**The Effect of using organic and minerals fertilizers on some Chemical and physical characteristics of sandy soil & quality productivity of lupine (*Lupinus termis* L.)** **yield**

**ABSTRACT.**

This study aimed to investigate the effectiveness of compost and biochar amendment As improvement in physical - chemical properties of sandy Loam soil and, So, maintaining the sustainability of **(Lupinus termis L.)** growing systems, a field experiment was carried out during the two successive winter seasons of 2021/ 2022 and 2022/ 2023 respectively, at the Ismailia Agriculture Research Station Agriculture Research center (ARC) – Egypt, (30o 35’ 41.9" N latitude 32o 16’ 45.8" E longitude .the super effect of compost and biochar amendment with different rates of mineral nitrogen on some chemical and physical properties and productivity of Lupine (Lupinus termis L.) under sandy Loam soil , the study design was a split block design in improving some physical and chemical properties of sandy Loam soil. Results showed that the available macronutrients N, P and K all Comparisons Test of Compost and Biochar for Mineral are significantly different from one another, while, all Comparisons Test of Rates of N and all treatments are no significant pairwise differences among the means, the impact of different rates of Mineral, compost and biochar treatment on soil pH by rates of N (0,20,40and 60 kg/fed), the results explained that no significant different between all treatments. But ,OM results showed that, compost or biochar compost were slightly increase organic matter content as compare with control and (CEC), results obtained that compost or biochar compost were slightly increase in CEC, this results due to decompose and release more carboxyl and hydroxyl phenolic groups, the main Effect of mineral, compost and biochar obtained in physical and chemical properties soil, The extra influence prosity was in The effect of Mineral-N, the results obtained that, Biochar treatment is significantly affected, but all treatments, there are no significant pairwise differences among the means. the values of drainable pores (DP) and water holding pores (WHP) were higher value in compost > biochar than the other pores in compost, Biochar treatments and the effect of physical properties on slowly drainable pores (SD) and (FC)field capacity were are no significant pairwise differences among the means, the application of all amendments decreased soil HC (cmh-1) values when compared to the control. the results observation that compost>Biochar>minerals and The effect of Mineral-N was followed the pattern of N60> N40 > N20 > N0, as results showed that, all two means are significantly different from one another. obtained that, the value of bulk density is decreased by adding treatments compost > biochar > minerals treatment there are no significant, finally, results obtained the effect of compost, biochar on improving sandy loamy soil, more than, The effect of Mineral-N.

**keyword:** Organic, Minerals Fertilizers, Soil physical chemical properties, quality productivity of lupine yield.

**INTRDUCTION**

Sandy Loam soils had a Huge massive scale in the world, it has to be cultivated. So that, it should be raise the fertility increase by adding soil amendments either organic or natural inorganic, which is reflected on the improvement of physical and chemical properties The coarse textured soils, due to their low content of clay, are infertile because they usually contain little humus, nutrients and water**. (Croker, et al., 2004).** More that, sandy soils are characterized by very low fertility and water holding capacity **(Goa, et al., 1998),** and a very limited microbial activity **(Morsli, et al., 2004).** This low fertility is one of the constraints in this region of limiting agricultural production mainly cereals which require improvement by industrial fertilizers to increase crop yields. Therefore, **Wafaa (2017).**

A Huge kinds of organic wastes had been related to multiple agriculture operations. The main recycling in this agricultural wastes because produced an organic fertilizer, So, increasing soil organic matter content which could improve the physical, chemical, and biological properties of soil as well minimize environmental pollution (**Wester man and Bicudo, 2005).**

