Effect of Short Term Management of Soil Organic Carbon Build up and Organic Residues Types on Some Soil Properties and Barleys Yield Under Saline Stress

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Abstract. A field experiment was carried out for three season 2017, 2018 and 2019 to investigate the role of some types of organic field residues (crop, tree and shrubs and orchard residues) in soil organic carbon built up and improving the soil fertility within conditions of salt stresses. Treatments were added based on their organic carbon content, to reach 1.0%, supplementing the organic carbon already present in the soil. The results showed that the percentage of loss in organic carbon differs according to the added organic residues. The percentage of the organic carbon remaining in the soil for season 2017 after harvest was 0.542%, 0.794%, 0.728% and 0.642% for control, crop residues, tree residues and shrubs and residues of orchards, respectively. In order to maintain the organic carbon ratio up to 1.0%, it was necessary to add organic residues in the following season 2018 in quantities of 0.742, 1.074 and 1.537 kg / m², down from the initial addition in 2017 by 55.79%, 41.63% and 23.18%. In the 2019 season, the addition amounted to 0.537, 0.691 and 1.108 kg / m², down from the initial addition in 2017 by 68.03%, 62.44% and 44.64% for the treatments, crop, tree and shrubs and orchard residues, respectively. The addition of orchard residue treatment showed a significant difference in the yield of straw and grains in all years of implementation of the experiment, at a rate of 18.67%, 7.38% and 11.22% in 2017, with a rate of 13.68%, 1.74% and 8.67% in 2018, at a rate of 17.11%, 3.44% And 6.59% in 2019 for control, tree and shrubs residues and crop residues, respectively. The addition of organic wastes improved the soil fertility for three years of study, as the salinity decreased by 16.65% and the total nitrogen, organic carbon, available nitrogen, available potassium and available phosphorus increased by 22.91%, 42.36%, 33.01%, 30.86% and 32.95%, respectively.

1. Introduction

Organic matter is one of the most important essential components of soil and represents the most complex part which consists of different type of organic compounds and interferes with the mineral part of soil to form soil aggregate [1]. Recalcitrance and accessibility of soil organic
matter to decomposition, dissolution, and decay depends on the interactions and interference between the organic matter and the rest of other soil components [2]. The organic matter in the soil consists of the hums, which represent the most stable part of SOC in the soil and it is complex compound rich in phenolic compounds [3], [4]. In addition, other components of organic matter in soil are: sugars, starches and proteins that represent rapidly decomposing substances in the soil and hemicellulose Cellulose, lignin, resins, and tannins, which represent slow-decomposing substances in soil, as well as Glomalin which produced by mycorrhizal fungi and Char, which represents incomplete burned plant remains, plant residues and organic waste [5]. In general, the presence of organic matter in soil is an essential element in determining soil fertility. As many studies have proven that adding organic matter increases soil fertility and improves its physical, chemical, and biological properties [6], as well as increasing plant resistance to stresses, as [7] mentioned that adding different types of organic matter increased the efficiency of the reclamation of salts affected soil and also contributed in increase resisting plants to salt stresses. The need to increase soil content of organic carbon emerged as one of the solutions to reduce carbon dioxide in the atmosphere and a positive contribution to reducing global warming. The soil plays an important role in the ecosystem as a self-regulator that preserves the environmental conditions necessary for the sustainability of plant and animal life, the accumulation of organic carbon in the soil depends largely on vegetation cover and that any change in land use will contribute significantly to changing the properties of the soil, either as a source of Greenhouse gases emission or sink to reduced greenhouse gases emission [8]. The earth's surface, represented by soil, can be a large storehouse of carbon and contribute to reduction of atmospheric CO2. According to statistics obtained from international sources, [9] showed that 720-750 KT of carbon is present in the atmosphere and 550-835 KT of carbon is present in the plant biomass. In contrast, the organic matter in the soil contains 1200-2200 KT of carbon and the soil in dry regions, it may contain an addition of carbon, up to 700-946 Kt. of carbon. The organic matter is in overlapping and varied stages of decomposition, and its values generally range from 2 g / kg as in desert soils to 800 g / kg as in organic soils and in agriculturally exploited soils whose values range between 10-40 g / kg. The soils containing 1-2% of by weight organic matter were considered lands with average content of organic matter, while the soils containing less than 1% of by weight organic matter were considered poor lands with organic matter. Therefore, this research aims to Study the effect of increasing the organic carbon content in the soil of three season by using three types of field plant residues on some soil properties and barleys yield under saline stress

