AJSWS

Applying some tillage practices and organic waste low economic value to enhance the productivity of calcareous soil and some oil crops.

Azza R. Ahmed, Mona H. M. Kenawy, Mohammad Y. Helmi, H.M. Khalil and Kadria M. El Azab.

Soils, Water and Envir. Res., Inst., Agri. Res. Center, Giza, Egypt

10.21608/ajsws.2024.296513.1016

Article Information

Received: June 29 2024

Revised: July 8 2024

Accepted: July 20 2024

Published: July 30 2024

ABSTRACT: To achieve self-sufficiency for oil crops in Egypt. It needs management to apply tillage practices with organic waste. So, an experiment was conducted at the Agricultural Research Station in Noubaria. It was planted with sunflower seeds, Sakha 53 summer 2021, followed by planting canola, Serw4 winter season. To study the effect of two different tillage practices, with the application of sugar beet waste (SBW) alone or mixed with compost on the productivity of calcareous soil and sunflower and canola crops. Results showed that: applying different tillage methods and organic waste had significant effects on EC_e, pH, and OM values and the availability of N, P, K, Zn, and Fe mg kg^{-1} values in calcareous soil.

Moreover, tillage methods had significant effects on the availability of Zn and Fe mg kg^{-1} values. Data revealed that seed yield (kg ha^{-1}), Oil % of sunflower and canola crops, and P, K, Zn, and Fe contents were significantly affected by deep tillage higher than surface tillage. Also, by applying organic treatments. Tillage methods had a significant effect on Oil % in the canola crop and Zn and Fe (kg ha^{-1}) values content of both crops.

The agronomic efficiency (kg kg^{-1}) and recovery of N, P, and K % in seed yield of sunflower and canola crops were more significantly affected by using organic amendment sources than by applying both tillage practices. Also, the investment ratio values increased due to applying organic waste low value.

Key Words: calcareous soil, tillage, organic materials, sunflower, canola

INTRODUCTION

The cultivation of newly reclaimed sandy and calcareous soil has become an unavoidable necessity for increasing our agricultural production to meet the ever-growing demand for food. Desert covers about 96% of the total area of Egypt; most of which are scattered in the eastern and western banks of the Nile Valley and Delta (**Abou Hussien *et al.*, 2019)**. Calcareous lands with difficult agricultural characteristics are widespread in northern Egypt. Sugar beet waste is also available because there are factories that extract sugar from beets. Due to the difficulty of collecting all this waste to produce compost, this requires a high additional production cost and time. The intricate relationship between compost utilization and subsequent oil production underscores the importance of sustainable agricultural practices in meeting the rising demands for edible oils (**Elsherpiny *et al.*, 2023).**

On the other hand, the Ministry of Agriculture and Soil Reclamation in Egypt is actively pursuing the sustainable expansion of oil crops, particularly through the cultivation of sunflower, canola, and different oil crops to decrease the import gap for various oil products and edible oils (**Faiyad *et al.*, 2023; Mohamed *et al.*, 2024)**. A critical component in optimizing oil crop production lies in the enhancement of soil health and fertility. Compost, derived from plant residues such as rice straw and soybean Stover, serves as a valuable soil amendment **(Rashwan, 2024)**.

Canola (*Brassica napus L.*) has been identified as a promising crop for production in Egypt to increase the country's edible oil supply. Over the last decades, canola has become a crop of high global agro-economic importance, featuring a wide range of uses for food, feed, and fuel purposes. It currently holds the third position among oil crops after palm oil and soybean (**FAO, 2018).** Also, the international oilseed market is dominated mainly by sunflowers and other oilseeds, so there is a need to intensify efforts to expand sunflower output to meet the demand for edible sunflower seeds, oil, and by-products (**Taher *et al.*, 2017).**

Canola has proved potential to be productive in Egypt even under salinity, heat, and drought stress in newly reclaimed arable land outside the Nile valley (**Abdallah *et al.*, 2010).** Conversely, **Elemike *et al*.**

(2019) indicate that producers have increased sunflower crop productivity by using fertilizers and these fertilizers have caused soil weakness, desertification, and even a decrease in vitality after years. The conventional agricultural practice of using chemical fertilizers for better crop yields and productivity adversely affects crop yield, physical and chemical properties of soil, and microbial ecological imbalance. Therefore, producers have started to use organic fertilizers to improve the physical and chemical structure of soils. The use of organic fertilizers should be expanded to reduce environmental pollution, guarantee sustainable soils, and reduce inorganic fertilizer use; especially as there are huge amounts of agricultural wastes produced every year in Egypt that could be effectively turned into organic fertilizer production (**Khodae-Joghan *et al.*, 2018).** The rated amount of agricultural waste in Egypt ranges from 22 to 26 million dry tons per year and can cause numerous problems in rural areas in Egypt (**Shaaban and Nasr, 2018)**.

Although tillage systems and crop rotations can affect crop production and uptake of nutrients, their long-term effects, particularly their interactions, are not well-documented (**Soon and Clayton, 2002)**. Tillage systems can change the distribution of nutrients and roots in different layers of soil (**Cannell and Hawes, 1994); Ball-Coelho *et al*., 1998)**. **Hargrove (1985)** showed that tillage affected the distribution of soil nutrients as early as the first year of treatment. Nutrient concentrations were higher in the surface soil layer under no-till as compared to conventional tillage (**Franzluebbers and Hons, 1996)**. Consequently, nutrient acquisition by crop plants may be affected by the type of tillage used in the production system.

This study aims to improve the service and properties of calcareous soils in the long term by adding organic waste as a resource for sustainable agriculture. This study focused on evaluating the impacts of organic waste addition and tillage methods under the conditions of these calcareous soils.