Biochar is gaining significant attention due to its potential for carbon (C) sequestration, improvement of soil health, fertility enhancement, and crop productivity and quality. In this review, we discuss the most common available techniques for biochar production, the main physiochemical properties of biochar, and its effects on soil health, including physical, chemical, and biological parameters of soil quality and fertility, nutrient leaching, salt stress, and crop productivity and quality. **Alkharabsheh .H.M (2021),** Most of research article explained that, The Besides composts, biochar also plays an important role in improving the physical and chemical properties of soil **(AbdelFattah and Mohamed, 2018).** Biochar amendment reduced soil compaction**,** promoted soil aggregation and increased soil permeability **(Jien et al (2013), Sun et al ( 2014).** furthermore, biochar contains high K+ content, which promotes the ion exchange process, thereby increasing the effectiveness of flushing salinity out of the soil. It was also proved that biochar amendment significantly decreased soil solution EC (ECe), exchangeable sodium percentage (ESP), sodium adsorption rate (SAR), and some soluble and exchangeable cations in salt-affected soils **(Saifullah et al., 2018).** Additionally, applying biochar can improve soil quality such as pH, water holding capacity, infiltration capacity, increase fertilizer use efficiency and crop productivity **(Chávez-García and Christina, 2019).**

Biochar is described as the solid materials produced through the thermochemical transfers conversion of plant residues from various crops, bio-solids, and wood with in an oxygen-neutral environment. **(IBI, 2015).** Furthermore, it has noted that, biochar is a black, Carbon rich and stable substance. newly, its application in agricultural has gained attention for its potential enhance soil quality, biochar properties had a physical and structural strength to chemical and composition, depend on both the raw materials and thermochemical process used. overall, the original biomass structure strongly influences the final biochar structure, reported by **(Fuertes *et al* (2010), Avanti *et al* (2015), Cong *et al*. (2017),** Furthermore, **Zhang *et al*. (2010) and Biederman and Harpole (2013)** reported that, biochar application, overall, increased the yield of crop plants and improved soil carbon ,this due to a stable Carbon compound being degraded slowly, particularly to nutrient deficient and its improving soil physical properties and nutrient use efficiency ,furthermore increasing plant growth.

The use of composted organic bio-wastes as fertilizers remains widespread, offering significant benefits for enhancing soil quality. Incorporating compost into the soil boosts nutrient levels and organic matter content, which in turn improves the soil's physical, chemical, and biological as suggest by, **Hargreaves *et al* (2008).**

Lupinus (Lupinus albus L.) exhibits a wide variety of colors and forms. Commonly referred to as Lupinus, some species are annual while others fall under the category of perennial herbaceous plants. The genus encompasses approximately 280 species. According to **Ainouche and Bayer,** lupine is regarded as a polymorphic species, though its taxonomic classification has long been a subject of debate. Previous research has demonstrated the plant's remarkable ability to develop 'proteoid roots,' characterized by clusters of rootlets that release chelating agents, including enzymes and organic anions such as Photase, hydrogen ions, and phosphatase. This adaptation occurs under nutrient-deficient conditions to improve the uptake of essential nutrients like phosphorus (P), iron (Fe), manganese (Mn), and zinc (Zn) **Ryan, P. R *et al* (2001)** and **Vance, C. P.et al (2003).**

**MARTIALS AND METHODS**

A field experiment was carried out during the two successive winter seasons of 2021/ 2022 and 2022/ 2023 respectively, at the Ismailia Agriculture Research Station Agriculture Research center (ARC) – Egypt, (30o 35’ 41.9" N latitude 32o 16’ 45.8" E longitude. The The study aims to evaluate the effect of organic matter (compost and biochar) application combined with different rates of mineral nitrogen on some chemical and physical properties and productivity of Lupine (Lupinus termis L.) under sandyLoam soil. Soil sample before planting were air dried, ground then sieved by a 2mm sieve and kept for analysis. Some of the physical and chemical properties of the experiment soil were recorded by **Page et al (1982) and Kult (1986). and Cottenie et al (1982).**