2. Materials and methods

A field experiment was carried out on salt-affected land at the Tuwaitha site, Desertification Combat Station for the season 2017, 2018 and 2019, for the purpose of evaluating the addition of three types of agricultural waste, namely:

| Organic waste                  | O.C (%)  |
|-------------------------------|----------|
| 1- Orchard residues            | 31.67    |
| 2- Remnants of trees and shrubs| 34.33    |
| 3- Crop residues               | 37.75    |

The aforementioned plant residues were prepared in the summer season by air drying, then crushed with a grinder with holes of 1 cm² and samples were taken from them for the purpose of conducting chemical analyses. Table 1 shows the most important chemical characteristics of the plant residues used in the experiment.

In the winter season 2017, the selected area was prepared with plowing and smoothing, then a plot was identified with dirt mounds and a heavy irrigation was applied to make sure of homogenizing the salts in the soil. Then, after the drought, the land was subdivided into plots with dimensions of 5 * 5 m per plot and the total number of 12 plots.
The treatments of plant residues were added to the soil according to their organic carbon content of each of the organic waste in order to reach a level of 1.0% organic carbon for soil depth of 10 cm, taking into account the initial soil content of organic carbon. Completely randomized block design was applied with three replications. The organic waste was incorporated with soil inside the plot homogeneously, essential fertilizers were added according to the approved recommendations [10], Barley were planted and irrigated with water provided by well and specifications of well water are shown in Table 2.

The maintenance, weeding and service of the crop were implemented along with trial period of the planted plots, and the harvest took place at the end of plant season, after that the weights of the vegetative part of the plants,

Table (1) some chemical properties of the organic material used in the experiment

| Organic material | EC 1:5 | PH 1:5 | Total Anions gm kg⁻¹ | Total Cations gm kg⁻¹ | Total N gm kg⁻¹ | Total O.C | Available P mg kg⁻¹ | C/N |
|------------------|-------|-------|----------------------|-----------------------|--------------|-----------|-------------------|-----|
| Orchard residues | 1.35  | 7.35  | Na 0.39              | SO₄ 0.42              | 7.97         | 316.7     | 6.89              | 39.74 |
|                   |       |       | Ca 0.81              |                       |              |           |                   |      |
|                   |       |       | Mg 0.49              | Cl 0.39              |              |           |                   |      |
|                   |       |       | K 1.82               |                       |              |           |                   |      |
| Remnants of trees | 1.64  | 7.21  | Na 0.45              | SO₄ 0.38              | 7.77         | 343.3     | 15.62             | 44.18 |
| and shrubs       |       |       | Ca 0.86              |                       |              |           |                   |      |
|                   |       |       | Mg 0.59              | Cl 0.36              |              |           |                   |      |
|                   |       |       | K 1.09               |                       |              |           |                   |      |
| Crop residues    | 1.86  | 6.85  | Na 0.41              | SO₄ 0.53              | 5.82         | 377.5     | 20.31             | 64.86 |
|                   |       |       | Ca 0.85              |                       |              |           |                   |      |
|                   |       |       | Mg 0.60              | Cl 0.41              |              |           |                   |      |
|                   |       |       | K 1.95               |                       |              |           |                   |      |

Table (2) some chemical properties of water which used in the experiment

| EC dS m⁻¹ | pH | Na | Ca | Mg | Cl | SO₄ | HCO₃ | SAR | Class |
|-----------|----|----|----|----|----|-----|------|-----|-------|
| 3.46      | 7.16 | 14.46 | 4.68 | 5.51 | 15.22 | 11.02 | 0.48 | 6.40 | C4-S1 |

the weights of grains and the biological characteristics of the crop were taken and soil samples were taken for the purpose of assessing the fertile status of soil after planting, measuring the remaining organic carbon content in the soil and making the necessary calculations to compensate for the lack of organic carbon, according to the type of treatment added, as detailed in the section results and discussion.
In the winter season of 2018, soil samples were taken from the plots that were used in the 2017 experiment from a depth of 0-10 cm. The organic carbon content in plot soil was determined and calculations were made to add the organic residues and according to the required amount of organic carbon to reach the content of 1.0% organic carbon in the soil with depth of 10 cm as explained in the section of results and discussion and all the process that made in 2017 season repeated in 2018 season.