MATERIALS AND METHODS

A field experiment was conducted on a calcareous sandy loam soil at El-Nubaria Agricultural Research Station, El Behira Governorate, Egypt (lat. 31^0.01´ & 31^0.11´ and between long. 30 ^{0}.10´ & 30 ^{0}.25´) during two successive seasons (sunflower in summer season (2021) and Canola in winter season, 2021/2022) in the same place, respectively. The experimental design was in a split-plot with four replicates. To examine the impacts of the applied treatments on improving calcareous soil productivity and comparing the low economic by-products as organic waste with compost (organic materials). The main plots were two tillage methods and the organic materials treatments were sub-main plots. This experiment included the following treatments:

1-Tillage methods: surface tillage (0 – 30 cm) and deep tillage (0 – 60 cm)

2- organic materials:

- Sugar beet waste (SBW) (outperforms or liming on its own and is applied at a rate of 14.28 Mg ha^{-1}.
- Compost (Comp.) applied at a rate of 19.04 Mg ha^{-1}.
- A mixture of compost with sugar beet waste was applied as 50% from each of them, the application of organic materials based on their OC percent content, they were adjusted and ground to less than 5 mm size.

3- Control treatment (cont.) (without organic materials).

In the summer, season (2021) the experimental field was prepared, and homogeneously mixed with the amendments (sugar beet waste) and compost. The plot's total area was 14 m^2. The seeds of sunflowers were planted (*Helianthus annuus* L., var. Sakha 53) at a rate of 9.5 kg ha^{-1} during the first week of June. All the fertilizers were added according to the recommendation of the Ministry of Agriculture. Phosphorus and potassium were applied with a rate of 107.1 kg P_2O_5 ha^{-1} and 57.1 kg K_2O ha^{-1} in the forms of superphosphate (15.5 % P_2O_5) and potassium sulfate (48 % K_2O), respectively, before planting. While, nitrogen was applied as ammonium nitrate (33.5% N) at a rate of 142.8 kg N ha^{-1}, at two equal doses after 45 and 75 days from sowing.

Canola seeds (*Brassica napus* L., var. Serw4) in the second week of November were planted at a rate of 9.5 kg ha^{-1} in the same place in the following winter season (2021/2022), after returning the land to service and adding the same treatments. Recommended doses of phosphorus, potassium, and nitrogen fertilizer were added as mentioned above. All the fertilizers were added according to the recommendation of the Ministry of Agriculture.

Plant analysis: At the harvesting stage, in both seasons (summer and winter) the total yield for each plot for different seasons was weighed and converted to Mg ha^{-1}. The wet digestion method was used according to **Sommers and Nelson (1972)** to determine N, P, K, Zn, and Fe in plants as described by **Chapman and Pratt (1961)**, Total nitrogen by micro-Kjeldahl, Total phosphorus colorimetrically in aliquots of digested samples in sulphomolybdic acid and ascorbic system and total potassium by flame – photometrically. Total iron, zinc, and manganese by atomic absorption spectrophotometer instrument.

Organic materials analysis: pH in (1:10: water suspension), total soluble salts in (1: 10 water extract). Total organic matter by Schollenberger oxidizable organic carbon method, was determined according to **Page *et al*. (1982)**. Total nitrogen was determined using the Kjeldahl digestion method (UDK 139/code F 30200 130) as described by **Jackson (1973).** Total phosphorus, potassium, iron, zinc, and manganese were determined in the extract described by **Brunner and Wasmer (1978).** Phosphorus was measured by spectrophotometer (SPECTRONIC 21D NARP 100034). Potassium was measured by flame photometer and micronutrients by atomic absorption spectrophotometer instrument.

Soil analyses: Soil samples at a depth of 0-15 cm were collected at the end of each season after harvesting both crops; a chemical analysis was carried out. **The** organic carbon percentage was determined according to **Jackson (1958)**. Electric conductivity (EC) was measured in soil paste using the method described by **Page *et al*. (1982).** Soil pH value was determined in (1:2.5, soil water suspension) **(Jackson, 1973).** Organic matter content was determined according to the **Walkley and Black (1934)** titration method **(Jackson, 1973)**. Available nitrogen as described by **Page (1982),** Available phosphorus as described by **Jackson (1973),** and Available potassium was determined using a flame photometer as described by **Richards (1954),** and Available micronutrients (Fe and Zn) according to **Lindsay and Norvell (1978).**

All collected data were subjected to statistical analysis of variance and treatment means and were compared using the MSTAT-C computer package to calculate the F ratio according to the Least Significant Differences (LSD) test method as described by **MSTAT-C. (1990).**

Table (1). Some soil physical and chemical analyses of the investigated experimental summer and winter seasons.

Soil characteristics				
Particle size distribution %				
Sand	55.71		**$CaCO_3$%**	22.8
Silt	25.11		**OM,%**	0.27
Clay	19.18		**pH (1:2.5, soil: water suspension)**	8.47
Textural class	**Sandy Loam**		**EC (dSm^{-1})**	2.18
Available water content %	25.13			
Available macronutrients (mg kg^{-1})			**Available micronutrients (mg kg^{-1})**	
N	**P**	**K**	**Fe**	**Zn**
37.3	2.68	77.3	0.44	0.11

Table (2): Some chemical analysis of used organic amendments samples.

Amendment	pH (1:10)	EC (dSm^{-1})	OC %	C\N Ratio	Macronutrients % N	P	K	Micronutrient mgKg^{-1} Fe	Zn
Compost	7.30	3.10	23.43	16.97	1.38	0.62	1.70	160	86
Sugar beet waste (SBW)	7.20	2.95	34.30	19.06	1.80	0.50	1.80	210	117

Uptake kg ha^{-1} of (N, P, and K) = (N, P, and K) % in grain × grain yield kg ha^{-1} × 1000 /100.

Nutrient use efficiency was examined as follows:

1. **Agronomic efficiency (AE):** is defined as the economic production obtained per unit of nutrient applied. It can be calculated as follows:

$$AE\ (kg\ kg^{-1}) = \frac{Yield\ F - Yield\ C}{(QNA)}$$ ***(Baligar et al., 2001).***

Where ***Yield* F** is the yield of fertilized crop (kg), ***Yield* C** is the yield of unfertilized crop (kg), and **QNA** is the quantity of nutrient applied (kg).

