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USING ONE OF THE YEAST INDUSTRIAL WASTES FOR IMPROVING SOME PROPERTIES OF SANDY SOIL

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ABSTRACT: A field experiment was conducted in sandy soil under New EL-Salheya conditions, Egypt, to investigate the effect of yeast industrial waste (YIW) and farmyard manure (FYM) both of them alone and combination at 3 different mixtures from studied soil amendments as well as control (without soil amendments) to enhance some chemical and physical properties of sandy soil and corn grain yield. The results demonstrated that soil pH, ECe, Bd, PR, and HC decreased by increasing application of YIW and FYM both of them alone and 3 different mixtures, while the OC, available NPK and MWHC were increased. Also, the results demonstrated that the application treatments of the YIW and FYM increased the corn grain yield. The average increases of corn grain yield were 64.77, 116.73, 182.21, 147.69 and 89.32% with the application treatments of YIW and FYM at T2, T3, T4, T5 and T6, respectively, relative to control. The more effective treatment caused highly increased in corn grain yield was applied mixture treatment of 20 m^3 ha^{-1} YIW+20 Mg ha^{-1} FYM (T4). So, we can say that the application mixtures from YIW and FYM are considered effective in improvement sandy soil properties and productivity, which reduces environmental pollution from those wastes in the event that they are not used as a soil conditioner.

Key words: yeast industrial waste, farmyard manure, sandy soil properties, corn grain yield.

INTRODUCTION

Corn (*Zea mays* L.) is one of the most important grain crops in Egypt and the world. Egypt's corn production area is roughly 1.1 million hectares; by an average yield of about 7.4 Mg ha^{-1}. However, world corn acreage reached 188 million hectares, with an average yield of around 5.6 Mg ha^{-1} (**FAO, 2016**). Yeast waste is a byproduct of the sugarcane industry. It is generated following the fermentation of the solid portions that are produced during consuming wash and drying. The composition of yeast waste exhibits significant variation, which is influenced by factors such as the type of molasses used, and the chemical treatments employed during the activation processing. Yeast waste is characterized by its elevated levels of proteins and micronutrients (**Deshmane, 1975**). The yeast wastes contained significant amounts of arabinose, galactose, xylose sugars, and glucose. It also contains more inorganic nitrogen and less hydrolysable nitrogen than FYM. In recent years, Egypt has seen an increase in the production of yeast industrial wastes, with alcohol fermentation producing the majority of the sub products. The yeast and yeast waste are obtained after processing and separation of yeast from the most rich in protein, vitamins, carbs, and some minerals. Dentition of yeast waste yields decanted yeast waste (CMSD), (**Mata, 2016**). Yeast wastes have been found to exert a positive influence not only on microbial and plant growth but also on the physical and chemical properties of soil. These wastes possess the capacity to enhance soil mineralization of organic matter, improve soil structure, increase nutrient availability, lower soil pH and calcium carbonate content, solubilize insoluble phosphates,

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promote soil health, and enhance plant root development in the rhizosphere (**Vieira *et al.*, 2016; Xi *et al.*, 2019**). Organic matter improved the calcareous soil's physical and chemical qualities. This includes soil structure, maximum water holding capacity, nutrient availability (macro and micronutrients), and CEC, as well as encouraging soil organisms and promoting plant growth. Adding organic and bio-fertilizers had a useful yield to increase the number of microorganisms, particularly in the surface layer, which reproduce some substances that catalyze plant growth, (**Abo-Baker, 2017; Aboukila *et al.*, 2018**)**.** Producing organic acids by acid-producing bacteria can aid in lowering soil pH and improving the characteristics of calcareous soil, which may be attributed to rendering the calcium carbonate susceptible to boosting phosphorus availability (**Abo-Baker, 2011**).

The objective of this experiment was to assess the impact of integrating yeast industrial waste (in the form of a suspension) as a soil amendment along with farmyard manure on both corn yield and specific soil properties. The aim was to address the inherent limitations of sandy soil by improving its quality through the application of these organic amendments.

MATERIAL AND METHODS

A field experiment was conducted on sandy soil in New EL-Salheya, Egypt, situated between (30^{o} 34' 5" and 30^{o} 34' 30" N) latitude, (31^{o} 48' 38" to 31^{o} 49' 11" E) longitude and 50 cm above sea level. Table 1 shows some soil chemical and physical properties of soil the experimental site as well as the two amendments; yeast industrial waste suspension (YIW) and farmyard manure (FYM).The bread yeast company produces yeast industrial waste (YIW). It came from the Egyptian yeast company in Alexandria, Egypt.

