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THE EFFECT OF BIOFERTILIZERS AND BENTONITE (TAFLA) ON SOME PHYSICAL PROPERTIES OF CULTIVATED SANDY SOILS

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ABSTRACT: *The effect of biofertilizer and bentonite (tafla) and mixture of them beside the control, on some physical properties of sandy soil and wheat yield was studied. A field experiment in a complete randomized block design with three replicates was conducted at Agriculture Research Station of Ismailia during the season of 2010-2011.*

The obtained results indicated a decrease in bulk density g/cm^3 of sandy by 4.76 % with the biofertilizer application. Data indicated that the application of biofertilizer had the highest effect on total porosity of treated sandy soil where the values increased from 39.62 % while the values of control was 36.60 where the value increased was 8.25 % compared with control. In the opposite, the addition of bentonite recorded the lowest values for total porosity. In respect to bentonite effect, it is clear that the relative increase of micro pores values after application of 5 ton bentonite was 50.28 % compared to control. With respect to meso pores their increments was 100.43 % compared to control, while macro pores was decreased by the values 16.75 % compared to control. The addition of biofertilizer give the highest values of Mean weight diameter (MWD).while the lowest ones obtained with addition of bentonite alone, data indicated that the highest grain yield was obtained with addition biofertilizers followed by addition of (mixture biofertilizer +2.5 ton bentonite /fed) and 5 ton bentonite /fed which the values of grain yield were, 2199, 1866.7 and 1769.6 kg/fed while value of control was 1639.9 kg/fed., respectively.

Key words: *Bentonite , Biofertilizers, sandy soil, Wheat.*

INTRODUCTION

Increasing cultivation in new reclaimed desert lands became a vital subject, these soils characterized with poor fertility, low water holding capacity, high leaching and alkaline pH. The use of organic fertilizer in such soil showed a good means in that concern. Numerous studies have shown a substantial increase in growth and yield of wheat plant in reclaimed desert lands (Shoman *et al.*, 2006; Badr *et al.*, 2009; Sary *et al.*, 2009 and Wali Asal, 2010). Organic agriculture is a holistic production management system which promotes and enhances agroeco-system, health, including biodiversity, biological cycles, and soil biological activity. It emphasizes the use of management practices in preference to the use of off-farm inputs, taking into account that regional conditions and locally adapted systems. This is accomplished by using, where possible, agronomic, biological, and mechanical methods, as opposed to using synthetic materials, to fulfill any specific function within the system. Organic agriculture is a system that relies on ecosystem management rather than external agricultural inputs (Samman *et al.*, 2008). Organic farming has emerged as an important priority area globally in view of the growing demand for safe and healthy food and long term sustainability and concerns on environmental pollution associated with indiscriminate use of agrochemicals. Though the use of chemical inputs in agriculture is inevitable to meet the growing demand for food in world, there are opportunities in selected crops and niche areas where organic production can be encouraged to tape the domestic export market (Karmakar *et al.*, 2007). Use of soil microorganisms which can either fix atmospheric nitrogen, solubilize phosphate, synthesis of growth promoting substances or by enhancing the decomposition of plant residues to release vital nutrients and increase humic content of soils, will be environmentally begin approach for nutrient management and ecosystem function (Wu *et al.,* 2005)

Application of biofertilizer is considered today to limit the use of mineral fertilizers and supports an effective tool for desert development under less polluted environments, decreasing agricultural costs, maximizing crop yield due to providing them with an available nutritive elements and growth promoting substances (Metin *et al.,* 2010). Soil microorganisms are important components in the natural soil sub ecosystem because not only can they contribute to nutrient availability in the soil, but also bind soil particles into stable aggregates, which improve soil structure and reduce erosion potential (Shetty *et al.,* 1994). Many authors have shown the positive effect inoculation of wheat with Azotobacter chroococcum or yeast. (Tawfik and Gomaa 2005, Abbasdokht 2008, Badr *et al.,* 2009 and Bahrani *et al.,* 2010).

The use of natural conditioners to improve the physical properties and consequently the chemical and biological properties of sandy soil and to stabilize their structure have been successfully proved since the past decade (Mohamed *et al* 1998; Awad 1989 and 1998; Rose 1991; Hassan *et al* 1994).

The addition of bentonite and /or organic manure to sandy soil increased the concentration of N,P and K in grains of wheat and soybean consequently the yield increased. (Latfy and El-Hady , 1984 ; El-Sokkary and El- Keiry 1989)

The biofertilizer is a cheap technique to produce plants in developing countries. The symbiotic nitrogen fixing bacteria is the most important organisms playing an important role in soil fertility.