2. Apparent nutrient recovery efficiency (ANR): is defined as the quantity of nutrient uptake per unit of nutrient applied. It can be calculated as follows:

$$ANR\ (\%) = \frac{NUF - NUC}{(QNA)} \times 100$$ **(Baligar *et al*., 2001).**

Where: ***NUF*** is the nutrient uptake of fertilized crop (kg), ***NUC*** is the nutrient uptake of unfertilized crop (kg), and ***QNA*** is the quantity of nutrient applied (kg).

Uptake kg ha^{-1} of (N, P, and K) = (N, P, and K) % in grain × grain yield kg ha^{-1} × 1000 /100.

Economic evaluation:

Evaluation of the farm profitability of all tested variability was considered and calculated as follows:

NI = TIO – TCI ……………………

NI = Net income LE.

TCI =Total cost input,

TIO = Total income outputs,

I.R = Investment Ratio (economic efficiency) = Output, L.E ha^{-1} /Input L.E ha^{-1} According to Rizk (2007)

RESULTS AND DISCUSSION

The obtained results through this study will be discussed under the following headings:

1. Chemical properties of soil:

1.1. Effect of different treatments on soil chemical characteristics after sunflower and canola crops harvest.

Data in Table 3 indicate that tillage methods and soil organic materials addition had positive and significant effects on the soil EC, pH, and OM values in calcareous soil under this study after sunflower and canola seed crops were harvested. The lowest values of soil pH, EC, and highest values of OM had significant changes in ascending order by applying sugar beet waste (low economic value), sugar beet waste + compost, and compost treatments, respectively, compared to the control. Moreover, there are positive significant effects on pH, EC, and OM values obtained with deep tillage practice.

The interactions between tillage methods and organic materials improved significantly the soil EC, pH, and OM% values. These findings could be attributed to the increasing organic matter decomposition over time and increasing microorganisms' activity in soil and buffering pH, especially in surface tillage application. Lowering the soil pH value through organic acid and increasing the activity of soil organisms liberates more nutrients from the unavailable reserves **(Modaihsh *et al*., 2005; Khalil, 2016)**. Also, decreased EC could be due to the increased permeability leading to the leaching of salts in case of deep tillage application **(Deepa and Govindarajan, 2002).** The decline of soil EC values as a result of the compost applications may be attributed to the improvement of physical soil properties, especially the increase in its hydraulic conductivity and total porosity **(El-Gamal, 2015)**. Also,

Mohamed *et al*. (2007) observed that applying different organic manures decreased soil pH, EC, SAR, and soluble Na^+, Cl^- and HCO^{3-} while CEC and soluble Ca^{2+} and Mg^{2+} increased. They attributed the slight change in values of Ca^{2+} to increased solubility of $CaCO_3$ due to applied manures.

The improvement some soil chemicals properties by application of compost compared with Sugar beet waste applicatin althought that the sugar beet waste is high contain in some elements than compost. This result may be due to complte maturated C/N about (1:16) and decomposition of compost as amendament in the soil.

Table (3). Effect of different treatments on EC, pH, and OM values in calcareous soil after sunflower and canola crops harvest.

Treatments (B)	pH			EC_e (dSm^{-1})			OM (%)		
	Tillage (A)			Tillage (A)			Tillage (A)		
	Surface	Deep	Mean (B)	Surface	Deep	Mean (B)	Surface	Deep	Mean (B)
Sunflower yield harvest after 2021 season									
Cont.	8.45b	8.47a	8.46a	0.95a	0.82b	0.88a	1.20h	1.22g	1.21d
SBW	8.41d	8.42c	8.41b	0.72c	0.62d	0.67b	1.27f	1.29d	1.28c
Comp. + SBW	8.25g	8.39e	8.32c	0.59e	0.51g	0.55c	1.28e	1.39c	1.33b
Comp.	8.12h	8.37f	8.24d	0.55f	0.49h	0.52d	1.49b	1.51a	1.50a
Mean (A)	8.30b	8.41a		0.70a	0.61b		1.31b	1.35a	
LSD 0.05 %	A=0.005 B=0.001 A*B=0.002			A=0.005 B=0.001 A*B=0.002			A=0.005 B=0.001 A*B=0.002		
Canola yield harvest after 2021/2022 season									
Cont.	8.36b	8.38a	8.37a	0.97a	0.86b	0.91a	0.94g	1.16e	1.05d
SBW	8.32c	8.36b	8.34b	0.86b	0.65d	0.75b	1.07f	1.21c	1.14c
Comp. + SBW	8.22e	8.32c	8.27c	0.68c	0.54f	0.61c	1.16e	1.24b	1.20b
Comp.	8.11f	8.25d	8.18d	0.64e	0.51g	0.57d	1.20d	1.29a	1.24a
Mean (A)	8.25b	8.33a		0.78a	0.64b		1.09b	1.22a	
LSD 0.05 %	A=0.005 B=0.001 A*B=0.002			A=0.005 B=0.001 A*B=0.002			A=0.005 B=0.001 A*B=0.002		

Cont.: control; (S.B.W.): sugar beet waste; Comp.: compost

1.2, Effect of different treatments on available N, P, and K in calcareous soil after sunflower and canola crops harvest.