Before corn cultivation, yeast industrial waste (YIW) and FYM were completely mixed onto the surface soil layer (0 – 15 cm). All treatments received mineral fertilizers at the recommended rate of 0.476 Mg ha^{-1} from super phosphate (65.4 g P kg^{-1}) before sowing, and potassium was added as potassium sulfate (398.4g K kg^{-1}) at 0.12 Mg ha^{-1} after 2, 4, 6, and 8 weeks from sowing into two equal doses. Nitrogen was provided at a rate of 0.84 Mg ha^{-1} in the form of ammonium sulfate (20% N). The first dose was applied at the seeding time, while the second dose was applied at 35 days later.

The experiment used a randomized complete block design with four replications. Each block (3 by 3 m) was divided for randomized two soil amendments; YIW and FYM for used six treatments rates where the FYM was incorporated with surface soil layer (0 - 15 cm) and the YIW was applied in two equal doses sprayed on soil surface during soil preparation and after 30 days from sowing. The different treatments were applied as follows:

T1: Control; without soil amendments

T2: 40 Mg ha^{-1}FYM

T3:10 m^{3} ha^{-1} YIW + 30 Mg ha^{-1}FYM

T4:20 m^{3} ha^{-1} YIW + 20 Mg ha^{-1}FYM

T5:30 m^{3} ha^{-1} YIW + 10 Mg ha^{-1}FYM

T6:40 m^{3} ha^{-1} YIW

During the summer season of 2022, at the rate of 48 Kg ha^{-1} corn grain were seeded on hill at 20 cm apart in the first week of May, 2022. All plots received the recommended rates of N, P and K and cultivation methods were carried out in accordance with the Ministry of Agriculture and Land Reclamation's recommendations.

Corn was harvested on August 26th, with whole plants taken from each plot to determine the yield of grains. Simultaneously, soil samples at soil depth (0 - 20 cm) were collected from each experimental unit for determining some chemical and physical properties using the standard procedures. Soil bulk density (Bd) was determined using core as described by **Blake (1986)**. The penetration resistance (PR) was measured using a penetrometer. PR measurements were taken six times in each plot from positions adjacent to measurements **(ASAE, 1993)**. Saturated hydraulic conductivity (HC) for the undisturbed soil samples was determined according to **Klute (1986).** Maximum water holding capacity (MWHC) was determined according to **Stolte *et al.* (1992)**.

The components in soil, YIW and FYM were determined in the soil paste extract, YIW suspension and water extract (1:2.5), respectively,

Table 1. Some chemical and physical characteristics of soil surface layer and soil amendments

Parameter	pH	EC dS m^{-1}	OC g kg^{-1}	Bulk Density Mg m^{-3}	$CaCO_3$ g kg^{-1}	Particle size distribution				
						Fine sand %	Coarse Sand %	Silt %	Clay %	Texture class
Soil depth (0 – 20 cm)	7.95	5.11	1.53	1.70	0.98	33.51	57.49	5.77	3.23	sandy
YIW	4.46	2.05	261	1.02	-					
FYM	7.29	1.43	222	0.86	0.19					

Total content of some elements of studied soil amendments

Soil amendments	N g kg^{-1}	P g kg^{-1}	K g kg^{-1}	Fe mg kg^{-1}	Mn mg kg^{-1}	Zn mg kg^{-1}	Cu mg kg^{-1}
YIW	21.34	4.31	24.32	133.35	5.72	1.68	2.85
FYM	11.13	2.25	18.17	16.88	3.43	3.12	2.31

YIW: yeast industrial waste and FYM: farmyard manure

and then the following determinations were conducted using the standard methods of analysis according to **Jackson (1973)**. The total soluble salts were determined using EC mater. The pH of soil determined in soil paste. Also pH of YIW and FYM determined in suspension and water extract 1:2.5, respectively, according to **Richards (1954)**. Organic matter was determined by the modified Walkley and Blake method (**Jackson, 1973)**.

Available N was extracted by 2.0 M KCl solution and determining according to **Dhank and Johson (1990)**. Available P was extracted by 0.5 M Na CO_3 pH 8.5 solution as described by *H* **Olsen *et al.* (1954)** and P was measured by Spectrophotometer according to **Watanabe and Olsen (1965)**. Available K was determined using 1.0 *N* ammonium acetate at pH 7.0 as described by **Jackson (1967)** and K was measured by the flame photometer.

RESULTS AND DISCUSSION

The following data investigate the effects of soil applications of yeast industrial waste (YIW) combined with farmyard manure (FYM) as a stimulant on enhancing several aspects of sandy soils, as well as nutrient availability and application efficiency by the corn plant.