**Table 1. Physical and chemical Characteristics of the soil study before planting at the Ismailia.**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Coarse sand (%)** | **Fin sand**  **( %)** | | **Silt**  **(%)** | | | **Clay**  **(%)** | | **Texture** | | | | | **O.M**  **(%)** | | | **CaCO3**  **(%)** | |  |
| **15.30** | **65.25** | | **13.34** | | | **6.11** | | **Loamy sand** | | | | | **0.66** | | | **1.75** | |  |
| **pH (1:2:5)** | **EC**  **(dS/m)** | | **Cations (meq/l)** | | | | | | | | **Anions (meq/l)** | | | | | | |  |
| **Ca++** | | **Mg++** | | **Na+** | | | **K+** | **HCO-3** | | | **Cl-1** | | | **S2O4- -** |  |
| **7.85** | **1.44** | | **4.60** | | **2.88** | | **5.73** | | | **0.85** | **1.80** | | | **4.15** | | | **8.45** |  |
| **Available macronutrients**  **(mg/kg)** | | | | | | | | | **Available micronutrients**  **(mg/kg)** | | | | | | | | |  |
| **N** | | **P** | | **K** | | | | | **Fe** | | | **Mn** | | | **Zn** | | | **Cu** |
| **32.75** | | **5.30** | | **179.00** | | | | | **3.46** | | | **1.10** | | | **0.59** | | | **0.37** |

**\* Soil Physical parameter analysis**

**\*Bulk density** was determined using undisturbed soil samples according to **Klute (1986).**

**\*\*Soil moisture** characteristics curves were determined using the pressure cooker under 0.001, 0.10, 0.33, 0.66, 1.0, 3.0 and 15.0 atmosphere according to **Klute (1986)**.

**\*\*\*Hydraulic conductivity** was conducted according to **Black (1965**) using falling head method, the governing equation is: -

K=(al\At) In (H1\H2)

Where:

a= is the area of cross section of the stand pipe.

L=is the length of the sample.

A=is he cross sectional area of the sample

t= is the time for the hydraulic head difference to decrease from H1toH2.

**\*\*Soil chemical analysis**

Chemical characteristics were determined according to **Page *et al*. (1982)** as follows:

**\* Total Soluble salts** was determined as **EC** in the soil paste extract by electrical conductivity method.

**\* Hydrogen ion activity (pH)** was measured in 1:2.5 soil: water suspension using **pH** meter.

### **\* Carbonate and bicarbonates** were determined in soil paste extract by titration against 0.01Msulphuric acid in presence of [Phenolphthalein](http://r.search.yahoo.com/_ylt=A0LEVi23atpXJNYAnk4PxQt.;_ylu=X3oDMTBybGY3bmpvBGNvbG8DYmYxBHBvcwMyBHZ0aWQDBHNlYwNzcg--/RV=2/RE=1473960759/RO=10/RU=https%3a%2f%2fwww.drugs.com%2fingredient%2fphenolphthalein.html/RK=0/RS=iLa18sqt06pRqjdCgAuQQr3V0ZI-)(phth) and methylorange (MO) indicators, respectively.

**\* Calcium and magnesuim** were determined in soil paste extract using the titration methods by versinate (0.01M) in presence of ammonium purpurate (murexide) and Erichrome black T (EBT), respectively.

**\* Chloride concentration** was determined in soil paste extract using the silver nitrate (0.01M) in presence of potassium chromate as an indicator.

**\* Sulphate** was calculated by subtracting total summation of total determined soluble anions from summation of total soluble cations.

**\* Sodium and potassium** were determined in soil paste extract by using flame photometer.

**\* The Organic matter** was determinate by the Walkely and Black methods.

**\* Cation Exchange Capacity (CEC)** was determined using ammonium acetate (pH= 7) and sodium acetate (pH=8.2).

**\* Exchangeable sodium** was determined using ammonium acetate.

The soil physical and chemical analyses of the experimental site are presented in Table (5,6,7,8,9). Physical parameters were determined according to the methods of **Haluschak (2006),** while chemical was according to **Van Reeuwijk (2002).** Organic fertilizer: potassium humate from Agricultural Research Center (ARC) at Giza governorate – Egypt.

Compost was obtained from Dr. Olive company, Egypt and biochar was supplied by the Egyptian Garden Company. Physical and chemical characteristics of the applied compost and biochar fertilizers as shown as in table 2 below.