Data in Table 4 indicate that tillage methods and organic treatment addition had positive and significant effects on the availability of N, P, and K values under this study after sunflower and canola harvest. The available N, P, and K values were higher upon the applied sugar beet waste (low economic value), sugar beet waste + compost, and compost, respectively, compared with the control. The increase in available N value might attributed to the N derived from the native N by enhancing microbial activities induced by humic and fulvic acid resulting from the decomposition of the added organic materials. Also, the increase in the availability of P could be attributed to the chemical and biochemical processes involved. The humic acids might have helped in the solubility of P insoluble forms to soluble form resulting in its increase. A similar increase was reported by **(Khan *et al*., 1997; Deepa and Govindarajan, 2002).** However, the data showed a difference in the effect between tillage methods and an increase in the availability of nitrogen, phosphorus, and potassium in the soil after harvesting sunflower and canola crops, respectively. The highest N values were recorded in surface tillage compared to the highest values of both available P and K were recorded in deep tillage in the first season after sunflower crop harvest. The residual effect of different treatments on available macronutrients in soil after harvesting sunflower and canola crops in calcareous soil is related to the chemical composition of added compost and its effect on soil chemical properties and its content of available macronutrients. Similar results were obtained by **El-Meselawe (2014) and Elgezery (2016)**.

Table (4). Effect of different treatments on soil available N, P, and K (mg kg^{-1}) after sunflower and canola crops harvest.

Treatments (B)	Available N			Available P			Available K		
	Tillage (A) Surface	Tillage (A) Deep	Mean (B)	Tillage (A) Surface	Tillage (A) Deep	Mean (B)	Tillage (A) Surface	Tillage (A) Deep	Mean (B)
Macro elements available in soil (mg kg^{-1}) after sunflower crop harvest									
Cont.	137.0f	130.0h	133.5d	6.88h	7.12f	7.00d	160.0g	344.0d	252.0d
SBW	151.0d	132.0g	141.5c	7.08g	7.92d	7.50c	240.0f	345.0c	292.5c
Comp. + SBW	159.0c	144.0e	151.5b	7.24e	9.82b	8.53b	315.0e	394.0b	354.5b
Comp.	165.0b	166.0a	165.5a	8.18c	10.21a	9.19a	344.0d	411.0a	377.5a
Mean (A)	153.0a	143.0b		7.34b	8.76a		264.8	373.5	
LSD 5 %	A=0.005 B=0.001 A*B=0.002			A=0.005 B=0.001 A*B=0.002			A=0.005 B=0.001 A*B=0.002		
Macro elements available in soil (mg kg^{-1}) after canola crop harvest									
Cont.	136.0g	121.0h	128.5d	5.12g	5.56e	5.34d	149.0g	259.0c	204.0d
SBW	151.0f	170.0d	160.5c	5.54f	6.38d	5.96c	171.0f	259.0c	215.0c
Comp. + SBW	159.0e	188.0b	173.5b	8.32b	6.38d	7.35b	196.0e	266.0b	231.0b
Comp.	176.0c	193.0a	184.5a	10.19a	8.24c	9.21a	217.0d	416.0a	316.5a
Mean (A)	155.5b	168.0a		7.29a	6.64b		183.3b	300.0a	
LSD 5 %	A=0.005 B=0.0018 A*B=0.002			A=0.005 B=0.001 A*B=0.002			A=0.005 B=0.001 A*B=0.002		

Cont.: control; (S.B.W.): sugar beet waste; Comp.: compost

1.3. Effect of different treatments on soil available Zn and Fe (mg kg^{-1}) after sunflower and canola crops harvest.

Data in Table 5 indicate that organic materials had a positive and significant effect on the availability of Zn and Fe (mg kg^{-1}) in calcareous soil under study after sunflower and canola crops harvest. The highest values of available Zn and Fe were obtained with the addition of sugar beet waste (low economic value), sugar beet west + compost, and compost compared with control respectively. At the same time, it was noticed that tillage methods had no significant effect on the availability of Zn and Fe (mg kg^{-1}) values in calcareous soil after sunflower and canola crops harvest. These trends are consistent with the chemical composition and nutrient content of the composts and also with their improving effects on calcareous soil properties and their contents of available macro- and micronutrients **(Elgezery, 2016; Abou Hussien *et al.*, 2019)**. Also, this might be attributed to the high decomposition of the organic amendments and its effect on soil biological conditions, nutrient mineralization, and release of essential nutrients in available forms, root development, and thus higher yields **(Frøseth *et al.*, 2014)**.

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Table (5). Effect of different treatments on soil available Zn and Fe (mg kg^{-1}) after sunflower and canola crops harvest.

Treatments (B)	Zn (mg kg^{-1})			Fe (mg kg^{-1})		
	Tillage (A) Surface	Tillage (A) Deep	Mean (B)	Tillage (A) Surface	Tillage (A) Deep	Mean (B)
Microelements available in soil (mg kg^{-1}) after sunflower harvest						
Cont.	0.120f	0.130e	0.125d	0.640e	0.440g	0.540d
SBW	0.160c	0.150d	0.155c	0.650d	0.620f	0.635c
Comp. + SBW	0.160c	0.160c	0.160b	0.720c	0.790b	0.755b
Comp.	0.180b	0.190a	0.185a	0.720c	0.860a	0.790a
Mean (A)	0.155a	0.157a		0.683a	0.678a	
LSD 5 %	A=NS B=0.001 A*B=0.002			A=NS B=0.001 A*B=0.002		
Microelements available in soil (mg kg^{-1}) after canola harvest						
Cont.	0.120f	0.130e	0.125d	0.660g	0.670f	0.665d
SBW	0.150d	0.130e	0.140c	0.690e	0.690e	0.690c
Comp. + SBW	0.170b	0.160c	0.165b	0.700d	0.740c	0.720b
Comp.	0.170b	0.190a	0.180a	0.790a	0.760b	0.775a
Mean (A)	0.152a	0.152a		0.710a	0.715a	
LSD 5 %	A=NS B=0.001 A*B=0.002			A=NS B=0.001 A*B=0.002		

Cont.: control; (B.W.): sugar beet waste; Comp.: compost

2. Plant nutrients content:

Data in Table 6 reveal that values of N, P, and K content of seed yield (kg ha^{-1}) of sunflower and canola crops in a calcareous soil were significantly affected by the tillage methods, and their values were higher than those of the surface tillage method except both P and K content in seed yield of canola after had no significant effect after surface tillage practice. Also, the highest values of such parameters values were obtained in ascending order by applying the sugar beet waste (low economic value), sugar beet waste + compost, and compost treatments, respectively as well as when compared with control. These results may be due to the improvement of soil properties affected by a decrease in soil EC and pH values and the increase in OM% in calcareous soil. In this respect, **Elgezery (2016) and Abou Hussien *et al.* (2017)** obtained similar results. Also, the addition of organic materials improved the soil's physical properties, such as hydraulic conductivity, infiltration rate, total porosity, and penetration resistance. **Azza. R. Ahmed *et al.* (2022)** confirmed that one of the most prevalent procedures for improving soil physical qualities has been the addition of organic materials from diverse sources to the soil.