Soil Chemical Properties

Soil pH

The reactions of YIW and FYM were acidic and neutral, respectively (Table 2). In terms of the influence of YIW and FYM on soil pH, the obtained values decreased slightly from 7.89 to 7.6. The application of FYM (T_2) and YIW (T_6) both of them alone as well as combination between FYM and YIW for 3 mixture rates (T_3, T_4 and T_5) decreased the pH values compared to the control treatment. The effect of the YIW, FYM and mixture from studied soil amendments on soil pH can be attributed to the production of organic acids, CO_2, and hydrogen ions (H^+). These results are in agreement with those obtained by **Farrag and Bakr (2021)** they found that applying farmyard manure alone or in combination with acid-producing bacteria and yeast, as well as molasses, to calcareous soil was particularly efficient in lowering soil pH. Also acid-producing bacteria and yeasts contribute to reducing soil pH through producing organic acids during the mineralization of organic material (**Vieira *et al.*, 2016; Xi *et al.*, 2019**). Moreover, reductions in the soil pH may be attributed to the activity of soil microorganisms producing CO_2, producing organic acids during the mineralization of organic material and root exudates during the decomposition of organic matter. These results are in an agreement with those of **Abo-Baker (2017)**, **Barka *et al.* (2018)**, **Vieira *et al.* (2016) and Xi *et al*. (2019).**

Table 2. Effect of studied soil amendments rates (YIW and FYM) on soil pH, EC_e, OC and Available NPK in soil

Treatments	pH	EC_e dSm^{-1}	OC g kg^{-1}	Available N mg kg^{-1}	Available P mg kg^{-1}	Available K mg kg^{-1}
T1	7.89	4.81	1.74	74.32	7.97	49.71
T2	7.79	3.91	2.35	93.44	12.74	61.92
T3	7.71	3.07	3.17	127.36	15.43	77.53
T4	7.61	2.05	4.13	173.41	19.32	101.17
T5	7.66	2.59	3.63	147.53	17.04	87.91
T6	7.75	3.51	2.73	109.69	14.03	69.22
LSD (0.05)	0.017	0.019	0.018	0.013	0.014	0.017

Concerning the effect of the YIW and FYM both of them alone and mixture rates from both soil amendments on the pH mean values of sandy soil after corn harvesting, data in Table 2 show that all mean values were generally slightly decreased or no change was visible with all treatments applied. The most effective treatment resulted in a decrease in the pH was T_4 (10 m^3 fed^{-1} YIW+10 Mg fed^{-1} FYM). This could be due to the release of CO_2 and organic acids as a resultant of soil microbes acting on the added organic matter as well as other chemical transformations. **Zein El-Abdeen, (2019**) found that applying organic amendments decreased soil pH as the level of organic amendment increased.

Soil salinity (ECe)

The electrical conductivity (ECe) of soil paste extract is a measure of salt content and an important indicator of soil health. With regard to the application of studied soil conditioners (FYM and YIW), the obtained results show that all mean values of ECe were significantly lower with all treatments applied when compared to the control treatment. The EC_e value at the control treatment was 4.81 dSm^{-1}, this value decrease to 2.05 dSm^{-1} at the application treatment of T_4 (20 m^3 ha^{-1} YIW + 20 Mg ha^{-1} FYM) (Fig. 1). This decrease could be the low percentage of soluble salts in FYM, increasing the amount supplied resulted in declines in soil ECe. The soil ECe was reduced in all studied treatments of both soil conditioners rates compared the control treatment. This could be owing to the soluble salts being leached by irrigation water. **Abo-Baker (2017)** stated that the ECe of the decrease of soil amended with various organic amendments might be related to organic acids created by organic matter decomposition, which precipitates the loss of soluble salts with irrigation water. Furthermore, microbial treatment of acid producing bacteria and yeast had discernible effect on soil salinity. **Farrag and Bakr (2021)** discovered that applying acid producing bacteria + molasses, yeast+ molasses, and their mixture to calcareous soil was significantly effective in decreasing soil ECe.

Soil organic carbon content (OC)

The application of the YIW and FYM as soil amendments significantly increased the soil organic carbon content as compared to the control treatment. Fig. 2 reveals that the soil OC recorded the greatest value due to the mixture of T_4; 20 m^3 ha^{-1} YIW+20 Mg ha^{-1} FYM, application when compared to the control. The soil OC ranged from 1.74 to 4.13 g kg^{-1}, and the relative increase percentages in soil OC were 35.06, 82.18, 137.36, 108.62, and 56.90 % for T2, T3, T4, T5, and T6 treatments, respectively, compared the control treatment (T1). Furthermore, increasing the YIW level in the mixture composition resulted in increases in soil organic carbon content, these findings are consistent with those by **El-Kamar (2020) and Farrag and Bakr (2021)**. This might be considered to be the utilization of organic carbon as a carbon source by microorganisms producing organic.