The aim of this investigation is to study the effect of bentonite with or without biofertilizer on some physical properties of sandy soil and wheat yield.

MATERIALS AND METHODS

A field experiment was conducted at Ismailia Agriculture Research Station through the winter season 2010/2011 to study the impact of bentonite and biofertilizers on soil physical properties and yield of wheat straw and grain. The experiment was laid out in a complete randomized block design with three replicates. The treatments were added before sowing as follows: biofertilizers, (mixture of biofertilizer and 2.5ton/fed bentonite) and 5ton/fed. Bentonite. Data in Tables 1 and 2 shows some soil physical and chemical properties of the studied soil as determined according to Piper (1950) and Jackson (1965) .

The treatments were Control, 5 ton bentonite (tafla), (biofertilizer +2.5 ton bentonite) and biofertilizers, Biofertilizer and bentonite were added before planting and mixed with soil surface layer 0-20 cm. All agriculture practices as recommended in the farm were followed and representative surface soil samples (0-20) cm were collected before wheat sowing and after harvesting to determine some physical properties. Soil chemical and physical properties of what were determined according to Black *et al* 1982 .

The mean weight diameter (MWD) of the soil aggregates was determined (Black , 1965) to give an index of aggregation. This was calculated as follows: the proportion by weight 'Vi' of a given size fraction of aggregates is multiplied by the mean diameter Xi of the same fraction, and the sum of these products for all size fractions is called the mean weight diameter (MWD).

$$MWD = \sum_{I=1}^{n} X_i V_i$$

Where: -

MWD = the mean weight diameter

Vi = Size fraction of aggregates

Xi = the mean diameter Xi of the same fraction,

Jangerius (1959) indicated that the soil pores could be classified into micro pores of <30µ and they are considered as a moisture reservoir for plant. Meso pores having a diameter in the range of 30-100µ these pores allow to air diffusion and transportations of soil moisture . Macro pores drainable pores >100µ which allow of water to penetrate deeply through soil profile

Table (1): Some physical and chemical properties of sandy soil .

Physical properties	values	Chemical properties	Values
Coarse sand %	86.57	Cations meq/100g	
Fine sand %	7.06	Ca^{+2}	0.68
Silt %	4.36	Mg^{+2}	0.31
Clay %	2.01	Na^+	0.96
$CaCO_3$ %	1.75	K^+	0.02
OM%	0.1	Anions meq/100g	
Texture	Sandy	$CO_3^{=}$	0
BD* g/cm3	1.68	HCO_3^-	0.25
Total porosity	35.85	Cl^-	0.98
Micro pores (<30 u)	7.75	$SO_4^{=}$	0.74
meso pores (30-10 u)	2.15	EC (dS/m)	0.35
Macro pores (> 100 u)	25.95	PH(1: 2.5) soil water extract.	8.05
MWD**	0.25	CEC meq/100g soil	2.6

BD* g/cm^3 = Bulk Density MWD** = Mean Weight Diameter

Table (2): Some physical and chemical properties of tafla

Physical properties	values	Cations and Anions meq/100g	
Coarse sand %	22.9	Ca^{+2}	2.47
Fine sand %	2.2	Mg^{+2}	19.4
Silt %	30	Na^+	16.5
Clay %	44.9	K^+	0.34
$CaCO_3$ %	27.9	$CO_3^{=}$	0.0
OM%	0.18	HCO_3^-	0.75
Texture	Clay	Cl^-	4.77
BD* (g/cm3)	0.83	$SO_4^{=}$	33.19
EC (dS/m)	3.85	PH(1: 2.5) soil water extract.	7.8

BD* g/cm^3: Bulk density

RESULTS AND DISCUSSION

1-The effect of different treatments on some physical properties of the studied soil

Data in Table 3 and Fig 1 show that the bulk density (g/cm^3) values of investigated soil are decreased by addition of biofertilizer alone or mixed with bentonite.

The obtained results indicated that the application of biofertilizer decreased the bulk density (g/cm^3). By 4.76 % compared with control. Concerning the effect of bentonite application, data in Table 3 indicated that values of treated soil recorded the maximum values where the values decreased with 2.38%, while the decreasing was 2.38% with applying the bentionite treatment. Generally the reducing effect of soil treatments on bulk density g/cm3 values could be arranged as follows;

biofertilizer > (biofertilizer +2.5 ton bentonite > 5 ton bentonite

Data in Table (3) Fig (1) indicated that the application of biofertilizers had the highest effect on total porosity of treated sandy soil where the values were 39.62 % while the values of control was 36.60 The value increased 8.25 % compared with control, while the addition of bentonie recorded the lowest values for total porosity. Also the obtained results cleared that the mixture of biofertilizer +bentonite led to medium effect on total porosity. Generally biofertilizer application led to the best results for bulk density (g/cm^3) and total porosity (%) compared to bentonite application. Soil microorganisms bind soil particles into stable aggregates which improve soil structure (Shetty, *et al.* 1994).

