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Studying the Effect of Carbon Dioxide on Truck Waste Due to the Moderate Morphology of Plants

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Abstract:

Biochar is defined as the solid carbon-rich residue obtained from the thermal decomposition of plant-derived biomass in the absence of oxygen or in the case of partial oxygen. It has been proven that the application of biochar in soil sequesters carbon, reduces greenhouse gas emissions and improves soil fertilization. It has also been proven that biochar has a very high capacity and ability to absorb organic pollutants due to its large surface area and high degree of porosity, as soil is considered the best medium for retaining carbon and at the same time a means of removing greenhouse gases.

The study was conducted for the period from the beginning of January 2022 to the end of April 2022. The As plant was used in the production of biochar and the palm fronds, sunflower seeds and olive pits were used in the production of NPK. Its effect on the morphological characteristics of corn and fava beans was studied by adding different concentrations of it in addition to the natural NPK that was produced to 6 groups of the two plants.

The study concluded that biochar had a positive effect on the germination rate for both types of plants under the experiment (corn, broad beans). The highest rate of stem length for corn and broad beans was achieved in sample (1-1) 1 gm myrtle and 1 gm natural (NPK) nutrients, where it reached

6.6 cm for corn and 40 cm for broad beans, and the lowest rate was in the Blank samples in anvils No. 1 and 5 for corn, while for broad beans, the lowest rate of stem length was recorded in anvil No. 5 for the Blank sample 16 cm for artificial fertilizer.

Introduction:

Biochar is defined as the solid carbon-rich residue obtained from the pyrolysis of plant-derived biomass in the absence of oxygen or in the presence of partial oxygen (Thines et al., 2017). It is specifically used as a soil improver and its properties depend on the quality and nature of the original biomass (chemical composition, ash content, and particle size), preparation conditions (carbonization temperature and carbonization time), pre-preparation procedures (drying and crushing), and post-preparation procedures (softening and activation). The application of biochar in soil improvement and water management is related to the amount of charcoal added, soil type, and environmental conditions (Zidan et al., 2021). The application of biochar in soil has been shown to sequester carbon, reduce greenhouse gas emissions and improve soil fertilization. Biochar has also been shown to have a very high affinity and ability to absorb organic pollutants due to its large surface area and high degree of porosity, making soil the best medium for retaining carbon and at the same time a means of removing greenhouse gases (Songa et al., 2021). Green charcoal has many benefits for the soil. It is considered one of the means that can help in rehabilitating degraded lands. The slow decomposition of charcoal in the soil makes it different from other sources of organic carbon in the soil. Its overall effect on the soil lies in improving its physical, chemical and biological properties. It helps in aerating the soil, absorbing water, fixing and storing nutrients in plant roots, and it also plays a role in attracting some microorganisms that have an important role in achieving balance within the soil and fertilizing it by converting nitrogen into nitrogenous compounds that the plant uses in protein formation. It activates microbial activity within the soil (Qassem et al., 2016).

Importance of the research:

The importance of this research comes from the production of biochar from biomass in an effective and environmentally friendly way, and studying its effect in increasing the efficiency of mineral fertilizers, as the excessive use of commercial chemical coal and chemical fertilizers leads to increased environmental pollution, accumulation of toxins, destruction of arable soils and a decrease in their efficiency, hence the need to produce locally produced biochar from organic materials (waste) free of any chemical additions, which can be used for soil as an alternative to chemical fertilizers to improve the morphological characteristics of plants and increase crop productivity.

The United Nations Convention to Combat Desertification (UNCCD) also emphasized the need to include a biochar-based soil management program as one of the strategies for managing degraded natural systems (Zidan et al., 2021).

As all UN programs and agencies are signatories to the 2030 Sustainable Development Goals Goal 15 "Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss" (UNEP, 2022).

Research objectives:

1. Study the efficiency of locally produced biochar
2. Study the effect of adding biochar on plant morphological characteristics

3. Comparison of the effect of adding biochar and not adding it
4. Comparison of locally produced biochar with commercial (chemical) char

Definition of the concept of biochar

Biochar is an inexpensive carbon material but shows some promising potential for removing various organic and inorganic pollutants from the environment. Biochar can be distinguished from charcoal based on its commercial purpose, as charcoal is the material used to produce fuel and energy, while biochar can help manage the environment through carbon sequestration. (Kamarudin et al., 2021)

Biochar is a black carbon derived from thermal conversion of biomass feedstocks including agricultural and forestry residues in an inert atmosphere. Biochar technology has attracted significant attention due to its potential to help mitigate climate change and improve soil fertility (Sun et al., 2014).

