck and Fryrear (1986) stated that aggregates mean diameter decreased with increasing BSNE sampler height. Such results are in harmony with that reported by Fryrear and Saleh (1993).

Concerning the dispersed particles size groups of the wind blown materials, the enrichment ratio (ER) was calculated and given in Table 5. ER values were < 1 for coarse sand in all treatments, however ER values of fine sand, silt and clay were greater than 1. It is clear that the coarse fraction was negatively enriched, whereas silt aud clay fractions were positively enriched as BSNE sampler height increased. This may be due to silt and clay particles are smaller and more easily transported by wind.

TABLE 5. Properties of soil surface layer (0 5 cm) and eroded materials collected by BSNE samplers for different treatments during the study period.

Treatment	Sampler height (m)	Dry sieving (diameter, µm) %				ER of particle size classes				Statistical parameters (φ units)		ER of the fertility constituents				
		>500	500-100	<100	MD	C. Sand	F. sand	Silt	Clay	MZ	σI	CEC	OM	T.N	Av.P	Av.K
Soil surface layer (0-5cm)	-	27.6	43.4	29.0	270	-	-	-	-	2.11	1.38					
A	-	-	-	-	-	-	-	-	-	-	-	1.11	2.0	1.68	1.31	1.17
	0.10	0.60	33.75	65.65	89	0.24	1.75	0.75	0.87	3.29	0.87					
	0.50	0.60	8.65	90.75	70	0.16	1.63	0.85	1.04	3.85	0.55					
	0.75	0.40	6.00	93.60	67	0.06	1.47	1.00	1.18	3.99	0.66					
	1.00	0.45	2.65	96.90	65	0.04	1.38	1.09	1.26	3.97	0.66					
B	-	-	-	-	-	-	-	-	-	-	-	1.01	2.67	1.70	1.25	1.17
	0.10	1.55	51.30	47.15	123	0.26	1.78	0.63	0.95	3.05	1.03					
	0.50	0.65	14.05	85.30	77	0.18	1.53	0.87	1.13	3.72	0.66					
	0.75	0.40	5.55	94.05	75	0.11	1.45	0.95	1.22	3.84	0.53					
	1.00	0.50	4.30	95.20	75	0.08	1.32	1.05	1.31	3.85	0.51					
Soil surface layer (0-5 cm)	-	17.2	45.2	37.6	175	-	-	-	-	2.46	1.26					
C	-	-	-	-	-	-	-	-	-	-	-	1.10	2.30	2.28	1.13	1.22
	0.10	5.1	41.75	53.15	108	0.34	1.89	0.55	1.13	2.99	1.04					
	0.50	3.2	16.40	80.40	78	0.30	1.76	0.60	1.33	3.52	0.95					
	0.75	1.7	7.35	90.95	73	0.24	1.53	0.83	1.48	3.85	0.66					
	1.00	0.55	3.35	96.10	67	0.10	1.42	0.95	1.67	3.98	0.56					
D	-	-	-	-	-	-	-	-	-	-	-	1.19	2.27	2.53	1.11	1.06
	0.10	6.0	43.00	51.00	112	0.35	1.81	0.63	1.14	2.92	1.04					
	0.50	3.3	14.00	82.70	73	0.23	1.67	0.73	1.42	3.68	0.86					
	0.75	1.4	6.25	92.35	53	0.24	1.48	0.80	1.61	3.95	0.55					
	1.00	0.25	3.75	96.00	44	0.14	1.43	0.92	1.66	4.14	0.61					

Cumulative frequency percentage for each sample was drawn as cumulative curve using probability graph paper. From the curves, seven phi-percentiles namely, $\phi5$, $\phi16$, $\phi25$,$\phi50$, $\phi75$,$\phi84$, and $\phi95$ were obtained. Then, the grain size parameters were calculated according to Folk and Ward (1957) for mean size (MZ), and sorting (σI), (Table 5). The MZ values for the eroded materials varied from very fine sand to coarse silt. While, the mean size values of the soil surface layer (0-5cm) for both sites varied from fine sand to medium sand. Table 5 reveals the increase in MZ values of fine grains with increasing BSNE sampler height. This result is related to the fact that most of the fine particles are present in the form of suspension at heigher elevation from the soil surface. Sorting values (σI) of the eroded materials indicated that the eroded materials are well sorted, moderately well sorted and moderately sorted, except some poorly sorted collected at lower heights. The soils surface (0-5cm) was poorly sorted because this alluvial soil is formed as a result of water action. In this respect, that Inman (1952) reported that sediments transported by wind are well sorted, while water deposits are poorly sorted.