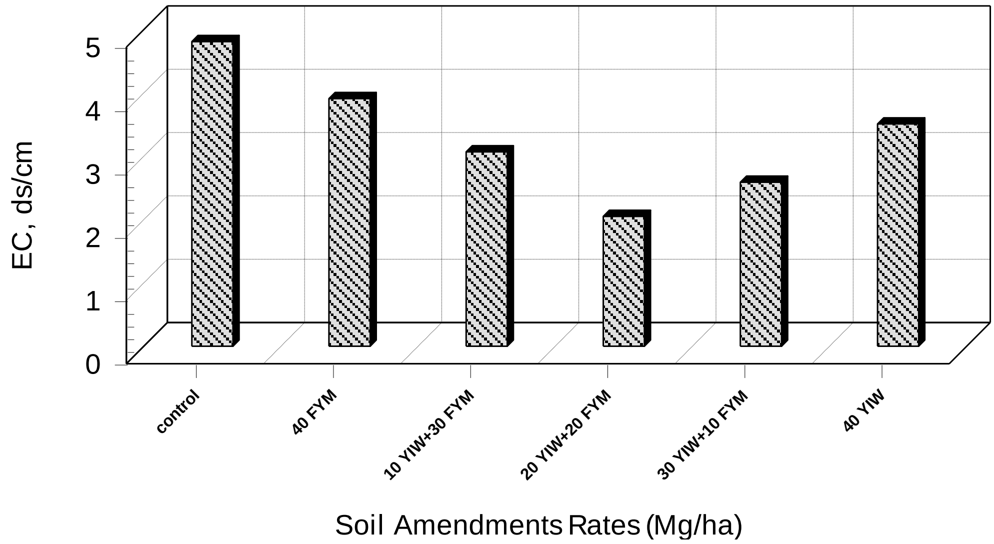

Fig. 1. Effect of studied soil amendments rates of (YIW and FYM) on soil salinity (EC_e)

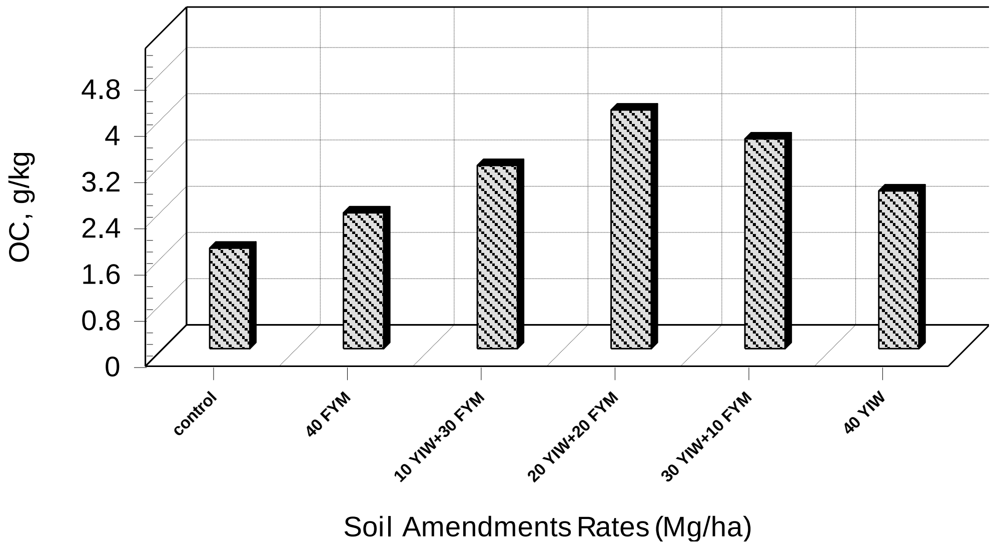

Fig. 2. Effect of studied soil amendments rates of (YIW and FYM) on soil OC

Rashid *et al.* (2004) and Abo-Baker (2017), they reported that the microorganisms strains acid-producing utilize organic matter in the soil as a carbon sources during the production of organic acids.

Available N contents in soil

The results in Table 2 show an increase in available N in soil by applying the soil amendments; YIW and FYM both of them alone and mixture rates from both soil amendments to the soil. The addition of soil amendments rates significantly increased the available soil N concentration following the growing season. The increase in available nitrogen in the soil may be due to the total nitrogen content of organic conditioner. Furthermore, the soil of organic conditioner increases the activity of microorganisms in the soil, which works to increase decomposition as well as the production of organic acids and amino acids in the soil, which increases the speed of available NPK in the soil in addition to its role in nutrient chelates and plant treatments, and the results are consistent with (**Hao *et al.*, 2008**).