Physical properties of biochar:

The physical properties of biochar are key to understanding how biochar works within soils and its ability to act as a pathway for sequestering atmospheric CO2. (Downie et al., 2012) Biochar incorporation can affect soil structure (texture, porosity, particle size distribution and density) and thus the oxygen content of air and water potentially alters the storage capacity and microbial and nutritional status of soils within the plant rooting zone (Amonette and Joseph, 2012). It is also clear that the soil-water regime itself can modify the stability of biochar depending on the initial properties of the materials used, with biochar produced at lower temperatures and from more easily scalable feedstocks (Nguyen et al., 2009). Variations in biochar particle size can have a significant impact on crop yield, but on the order of 2 mm to at least 20 mm in some studies (Lehmann et al., 2003).

Devices and tools used in the research:

Table (1): Devices and tools used in the research

N	Devices and tools used in the research
1.	**Furnace device for burning**
2.	**Sensitive balance**
3.	**Current lids**
4.	**pH - meter device**
5.	**EC - meter device**
6.	**Plastic house**
7.	**Ruler**
8.	**Vernier caliper**
9.	**Plastic anvils**
10.	**Sensitive condenser**
11.	**Plunger**
12.	**Cylinder**
13.	**Sieve**
14.	**Beaker**
15.	**Beaker**
16.	**Glass funnel**
17.	**Filter paper**
18.	**Distilled water**

Biochar Production:

Myrtle Plant:

Myrtle plant was chosen for this study because it is widely spread and is found in most homes and public gardens in the city of Mosul. It is also an evergreen plant throughout the year and reaches a height of approximately 4 meters, as well as because of the large waste it produces.

Myrtle is a well-known aromatic oil plant, scientifically known as (Myrtus Communis) from the myrtle family. It is a small shrub that grows throughout the ancient Near East in the Mediterranean basin regions. It often grows in humid, shady places, areas with abundant water, and on the banks of rivers. The myrtle shrub rises to two meters and has many smooth branches with fragrant glands. The myrtle plant is evergreen and its leaves maintain their freshness for a long time. The myrtle plant contains chemical components, including volatile oils, the most important of which are cineole, gabaine, martenol, limonene, patherpineol, geraniol, and myrtol. It also contains tannins (Al-Mutawali, 2013). 2.3.3 Production process

The waste of the myrtle plant, including leaves and wood, was used. A suitable amount of it was taken and dried by exposing it to sunlight for several days. After that, it was cut into small pieces and placed in small lids in preparation for burning. The burning was done using the furnace device, Figure (3), at a temperature of 650 degrees Celsius, according to what was stated in (2009, Joseph and Lehmann) for one hour. After that, it was cooled by exposing it to air at laboratory temperature, then it was ground using a light hammer, and thus the charcoal became ready for use.

Figure (1): Myrtle plant before and after drying and cutting

Figure (2): The eyelids used in the burning process Figure (3): The furnace device for burning myrtle at a temperature of 650

Figure (4): The final biochar produced after burning

Natural Nutrients (Fertilizers) NPK:

This study relied on three different plants in the production of natural nutrients, namely (sunflower seeds, olives and palms), by taking their waste, as each of them is considered a plant rich in the main minerals useful for improving the soil and plant, namely (nitrogen, phosphorus and potassium) (Al-Kazem et al., 2019).

Chemical fertilizers are among the most important agricultural inputs to increase agricultural production, including nitrogen fertilizers, which greatly affect and determine productivity. There are some environmental problems that accompany the addition of nitrogen, as nitrogen may wash away the depths of the soil, and some of it may reach the groundwater, and thus that water will be polluted. The remaining fertilizers in the soil affect the increase in both the pH and salinity, which negatively affects the biological content in it, in addition to the economic losses resulting from the loss of nitrogen during the washing process away from the areas of root absorption or volatilization or by fixation on the surfaces of clay minerals. In recent years, the world has turned to the use of biofertilizers to get rid of the environmental pollution problems caused by mineral fertilizers, while increasing soil fertility and raising the production capacity of field crops (Al-Kazem et al. 2019). 1.4.3 Production of Natural NPK

To produce natural NPK, three types of plants were used and mixed in equal proportions. The first is olive waste, where the olive pit was taken and ground, and 13 grams of it was used. The second type is sunflower seeds, where it was ground, and 13 grams were taken. Palm fronds were also used, where they were cut into small pieces, then burned in the oven at a temperature of 450 degrees Celsius for 45 minutes, then ground, and 13 grams of it were taken as well. After that, all the ingredients were mixed together, and thus the natural NPK became ready for use.