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Table (6). Effect of different treatments on N, P, and K contents of seed yield (kg ha^{-1}) of sunflower and canola crops in calcareous soil.

Treatments (B)	N-content in seed (kg ha^{-1})			P-content in seed (kg ha^{-1})			K- content in seed (kg ha^{-1})		
	Tillage (A)		Mean (B)	Tillage (A)		Mean (B)	Tillage (A)		Mean (B)
	Surface	Deep		Surface	Deep		Surface	Deep	
Nutrient contents in seed yield of sunflower (kg ha^{-1})									
Cont.	54.85f	48.09f	51.47d	57.45f	84.07d	70.76d	15.02e	19.16d	17.09d
SBW	64.78e	76.58cd	70.68c	68.69e	95.95c	82.32c	18.86d	23.96c	21.41c
Comp. + SBW	73.71d	95.07b	84.39b	80.32d	114.40b	97.34b	21.16cd	28.65b	24.90b
Comp.	84.08c	106.80a	95.46a	97.24c	150.90a	124.10a	22.28c	37.81a	30.04a
Mean (A)	69.36b	81.64a		75.93b	111.30a		19.33b	27.39a	
LSD 5 %	A=11.41 B=6.17 A*B=8.73			A=9.06 B=7.54 A*B=10.67			A=4.22 B=1.99 A*B=2.81		
Nutrient contents in seed yield of canola (kg ha^{-1})									
Cont.	61.10e	72.80d	66.95d	9.29e	11.13d	10.21c	9.03e	9.27de	9.15d
SBW	73.57d	86.87c	80.22c	11.30d	13.51c	12.40b	10.91d	13.07c	11.99c
Comp. + SBW	84.97c	107.80b	96.37b	12.76cd	13.48c	13.12b	13.60c	16.45b	15.03b
Comp.	100.60b	146.00a	123.30a	17.07b	18.77a	17.92a	16.32b	21.89a	19.11a
Mean (A)	80.07b	103.40a		12.60a	14.22a		12.47a	15.17a	
LSD 5 %	A=21.03 B=5.23 A*B=7.40			A=NS B=1.17 A*B=1.66			A= NS B=1.162 A*B=1.643		

Cont.: control; (S.B.W.): sugar beet waste; Comp.: compost

Data in Table 7 indicate that tillage methods had a significant effect on Zn and Fe (kg ha^{-1}) values content of seed yield in calcareous soil after sunflower and canola crops harvest. Also, the application of organic materials had a significant effect on the availability of Zn and Fe (mg kg^{-1}) in the soil after sunflower and canola crops harvest. The highest values of availability Zn and Fe were obtained with the addition of organic materials in ascending order sugar beet waste (low economic value), sugar beet waste + compost, and compost compared with control, respectively. These trends are consistent with the chemical composition and nutrient content of the composts and also with their improving effects on calcareous soil properties and its content of available macro- and micronutrients **(Elgezery, 2016; Abou Hussien *et al.*, 2019)**. Also, this might be attributed to the high decomposition of the organic matter and its effect on soil biological conditions, nutrient mineralization, and release of essential nutrients in available forms, root development, and thus higher yields **(Frøseth *et al.*, 2014)**.

Table (7). Effect of different treatments on Zn and Fe contents of seed yield (mg kg^{-1}) of sunflower and canola crops in calcareous soil. Microelements content in seed yield of sunflower (mg kg^{-1}).

Treatments (B)	Zn (mg kg^{-1})			Fe (mg kg^{-1})		
	Tillage (A)		Mean (B)	Tillage (A)		Mean (B)
	Surface	Deep		Surface	Deep	
Cont.	1.66g	1.56h	1.61d	1.29h	1.61e	1.45d
SBW	1.75e	1.71f	1.73c	1.48g	1.69d	1.58c
Comp. + SBW	1.76d	1.77c	1.76b	1.56f	1.73c	1.64b
Comp.	1.89b	1.90a	1.89a	1.81a	1.77b	1.79a
Mean (A)	1.76a	1.73b		1.53b	1.70a	
LSD 5 %	A=0.005 B=0.0018 A*B=0.0025			A=0.0051 B=0.0018 A*B=0.0025		
Microelements content in seed yield of canola (mg kg^{-1})						
Cont.	31.90g	30.50h	31.20d	79.80h	85.20g	82.50d
SBW	37.90f	41.30c	36.60c	88.50f	95.70c	92.10c
Comp. + SBW	39.60e	45.60b	42.60b	89.57e	97.70b	93.63b
Comp.	40.37d	49.10a	44.73a	100.50a	93.50d	97.00a
Mean (A)	35.94b	41.63a		89.59b	93.03a	
LSD 5 %	A=0.434 B=0.153 A*B=0.217			A=0.005 B=0.058 A*B=0.082		