Table (3) some of the physical and chemical characteristics of the soil used in the experiment

| Characteristics | Units | Value  |
|-----------------|-------|--------|
| EC 1:1          | dS m⁻¹| 8.25   |
| pH 1:1          |       | 7.31   |
| O.C             | %     | 0.534  |
| eq. CaCO₃       | %     | 21.05  |
| Available N     | mg kg⁻¹| 37.2   |
| Available K     | mg kg⁻¹| 42.1   |
| Available P     |        | 7.65   |
| Ca²⁺            |       | 0.53   |
| Mg²⁺            |       | 0.41   |
| Na⁺             |        | 1.53   |
| Cl⁻             |        | 1.41   |
| SO₄²⁻           | mmol kg⁻¹| 0.69 |
| HCO₃⁻           |        | 0.04   |
| CO₃²⁻           |        | Nil    |
| SAR             |        | 1.57   |
| Soil texture    | sand  | 292.01 |
|                 | silt  | 467.85 |
|                 | clay  | 240.14 |
|                 | Loam  |        |

*Chemical soil analyzes were performed according to Page et al (1982) [11]

**Soil texture was estimated according to (Day, 1965) described in (Black, 1965) [12]

In the winter season 2019, all the process that made in 2017, 2018 season were repeated in 2019. In all years that the experiment was applied, nitrogen fertilizers were added in the form of urea at rate of 200 kg h⁻¹ and TSP fertilizer at rate of 50 kg h⁻¹ to all treatments. The experiment was carried out with three replications. Therefore, the experiment included 12 experimental units according to complete randomized block design. All plots were irrigated with water, and the added water was calculated on the basis of 75% of the field capacity.

3. Results and discussion

3.1. Soil organic carbon content

The soil used in the experiment was poor in organic carbon content at the beginning of the experiment in 2017 season, reaching 0.534%, and that indicated the need to enhanced soil organic carbon (Table 3). The actual need for organic carbon to reach a percentage of 1.0% amounted to 0.466 regardless to all type of organic matter addition treatments and with regard to content of these organic residues of organic carbon. Differences in organic carbon content of plant residues led to a difference in the quantities to be added from these wastes in order to reach 1.0% soil organic carbon content, as shown in Table 4. The amount of organic waste added to reach 1.0% organic carbon was 1.679,
1.841 and 2.001 kg m\(^{-2}\) for crop residues, remnants of trees and shrubs and orchard residues respectively. 

Table 4 shows at the end of the 2017 planting season that the amount of residual organic carbon in the soil has decreased from the 1.0% added at the beginning of the experiment. The loss percentages of organic carbon differed according to the added organic residues. The percentage of residual organic carbon in the soil after harvest was 0.542%, 0.794%, 0.728% and 0.642% for control, crop residues, remnants of trees and shrubs and orchard residues respectively. These decreases in soil organic carbon from the target organic content may be attributed to difference in C/N ratio of added organic residues, as shown in Table I of properties of organic residues, and this is corresponding with [5].

Table 4. Organic carbon in the soil and organic residues added in the 2017 season

| Added organic matter | control | Crop residues | Remnants of trees and shrubs | Orchard residues |
|----------------------|---------|---------------|------------------------------|----------------|
| The percentage of organic carbon mainly present in the soil(%) | 0.534   | 0.534         | 0.534                        | 0.534          |
| The percentage of organic carbon added to reach 1.0% organic carbon | 0       | 0.466         | 0.466                        | 0.466          |
| The amount of organic carbon that must be added to reach a ratio of 1.0% in kg m\(^{-2}\) for a depth of 10 cm soil | 0.634   | 0.634         | 0.634                        | 0.634          |
| The amount of organic residues added to the soil in kg m\(^{-2}\) for a depth of 10 cm to reach an organic carbon content of 1.0% | 0       | 1.679         | 1.841                        | 2.001          |
| Residual organic carbon (%) | 0.542   | 0.794         | 0.728                        | 0.642          |
| The percentage of organic carbon that must be added to reach 1.0% | 0.206   | 0.272         | 0.358                        | 0.487          |
| The amount of organic carbon that must be added to reach 1.0% in kg m\(^{-2}\) for a depth of 10 cm soil for next season | 0       | 0.280         | 0.370                        | 0.487          |
| The amount of organic residues added to the soil in kg m\(^{-2}\) for a depth of 10 cm to reach an organic carbon content of 1.0% | 0       | 0.742         | 1.074                        | 1.537          |

In order to maintain the soil organic carbon in the range of 1.0%, it was necessary to add organic residues in the next season 2018 in quantities that vary according to the content of these residues of organic carbon, as indicated in Table 5, so the added organic residues were 0.742, 1.074 and 1.537 kg m\(^{-2}\), down from the initial addition in 2017 by 55.79%, 41.63% and 23.17% for crop residues, remnants of trees and shrubs and orchard residues respectively.