Figure (5): Olive pit after grinding Figure Figure (6): Ground sunflower seeds


Figure (7): Palm fronds before burning Figure (3-8): Palm fronds after burning and grinding

Figure (9): Final product of natural NPK

Cultivation process:

The cultivation process was carried out at the beginning of January 2022 inside the college's greenhouse, which we rehabilitated in order to be able to provide the appropriate conditions for plant growth. Plastic anvils were used to control the cultivation process, and pieces of nylon were placed under all anvils to prevent the plant roots from extending outside the anvil and reaching the ground soil.

Corn and fava beans were chosen for the study as they are among the most important fast-growing food crops. Fava beans and corn seeds were planted in plastic anvils, and the empty anvil weighed 15 grams and weighed 960 grams with the soil. Three seeds were placed inside each anvil, and then biochar and NPK were added, and irrigation was carried out after the cultivation process.

Corn plant:

Yellow corn is an important cereal crop that is used in human and animal nutrition, in addition to its many industrial uses, as its grains are used to make starch, beer, molasses, rubber, medicines, gum and biofuel (Reem Al-Abdel Hadi, 2022). It is thus one of the most important crop plants in the world, as it is one of the three important basic crops (wheat, rice and corn) that are widely cultivated, with a value of several billion dollars in annual revenues. In addition to its agricultural importance, corn has been a model for basic research for nearly a century (Strable and Scanlon, 2009).

Broad bean plant:

Broad bean is an important seed legume crop, as it is a basic food for millions of people in poor countries because it contains a high percentage of protein (from 23 to 42%), in addition to its use as animal feed, and it increases soil fertility by fixing atmospheric nitrogen through bacterial nodules formed on its roots (Kamal et al. 2016). 6.3 Seed germination After several days, approximately a week, of planting, the seeds began to germinate. The germination process is known as the process of embryonic plant growth inside the seed. We say that the seed has germinated if the root emerges or penetrates the seed coat. We say that it is in a state of dormancy if all the necessary conditions for germination are available and the seed has not germinated. The germination process includes natural, chemical, and physiological processes (boufenar, 2006).

1.6.3 Growth The embryonic cells begin to divide and grow until the root extends downward and works to fix the plant in the soil, thus connecting to its natural food source, which it absorbs in the form of nutritional juice consisting of water and its dissolved elements and compounds, or which the root system extracts directly from the soil components. After the root system is formed, the feather rises, penetrating the cracks in the soil to appear above the ground level, and thus the (germinated seed) turns into what is called a (seedling) that gradually elongates to give the stem carrying the leaves and buds forming the green group, and with the continuation of the successive stages of growth, the seedling turns into a complete plant. (Hamidato, 2019)

Calculating the germination percentage:

The germination percentage was calculated by applying the following law:

Germination percentage % = (Number of germinated seeds / Total number of seeds) * 100

Number of planted grains:

- Corn plant: 150 grains of corn were distributed equally among the sample groups, 24 in each group and 5 grains in each anvil.
- Broad bean plant: 90 grains of broad bean were distributed equally among the sample groups, 15 grains per group, 3 grains in each anvil (Hamidato, 2019).

Soil:

Soil is a mixture of mineral and organic matter, water and air and consists of particles that differ in shape, size, chemical composition, color and weight. These particles are divided into groups based on their sizes only and the groups are called soil separators, which are sand, silt and clay (Al-Kazem et al., 2019).

Physical and chemical properties of soil:

Samples of the soil used in the experiment were taken at a depth of (0-30 cm) and some of its physical and chemical properties were measured and the soil was analyzed in the soil laboratory, Technology Department - College of Environmental Sciences and Technologies - University of Mosul.

Measuring the degree of soil reaction and electrical conductivity:

Soil samples were taken for each of the six groups and an extract (1:2) was made by taking soil weighing 40 gm and 80 ml of water and mixing them well, then filtering the solution and taking readings using the pH-meter and EC-meter devices.

Figure (10): Tools and devices used in measuring pH and EC

Volumetric analysis of soil particles (soil texture):

Soil texture is the relative distribution of different groups of primary soil particles, texture affects the physical, chemical and biological properties of the soil, as there are 12 types of texture based on the varying proportions of sand, silt and clay separators (Al-Kazem et al., 2019).

As for the main groups of soil, sandy soils (coarse soils), mixed soils (medium soils) and clay soils (fine soils).

- Method of determining soil texture:

The hydrometer method (hydrometer method) was adopted in making measurements to determine the soil texture of the soil used in the agricultural process, as the hydrometer method is based on Stock's law, which states that the speed of falling particles is directly proportional to the square of the radius and inversely proportional to the viscosity of the liquid, and viscosity is inversely proportional to temperature (Al-Kazem et al., 2019).