Cont.: control; (S.B.W.): sugar beet waste; Comp.: compost

3. Nutrient use efficiency

Results in Tables (8 and 9) indicate that the agronomic efficiency (kg kg^{-1}) and recovery of N, P and K % in seed yield of sunflower and canola were positive as affected significantly by applying organic material treatments in the calcareous soil. Also, the recovery of N % in the seed yield of sunflower and canola was positive as affected significantly by tillage methods in this calcareous soil except for recovery of P and K % in the seed yield of sunflower and recovery of P % in the seed yield of canola was negative as affected significantly by tillage methods. On the other hand, the agronomic efficiency (kg kg^{-1}) of N and P % in seed yield of sunflower and canola was negative as affected significantly by tillage methods in this calcareous soil except k % in canola seeds had significant by applying deep tillage practice. The agronomic efficiency of N and P and recovery of P have no significant effect for either different tillage practices on the seed yield of two crops or organic material treatments of N on the seed yield of canola and P on the seed yield of sunflower. The recovery of N, P and K % in the seed yield of sunflower and canola crops was increased significantly using the organic amendment sources. These results indicate that the tillage deep method and organic materials led to an increase in the nutrient use efficiency in calcareous soil. On the other hand, the highest values of agronomic efficiency (kg kg^{-1}) and recovery of N, P, and K % in seed yield of sunflower and canola were obtained with the addition of organic amendment sources. The highest values of agronomic efficiency (kg kg^{-1}) and recovery of N, P, and K % in seed yield of sunflower and canola were obtained by applying organic materials in ascending order sugar beet waste (low economic value), sugar beet west + compost and compost, respectively. These results indicate that the organic sources with compost amendments increase nutrient use efficiency in the calcareous soil. This result indicates that the use of sugar beet waste without compost led to decreasing nutrient use efficiency in calcareous soil. These results were confirmed by **(Shindo and Nishio, 2005)**. Finally, the interaction between all factors under study gave the highest significant values of agronomic efficiency (kg kg^{-1}) and recovery of N, P, and K % in seed yield of sunflower and canola crops growing in the calcareous soil.

Table (8). Effect of different treatments on N, P, and K recovery (%) in seed yield of sunflower and canola crops in calcareous soil.

Treatments (B)	N			P			K		
N, P, and K recovery (%) in seed yield of sunflower harvest									
	Tillage (A)		Mean (B)	Tillage (A)		Mean (B)	Tillage (A)		Mean(B)
	Surface	Deep		Surface	Deep		Surface	Deep	
Cont.	0	0	0	0	0	0	0	0	0
SBW	2.570f	8.467c	5.518c	4.150e	4.390de	4.270c	1.047c	1.307c	1.177c
Comp. + SBW	4.950e	11.950b	8.452b	7.060cd	9.360bc	8.210b	1.510c	2.330b	1.920b
Comp.	7.237d	14.650a	10.944a	10.540b	17.720a	14.130a	1.623c	4.173a	2.898a
Mean (A)	4.919b	11.689a		7.250a	10.490a		1.393a	2.603a	
LSD 5 %	**A=0.01 B=0.85 A*B=0.67**			**A=NS B=3.36 A*B=2.7**			**A=NS B=0.74 A*B=0.59**		
N, P, and K recovery (%) in seed yield of canola harvest									
Cont.	0	0	0	0	0	0	0	0	0
SBW	3.020d	3.473d	3.247c	0.773c	0.877bc	0.825b	0.510d	1.037c	0.773c
Comp. + SBW	5.683c	8.377b	7.030b	1.097b	0.727c	0.912b	1.123c	1.763b	1.443b
Comp.	9.317b	17.470a	13.394a	2.087a	2.027a	2.057a	1.628b	2.823a	2.226a
Mean (A)	6.007b	9.773a		1.319a	1.210a		1.087b	1.874a	
LSD 5 %	**A=0.42 B=1.65 A*B=1.33**			**A=NS B=0.40 A*B=0.32**			**A=0.26 B=0.34 A*B=0.27**		

Cont.: control; (S.B.W.): sugar beet waste; Comp.: compost

Table (9). Effect of different treatments on agronomic efficiency (kg kg^{-1}) of seed yield for sunflower and canola crops in calcareous soil.

Treatments (B)	N Tillage (A) Surface	N Tillage (A) Deep	N Mean (B)	P Tillage (A) Surface	P Tillage (A) Deep	P Mean (B)	K Tillage (A) Surface	K Tillage (A) Deep	K Mean (B)
Agronomic efficiency (kg kg^{-1}) on seed yield of sunflower harvest									
Cont.	0	0	0	0	0	0	0	0	0
SBW	0.930d	1.270cd	1.100b	1.363a	1.867a	1.615a	6.480d	8.870cd	7.675b
Comp. + SBW	1.476cd	2.601ab	2.039ab	1.830a	3.230a	2.530a	10.380cd	18.330ab	14.355ab
Comp.	1.900bc	3.157a	2.529a	2.040a	3.383a	2.712a	13.480bc	22.410a	17.945a
Mean (A)	1.435a	2.343a		1.744a	2.827a		10.113a	16.537a	
LSD 5 %	**A=NS B=0.99 A*B=0.79**			**A=NS B= NS A*B= NS**			**A=NS B=6.98 A*B=5.61**		
Agronomic efficiency (kg kg^{-1}) on seed yield of canola harvest									
Cont.	0	0	0	0	0	0	0	0	0
SBW	0.683b	0.903b	0.793a	1.010c	1.330c	1.170b	4.783d	6.303cd	5.543b
Comp. + SBW	1.117b	1.060b	1.088a	1.387c	1.317c	1.352b	7.877c	7.470c	7.674b
Comp.	1.963ab	3.907a	2.935a	2.111b	2.603a	2.357a	13.950b	17.220a	15.585a
Mean (A)	1.254a	1.957a		1.503a	1.750a		8.870b	10.331a	
LSD 5 %	**A=NS B=NS A*B=2.14**			**A=NS B=0.48 A*B=0.38**			**A=0.84 B=2.95 A*B=2.37**		

Cont.: control; (S.B.W.): sugar beet waste; Comp.: compost

4. Seed yield of sunflower and canola crops:

Data in Table 10 indicate that positive and significant effects exist in the case of using a deep tillage system on seed yield of both sunflower and canola which is higher than surface tillage in calcareous sandy loam soil. On the other hand, the Oil % in the seed yield of the sunflower crop positively increased and the effects were significant by using the deep tillage method as well as the oil % in the seed yield of the canola crop positively increased, but the effects were not significant.