As a measure of the selectiveness of the erosive process, the ER was calculated by dividing the concentration of fertilily constituents in the wind blown materials into its concentration in the soil surface layer, 0-5cm, both on an oven-dry basis, (Table 5). The obtained data show that the ER values varied among treatments, between 1.01 for CEC and 2.67 for OM. The average ER values, regardless of treatments, are 1.10, 2.31, 2.05, 1.20 and 1.16 for CEC, OM, total N, available, P and available K, respectively. This may lead to soil degradation and decrease its producttivity over a period of several years. In this respect, Zobeck (1991) reported that the ERs of eroded materials ranged from 1 to 3. He refereed the higher ER of nutrient content, OM and CEC to the selectivity of soil erosion that transport fine materials.

Fertility index loss per year for total N, and available K as well as OM, was obtained by multiplying the fertility index concentration of eroded materials throughout the collected heights of 0.1 and 1.0 meter by the annual loss of wind blown materials, and the obtained results are given in Fig. 2. It is noticed that fertility index loss remarkably varied among treatments and nutrients. The annual loss followed the order OM > T.N > Av. K. Concerning the effect of treatments on the fertility index loss, the greatest value was obtained in case of B treatment. Consequently, the selective removal of essential plant nutrients and OM in wind blown materials dependent upon cropping system and the direction of tillage practices. Therefore, the application of the proper conservation measures is essential to conserve soil from wind erosion hazards.