Figure (11): Soil texture measurement

A sample of air-dried soil was taken and prepared by hitting it with a wooden hammer to homogenize it, then it was sieved with a sieve with a 2 mm diameter opening. 40 grams of soil were weighed with a sensitive balance and placed in a 250 ml beaker, and distilled water was added to it and shaken well for five minutes to wash it from salts. Then, the calcone (sodium hexametaphosphate) was prepared and 60 ml of it was added to the soil. Calcone is a highly valence ion dispersant. After that, the soil was transferred quantitatively to a 1000 ml graduated cylinder, and distilled water was added to it until it was full. Then, the mixture was shaken with a plunger from top to bottom several times for two minutes. After 40 seconds had passed since the last shake, the first reading was taken using a hydrometer, which represents the density of clay and silt suspended in the liquid. Then, we measured the temperature using a thermometer. Two hours after the first reading, the second reading was taken using a hydrometer and the temperature. Also, since the second reading represents the density of the clay, the necessary calculations were made and the proportions were projected onto the tissue triangle.

Dividing the samples:

60 samples were taken and the cultivation and experimentation process was carried out on them, where they were divided into six groups as follows:

- The first group:

It consists of 10 plank anvils without any addition, the first five anvils were planted with corn, and the other five were planted with fava beans seeds numbered from one to five.

Figure (12): The first group is the blank.

➢ The second group:

It consists of 10 anvils containing NPK fertilizer, which was added at a weight of 0.26 grams, equivalent to five grains, and equally to all anvils.

Five anvils were planted with corn, and the other five were planted with fava beans, numbered from one to five.

Figure (13): The second group is artificial fertilizer.

➢ The third group:

It consists of 10 anvils containing biochar (ace only) added in three different weights (3 grams, 5 grams, 7 grams)

➢ 3 grams of biochar

Anvil (1,2) contains corn, anvil No. 1 contains beans

➢ 5 grams of biochar

Anvil (3,4) contains corn, anvil (2,3) contains beans

➢ 7 grams of biochar

Anvil (5) contains corn, anvil No. (4,5) contains beans

Figure (14): Group 3 Biochar (Ace only)

➢ The fourth group: It consists of 10 anvils, each containing (1 gram of biochar + 1 gram of NPK). Five anvils were planted with corn, and the other five were planted with fava bean seeds, numbered from one to five.

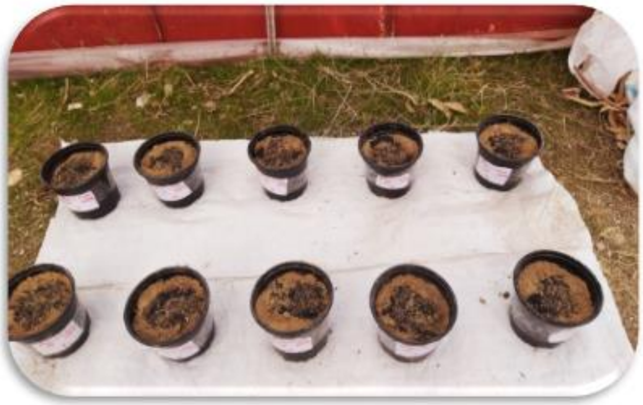

Figure (15): The fourth group: 1 gram of biochar + 1 gram of NPK

➢ The fifth group: It consists of 10 anvils, each containing (3 grams of biochar + 1 gram of NPK). Five anvils were planted with corn, and the other five were planted with fava bean seeds, numbered from one to five.

Figure (16): The fifth group: 3 grams of biochar + 1 gram of NPK

The sixth group: It consists of 10 anvils, each containing (5 grams of biochar + 1 gram of NPK). Five anvils were planted with corn, and the other five were planted with fava bean seeds, numbered from one to five.

Figure (17): Group 6: 5 grams of biochar + 1 gram of NPK

Figure (18): The plastic house

Results and Discussion:

Samples were collected, readings were taken, and morphological characteristics of plants were studied at the end of April 2022. The planted samples were removed from the plastic anvils and the soil was removed. Measurements were taken and the characteristics of all samples were studied using a graduated ruler and a vernier caliper tool, Figure (19). The number of seedlings was counted and the germination percentage was calculated. The root lengths, stem length, number of leaves, leaf length and width were also measured, and the seedling weights were taken.