After growth season, the maximum available N content was recorded in soil treated with soil amendments rates, the relative increased in available N content compared the control treatment, reached 133.33, 98.51, 71.37, 47.59 and 25.73% for T_4, T_5, T_3, T_6 and T_2 treatments, respectively. In general, the increases in the available soil N content were linked with increasing the yeast industrial waste addition level in mixture. These results in harmony with those of **Yousif *et al.* (2020) and Abdulrhman and Naguib (2022)** they reported that the improvement of soil properties with yeast application showed in the content of the moisture in the soil N, P and K and with natural amendments yeast treatment significantly increased the content of the NPK ions compared to control treatment. Furthermore, there was no statistically significant change in NPK content between treated soil with yeast waste and the control. Furthermore, there was a considerable drop in the N, P and K levels in the non-treated soil during drought conditions compared to the control treatment.

Available soil phosphorus (P)

The available P increased significantly when the YIW and FYM both of them alone and mixture rates from both soil amendments to the soil was used in combination (Table 2). After the growing season, the relative increase in available P content in soil treated with T4, T5, T3, T6 and T2 was 142.41, 113.80, 93.60, 76.04, and 59.85%, respectively, compared to control (T1). Increases in available soil P content were generally associated with increasing the level of yeast industrial waste added in the mixture.

The P liberated through organic matter decomposition, as well as soil P rendered available as a result of the degraded product effect, is responsible for enhancing the availability of P in soil for plants. Organic and inorganic acids, as well as CO_2 produced by the decomposition and mineralization of organic matter, have a substantial effect on enhancing the availability of P in soil. These results in harmony with those of **Farrag and Bakr (2021)** they found that addition of yeast + molasses or acid producing bacteria (APB) + molasses or their mixture with FYM increased available P more than using addition of FYM alone, as well as, using yeast + molasses or yeast + APB + molasses with FYM increased available P more than adding the APB + molasses with FYM. Also, yeasts play a role to solubilizing insoluble phosphates, because they use molasses and organic matter as a carbon source to produces organic acids, lower the soil pH and dissolves the calcium phosphate in calcareous soils. Yeast waste helps on microbial growth resulting in improvement the soil properties of the rhizosphere and thus increasing availability of phosphorus in the soil **(Vieira *et al.*, 2016; Xi *et al.*, 2019)**.

Available soil potassium (K)

The combination of YIW and FYM as soil amendments and both of them alone significantly increased the available K (Table 2). After the growing season, the relative increase in available K content in treated soil with T4, T5, T3, T6, and T2 was 103.52, 76.85, 55.96, 39.25, and 24.56%, respectively, compared to control (T1). In general, increasing the level of yeast industrial waste in the mixture led to an increase in the available soil K concentration. These increases in available K could be attributed to K release during organic matter mineralization (**Abo-Baker, 2017**). Furthermore, (**Farrag and Bakr, 2021**) showed that using FYM in combination with molasses + acid producing bacteria, molasses + yeast, or their mixture resulted in higher available K increases than using FYM alone. Molasses includes significant levels of K. Furthermore, during the decomposition of organic matter, bacteria or yeast reduce soil pH by creating organic and inorganic acids, which increases the release of K from soil minerals.

Soil Physical Properties

Soil bulk density (Bd)

According to the findings in Table 3, there were significant differences in soil bulk density between all treatments. Furthermore, the data demonstrate that the soil bulk density values in all studied treatments of YIW and FYM are lower than the control treatment, with statistically significant differences (Table 3). This could be due to the influence of farm yard manure's (FYM) low bulk density. These results are consistent with those produced by **Abdeen (2020)**.

Table 3. Effect of soil amendments rates (YIW and FYM) on some soil physical properties and corn grain yield

Treatments	Bd Mg m^{-3}	PR kPa	MWHC %	HC cm h^{-1}	Corn grain yield Mg ha^{-1}
T1	1.66	8.68	4.12	27.03	2.81
T2	1.55	7.11	7.21	24.37	4.63
T3	1.47	6.18	8.62	20.41	6.09
T4	1.36	5.05	10.63	15.72	7.93
T5	1.42	5.63	9.51	18.13	6.96
T6	1.51	6.68	7.87	22.55	5.32
LSD_{05}	0.018	0.015	0.017	0.116	0.0307

Bd: Bulk density, PR: penetration resistance, MWHC: maximum water holding capacity and HC: hydraulic conductivity

