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Effect of Soil Tillage System, Application of Organic and Biofertilizers on Economic Productivity of Wheat and Cowpea Crops

Megahed M. Amer[1*], Alaa El-Dein Omara[2], EL Sayed A. Gazia[1] and Hassan El-Ramady[3]

[1] Department of Soil Improvement and Conservation, Soils, Water and Environment Research Institute, Agricultural Research Center, Giza 12112, Egypt
[2] Department of Agricultural Microbiology, Soils, Water and Environment Research Institute, Agricultural Research Center, Giza 12112, Egypt
[3]Soil and Water Department, Faculty of Agriculture, Kafrelsheikh University, Kafr El-sheikh University, Egypt

SOIL tillage (ST), applied organic and biofertilizers are considered essential agronomic practices that effect on soil sustainability and have a direct impact on economic productivity. Hence, field experiments were conducted during three growing successive seasons (winter 2019, summer 2020 and winter 2021) to study the effect of soil tillage, applied organic and biofertilizers on economic productivity of wheat and cowpea crops. The experimental treatments were arranged in split plot design with three replications. The main plots were occupied by soil tillage, T_1 (tillage for three seasons), T_2 (tillage in 1st and 2nd season, but non-tillage in the 3rd season), T_3 (tillage in 1st and non-tillage in 2nd season and 3rd season and T_4 (non-tillage for three seasons). The sub plots were devoted to without treatment, compost, beneficial microorganisms (BM) and compost + BM. According to the experiment's findings, compost and biofertilizer had a significant impact on the grain and straw yield of wheat and cowpea. Grain and straw yield of wheat were highly significant increased by application of compost, biofertilizer and recorded highest values (4.993 Mg ha^{-1}) with T_3 and straw (5.313 Mg ha^{-1}) due to the interaction between T_1 X bio and compost for 1st season. While, grain (5.326 Mg ha^{-1}) with T_4 and straw (5.346 Mg ha^{-1}) with T_3 X bio and compost for 3rd season, due to the interaction between T and C + BM. Yield of cowpea were highly significant increased due to the interaction between the tillage and soil application. Where, grain yield of cowpea was recorded highest values (4.188 Mg ha^{-1}) with T_2 or T_3 and both of biofertilizer and compost. Also during the 2nd season, the same trend was observed for the straw yield of cowpea (4.788 Mg ha^{-1}) with T3 and application of biofertilizer + compost. Total income of wheat yield was recorded highest value (29530 LE ha^{-1}) using T_1 and compost + biofertilizer (1st season). Income wheat yield was recorded highest values with T_4 and bio-application (1st season). Total income yield of wheat during 1stseasonwas recorded highest value (29530 LE ha^{-1}) with T_1 and compost + biofertilizer. Total income of wheat 2nd season can be arranged in the following order $T_1 > T_2 > T_3 > T_4$. Net income yield wheat 2nd season can be put in descending order $T_2 > T_3 > T_4 > T_1$. From our results, it can be concluded that the negative economic productivity of wheat and cowpea in salt-affected soil can be remedied through the joint application between compost + biofertilizer and soil tillage.

Keywords: deficit irrigations; acidified biochar; arid soils; NPK uptake; proline.

1. Introduction

Wheat is becoming increasingly important because it is one of the most important cereal crops and a basic source to individual food. Wheat production in Egypt was estimated to be 9.7 million tonnes in 2023. The Egyptian population consumes around 20 million tons of wheat annually, whereas importing a little over half of that amount (Central Agency 2024). The final technical report of the National Campaign to promote the wheat crop for the 2023/2024 season revealed that the area planted with wheat is 3.25 million fed., producing 9.4 million tons with an average productivity of 6.948 Mg ha^{-1}. It

*Corresponding author e-mail: megahedamer3@gmail.com
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is an urgent necessity to meet the rapid increase of humanity on food and water.