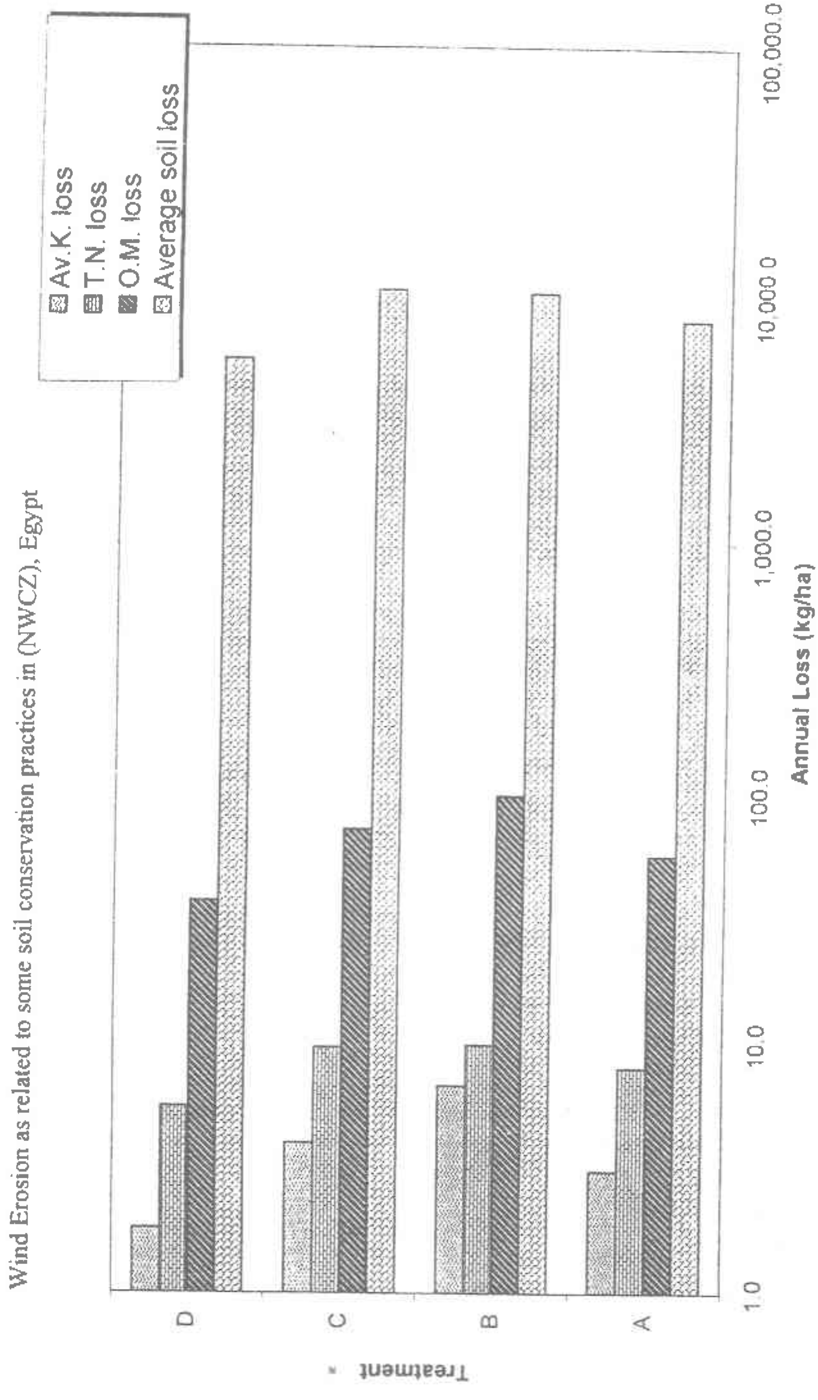

Fig . 2. Average losses (kg/ha) for four treatments .

Conclusions

The data presented in this study clearly show that the quantity of soil loss due to wind erosion is greater than the tolerant level in some eases. It contains high percentage of soil particles < 0.1 mm. Also, the ERs for essential nutrients and organic matter are greater than 1. The cumulative loss of soil nutrients and organic matter lead to degraded soil over a period of several years. Consequently, land degradation could take place in NWCZ due to wind erosion.

As has been shown perpendicular tillage with the erosive wind direction constitute effective measure for wind erosion control. It is also clear that soil loss under olive trees is less than that of fig trees. Therefore, the strong relationship between the incidence of wind erosion and tillage practices suggests that it is possible to recommend this measure to control wind erosion, particularly the Bedonins favour soil conservation practices that are low cost, simple to implement and rely on local skills and inputs.

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علاقة الإنجراف بالرياح ببعض عمليات صيانة الأراضي في الساحل الشمالي الغربي (مصر)

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تتعرض منطقة الساحل الشمالي الغربي بمصر لمخاطر الإنجراف بالرياح لذلك اختيرت هذه المنطقة لدراسة تأثير بعض نظم الحرث واستغلال الأراضي على كمية ونوعية فاقد التربة بالرياح. تم تقييم أربعة أنواع من المحاصيل وثلاثة عمليات حراثة وقد تم تسجيل سرعة واتجاه الرياح خلال فترة الدراسة . سجلت سرعة الرياح النشطة والتي تتراوح من (٥م/ث) إلى (٢٩ . ١٤ م/ث) ٧ . ٢٧٪ في فترة الدراسة .

جمعت عينات المادة المنجرفة باستخدام جهاز (BSNE)١٦ مرة خلال فترة الدراسة على أربع ارتفاعات من ١و إلى ١م أعلى سطح التربة واختلفت كمية فاقد التربة تبعا لتاريخ أخذ العينة وارتفاع مصيدة تجميع العينة ونوع المحصول المستخدم ونظم الحرث .

تشير النتائج إلى أن معاملة الحرث المكثفة والمنفذة بواسطة الفلاح لأشجار التين أدت إلى أعلى متوسط سنوى لفاقد التربة (٦٣و١٠ طن/ هكتار/سنه). بينما انخفض المعدل السنوى لفاقد التربة بمعاملة الحرث العمودية بمعدل ٩و٣٩٪ مقارنة بمعاملة الحرث الموازية لاتجاه الرياح النشطة. وتفوقت كمية فاقد التربة بالرياح من زراعات التين على زراعات الزيتون.

بالنسبة لنسبة الإغناء لمكون الرمل الخشنة فكانت أقل من الواحد في كل المعاملات، بينما كانت قيمة نسبة الإغناء لكل من الرمل الناعم والسلت والطين أكثر من الواحد. وتراوحت نسبة الإغناء بين ١ , ٠١ للسعة التبادلية الكاتيونية (CEC)إلى ٩٣ . ٢ للنتروجين الكلى.

يتضح مما سبق ضرورة إجراء عملية الحرث عمودية على اتجاه الرياح النشطة ويفضل زراعة أشجار الزيتون عن اشجار التين لخفض معدل فاقد التربة بالإنجراف بالرياح.