According to the data in Table 3, the mean values of sandy soil bulk density as affected by all treatments reduced from 1.66 to 1.36 Mgm^{-3} for soil cultivation with corn plants. Furthermore, the highest reduction was reported with the mixture treatment T4 therapy compared to the control treatment. This is most likely due to the positive influence of organic matter content on soil structure, which is reflected in soil bulk density. The obtained results also coincide with **(Khan *et al*., 2012)**, who indicated that raising the degree of filter mud application as organic soil conditioner from 10 Mg ha^{-1} to 100 Mg ha^{-1} lowered soil bulk density and improved total porosity. These findings are consistent with those of **Xi *et al.* (2019**) they reported that increasing the amount of yeast extract applied enhanced the bulk density of soil in three layers. Under the 40 g yeast extract treatment, the values of the Bd at soil surface layer (0 – 20 cm) decreased by 0.07 Mgm^{-3}, at least significant difference (LSD_{05}). The application levels of 20 g, 30 g, and 40 g of yeast extract induced a significant decrease in the rhizosphere soil at a depth of 20-60 cm, particularly in the mid-layer soil, which reduced from 1.44 Mgm^{-3} to 1.22 Mgm^{-3} after the 40 g yeast extract treatment.

Moreover, **Liang *et al.* (2014) and Xi *et al.* (2019)** showed that the favorable effect of yeast waste on soil physical parameters can be due to yeast waste adhesion to soil particles. Organic matter from yeast waste stimulates microbial activity in the soil, which leads to more organic matter breakdown, more capillary pores, decreased bulk density, and increased overall porosity. Also, polymeric compounds in yeast cell walls, such as ex-polysaccharide, have an effect on soil particle adhesion, which leads to an increase in soil aggregation and total porosity (**Raspor and Zopan, 2006**).

Penetration Resistance (PR)

The soil penetration resistance (PR) is an indicator of the physical characteristics of the soil; a decrease in penetration resistance allows plant roots to easily penetrate the soil. As demonstrated in Table 3, a decrease in soil penetration resistance is accompanied by an increase in YIW rates in the mixtures from YIW and FYM compared to the control treatment. There are significant differences in soil penetration resistance between all studied treatments and the control treatment. Also, the soil PR varied from 8.68 to 5.05 kPa for the YIW and FYM both them alone and mixture rates, Table 3 indicating that the combinations between YIW and FYM application resulted in the lowest PR values when compared to both them alone. As a result of an increase in the rate of yeast industrial waste in combination treatment T2, T3, T4, T5 and T6, the relative reductions in PR reached 18.09, 28.80, 41.82, 35.14, and 23.04% on average compared to control treatment. This clearly shows that increasing the application rates of yeast industrial waste rather than FYM has a negative effect on soil penetration resistance. These findings are consistent with those of **ElCossy (2022)**, who showed that the penetration resistance reduced with increased application rates of soil amendments.

Maximum water holding capacity (MWHC)

Incorporating PW and FYM both them alone and combination between both them as mixture in soil surface layer (0–15 cm) could be improve soil physical properties. The data in Table 3 and Fig. 3 show that the impacts of soil amendments rates of YIW and FYM on maximum water holding capacity are significant, with increasing rate of YIW in mixture from YIW and FYM. In addition, a significant variation in maximum water holding capacity was observed within the both soil amendments them alone and 3 combination mixture rates between YIW and FYM. The application treatments of T2, T3, T4, T5 and T6 had relative increases in maximum water holding capacity of 75.00, 109.22, 158.01, 130.83, and 91.02% respectively, on an average basis when compared to the control treatment (T1). This clearly shows that increasing YIW application rates in the mixture from YIW and FYM had a negative influence on soil maximum water retention capacity. These findings are consistent with those of **Bassouny and Abuzaid (2017)**, who found that the highest application rate of ceramic waste dust and biogas slurry increased, soil maximum water retention capacity values.

Hydraulic conductivity (HC)

Concerning the influence of YIW and FYM both them alone and mixture rates of both them on soil hydraulic conductivity, data reported in Table 3 reveal that the hydraulic conductivity decreased with application of the soil amendments. When soil amendments with a YIW and FYM were used, the soil hydraulic conductivity (HC) ranged from 27.03 to 15.72 cm h^{-1}. Table 3 shows that the YIW and FYM applications resulted in the lowest soil hydraulic conductivity values when compared to control treatment. Due to an increase in the rate of yeast industrial waste in combination treatments of T3, T4 and T5, the relative reduction in soil hydraulic conductivity reached 24.49, 41.84 and 32.93% on an average basis. This clearly shows that increasing the application rates of yeast industrial waste in the combination mixture rates than the application of FYM and YIW both them alone, had a negative effect on soil hydraulic conductivity. Also, the application of studied treatments of the YIW and FYM significantly decreased soil hydraulic conductivity compared to the control treatment. In this regard, **Abdullah *et al.* (2009)** showed that the relative decreases in hydraulic conductivity reach 19.98, 27.95, and 30.51% on an average basis as food industrial waste manure application rates increase from 0 to 10, 20, and 30 t/fed., respectively. While, on average, the relative decreases in hydraulic conductivity reached 9.29, 14.56 and 21.03% as poultry manure application rates increased from 0 to 10, 20, and 30 t/fed, respectively.