**Table 2. Physical and chemical properties of the applied compost and biochar fertilizers.**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Types** | **Bulk density, Mg m-3** | **Moisture content, %** | **pH** | **EC dS m-1** | **OC**  **%** | **OM%** | **C/N ratio** | **Total-N, mg kg-1** | **Total-P**  **,mg kg-1** | **Total-K, mg kg-1** | **Total** | **content** | **mg kg-1** |
|  |  | **Fe** | **Zn** | **Mn** |
| **Compost** | **0.75** | **30** | **7.34** | **5.09** | **14.98** | **25.84** | **12:1** | **1.2** | **0.35** | **0.66** | **311** | **96** | **110** |
| **Types** | **Bulk density, Mg m-3** | **Moisture content, %** | **pH** | **EC dS m-1** | **C**  **%** | **OM%** | **C/N ratio** | **Total-N, g kg-1** | **Total-P, g kg-1** | **Total-K, g kg-1** | **Total** | **content,** | **mg kg-1** |
| **Biochar** | **0.33** | **25** | **8.87** | **4.32** | **30.23** | **43.96** | **20:1** | **1.45** | **0.86** | **7.88** | **332** | **75** | **108** |

**pH and EC were determined in 1:10 organic-amendment: water suspension.**

**\*\*\*Field plantation experiment: -**

Sowing Seeds of the lupine **(Lupinus termis L.) (Giza 2),** were supplemented from the Field Crop Research Intitule, Agricultural Research center, Giza, Egypt. on the 10 November of 2021/ 2022 and 2022/ 2023 respectively, at the Ismailia Agriculture Research. The seeds had been hand sown 2-3 seeds /hill of 2 cm depth and 25 cm apart. The plants were thinned to one plant after 30 days of planting. So, the experiments were organized in a split plot design. The plot area was 3X 3 m divided into rows 60 cm and three replicates. The organic matter was compost and biochar applied at 5 ton/fed mixed in soil before 20 days for planting. The Super phosphate (15.5 % P2O5) applied at rate 300 kg/fed) during soil tillage. Urea (46 % N) applied at rates (20, 40 and 60 kg N /fed) after 30, 50 and 75 days from sowing. Potassium Sulphate (48 K2O) applied at rate (50 Kg K2O /fed). At harvest in 10 may a random sample of 10 plants from each plot. The plant morphology determined by the growth and yield parameters was plant height (cm), No. of branches/ plant, No. of pods /plant, weight of 100 seeds(g), weight of seeds yield (ton/fed) and weight of pods (ton/fed) Ether of oven-dried straw or seeds were ground and kept in plastic bags for chemical analysis. A 0.5 g of each oven dried ground plant sample was digested using H2SO-4, HCIO4 mixture according to the method described by **Chapman and Pratt (1961).** The plant content of N, P, K, Fe, Mn, Zn and Cu was determined in plant digestion using the methods described by **Cottenie et al (1982) and Page *et al* (1982).**

Total carbohydrates were determined in dry leaves using the method described by **Dubois *et al* (1956)**. Protein percentage of seeds was calculated by multiplying produce of the nitrogen percentage by the factor 6.25**FAO (2003),** the chemical physical analysis of soil properties was measured after as taken mean of two seasons in each treatments.

**Table 3. The details of the experimental design**

|  |  |  |
| --- | --- | --- |
| **Soil** | **Treatment.** | **Rates**  **of N (kg/fed )** |
| **Sandy Loamy soil** | Control | 0 |
|  | Mineral | 20  40  60 |
|  | Compost | 0  20  40  60 |
|  | Biochar | 0  20  40  60 |

**Statistical analysis: -**

**Statistical analysis procedure:** All experiments and analytical determinations were replicated at least three times and the presented data are the mean values. The obtained results were subjected to one way **(ANOVA)** analysis of variance analysis (type of analysis depended on the factors affected the experiment) to determine the significance between treatments and L.S.D. test at the probability levels of 5% was calculated according to **Gomez and Gomez (1984)** and using **CoStat software (Stern, 1991).**