The decrease in organic carbon is due to the drought conditions, the high temperature in summer, and the high solar brightness that prevails in the climate of Iraq, which makes the added organic waste easily lose through the process of oxidation of organic matter [13].

At the end of the 2018 season, the percentage of residual organic carbon in the soil was 0.561%, 0.851%, 0.825% and 0.742% for control, crop residues, remnants of trees and shrubs and orchard residues respectively, with an increase in organic carbon amounting to 5.05%, 59.36%, 54.49% and 38.95% for control, crop residues, remnants of trees and shrubs and orchard residues respectively. In order to maintain a percentage of organic carbon in the range of 1.0%, it is necessary to add organic residues in the season 2019 in quantities that vary according to the content of these residues of organic carbon, as indicated in Table 6, they amounted to 0.537, 0.691 and 1.108 kg m\(^{-2}\), and this was a decrease from the initial addition in 2017 by 68.03%,
62.44% and 44.63% for the treatments crop residues, remnants of trees and shrubs and orchard residues respectively.

Table 5. Organic carbon in the soil and organic residues added in the 2018 season

| Added organic matter | Control | Crop residues | Remnants of trees and shrubs | Orchard residues |
|----------------------|---------|---------------|------------------------------|-----------------|
| The percentage of organic carbon mainly present in the soil (%) | 0.542   | 0.794         | 0.728                        | 0.642           |
| The percentage of organic carbon added to reach 1.0% organic carbon | 0       | 0.206         | 0.272                        | 0.358           |
| The amount of organic carbon that must be added to reach a ratio of 1.0% in kg m⁻² for a depth of 10 cm soil | 0.280   | 0.370         | 0.487                        |
| The amount of organic residues added to the soil in kg m⁻² for a depth of 10 cm to reach an organic carbon content of 1.0% | 0       | 0.742         | 1.074                        | 1.537           |
| Residual organic carbon (%) | 0.561   | 0.851         | 0.825                        | 0.742           |
| The percentage of organic carbon that must be added to reach 1.0% | 0.149   | 0.175         | 0.258                        |
| The amount of organic carbon that must be added to reach 1.0% in kg m⁻² for a depth of 10 cm soil for next season | 0       | 0.203         | 0.238                        | 0.351           |
| The amount of organic residues added to the soil in kg m⁻² for a depth of 10 cm to reach an organic carbon content of 1.0% | 0       | 0.537         | 0.691                        | 1.108           |

Results showed that the percentage of remaining organic carbon in soil after the end of the 2019 season was 0.569%, 0.887%, 0.874% and 0.805% for control, crop residues, remnants of trees and shrubs and orchard residues respectively, which showed an increase in soil organic carbon content compare to the primary content in 2017 by 6.55%, 66.11%, 63.67% and 50.74% for control, crop residues, remnants of trees and shrubs and orchard residues respectively.

Table 6. Organic carbon in the soil and organic residues added in the 2019 season

| Added organic matter | Control | Crop residues | Remnants of trees and shrubs | Orchard residues |
|----------------------|---------|---------------|------------------------------|-----------------|
| The percentage of organic carbon mainly present in the soil (%) | 0.561   | 0.851         | 0.825                        | 0.742           |
| The percentage of organic carbon added to reach 1.0% organic carbon | 0.286   | 0.149         | 0.175                        | 0.258           |
| The amount of organic carbon that must be added to reach a ratio of 1.0% in kg m⁻² for a depth of 10 cm soil | 0.203   | 0.238         | 0.351                        |
| The amount of organic residues added to the soil in kg m⁻² for a depth of 10 cm to reach an organic carbon content of 1.0% | 0       | 0.537         | 0.691                        | 1.108           |
| Residual organic carbon (%) | 0.569   | 0.887         | 0.874                        | 0.805           |
| The percentage of organic carbon that must be added to reach 1.0% | 0.113   | 0.126         | 0.195                        |
The amount of organic carbon that must be added to reach 1.0% in kg m\(^{-2}\) for a depth of 10 cm soil for next season