Tillage has been an important aspect of technological development in the evolution of agriculture, in particular in food production. The objectives of soil tilling include seedbed preparation, water and soil conservation and weed control. Tillage has various physical, chemical and biological effects, which lea to beneficial and/or degradation, depending on used method (Euteneuer and Butt 2025). The physical effects (i.e., aggregate-stability, infiltration rate, soil and water conservation) have direct influence on soil productivity and sustainability (Euteneuer et al. 2024). Different tillage practices showed that they influenced soil physical and chemical properties along with the improvement of soil organic matter (SOM) status under different crop production (El-Ramady et al. 2019; Amer et al. 2023a). Tillage have also its own positive and negative influence on residue incorporation conserved moisture in the soil and other soil properties like, soil pH, soil organisms, water holding capacity, soil structure and bulk density (Janke and Papendick 1994). Decreasing the tillage or no-till (NT) has the potential to decrease the amount of soil organic carbon (SOC) lost from the profile by decreasing the turnover rate of macro-aggregates, increasing the physical protection of particulate organic material, and reducing soil to residue contact (Fuentes et al. 2009). No-tillage system has increased in the world because of the need to reduce costs, to establish winter crops timeously and because of perceived environmental benefits (Liu et al. 2025). However, the main objective of the use of non- ploughing tillage is to reduce the costs of production whilst maintaining or increasing yields (Wang et al. 2025). Reduced costs take the form of savings of time and machinery. Thus, there should be fewer or faster cultivation passes at a shallower depth than under normal ploughing, giving a minimum tillage system. Environmental benefits of these systems include reductions in soil erosion, nitrate leaching and fuel use, increased soil organic matter and improved soil structure (Yang et al. 2024). According to Govaerts et al. (2008), ST affects the sustainable use of soil resources through its influence on soil properties. Proper use of tillage can improve soil related constraints, while improper tillage may cause a range of undesirable processes. Conservation tillage like no tillage had been reported to improve the properties of the soil. ST is among the important factors affecting soil properties and crop yield. Among the crop production factors, tillage contributes up to 20% (Kandeler et al, 1999). Mitchel et al. (2016) reported that soil tillage systems could have advantages and disadvantages in different situations, but there is no an ideal single system in all soil, climate and crop conditions.

Organic substances play very important role on soil physical, chemical and biological characteristics (Amer et al 2023b), as well as soil productivity and sustainability (Amer and Hashem 2018; Aiad 2019; Amer et al. 2020). Addition of organic matter to salt-affected soils significantly effects on physical and chemical properties as well as plant growth and crop yield. This reason may back to the release of organic acids from decaying of organic matter, which dissoluble and liberate more calcium compared to the exchangeable sodium (Rashed et al. 2022; El-Ramady al. 2022). Application of biofertilizer improved soil physical properties and yield in salt-affected soil (Amer et al. 2023b).

Therefore, this study was carried out to evaluate no-tillage practice under salt-affected soils. This practice was studied along with applied organic and biofertilizers for economic productivity of wheat and cowpea crops. This work also will answer about the economic issues of such agricultural practices to support the local farmers to avoid the problems of negative economic productivity under salt-affected soil conditions.

2. Materials and Methods

A surface soil sample was collected for the experimental farm of the Faculty of Agriculture, Benha University, Egypt (31^{o} 13′ 24.4″ E and 30^{o}; 21′ 22.2″ N). This sample was air dried, crushed and sieved via a 2 mm sieve then analyzed for its physical and chemical properties according to Klute (1986) and Sparks *et al.* (2020), respectively. The obtained results are shown in Table 1.

2.1. Location

Field experiments were conducted in the Sidi Salem region (31°19'47.6"N and 30°46'26.6"E), Kafr El-Sheikh, Egypt, for three growing seasons: winter 2019/2020 (wheat, Cv. Sakha-95), summer 2020 (cowpea, Cv. Kafrelsheikh), and winter 2020/2021 (wheat, Cv. Sakha-95). The purpose of the experiments was to investigate the effects of soil tillage and the application of organic and beneficial microbes on the physical, chemical, and biological characteristics of the soil as well as its productivity. Analyses of the physical and chemical properties of the soil sample showed that clayey soil, pH 8.10, $CaCO_3$ 2.05 %, EC 4.15 dSm^{-1}, ESP 13.15% and OM 16.5 g kg^{-1}.