**Results and Discussion**

**\*Impact of Available macro and micronutrients contents with all treatments (Mineral-Compost and Biochar) on soil after harvest.**

**Table 4. Available macro and micronutrients contents with all treatments (Mineral-Compost and Biochar) in soil after harvest.**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Treatments | Rates  of N (kg/fed ) | Available macronutrients (mg/kg) | | | Available micronutrients (mg/kg) | | |
| N | P | K | Fe | Mn | Zn |
| Mineral | 0 | 35.60 | 5.88 | 182.00 | 3.66 | 1.34 | 0.62 |
| 20 | 38.99 | 6.03 | 183.00 | 3.75 | 1.36 | 0.66 |
| 40 | 42.60 | 6.14 | 183.80 | 3.82 | 1.42 | 0.68 |
| 60 | 44.11 | 6.22 | 185.30 | 3.85 | 1.44 | 0.72 |
| Mean | | 40.32 | 6.06 | 183.52 | 3.77 | 1.39 | 0.67 |
| Compost | 0 | 39.50 | 6.07 | 184.00 | 3.79 | 1.42 | 0.64 |
| 20 | 45.30 | 6.34 | 186.30 | 3.88 | 1.55 | 0.73 |
| 40 | 48.50 | 6.48 | 189.65 | 4.02 | 1.67 | 0.77 |
| 60 | 53.19 | 6.77 | 190.22 | 4.13 | 1.75 | 0.81 |
| Mean | | 46.62 | 6.29 | 187.54 | 3.95 | 1.59 | 0.73 |
| Biochar | 0 | 37.10 | 5.90 | 182.88 | 3.69 | 1.40 | 0.63 |
| 20 | 40.39h | 6.13 | 184.89 | 3.83 | 1.52 | 0.70 |
| 40 | 44.28f | 6.33 | 185.44 | 3.88 | 1.64 | 0.75 |
| 60 | 47.88c | 6.45 | 187.00 | 4.08 | 1.73 | 0.78 |
| Mean | | 42.41 | 6.20 | 185.05 | 3.87 | 1.57 | 0.71 |
| LSD. 5 % Treatments | | 2.037 | \*\*\* ns | \*\*\* ns | \*\*\* ns | \*\*\* ns | \*\*\* ns |
| LSD. 5 % Treatments \* Rate | | 2.01 | \*\*\* ns | \*\*\* ns | \*\*\* ns | \*\*\* ns | \*\*\* ns |
| LSD. 5 % Interaction | | \*\*\* ns | \*\*\* ns | \*\*\* ns | \*\*\* ns | \*\*\* ns | \*\*\* ns |

Data presented in table ( 3) showed that the available macronutrients N,P and K all Comparisons Test of Compost and Biochar for Mineral are significantly different from one another, but on other hand, all Comparisons Test of Rates of N and all treatments are no significant pairwise differences among the means , So, The mean values of the available N,P ,K were arranged as N (30.6: 47.88),P(5.88: 6.45) and K (182.00: 187.00) These results are in agreement by **Osman M. A., (2016)** ,found that the increase rate of biochar application led to increasing the availability of N, P and K nutrients in sandy soil. **Korai P. K. *et al* (2018**), shown that biochar application increased N and P content in soil. On other hand, results obtained that, Fe, Mn, Zn are non –significant different among the means of (mineral-compost- Bio chare). The slightly increases of mean values for available Fe, Mn and Zn in soil as minerals application were (3.66% and 3.85%) and (1.34% and 1.44%) and (0.62% and 0.78%), while the corresponding values were increased from (3.69% and 4.08% ) and (1.40% and 1.73%) and (0.63% and 0.78%) in this study of the biochar treatment, overall, Compost treatment were(3.79% and 4.13% ) and (1.42% and 1.75%) and (0.64% and 0.81%).this results as harmony with ,the micronutrients (Fe, Mn and Zn) available in soil were significant increased due to the application of charcoal and biochar at different rates individually or combined with mineral nitrogen fertilizers and bio-fertilizer. **Fouda S. S .*et al* (2020).**