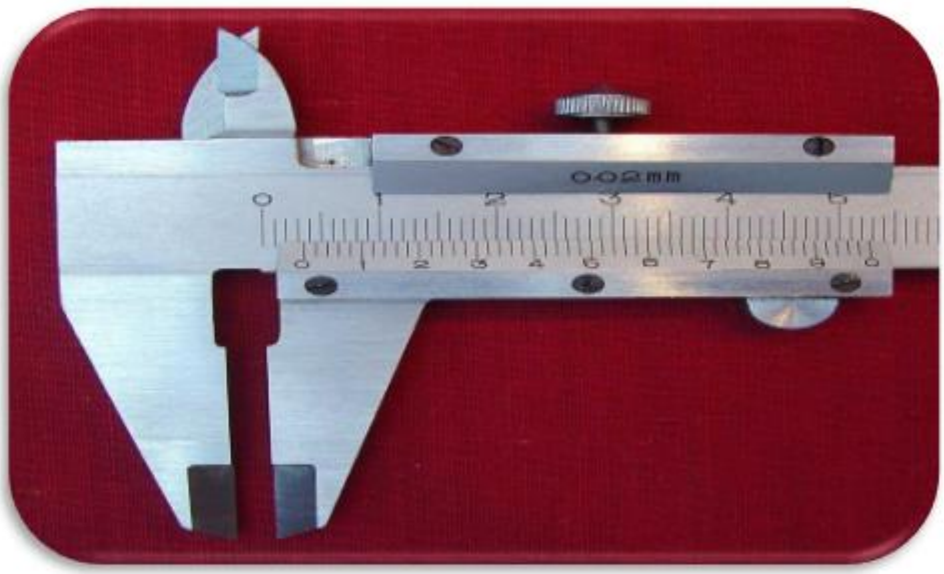

Figure (19) Vernier Caliper

2.4**Morphological Characteristics Studied:**

All morphological (shape) characteristics of both maize and fava beans and the physical and chemical properties of the soil were studied Figure (20) after the end of the study period, which lasted for 16 weeks.

Figure (20) shows the detailed scheme of the tests on fava beans and corn.

Germination percentage:

Table (2): Germination percentage results distributed for fertilizer types in comparison to their performance in corn and bean crops, respectively.

Groups	Germination rate%	
	Corn	Broad bean
Blank	70.8	80
Artificial fertilizer	83.3	80
Ace only	95.8	6.85
1NPK 1 –Ace	83.3	93.3
1NPK 3 –Ace	95.8	93.3
1NPK 5–Ace	91.6	100

It is noted from Table (2) that biochar had a positive effect on the germination percentage for both types of plants under the experiment (corn, broad beans). It is noted that biochar and natural NPK in its different proportions were superior to Blank and there was a slight convergence in the case of (1NPK-1 As) with the germination percentage of artificial fertilizer for corn plants. As for the broad bean crop, it was very encouraging, as the highest germination percentage of 100% was recorded in the sixth group (1NPK)-5 As) for broad bean plants and the lowest percentage of 70.8% in the first group (Blank) for corn plants. In general, for all samples, the proposed fertilizer was superior to artificial fertilizer and Black or traditional fertilizer for all samples that were studied. Remarkably, broad bean plants were superior in germination to corn plants in germination percentage.