2.2. Compost and biofertilizers (Beneficial Microorganisms)

From Sakha Research Station, SWERI, Egypt, compost (C) and biofertilizers (bio) were supplied which used as soil additives. In accordance with **(Marinari et al., 2000),** compost was scattered over the soil surface for the no-tillage treatments and applied to the soil at a rate of 10 tons ha^{-1} during the plowing process at a depth of 20 cm for the tillage treatments. The compost analysis that was carried out is described in Table 1.

TABLE 1: Different characteristics of compost used

Parameter	Value	Parameter	Value
pH	8.21	**Organic Carbon (%)**	20.11
EC (dS m^{-1})	4.25	**C/N ratio**	15.01
Bulk density (kg m^{-3})	550	**K content (%)**	1.53
Moisture content (%)	35	***Salmonella* sp.(account)**	0.0
N content (%)	1.62	***Escheria coli* (account)**	0.0
P content (%)	0.45	**Germination (%)**	93.15

For beneficial microorganisms, two strains of *Azospirillum lipoferum* SP2 and *Bradyrhizobium* sp. (TAL-169) were employed as helpful microorganisms for BM. *A. lipoferum* was cultivated on a semi-solid malate medium **(Döbereiner and Day, 1976),** while *Bradyrhizobium* sp. was cultivated on yeast extract mannitol media **(Vincent, 1970).** A mixture of strains (1:1) was prepared as peat-based inoculums using 50 g of the sterilized carrier and 100 mL of 10^8 CFU ml^{-1} from each culture. The seeds were then combined for 20 minutes before being applied on a plastic sheet away from the sun.

2.3. Field Experiment

The field experiment (48 plots) had been set up for a winter wheat–summer cowpea rotation system before the trial began. Three replicates were used in the split-plot design of the experiment. Four primary plots were used: (T_1) three seasons of conventional soil tillage (T_2); first and second season tillage (T_3); first season tillage; (T_4) three seasons of no-tillage. The subplots (soil additions) were conditioned as follows: without treatment (control), compost (C), bio fertilizers (bio), and C + bio. The Field Crops Research Institute, SARS, Kafr El-Sheikh, Egypt, provided the wheat seeds, which were sown at a rate of 140 kg ha^{-1}, using normal drilling techniques on November 20 and 25, 2020, throughout seasons 1. There were 20 rows in each plot for the soil tillage treatments, each measuring 3 m in width and 3.5 m in length. The rows were spaced 15 cm apart, and there was a 1 m gap between replication. K fertilizer was added at a rate of 120 kg ha^{-1} as potassium sulfate (48% K_2O) and P fertilizer at a rate of 360 kg ha^{-1} as calcium superphosphate (15.5% P_2O_5) after soil tillage. Two different rates of urea (46.5% N) were applied: a complete dose (360 kg ha^{-1}) for the majority of treatments, and two-thirds of a full dose (240 kg ha^{-1}) divided into two equal doses (before to the first and second irrigations) for bio fertilizers (BM-inoculated treatments). The Horticulture Research Institute, SARS, Kafr El-Sheikh, Egypt, provided the cowpea seeds, which were planted on May 20, 2020, at a rate of 75 kg ha^{-1}. Each plot had five ridges, each measuring 4 m in length and 60 cm apart, for soil tillage treatments. Each hole received three seeds, with one meter separating each replication. During soil tillage, 360 kg of P and 120 kg of K were disseminated and assimilated, respectively. For the majority of treatments, urea was administered at a full dosage (100 kg ha^{-1}), but for bio-inoculated treatments, one-third of a complete dose (35 kg ha^{-1}) was divided into two equal doses (before to the first and second irrigations).