Corn grain yield

The findings in Table 3 and Fig. 4 indicate that the response of corn grain yield to YIW and FYM both them alone treatment and combination rates between both studied soil amendments. The treatments applications of YIW and FYM improved corn yield on average by 4.63, 6.09, 7.93, 6.96, and 5.32 $Mgha^{-1}$ compared to the control treatment on average by 2.81 $Mgha^{-1}$. The statistical analysis of the data in Table 3 revealed that the treatment T1 yielded significantly lower corn grains than the other treatments of T2, T3, T4, T5 and T6. Similar findings were reported by **El-Kamar (2020)**, who observed that the treatment of dried or liquid yeast waste significantly improved yield and yield components of fava bean. The addition of a YIW and FYM mixture ratio significantly improved corn grain yield. The highest yield was obtained by using a mixture of 20 m^3 ha^{-1} and 20 Mg fha^{-1} of YIW and FYM (T4).

According to the findings shown in Table 3 and Fig. 4, the difference between the YIW and FYM of studied treatments was significant. The application treatments of YIW and FYM at T2, T3, T4, T5 and T6 enhanced corn grain production by an average of 64.77, 116.75, 182.21, 147.69, and 89.32% compared to the control (T1).The statistical analysis of the data in Table 3 and Fig. 4 demonstrates that the application mixture of YIW and FYM had a significant impact on corn grain yield. At all application mixture rates, this effect is more prominent with YIW than with FYM.