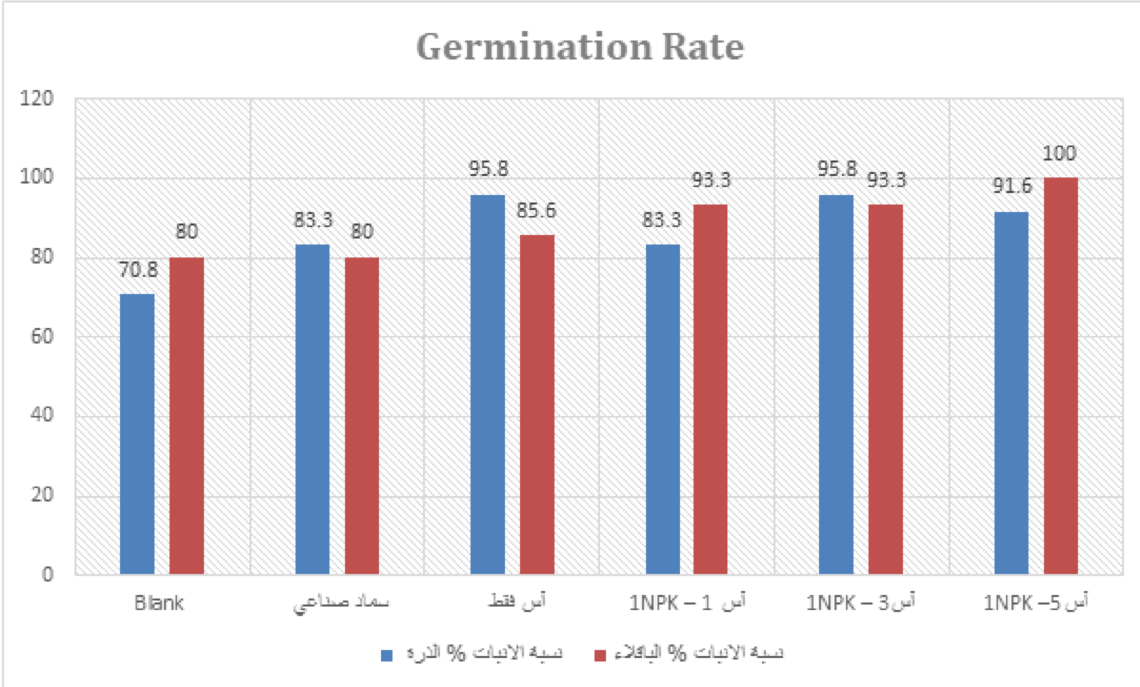

Figure (21) shows the germination rates of corn and bean crops for the different groups.

When comparing the different percentages of biochar added to each other, we notice that the third group (AS only) and the fifth group (1NPK-3AS) outperformed the rest of the groups by 95.8% for corn, while for fava beans, the sixth group (1NPK-5AS) outperformed the rest of the groups by 100%. This is due to the ability of biochar to retain soil moisture, conserve water, and increase the acidity of the soil. Biochar also absorbs and gradually releases nutrients to plants, enhances soil moisture retention, conserves water, and increases soil acidity, which helps farmers reduce the percentage of fertilizers used, which positively reflects on improving yields and increasing the rate of crop emergence.

Average stem length:

This study was conducted at the end of the germination stage to determine the extent of the effect of biochar on the stem length for each group separately. The measurement process was done using a graduated ruler.

Table (3): Average stem length (in centimeters) for corn and fava beans

corn plant					
Groups	Anvil numbers				
	1	2	3	4	5
Blank	3	4.3	3.5	3.6	3
Artificial fertilizer	3.25	3.33	3.4	4.3	4.8
Ace only 3 gm 5 gm 7gm	4.1	6.1	5	6	5
(1-1)	4.6	4.7	4.3	5.5	6.6
(1-3)	4	5.5	5.8	4.5	3.7
(1-5)	4.3	4.3	5	4.7	4.6
Broad bean plant					
Groups	Anvil numbers				

	1	2	3	4	5
Blank	19	24	24	22	16
Artificial fertilizer	22	23	25.3	16	17.5
Ace only 3 gm 5 gm 7 gm	30.5	24.5	29	22	21
(1-1)	23.5	23.5	40	23.3	25
(1-3)	27.5	19	26.3	28	23.6
(1-5)	20	23	26.3	22	22.7

1gm As and 1 gm Nutrients (NPK)* (1-1)

3gm As and 1 gm Nutrients (NPK)(3-1)

5gm As and 1 gm Nutrients (NPK)(5-1)

Includes palm kernel, olive kernel and sunflower seeds NPK

It is noted from Table (3) that the highest rate of stem length for corn and fava bean plants was achieved in sample (1-1) 1 gm As and 1 gm Nutrients (NPK) natural, where it reached 6.6 cm for corn and 40 cm for fava bean plants, and the lowest rate was in the Blank samples in anvil No. 1 and 5 for corn plants, while for fava bean plants, the lowest rate of stem length was recorded in anvil No. 5 for the Blank sample and anvil No. 16 for artificial fertilizer.

Average stem diameter:

The stem diameter was measured using a vernier caliper

Table (4): Average stem diameter (in centimeters) for corn and fava beans

Anvil numbers	corn plant					
	Groups	Anvil numbers				
		1	2	3	4	5
	Blank	1.5	0.6	0.6	0.2	1.1
	Artificial fertilizer	0.55	0.63	0.6	0.57	0.7
	Ace only 3 gm 5 gm 7gm	0.6	0.8	0.7	0.7	0.7
	(1-1)	1.7	0.6	1.9	0.8	0.7
	(1-3)	0.5	0.8	0.8	0.65	0.6
	(1-5)	0.6	0.7	0.75	0.6	0.6
	Broad bean plant					
	Groups	Anvil numbers				
		1	2	3	4	5
	Blank	0.8	0.8	0.7	0.55	0.7
	Artificial fertilizer	0.85	0.9	0.6	0.8	0.7
	Ace only 3 gm	0.7				

5 gm 7 gm		1	0.75	0.7	0.7
(1-1)	0.7	0.8	0.6	0.6	0.5
(1-3)	0.3	0.5	06	0.7	0.5
(1-5)	0.5	0.5	1.66	0.55	0.65

It is noted from Table (4) that the highest stem diameter rate was achieved in sample (1-1) 1 gm myrtle and 1 gm natural nutrients (NPK), where it reached 1.9 cm for corn, while the highest stem diameter rate was achieved for the broad bean plant in sample 5-1 where it reached 1.66, and the lowest rate was in the Blank samples in anvil No. 4 for the corn plant, while for the broad bean plant, the lowest stem diameter rate was recorded in anvil No. 1 for sample 3-1.