2.4. Measurements and Analyses

Total return (LE ha^{-1}), net return (LE ha^{-1}) and economic efficiency were used to run the economic evaluation

1- Total cost (LE ha^{-1}) = fixed cost (LE ha^{-1}) + variable cost (LE ha^{-1})

2 -Total income (LE ha^{-1}) = grain yield x price + straw yield x price

3 -Net income = Total income (LE ha^{-1}) - total costs (LE ha^{-1})

4- Benefit cost ratio (BCR) = Total income (LE ha^{-1}) /total cost (LE ha^{-1})

2.5. Statistical Analyses

Data were statistically analyzed using Co Stat statistical software, version 6.303. The various treatments were compared using ANOVA. Multiple comparisons were performed via Tukey's range tests at $p \leq 0.05$ **(Gomez and Gomez 1984).**

3. Results

3.1. Wheat yield

The results in Table (2) indicates that grain and straw yield of wheat was highly significant affected by treatment of soil tillage T1, T2, T3 and recorded lowest values with T4 during 1st season and 3rd season. On the other hand grain and straw yield of wheat were recorded highest values with soil tillage (T_1) during 1st season and 3rd season. Also data showed that grain and straw yield of wheat highly significantly increased with soil application of bio or compost and recorded highest values (4.99 and 5.28 ton ha^{-1}) for 1st season and (5.29 and 5.32 ton ha^{-1}) for 3rd season with application of (compost +

biofertilizer). Table (2) shows that grain and straw yield of wheat were highly significant increased due to the interaction between the treatment of tillage and soil application. And grain yield of wheat was recorded highest values (4.993 ton ha^{-1}) with T3 and straw (5.313 ton ha^{-1}) with T1 x bio and compost for 1^{st} season while, grain (5.326 ton ha^{-1}) with T4 and straw (5.346 ton ha^{-1}) with T3 x bio and compost for 3^{rd} season.

3.2. Cowpea yield

Table (2) indicates that grain and straw yield of cowpea was increased due soil tillage of T1, T2, T3 and recorded lowest values with T1 during 2^{nd} season. Also, data showed that grain and straw yield of cowpea was highly significant increased with soil application of bio or compost and recorded highest values with application of (compost + biofertilizer). Grain and straw yield of cowpea were highly significantly increased due to the interaction between the treatment of tillage and soil application, where grain yield of cowpea recorded highest values (4.188 ton ha^{-1}) with T2 or T3 and both of bio and compost. Also, cowpea straw yield was recorded (4.788 ton ha^{-1}) with T3 and (compost + biofertilizer) during 2^{nd} season, as show in Table (2).

TABLE 2: Grain and straw yield of wheat and cowpea(ton ha^{-1}) as affected by the interaction between tillage and soli application for winter, 2019/2020; summer, 2020 and winter, 2020/2021 growing seasons

Treatments		winter, 2019/2020		summer, 2020		winter, 2020/2021	
		Wheat Grain (ton ha^{-1})	Straw	Cowpea Grain	Straw	Wheat Grain	Straw
T_1	Control	4.897g	4.920i	1.590i	1.674g	5.171j	5.177k
	Bio	4.922e	5.065g	1.642e	1.8063f	5.197g	5.202i
	Compost(C)	4.935d	5.252c	1.711c	1.8593e	5.214f	5.220g
	C+ Bio	4.983b	5.313a	1.745a	1.8806b	5.326a	5.339b
T_2	Control	4.892g	4.920i	1.590i	1.672h	4.857 l	4.943l
	Bio	4.920e	5.061g	1.636f	1.804f	5.183h	5.215h
	Compost(C)	4.937d	5.248c	1.708d	1.859d	5.230e	5.242f
	C+ Bio	4.990a	5.288b	1.745a	1.878c	5.259d	5.283d
T_3	Control	4.893g	4.924i	1.347l	1.445j	4.619m	4.634m
	Bio	4.922e	5.059g	1.599h	1.673gh	5.181hi	5.214h
	Compost(C)	4.937d	5.233d	1.636f	1.813e	5.196g	5.245e
	C+ Bio	4.993a	5.286b	1.715b	1.995a	5.306b	5.346a
T_4	Control	4.123h	4.269j	1.399k	1.403m	4.400n	4.450n
	Bio	4.907f	5.049h	1.576 j	1.454l	5.156k	5.189j
	Compost(C)	4.954c	5.133f	1.600h	1.470j	5.180i	5.220g
	C+ Bio	4.991a	5.214e	1.609g	1.519i	5.265c	5.308c
F-test							
A		**	**	**	**	**	**
B		**	**	**	**	**	**
A x B		**	**	**	**	**	**