|          | 0   | 0.154 | 0.171 | 0.265 |
|----------|-----|-------|-------|-------|
The amount of organic residues added to the soil in kg m\(^{-2}\) for a depth of 10 cm to reach an organic carbon content of 1.0%

|          | 0   | 0.407 | 0.498 | 0.837 |

3.2. Plant growth indicators:

Results in Table 7 indicated that the addition of organic material residues led to an increase in the vegetative growth and grain yield of the barley regardless of type of organic residues added in all seasons of the experiment compared to the treatment not add any type of organic waste. The rate of increase in straw yield was 10.81%, 6.73% and 10.04% for the seasons 2017, 2018 and 2019, respectively. The percentage of increase in cereals was 15.08%, 19.31% and 22.65% for the seasons 2017, 2018 and 2019, respectively. This may be due to the role of organic matter in improving plant growth conditions, increasing soil fertility, and reducing the effect of salt stress, as mentioned by many researchers [14] and [15]).

The treatment of adding orchard residues showed a significant superiority in the yield of straw and grains over the treatments of crop residues, trees and shrubs by 18.67%, 7.38% and 11.22% in 2017, and by 13.68%, 1.74% and 8.67% in 2018, with a rate of 17.11%, 3.44 % And 6.59% in the year 2019 comparison with control, tree and shrub residues and crop residues, respectively. This may be due to the fact that the nitrogen content of orchard residues is higher than the rest of the other organic remains, as shown in Table 7 Cereals and straw of barley (ton / hectare ) with adding crop residues, remnants of trees and shrubs and orchard residues for season 2017, 2018 and 2019

| Treatment                        | 2017 Straw | 2017 Cereals | 2018 Straw | 2018 Cereals | 2019 Straw | 2019 Cereals |
|----------------------------------|------------|--------------|------------|--------------|------------|--------------|
| Control                          | 7.816      | 2.872        | 8.216      | 2.892        | 8.272      | 2.996        |
| Crop residues                    | 8.58       | 3.232        | 9.016      | 3.396        | 9.152      | 3.604        |
| Remnants trees and shrubs        | 8.256      | 3.148        | 8.416      | 3.204        | 8.908      | 3.472        |
| Orchard residues                 | 9.148      | 3.536        | 8.876      | 3.752        | 9.248      | 3.948        |
| Straw LSD 0.05                   | 0.326      | 0.318        | 0.2796     |              |            |              |
| Cereals LSD 0.05                 | 0.2928     | 0.3436       | 0.2832     |              |            |              |

3.3. Soil fertility indicators:

The results of Tables 8, 9, and 10 showed that the soil fertility indicators improved as a response of the addition of various types of organic residues. The addition of organic wastes led to a clear decrease in soil salinity values over the season of the study 2017, 2018 and 2019, respectively, compared to the control treatment when not adding any type of organic waste, and the decrease was 11.88%, 10.37% and 27.70%. The addition of organic waste led to an increase in the total nitrogen values by 23.99%, 23.56% and 21.17%, an increase in the organic carbon content by 33.08%, 43.67% and 50.32%, an increase in the available nitrogen content by 28.12%, 34.28% and 36.63%, as well as an increase in available potassium by 29.37%, 24.99% and 38.23% and an increase in available phosphorus by 23.64%, 35.13% and 40.10% for the season 2017, 2018 and 2019, respectively.
Table 8: Soil chemical characteristics when adding crop residues, remnants of trees and shrubs and orchard residues after harvest for season 2017

| Characteristics       | Unite   | Control | Crop residues | Remnants of trees and shrubs | Orchard residues | LSD 0.05 |
|-----------------------|---------|---------|---------------|-------------------------------|------------------|----------|
| EC 1:1                | dS m⁻¹  | 3.45    | 3.05          | 2.95                          | 3.12             | 0.335    |
| pH 1:1                |         | 7.24    | 7.15          | 7.28                          | 7.24             | 0.552    |
| Total N              | %       | 0.0489  | 0.0545        | 0.0634                        | 0.0640           | 0.00587  |
| O.C                  | %       | 0.542   | 0.794         | 0.728                         | 0.642            | 0.0471   |
| C/N                  |         | 11.08   | 14.56         | 11.48                         | 10.03            | 1.042    |
| Avail. N             | mg kg⁻¹ | 51.67   | 60.81         | 66.74                         | 71.05            | 4.943    |
| Avail. K             |         | 101.35  | 125.36        | 129.68                        | 138.31           | 8.468    |
| Avail. P             |         | 7.98    | 8.74          | 9.85                          | 11.01            | 1.689    |