Regarding pore size distribution of different soils (Jangerius 1959) indicated that the soil pores could be classified into micro pores of <30µ and they are considered as a moisture reservoir for plant. Meso pores having a diameter in the range of 30-100µ these pores allow to air diffusion and transportations of soil moisture .Macro pores drainable pores >100µ which allow of water to penetrate deeply through soil profile.

Data presented in Table 3 Fig 1 show the effect of different treatments on soil pores of the studied sandy soil. In respect to bentonite effect , it is clear that the values of micro pores were the lowest values , where the relative increase of micro pores values after of 5 ton bentonite was 50.28 % compared to control . With respect to meso pores their increment was 100.43 % compared to control while macro pores was decreased by the values 16.75 % compared to control . The maximum values were obtained by addition of biofertilizer where the values increased with 53.08 % and 110.77 % for micro and meso pores respectively while micro pores was decreased to values 14.75 % compared to control .From above mentioned results, the effect of different treatments for improving the soil pores values (increase of micro and meso pores and decreased of macro pores) could be arranged in the following order;

biofertilizer > (biofertilizer +2.5 ton bentonite) > 5 ton bentonite, respectively

It well known that the well aggregated soils provide adequate physical conditions for plant root penetration .Also; they create favorable conditions soil-air –moisture relations for plant. Therefore it is profitable to increase stable aggregates in sandy soil concerning the Mean Weight Diameter (M.W.D) as a measure for soil aggregation.

Table (3): The effect of different treatments on some physical properties of sandy soil

Treatments	BD g/cm^3	TP %	pore size distribution			MWD Mm
			micro <30µ	meso 30-100µ	macro > 100µ	
Control	1.68	36.60	7.12	2.32	27.45	0.27
5 ton bentonite (tafla)	1.64	38.11	10.70	4.65	22.85	0.38
Biofertilizer and 2.5 ton bentonite	1.62	38.87	9.13	4.24	24.51	0.40
Biofertilizers	1.60	39.62	10.90	4.89	23.40	0.43
Mean	1.64	38.30	9.46	4.03	24.55	0.37