Notices: T1: conventional tillage (CT) for three seasons, winter 2019/2020; summer 2020 and winter 2020/2021 T_2; T2: CT in both of 1st season and 2^{nd} season where without T in 3^{rd} season, T_3: CT in 1^{st} season, non-tillage in both of 2^{nd} and 3rd season; T_4: non- tillage for three seasons

3.2. Economic productivity

3.2.1. Wheat yield of (season of 2019/2020)

Table (3) showed that the total income yield of wheat during season of 2019/2020 was recorded highest values (29530 LE ha^{-1}) with treatment of soil tillage (T1) and by soil application of compost + bio. In the other hand the lowest values (24306 LE ha^{-1}) was recorded with non-tillage (T4) and without of soil application. Also, the same data showed that the fixed cost recorded (11760 LE ha^{-1}). Total cost was recorded highest values (15840 LE ha^{-1}) with soil tillage and application of (compost + biofertilizer) during winter season 2019/2020. Whereas, the total cost recorded lowest values (11760 LE ha^{-1}) with no-tillage and without application of (compost + biofertilizer). Table (3) cleared that income yield of wheat was recorded highest values (17017 LE ha^{-1}) with treatment of (T4) no-tillage and treatment of bio application. Also, the same data pointed out that benefit cost ratio (BCR) was recorded highest values (1.43) due to non-tillage (T4) and treatment of bio-application. Consequently, the effect of treatments on total income of wheat (season of 2019/2020) values could be arranged in the descending order (compost + biofertilizer) > compost> bio >control. The net income and BCR were in the descending order of bio > (compost + biofertilizer) > C > control. The total income and net income of winter wheat 2020/2021 values could be arranged in the descending order (compost + biofertilizer) > C > bio > control. The BCR values were recorded in descending order bio >bio + C > C > control. The effect of soil tillage treatments on the total income values for winter wheat (season of 2019/2020) can be arranged in the following order: T1 > T3 > T2 > T4 for net income: T4 > T1 > T3 > T2 and BCR: T4 > T1, T2, T3

TABLE 3: Income, total income, total cost, net income and benefit cost ratio for wheat (winter 2019/2020)

Treatments		Income (LE ha^{-1})		Total income (LE ha^{-1})	Fixed cost (LE ha^{-1})*	Variable cost (LE ha^{-1})**	Total cost (LE ha^{-1})	Net income (LE ha^{-1})	BCR
		Grain	Straw						
T_1	Control	23799	4920	28719	11760	1800	13560	15159	1.12
	Bio	23920	5065	28985	11760	1920	13680	15305	1.12
	Compost (C)	23984	5252	29236	11760	3960	15720	13516	0.86
	C+ Bio	24217	5313	29530	11760	4080	15840	13690	0.86
T_2	Control	23775	4920	28695	11760	1800	13560	15135	1.12
	Bio	23911	5061	28972	11760	1920	13680	15292	1.12
	Compost (C)	23993	5248	29241	11760	3960	15720	13521	0.86
	C+ Bio	24251	5288	29539	11760	4080	15840	13699	0.86
T_3	Control	23779	4924	28703	11760	1800	13560	15143	1.12
	Bio	23920	5059	28979	11760	1920	13680	15299	1.12
	Compost (C)	23993	5233	29226	11760	3960	15720	13506	0.86
	C+ Bio	24265	5286	29551	11760	4080	15840	13711	0.87
T_4	Control	20037	4269	24306	11760	0	11760	12546	1.07
	Bio	23848	5049	28897	11760	120	11880	17017	1.43
	Compost (C)	24076	5133	29209	11760	2160	13920	15289	1.10
	C+ Bio	24256	5214	29470	11760	2280	14040	15430	1.10

- Price of grain and straw yield of wheat (4.86 and 0.85 LE kg^{-1})
- Fixed cost (a)*:cost of tillage, irrigation, seed, planting, workers, fertilizer, pesticide , harvesting and rent the soil, Where fixed cost were 11760, for production of winter wheat 2019/2020,
- Variable cost (b)**: including soil application (SA), Bio and compost (C), costs of compost were dividing in the three growing season