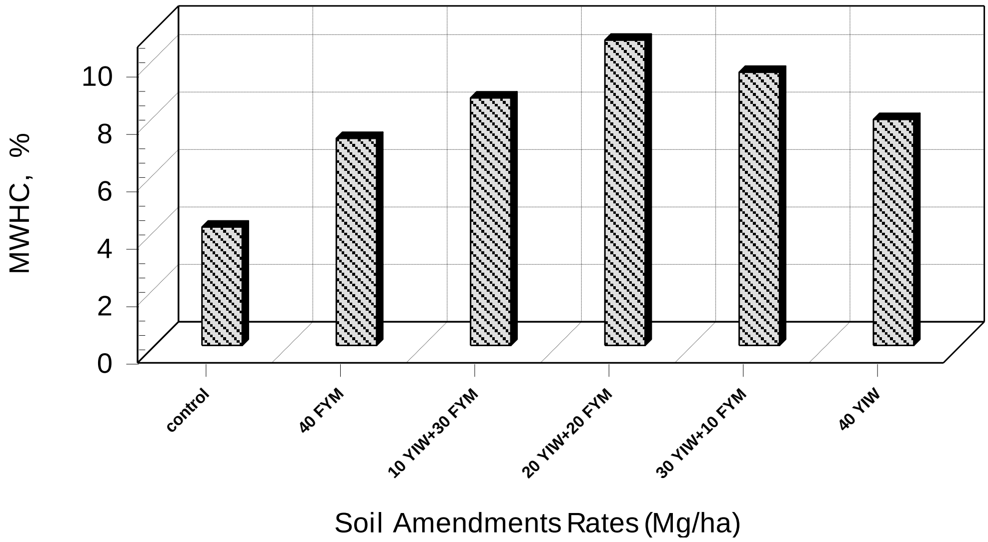

Fig. 3. Effect of studied soil amendments rates of (YIW and FYM) on soil MWHC

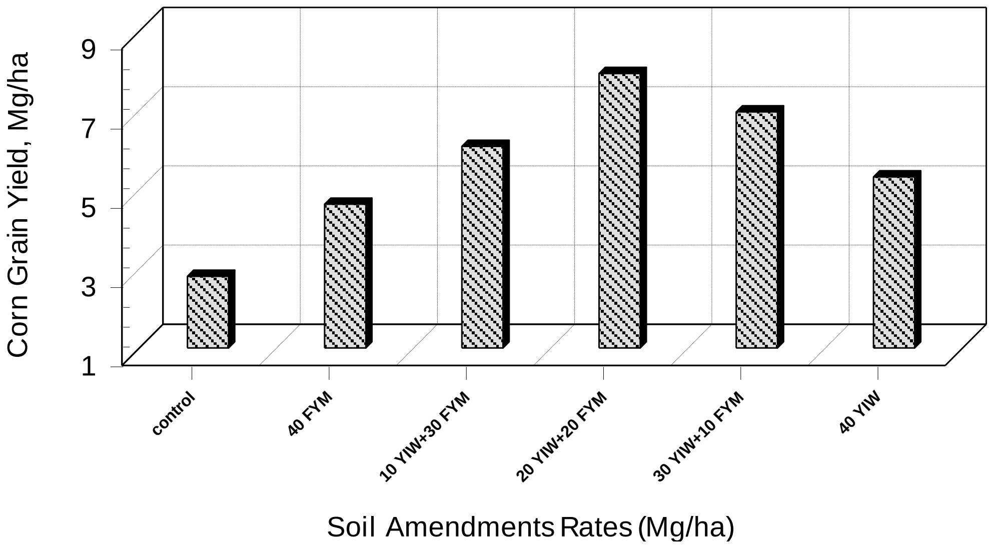

Fig. 4. Effect of studied soil amendments rates of (YIW and FYM) on corn grain yield

According to **Farrag and Bakr (2021)**, using FYM in combination with acid-producing bacteria (APB) and molasses; yeast and molasses; or their mixture significantly increases the dry matter yield of wheat plant compared to FYM alone. APB and yeast had useful effects in increasing the dry matter yield of the wheat plant. Direct optimization of plant growth through varied products that not only boost nutrient mobilization but also aid in the solubilization of insoluble inaccessible forms of nutrients, resulting in compounds with higher nutrient availability in the soil. In addition, the positive impact of yeast waste treatment on plant growth, yield, and yield quality in salinity-affected soil may be due to the presence of amino acids, trace elements, gibberellins, auxins, and cytokinin, which increase plant growth while mitigating the negative effects of salinity. According to **Yousf *et al.* (2019), Xi *et al.* (2019) and Abdelaal *et al.* (2019)**, application of yeast extract of 6 gm l^{-1}, improved decrease of vegetative growth of plant grown in salt impacted due to good influence on soil chemical and physical properties and physiological characteristics of plants.

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إستخدام أحد مخلفات صناعة الخميرة لتحسين بعض خواص التربة الرملية

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أجريت تجربة حقلية في تربة رملية تحت ظروف الصالحية الجديدة، مصر، لدراسة تأثير مخلف صناعة الخميرة (YIW) والسماد العضوي (FYM) لكل منهما منفرداً (T6 , T2) علي التوالي، وتم عمل 3 مخاليط من هذه المحسنات (T5, T4, T3) بالإضافة إلي الكنترول (T1) بدون إضافة محسنات وذلك لتحسين بعض خواص التربة الرملية الكيميائية والفيزيائية وإنتاجية محصول حبوب الذرة الشامية. وقد أظهرت النتائج التي تم الحصول عليها أن إضافة تلك المحسنات قد أدت إلي إنخفاض في قيم pH التربة، ملوحة التربة، الكثافة الظاهرية للتربة، مقاومة التربة للاختراق والتوصيل الهيدروليكي للتربة مع الإضافات المنفردة ومعدلات الخلط بين YIW و FYM، بينما زادت قيم كل من الكربون العضوي للتربة، الميسر من النيتروجين والفوسفور والبوتاسيوم بالتربة والسعة التشبعية العظمي للتربة مقارناً بالكنترول (T1). كما أظهرت النتائج التي تم الحصول عليها أن معاملات الإضافة قد أدت أيضاً إلي زيادة معنوية في محصول حبوب الذرة الشامية مع تطبيق معدلات الخليط بين YIW و FYM. وكان متوسط الزيادات في محصول حبوب الذرة الشامية 64.77، 116.73، 182.21، 147.69، 89.32% مع إضافة معاملات المحسنات (T6, T5, T4, T3, T2) على التوالي، مقارناً بمعاملة الكنترول (T1). و كانت المعاملة الأكثر فاعلية والتي أدت إلى زيادة عالية في محصول حبوب الذرة الشامية المعاملة T4 (20 m^3 ha^{-1} YIW +20 Mg ha^{-1} FYM). لذلك، يمكننا القول أن إضافة مخلفات صناعة الخميرة YIW بالخلط مع السماد العضوي FYM يعتبر فعالاً في تحسين خصائص التربة الرملية و زيادة إنتاجيتها، مما يقلل من التلوث البيئي من تلك المخلفات في حالة عدم الاستفادة منها كمحسن للتربة.

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