BD = Bulk Density g/cm^3 TP = Total Porosity, MWD = Mean Weight Diameter

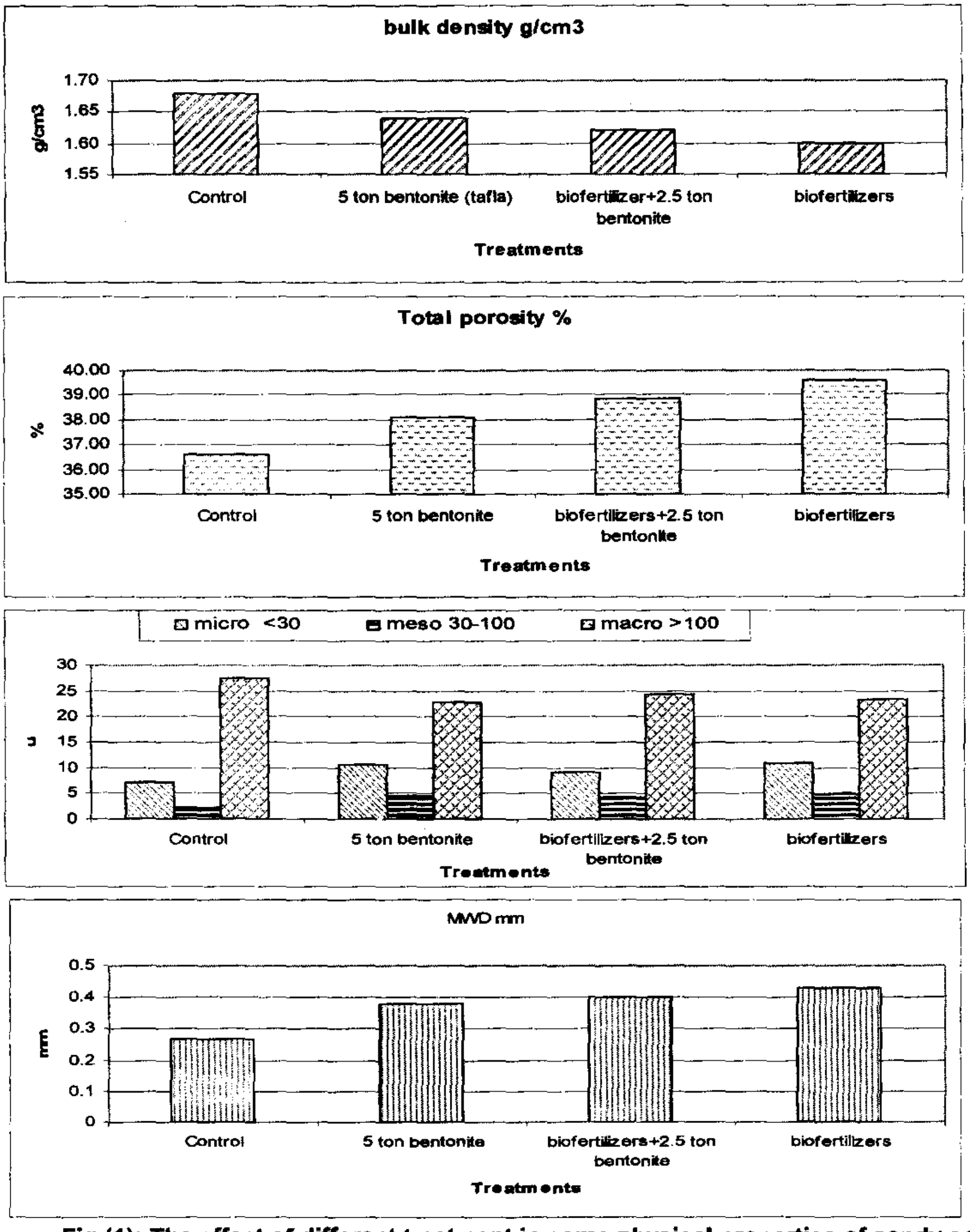

Fig (1): The effect of different treatment in some physical properties of sandy soil.

Data in Table 3 Fig. 1 revealed that the values of M.W.D for treated sandy soil increased with application of biofertilizer or bentonite and their mixture. The addition of biofertilizer give the highest values of MWD .while the lowest ones obtained with addition of bentonite alone The obtained values of M.W.D clear that values increased from 0.27 for control to 0.38, 0.40 and 0.43 for addition of 5 ton bentonite (tafla); (mixture of biofertilizer and 2.5 ton bentonite) and biofertilizers respectively.

The general trend of the previous results located in agreement with the finding of Awad *et. al* 2000 Abd –Ghani 2005.

2-The effect of different treatments on wheat yield

The effect of different soil amendments i.e. biofertilizer or bentonite and their mixture on grain and straw yield of wheat grown on sandy soil are given in Table 4 Fig. 2 The obtained data indicated that application of biofertilizer , bentonite and their mixture significantly increased wheat grain yield , compared to the control. Also, data indicated that the highest grain yield was obtained with addition of biofertilizers followed by addition of (biofertilizer +2.5 ton bentonite /fed) and 5 ton bentonite /fed which the values of grain yield were, 2199, 1866.7 and 1769.6 kg/fed while the control was 1.639.9 respectively.

Table 4 Effect of different treatments on wheat grain and straw yield

Treatments	grains kg/fed	straw kg/fed
Control	1.639	3400
5 ton bentonite (tafla)	1769	3390
Biofertilizers +2.5 ton bentonite	1866	3103
Biofertilizers	2199	3391
Mean	1458	3321