3.2.2. Yield of cowpea (summer season 2020)

Table (4) presents that total income was varied due to the different treatments, where total income was recorded highest values (75880) with treatment of soil tillage (T1) and soil application of C+Bio. Fixed cost was recorded (10800 LE ha^{-1}) during summer season 2020 and total cost was recorded lowest values (10800 LE ha^{-1}) due to non-tillage and without application of compost +Bio. On the other hand, the total cost was recorded highest values (14880 LE ha^{-1}) due to the treatment of soil tillage T1, T2) and with application of compost +Bio. Total income and net income of cowpea can be arranged in the following order T1 > T2 > T3 > T4. Table (4) shows that net income of cowpea records highest values (61000 LE ha^{-1}) with treatment of soil tillage (T1) and application of compost +Bio. Also the same data pointed out that benefit cost ratio (BCR) was recorded highest values (5.73) due to no-tillage (T3) and bio –application. BCR of cowpea can be arranged in the following order: T3 > T4 > T1 > T2. Total income and net income of cowpea, values could be arranged in the descending order bio + C > C >bio > control. Where BCR were recorded in descending order bio >bio + C > C > control

TABLE 4: Income, total income, total cost, net income and benefit cost ratio for cowpea (summer 2020)

Treatments		Income (LE ha^{-1}) Grain	Income (LE ha^{-1}) Straw	Total income (LE ha^{-1})	Fixed cost (LE ha^{-1})	Variable cost (LE ha^{-1})	Total cost (LE ha^{-1})	Net income (LE ha^{-1})	BCR
T_1	Control	68688	441.9	69129	10800	1800	12600	56529	4.49
	Bio	70920	476.9	71396	10800	1920	12720	58676	4.61
	Compost(C)	73908	490.8	74398	10800	3960	14760	59638	4.04
	C+ Bio	75384	496.4	75880	10800	4080	14880	61000	4.10
T_2	Control	68688	441.4	69129	10800	1800	12600	56529	4.49
	Bio	70668	476.2	71144	10800	1920	12720	58424	4.59
	Compost(C)	73782	490.7	74272	10800	3960	14760	59512	4.03
	C+ Bio	75384	495.8	75879	10800	4080	14880	60999	4.10
T_3	Control	58176	381.5	58557	10800	0	10800	47757	4.42
	Bio	69066	441.7	69507	10800	120	10920	58587	5.37
	Compost (C)	70668	478.6	71146	10800	2160	12960	58186	4.49
	C+ Bio	74088	526.7	74614	10800	2280	13080	61534	4.70
T_4	Control	60426	370.4	60796	10800	0	10800	49996	4.63
	Bio	68076	383.8	68459	10800	120	10920	57539	5.27
	Compost(C)	69120	388.1	69508	10800	2160	12960	56548	4.36
	C+ Bio	69498	401.0	69899	10800	2280	13080	56819	4.34

- Price of grain and straw yield of cowpea (14 and 0.001 LE kg^{-1}) in summer season of 2020,
- Fixed cost (a)*: cost of tillage, irrigation, seed, planting, workers, fertilizer, pesticide, harvesting and rent the soil, Where fixed cost were10800 cowpea in summer 2020 and.
- Variable cost (b)**: including soil application (SA),Bio and compost (C), costs of compost were dividing in the three growing season

3.2.3. Wheat Yield (2020/2021)

Table (5) shows that the total income yield of wheat during season of 2020/2021 was recorded highest values 29530 LE ha^{-1} with treatment of soil tillage (T1) and by soil application of compost + bio. On the other hand, the lowest values (24306 LE ha^{-1}) was recorded with no-tillage (T4) and without of soil application. Also the same data showed that the fixed cost recorded 11760 LE ha^{-1}. Total income of wheat 2020/2021 can be arranged in the following order T1 > T2 > T3 > T4. Total cost was recorded highest values (15840 LE ha^{-1}) with soil tillage and application of compost + bio during winter season 2019/2020.Where total cost recorded lowest values (11760 LE ha^{-1}) with no-tillage and without application of compost + bio. Table (5) cleared that income yield of wheat was recorded highest values (17017 LE ha^{-1}) with treatment of (T4) non-tillage and treatment of bio application. Also the same data pointed out that benefit cost ratio (BCR) was recorded highest values (1.43) due to no-tillage (ST4) and treatment of bio-application. Net income of winter wheat 2020/2021 can be put in descending order ST2 > T3 > T4 > T1. Where BCR of winter wheat 2020/2021: T2 > T3 > T4 > T1.