These results are in agreement with many researchers who have pointed out the important role of organic matter in improving soil properties and increasing its content of nutrients that needed by plants in different growth stages, as well as the contribution of decomposition products of added organic matter in increasing the available of nutrients that are difficult to absorb by plant in the conditions of Iraqi soils which known of their low organic matter content. [13], [18]and [19].

Table 9: Soil chemical characteristics when adding crop residues, remnants of trees and shrubs and orchard residues after harvest for season 2018

| Characteristics       | Unite   | Control | Crop residues | Remnants of trees and shrubs | Orchard residues | LSD 0.05 |
|-----------------------|---------|---------|---------------|-------------------------------|------------------|----------|
| EC 1:1                | dS m⁻¹  | 3.02    | 2.87          | 2.54                          | 2.71             | 0.271    |
| pH 1:1                |         | 7.15    | 7.22          | 7.28                          | 7.19             | 0.272    |
| Total N              | %       | 0.0512  | 0.0584        | 0.0643                        | 0.0671           | 0.00585  |
| O.C                  | %       | 0.561   | 0.851         | 0.825                         | 0.742            | 0.0326   |
| C/N                  |         | 10.96   | 14.57         | 12.83                         | 11.06            | 1.486    |
| Avail. N             | mg kg⁻¹ | 53.33   | 67.72         | 70.95                         | 76.17            | 5.638    |
| Avail. K             |         | 99.28   | 121.22        | 119.98                        | 131.08           | 9.453    |
| Avail. P             |         | 8.15    | 9.24          | 11.13                         | 12.67            | 1.302    |

Table 10: Soil chemical characteristics when adding crop residues, remnants of trees and shrubs and orchard residues after harvest for season 2019

| Characteristics       | Unite   | Control | Crop residues | Remnants of trees and shrubs | Orchard residues | LSD 0.05 |
|-----------------------|---------|---------|---------------|-------------------------------|------------------|----------|
| EC 1:1                | dS m⁻¹  | 3.14    | 2.25          | 2.21                          | 2.35             | 0.387    |
| pH 1:1                |         | 7.20    | 7.23          | 7.27                          | 7.09             | 0.122    |
| Total N              | %       | 0.0543  | 0.0598        | 0.0664                        | 0.0712           | 0.0070   |
| O.C                  | %       | 0.569   | 0.887         | 0.874                         | 0.805            | 0.0273   |
| C/N                  |         | 10.48   | 14.83         | 13.16                         | 11.31            | 1.484    |
| Avail. N             | mg kg⁻¹ | 53.97   | 69.23         | 73.11                         | 78.88            | 4.579    |
| Avail. K             |         | 97.25   | 132.6         | 128.7                         | 142.0            | 5.864    |
| Avail. P             |         | 8.37    | 9.92          | 11.85                         | 13.41            | 1.232    |
4. Conclusions
It is possible to benefit from the organic waste that is considered to be the remains of caring for orchards, parks and gardens, or the remnants of field crops, which is often a problem that needs funding for the purpose of disposal or burning. These wastes can be recycled to the lands affected by salts after carrying out some operations and treatments in order to be easy to handle, transport and use, as the results indicated can increase the percentage of organic carbon in the soil, which leads as a result to improving soil properties and increasing its resistance to salt stresses. Although all the organic wastes used in the experiment led to an increase in the organic carbon content of the soil, increase the yield and improve the fertile soil characteristics, but it showed some differences in the quality of the organic matter used. As the orchard residues were the best in increasing the yield and grain production, but they were the least in the accumulation of organic carbon at the end of the experiment. The residues of the yield also showed an accumulation of organic carbon more than the rest of the organic waste used in the experiment, although it was not the best in increasing soil productivity than yield and grains. Therefore, we recommend an increase in research and studies in the use of other sources of organic matter or organic waste that are more efficient in increasing soil productivity (yield and grains) and at the same time be more efficient in increasing the accumulation of organic carbon and improving soil fertility

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