Also, data clear that the positive and significant effects were obtained with seed yield and Oil % of sunflower and canola obtained with the use of soil organic amendment sources in calcareous sandy loam soil. The highest values of seed yield and Oil % of both sunflower and canola were obtained with the addition of sugar beet waste (low economic value), sugar beet waste + compost, and compost compared with control, respectively.

This may be due to the effect of compost addition with sugar beet waste (low economic value) which plays an important role in the assimilation of sunflower and canola plants which in turn increased this value. These results conform with those reported by **Radwan *et al.* (2014)**.

The lowest values of seed yield of sunflower and canola crops were obtained with control and sugar beet waste addition, respectively. This result concluded that the use of sugar beet waste residues led to decreased values of seed yield of sunflower and canola crops in calcareous sandy loam soil. These results were confirmed by **Shindo and Nishio (2005)**. **Powlson and Olk (2000)** found that the nutrients supplied through soil organic matter mineralization can lead to a decrease in the inorganic fertilizer requirements of crops. There is still a strong need for placing buried residue of sugar beet waste under long-term experiments, where adding sugar beet waste residues to the soil ensures the sustainability of soil fertility with an increase in productivity. Several studies have shown modest improvements in soil organic matter and soil physical properties following medium to long-term straw incorporation (i.e. >8-10 years), whereas there was little evidence of short-term impacts on soil quality, workability, or yield **(HGCA. 2014)**. Generally, the effects of the interaction between tillage methods use of soil organic amendments sources 75 with compost addition and its effect on increasing seed yield and Oil % of sunflower and canola were positive and significant in the calcareous sandy loam soil.

Table (10). Effect of different treatments on seed yield (Mg ha^{-1}) and oil (%) of sunflower and canola crops in calcareous soil.

Treatments (B)	Seed yield of sunflower (Mg ha^{-1})			Seed yield of canola (Mg ha^{-1})		
	Tillage (A)		Mean (B)	Tillage (A)		Mean (B)
	Surface	Deep		Surface	Deep	
Cont.	2.887e	3.910c	3.398c	1.673f	1.857e	1.765d
SBW	3.257de	4.417b	3.837b	1.947e	2.217cd	2.082c
Comp. + SBW	3.480cd	4.957a	4.218a	2.123d	2.283c	2.203b
Comp.	3.657cd	5.190a	4.423a	2.470b	2.840a	2.655a
Mean (A)	3.320b	4.618a		2.053b	2.299a	
LSD 5 %	A=0.016 B=0.338 A*B=0.479			A=0.240 B=0.100 A*B=0.142		
	Oil (%) on seed yield of sunflower			**Oil % on seed yield of canola**		
Cont.	43.10g	44.10e	43.60d	44.77e	45.10d	44.93d
SBW	44.00f	45.00b	44.50c	45.60c	45.80bc	45.70c
Comp. + SBW	44.50d	45.00b	44.75b	45.87b	46.00b	45.93b
Comp.	44.70c	45.10a	44.90a	46.03b	46.70a	46.37a
Mean (A)	44.08b	44.80a		45.57a	45.90a	
LSD 5 %	A=0.0016 B=0.0018 A*B=0.0025			A=NS B=0.174 A*B=0.246		

Cont.: control; (S.B.W.): sugar beet waste; Comp.: compost

5. Economic evaluation

Data in Table (11a&b) show profitability calculations for applying S.B.W as organic material versus mixed compost with sugar-beat waste and compost alone as treatments under this research. Input cost, outputs, net income, and investment ratio for the tested treatments are presented in the same tables for both sunflower and canola crops. The obtained results revealed that the highest net income was ascertained in ascending order by applying compost, mixing S.B.W with compost, and compost alone for two crops.

Table (11a). Total input production items and output of the experiment.

Items	Treatments	Treatment unit	Unit price (L.E)
Total inputs			
Ammonium nitrate 33.5%	142.8	kg(N)ha^{-1}	10
Superphosphate 15.5%	107.1	kg(P_2O_5) ha^{-1}	16.67
Potassium sulphate 48%	57.1	kg(K_2O) ha^{-1}	40
Organic materials			
Sugar beat waste	14.28 Mg	Mg ha^{-1}	100
Sugare beat waste + compost	(7.14 + 9.52 Mg)	Mg ha^{-1}	600
Compost	19.04 Mg	Mg ha^{-1}	500
sunflower seeds	9.5	kg ha^{-1}	60
Canola seeds	9.5	kg ha^{-1}	60
Land preparation		Per ha	1800
Pesticides		Per ha	1800
Other fixed costs of deep tillage		Per ha	2850
Outputs			
Sunflower yield price			28000
Canola yield price			28000

Table (11b). Economical assessment of tested variables for the experiment.

Tillage methods	Organic materials	Grain yield Mg ha^{-1}		Total output LE ha^{-1}		Total input LE ha^{-1}		Net income LE ha^{-1}		I.R	
		Sunflower	Canola	Sunflower	Canola	Sunflower	Canola	Sunflower	Canola	Sunflower	Canola
S.T	**SBW**	3.257de	1.947e	91196	54516	16065	16065	75131	38451	5.7	3.4
	Comp.+SBW	3.480cd	2.123d	97440	59444	20111	20111	77329	39333	4.9	2.9
	Comp.	3.657cd	2.470b	102396	69160	24157	24157	78239	45003	4.2	2.9
D.T	**SBW**	4.417b	2.217cd	123676	62076	22848	22848	100828	39228	5.4	2.7
	Comp.+SBW	4.957a	2.283c	138.796	63924	28322	28322	110474	35602	4.9	2.3
	Comp.	5.190a	2.840a	145320	79520	30940	30940	114380	48580	4.6	2.5

The investment ratio values increased due to applied sugar beat waste by 16.32% and 35.7% than the investment ratio values by applying either mixed sugar beat waste and compost or compost alone treatments during the summer season for sunflower crop. Moreover, the same trend was noticed in the winter season for canola crop.