TABLE 5: Income, total income, total cost, net income and benefit cost ratio for wheat (winter 2020/2021)

Treatments		Income (LE ha^{-1})		Total income (LE ha^{-1})	Fixed cost (LE ha^{-1})	variable cost (LE ha^{-1})	Total cost (LE ha^{-1})	Net income (LE ha^{-1})	BCR
		Grain	Straw						
T_1	Control	30302	776.55	31078	12708	1800	14508	16570	1.14
	Bio	30454	780.3	31234	12708	1920	14628	16606	1.14
	Compost(C)	30554	783.0	31337	12708	3960	16668	14669	0.88
	C+ Bio	31210	800.85	32011	12708	4080	16788	15223	0.91
T_2	Control	28462	741.45	29203	12708	1800	14508	14695	1.01
	Bio	30372	782.25	31154	12708	1920	14628	16526	1.13
	Compost(C)	30647	786.3	31434	12708	3960	16668	14766	0.89
	C+ Bio	30817	792.45	31610	12708	4080	16788	14822	0.88
T_3	Control	27067	695.1	27762	12708	0	12708	15054	1.18
	Bio	30360	782.1	31142	12708	120	12828	18314	1.43
	Compost (C)	30448	786.75	31235	12708	2160	14868	16367	1.10
	C+ Bio	31093	801.9	31895	12708	2280	14988	16907	1.13
T_4	Control	25784	667.5	26451	12708	0	12708	13743	1.08
	Bio	30214	778.35	30992	12708	120	12828	18164	1.42
	Compost(C)	30354	783	31137	12708	2160	14868	16269	1.09
	C+ Bio	30852	796.2	31649	12708	2280	14988	16661	1.11

- Price of grain and straw yield of wheat (5.86 and 0.91LE/kg) for season 2020/2021. Fixed cost (a)*:cost of tillage, irrigation, seed, planting, workers, fertilizer, pesticide , harvesting and rent the soil,
- Where fixed cost were 12708LE $ha.^{-1}$ for production of winter wheat 2020/2021.
- Variable cost (b)**: including soil application (SA),Bio and compost (C) , costs of compost were dividing in the three growing season

4. Discussion

In developing countries, the trend towards reducing tillage operations is inevitable in sustainable agriculture in order to preserve crop yields as well as to preserve economic productivity of wheat and cowpea at salt affected soil. Grain and straw yield of wheat was highly significant affected by treatment of soil tillage systems (i.e., T1, T2, and T3) and recorded lowest values with T4 during 1st season and 3rd season. Grain and straw yield of wheat were recorded highest values with T1 during 1st season and 3rd season. Grain and straw yield of wheat was highly significant increased with soil application of bio or compost and recorded highest values with application of bio and compost during 1st season and 3rd season. Grain and straw yield of wheat were highly significant increased due to the interaction between the treatment of tillage and soil application. Grain yield of wheat was recorded highest values with T3 and straw with T_1 x bio + compost for 1st season, whereas grain with T4 and straw with T3 x bio + compost for 3rd season.

Grain and straw yield of cowpea was increased due soil tillage of T1, T2, T3 and recorded lowest values with T1 during 2nd season. Grain and straw yield of cowpea was highly significant increased with soil application of bio or compost and recorded highest values with application of bio and compost. Grain yield of cowpea was recorded the highest values with T_2 or T_3 and both of bio and compost, whereas straw yield of cowpea belonged T3 and application of bio + compost during 2nd season. Total income yield of wheat during season of 2019/2020 was recorded highest values with treatment of soil tillage (T1) followed by soil application of compost + bio. The lowest values was recorded with non-tillage (T4)