Average number of leaves:

The number of leaves was chosen to be calculated in each seedling and for all samples and for both types of broad bean and corn, and the total average number of leaves in each sample was taken

Table (5): Average number of leaves for corn and broad bean plants

	corn plant				
Groups	Anvil numbers				
	1	2	3	4	5
Blank	6	6	5.3	6	7.5
Artificial fertilizer	3.5	3.66	5.3	5	5.3
Ace only 3 gm 5 gm 7gm	7	7	4	5	5
(1-1)	6.25	6	5.7	7	9
(1-3)	7	6.6	8	4.5	6.5
(1-5)	7.3	6.6	6.5	5.73	6.3
Broad bean plant					
Groups	Anvil numbers				
	1	2	3	4	5
Blank	22.6	20.5	24	18	12
Artificial fertilizer	22.5	28	16	16	17.5
Ace only 3 gm 5 gm 7 gm	17	27	16	20	14
(1-1)	32	28	33.5	34	19.5
(1-3)	20	30.5	29.3	26.5	16.3
(1-5)	19.5	21.5	35.6	22.3	31

It is noted from Table (5) that the highest rate of the number of leaves was achieved in sample (1-1) 1 gm Ace and 1 gm natural nutrients (NPK), where it reached 9 for corn, while the highest rate of the number of leaves was achieved for the broad bean plant in samples (5-1) and (1-1), where it reached 35.6 and 33.5 respectively, and the lowest rate was in the 5 gm Ace samples in anvil No. 3 for the corn plant, while for the broad bean plant, the lowest rate of the number of leaves was recorded in anvils No. 1 and 2 for the artificial fertilizer sample.

Average leaf length and width:

The length and width of the leaf were measured by randomly selecting a leaf from each sample using a ruler.

Table (6): Average leaf length for corn and broad bean plants

corn plant					
Groups	Anvil numbers				
	1	2	3	4	5
Blank	12	13.3	12	11.3	10.7
Artificial fertilizer	10.5	10.3	11.3	8.37	14.5
Ace only 3 gm 5 gm 7gm	13.2	17.6	13	13.3	15
(1-1)	15.25	14.2	12.12	15.7	19
(1-3)	12	15	17	14.7	13
(1-5)	12.3	15.6	15.2	14.5	14.5
Broad bean plant					
Groups	Anvil numbers				
	1	2	3	4	5
Blank	3.1	3.5	3.5	3.5	3.5
Artificial fertilizer	2.7	3.1	3.1	2.5	3
Ace only 3 gm 5 gm 7 gm	3.75	4.75	3.75	3.5	2.5
(1-1)	4.8	4.7	4.4	4.6	5.8
(1-3)	2.05	3.3	4.1	4	2.6
(1-5)	3.85	3.6	3.8	3.2	3.9

Table (7): Leaf width ratio for corn and bean plants

corn plant					
Groups	Anvil numbers				
	1	2	3	4	5
Blank	1.2	1.5	1.4	1.4	1.1
Artificial fertilizer	1.3	1.16	1.3	1.4	1.2
Ace only 3 gm 5 gm 7 gm	1.2	2.2	1.8	2.26	1.3
(1-1)	1.25	1.5	1.4	2.3	2.8
(1-3)	1.3	1.75	1.75	1	1.03
(1-5)	1.1	1.5	1.25	1.43	1.46
Broad bean plant					
Groups	Anvil numbers				
	1	2	3	4	5
Blank	2	2	1.5	1.15	1.5

Artificial fertilizer	1.9	1.5	1.8	1	1.3
Ace only 3 gm 5 gm 7 gm	2.75	2.25	2.25	2.5	1.5
(1-1)	2.5	2.1	2.35	2.2	2.7
(1-3)	1.35	2	2.1	1.8	1.2
(1-5)	2.8	1.85	1.8	1.3	1.9

It is noted from Tables (6) and (7) that there is a difference in the measurements of leaf length and width for both maize and fava beans. In general, the concentration (1-1) 1 gm myrtle and 1 gm natural NPK achieved the highest rates.

Root length rate:

The root length was measured in the same way that the green part was measured.