Thus, by applying sugar beat waste (SBW) was incremented by 17.2 than investment ratio values by applying either mixed SBW and compost or compost alone treatments for canola crop. It was noticed that the difference in investment ratio values between the organic materials for both two crops may be due to the different prices of organic materials. As the sugar beat waste was considered as low economic value. As well as the same behavior was achieved between the two tillage methods. It took into consideration, that the investment ratio values obtained by applying deep tillage practice were lesser than by applying surface tillage practice for all treatments. This result was produced because of the high price of deep tillage practice.

It was obvious, from the previous data that the S.B.W mixed with compost or compost alone with the deep tillage practice has higher costs, lower the return, and decreased the economic efficiency.

CONCLUSION

Under the same experimental conditions, data indicated that the application of compost markedly improved sunflower and canola yields with both tillage methods. As well as, the elements components of both plants and the available nutrients of calcareous soil were ameliorated by applying the organic materials treatments in ascending order applying compost, mixing SBW with compost, and compost alone for the two crops and two tillage methods.

However, the obtained results revealed that the highest net income was ascertained as monition above. However, investment ratio (economic efficiency) values increased due to applied sugar beat waste alone due to it was considered a low economic value by-product. More detailed research must done on a narrower range of applied sugar beat waste to formulate a better guideline to maintain sustainable agricultural production.

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تطبيق بعض أساليب الحراثة والمخلفات العضوية ذات القيمة الاقتصادية المنخفضة لتعزيز إنتاجية التربة الجيرية وبعض المحاصيل الزيتية

عزة رشاد احمد منى حفنى محمد قناوى محمد يحيى حلمى

حسين محمود خليل قدرية مصطفى العزب

معهد بحوث الأراضي والمياه والبيئة – مركز البحوث الزراعية– – جيزة– مصر.

لتقليل الفجوة الغذائية والعمل علي اجتياز الاكتفاء الذاتي من المحاصيل الزيتية يتطلب الأمر تحسين زراعة الأراضي الجيرية مع الاهتمام بتطبيق العمليات الزراعية، ومنها عملية الحرث مع إضافة مخلفات مصانع عضوية نباتية (منخفضة القيمة الاقتصادية) للتربة. لذلك تم إجراء تجربة بحثية في محطة البحوث الزراعية بالنوبارية محافظة البحيرة بزراعة محصول عباد الشمس صنف سخا 53 خلال الموسم الصيفي 2021، تلاه زراعه محصول الكانولا صنف سرو 4 خلال الموسم الشتوي 2022/2021 لدراسة تأثير تطبيق طريقتين من الحرث (حرث سطحي بعمق صفر– 30 سم من سطح التربة وحرث عميق بعمق صفر – 60 سم من سطح التربة)، مع إضافة مخلفات عضوية نباتية متمثلة في مخلفات بنجر السكر (قيمة اقتصادية منخفضة) بمفردها أو مخلوطة مع الكمبوست بنسبة 50% من الكميات المضافة من كل منهما (6 طن من مخلف بنجر السكر و 8 طن من الكمبوست)، أو الكمبوست بمفرده على بعض خواص وإنتاجية التربة الجيرية من محصولي عباد الشمس والكانولا.

أظهرت النتائج أن:

تطبيق معاملات طرق الحرث المختلفة مع المواد العضوية كان له أثر إيجابي معنوي على خفض قيم التوصيل الكهربائي ورقم الحموضة، وزيادة نسبة المادة العضوية، وزيادة تيسر عناصر النيتروجين والفوسفور والبوتاسيوم والزنك والحديد في التربة الجيرية قيد الدراسة بعد حصاد محصولي عباد الشمس والكانولا.

علاوة على ذلك، كان لأسلوب الحرث العميق تأثير معنوي أكبر من تأثير أسلوب الحرث السطحي بالنسبة لكل من إنتاجية محصولي عباد الشمس والكانولا، ونسبة الزيت في كلا المحصولين، ومحتوى البذور من عناصر الفوسفور والبوتاسيوم والزنك والحديد في كلا المحصولين.

أيضًا، أظهرت النتائج زيادة معنوية في إنتاجية التربة الجيرية من خلال إضافة المواد العضوية مع معاملات الحرث المختلفة، خاصة معاملة الحرث العميق مع إضافة الكمبوست التي أعطت أعلى إنتاجية محصوليه وأعلى نسبة زيت وأعلى محتوى من العناصر مقارنة بمعاملة الكنترول وباقي المعاملات الأخرى في كلا المحصولين.

تمت زيادة الكفاءة الزراعية (كجم محصول/كجم سماد)، وكذلك استخلاص عناصر النيتروجين والفوسفور والبوتاسيوم (%) في محصول بذور كل من عباد الشمس والكانولا بشكل ملحوظ من خلال تطبيق طريقتي الحرث السطحي والعميق (خاصة طريقة الحرث العميق) مع إضافة المواد العضوية للتربة. وكانت أعلى قيم الكفاءة الزراعية واستخلاص عناصر النيتروجين والفوسفور والبوتاسيوم في إنتاجية محصول بذور كل من عباد الشمس والكانولا عند إضافة الكمبوست، (مخلفات بنجر السكر + الكمبوست)، مخلفات بنجر السكر (قيمة اقتصادية منخفضة) تحت معاملة الحرث العميق مقارنة بمعاملة الكنترول على التوالي.

على الرغم من أن التقييم الاقتصادي للمعاملات المختبرة في هذه التجربة أظهر أن أعلى إرباحيه تم تحقيقها من خلال تطبيق معاملة الكمبوست مع الحرث العميق إلا أن أعلى كفاء اقتصادية تم تحقيقها من خلال تطبيق معاملة مخلفات بنجر السكر مع الحرث السطحي، وذلك نتيجة لانخفاض كل من القيمة الاقتصادية لمخلفات بنجر السكر وتكلفة عمليات الحرث السطحي.