Total income yield of cowpea was recorded the highest value with treatment of soil tillage (T1) and soil application of C + bio. Net income of cowpea recorded the highest values with treatment of soil tillage (T1) and application of compost +Bio. Benefit cost ratio (BCR) was recorded highest values due to non-tillage (T3) and bio –application. Total income yield of wheat during season of 2020/2021 was recorded highest values. The lowest values was recorded with non-tillage (T4) and without of soil application. Income yield of wheat was recorded highest values with treatment of (T4) non-tillage and treatment of bio application. Benefit cost ratio (BCR) was recorded highest values due to non-tillage (T4) and treatment of bio application. Total income yield of wheat during season of 2020/2021 was recorded highest values with treatment of soil tillage (T1) and by soil application of compost + bio. In the other hand the lowest values was recorded with non-tillage (T4) and without of soil application. Income yield of wheat was recorded highest values with treatment of (T4) non-tillage and treatment of bio application. Benefit cost ratio (BCR) was recorded highest values due to non-tillage (T4) and treatment of bio application.

The decrease in the grain and straw yield of wheat during the first season can be explained by the no-tillage treatment, but it was a slight decrease compared to the plowing. However, the result of no-tillage for three seasons led to a decrease in the yield, but it is considered an indicator to measure and know the effect of the result of no-tillage for three seasons on the wheat yield as a treatment to preserve the soil and its organic carbon content and not compact the soil as a result of using heavy tillage machines and not depleting nutrients (Aiad 2019 and Amer and Hashem 2018). This can be done every period of soil cultivation as a way to save costs and increase farm income. It has been shown that plowing for two seasons is beneficial and then no-tillage. It was found that plowing for two agricultural seasons and then not plowing for a second season or vice versa had a positive result on the crop and thus the costs of plowing the soil for one season every three seasons can be saved, which reduces the burden on the farmer and the increase in the grain and straw yield of the wheat crop under soil conditions is attributed to the role of organic and biological fertilizer in improving the physical, chemical and biological properties of the soil (Amer et al 2023a), which was reflected in increasing the soil's ability to supply and provide water and food for the plant and thus the economic yield, total return, net return and the ratio of benefits to costs. The increase in the total return of the wheat crop during the first season is attributed to the addition of organic fertilizer with plowing. The increase in the total return of wheat can be explained as a result of not treating the plowing and not increasing the crop. As for cowpea, the best treatment is the result of plowing for two seasons with the addition of organic and biological fertilizer, and it is preferred in legume crops when planting.

5. Conclusion

Based on the results of our short-term study, the combination treatment (no-tillage and (compost + biofertilizer)).Grain and straw yield of wheat were highly significant increased by application of compost, bio and recorded highest values due to the interaction between T_1 x (compost + biofertilizer) for 1st season while grain with T_4 and straw with T_3 and (compost + biofertilizer) for 3rd season. Grain and straw yield of cowpea were highly significant increased due to the interaction between the treatment of tillage and soil application .Where grain of cowpea was recorded highest values with T_2 or T_3 and both of (compost + biofertilizer). And also, straw of cowpea with T_3 and application of bio + compost during 2nd season. Total income wheat yield recorded highest values with T_1 and compost + bio.Income wheat yield was recorded highest values with T_4 and bio application 1st season. Total income of wheat 2nd season can be arranged in the following order $T_1 > T_2 > T_3 > T_4$. Income yield of wheat recorded highest values with non-tillage T_4 and bio. BCR was recorded highest values due to (T_4) and bio. Total income cowpea yield was recorded highest values with ST_1 and C+ bio. Net income of cowpea was recorded highest values with ST_1 and compost + bio. Total income and net income of cowpea can be arranged in the following order $T_1 > T_2 > T_3 > T_4$. Benefit cost ratio (BCR) of cowpea recorded highest values (5.73) due to non-tillage (T_3) and bio – application. BCR of cowpea can be arranged in the following order: $T_3 > T_4 > T_1 > T_2$. Total income and net income of cowpea, 2020 values could be arranged in the descending order; bio + C > C > bio > control, whereas BCR were recorded in descending order; bio > bio + C > C > control. From our results, it can be concluded that the negative economic productivity of the soil affected by salinity can be remedied through the joint application between (compost + biofertilizer) treatment and soil tillage.

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