Table (8): Root length rate for maize and fava beans

corn plant					
Groups	Anvil numbers				
	1	2	3	4	5
Blank	20	17.6	16	21.3	19
Artificial fertilizer	14.5	14.66	16.3	18.25	19.6
Ace only 3 gm 5 gm 7gm	17	28.6	18	19	14
(1-1)	18.5	18	20	18	44
(1-3)	13	19	28.2	18	16.1
(1-5)	18.3	18.6	18	21	21.3
Broad bean plant					
Groups	Anvil numbers				
	1	2	3	4	5
Blank	12.3	13	13	15	17
Artificial fertilizer	20.5	13.5	20	13	16.5
Ace only 3 gm 5 gm 7 gm	16.5	16	13.5	17	15
(1-1)	35.5	19.5	17.15	14.4	14
(1-3)	16	16.5	20.6	20	23
(1-5)	24.5	19	15	22.6	16.25

It is also noted from Table (8) that there is a difference in the measurements of the root length rate for both corn and fava beans. In general, the concentration of 3 gm Ace (3-1) achieved the highest root growth rate for corn and the concentration (1-1) for fava beans.

Wet Weight:

After completing all measurements, the weights of each sample were calculated separately using a sensitive balance device, where the green and root groups of each variety were taken and weighed and measurements were taken.

Table (9): Average weights (in grams) for corn and fava beans

corn plant					
Groups	Anvil numbers and weights in grams				
	1	2	3	4	5
Blank		45	37	12.5	17
Artificial fertilizer	15	30	14	13.5	20
Ace only 3 gm 5 gm 7 gm	40	30	20	11	24
(1-1)	13	22	48	25	23
(1-3)	45	20	30	14	22
(1-5)	15	25	42	14	9
Broad bean plant					
Groups	Anvil numbers and weights in grams				
	1	2	3	4	5
Blank	23	17	18	10.5	
Artificial fertilizer	16	14	30	10	15
Ace only 3 gm 5 gm 7 gm	30	35	24	30	35
(1-1)	30	25	38	21	33
(1-3)	17	10.5	20	3.2	35
(1 -5)	18	20	20.5	20	11

Table (9) shows a difference in the wet weight values for both corn and fava beans, and the concentration 1-1 generally recorded the highest percentage of the wet weight rate.

Physical and chemical properties:

The other side of the study focused on analyzing the physical and chemical properties of the soil, and the results are listed in the following table:

Table (10): Results of physical and chemical analyses of the soil

Tissue type	Mixture						
Sand%	42						
Silt%	34						
Clay%	24						
Groups	Before planting	Blank	Artificial fertilizer	Ace only	1 NPKآس1	1NPK آس3	1NPK آس5
PH	.85	.85	7.1	7	7.3	7.2	7.1
Em	1218	1218	925	633	859	724	866

Through the physical analysis of the soil, the results showed that the type of soil texture used in the study is mixed, as it is considered one of the good types of soil, as the mechanical analysis of the soil particles was Sand 42% Salt 34% and Clay 20% respectively. From observing the results of the chemical analyses for both pH and EC values, we find an increase in the acidity of the soil in the samples to which biochar was added in different proportions compared to both the pH of the soil before planting and Blank, where the highest acidity was recorded in the fourth group (1 NPK1 acetate) pH 7.3, and the lowest value for the acidity of the soil pH was 5.8 before planting and in the first group of Blank samples, while the acidity in the samples of the artificial fertilizer was equal to the biochar in the sixth group (1 NPK 5 acetate) pH

The results of the soil salinity analysis (EC):

also indicated a significant decrease in the salinity when applying biochar to the plant, as the lowest EC value was recorded in the third group (Ace only) at 633 ds.m-1), while the highest value was recorded for the soil before planting and Blank (1218 ds.m-1). Biochar also outperformed the synthetic fertilizer in its different proportions, but to similar degrees, as the salinity of the synthetic fertilizer sample group was (925 ds.m-1). When comparing the biochar proportions among themselves, we find that the best and highest result was recorded for the third group (Ace only), followed by the fifth group (1 NPK 3 Ace), then the fourth and sixth, respectively (633, 724, 859, 866 ds.m-1). Through these results, we notice the positive effect of biochar in improving the chemical properties of the soil, as it increased the acidity to make the soil moderate, as soil pH plays an important role in plant growth and nutrient availability. Biochar also reduced the salinity of the soil, which is considered one of the problems of agricultural soils that affect growth, nutrient availability and crop quality. These results were consistent with what was stated by (Agegnehu et al., 2017).

Figure (22): Corn and bean plants when taking readings.

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