L.S.D at 5% for grain: 86 Straw: 166

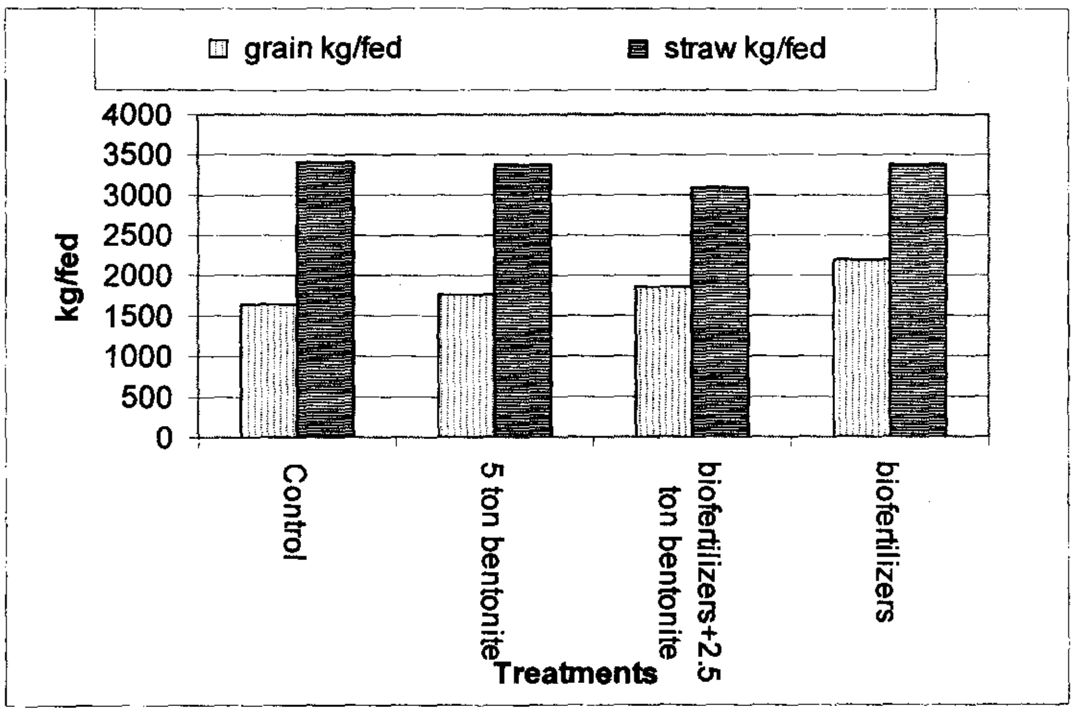

Fig. (2): Effect of different treatments on wheat grain and straw yield

The increment of grain yield were 7.90, 5.48 and 17.80 compared to control for 5 ton bentonite (tafla), (biofertilizers +2.5 ton bentonite) and biofertilizers respectively

Regarding to the effect of what on straw yield , the obtained data showed that the maximum values was produced by biofertilizers followed by (biofetilizers +2.5 ton/fed bentonite) and 5 ton/fed bentonite (opposite trend for grain yield . their values were 3400.1, 3390.4, 3103.3 and 3391.1 for control , 5 ton bentonite (tafla), biofertilizers +2.5 ton bentonite) and biofertilizers, respectively

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تاثير التسميد الحيوى والطفله على بعض الخواص الطبيعيه للاراضى الرمليه

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الملخص العربى

اجريت هذه التجربه فى محطه بحوث الاسماعليه خلال موسم ٢٠١٠ -٢٠١١ لدراسه تاثير التسميد الحيوى والطفله ومخلوط منهما بجانب الكنترول على بعض الخواص الطبيعيه للاراضى الرمليه ومحصول نبات القمح.

اوضحت النتائج ان اضافه التسميد الحيوى ادى الى انخفاض الكثافه الظاهريه ووصلت قيمه هذا الانخفاض ٤,٧٦% بالمقارنه بالكنترول.

كما ادت الى زياده المساميه الكليه الى ٣٩,٦٢% بينما كانت قيمه الكنترول ٣٦,١٠ وكانت الزياده مقدارها ٨,٢٥% بالمقارنه بالكنترول. بينما اضافه الطفله سجلت انخفاض فى المساميه الكليه.

اظهرت الطفله تاثيرواضح فى قيمه المسام الدقيقه فكانت اقل قيمه بينما الزياده النسبيه للمسام الدقيقه بعد اضافه ٥ طن طفله كانت ٥٠,٢٨ % بالمقارنه بالكنترول. وكانت المسام المتوسطه Meso بزياده كانت ١٠٠,٤٣ % بالمقارنه بالكنترول . بينما المسام الكبيره انخفضت بمقدار ١٦,٧٥ % بالمقارنه بالكنترول واضافه التسميد الحيوى اعطى اعلى قيمه من MWD بينما كانت اقل قيمه تم الحصول عليها باضافه الطفله بمفردها.

اوضحت النتائج ان اعلى محصول لنبات القمح كانت باضافه التسميد الحيوى يليها (مخلوط من ٢,٥ طن طفله + سماد حيوى) يليها ٥ طن طفله /فدان . وكانت القيم المتوسطه للمحصول ٢١٩٩و١٨٦٦,٧و ١٧٦٩,٦ كجم /فدان بينما كانت قيمه الكنترول ١٦٣٩,٩ كجم /فدان.