**Table 5. Macro- micronutrients concentrations in seeds lupine.**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Treatments | Rates  of N (kg/fed ) | Concentrations macronutrients (%) | | | Concentrations micronutrients (mg/kg) | | |
| N | P | K | Fe | Mn | Zn |
| Mineral | 0 | 2.45 | 0.26 | 2.19 | 56.90 | 33.90 | 15.60 |
| 20 | 2.85 | 0.35 | 2.75 | 62.67 | 36.86 | 22.30 |
| 40 | 3.02 | 0.38 | 2.88 | 66.80 | 38.75 | 23.65 |
| 60 | 3.12 | 0.42 | 2.96 | 71.89 | 39.66 | 26.70 |
| Mean | | 2.86 | 0.35 | 2.69 | 64.56 | 37.29 | 22.06 |
| Compost | 0 | 2.95 | 0.33 | 2.54 | 62.40 | 35.40 | 17.40 |
| 20 | 3.15 | 0.43 | 2.99 | 73.80 | 39.20 | 25.63 |
| 40 | 3.27 | 0.53 | 3.14 | 75.90 | 44.49 | 29.60 |
| 60 | 3.54 | 0.58 | 3.25 | 80.12 | 46.00 | 32.10 |
| Mean | | 3.22 | 0.46 | 2.98 | 73.05 | 41.27 | 26.18 |
| Biochar | 0 | 2.63 | 0.31 | 2.44 | 60.66 | 32.77 | 16.40 |
| 20 | 2.99 | 0.38 | 2.88 | 70.77 | 37.90 | 24.77 |
| 40 | 3.17 | 0.44 | 2.98 | 75.90 | 42.87 | 27.88 |
| 60 | 3.33 | 0.52 | 3.12 | 78.44 | 45.30 | 29.86 |
| Mean | | 3.03 | 0.41 | 2.85 | 71.44 | 39.71 | 24.72 |
| LSD. 5 % Treatments | | 0.499 | 0.37 | \*\*\* ns | \*\*\* ns | \*\*\* ns | \*\*\* ns |
| LSD. 5 % Treatments \* Rate | | 0.499 | \*\*\* ns | \*\*\* ns | \*\*\* ns | \*\*\* ns | \*\*\* ns |
| LSD. 5 % Interaction | | \*\*\* ns | \*\*\* ns | \*\*\* ns | \*\*\* ns | \*\*\* ns | \*\*\* ns |

**\*Impact of (Mineral-Compost and Biochar) on Growth parameters and yield of seeds lupine.**

**Table 6. Growth parameters and yield of seeds lupine.**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Treatments | Rates  of N (kg/fed ) | Plant height (cm) | No. of branches  plant | | No. of pods/plant | Weight of 100 seeds (g) | Shoot yield (ton/fed) | Seeds yield (ton/fed) | | Protein  % |
| Mineral | 0 | 51.54 | | 4.88 | 18.38 | 33.62 | 1.180 | | 0.952 | 15.31 |
| 20 | 65.45 | | 5.03 | 21.45 | 36.66 | 2.568 | | 1.756 | 17.81 |
| 40 | 70.23 | | 6.34 | 22.14 | 38.68 | 2.634 | | 1.799 | 18.87 |
| 60 | 74.55 | | 7.22 | 22.62 | 44.72 | 2.715 | | 1.964 | 19.5 |
| Mean | | 65.44 | | 5.86 | 21.14 | 38.42 | 2.27 | | 1.61 | 17.87 |
| LSD. 5 %of protein | | (sg) | | | | | | | | 0.657 |
| Compost | 0 | 53.25 | | 5.17 | 19.25 | 34.66 | 1.210 | | 1.085 | 18.43 |
| 20 | 67.32 | | 6.25 | 22.56 | 42.14 | 2.590 | | 1.799 | 19.68 |
| 40 | 70.45 | | 6.55 | 23.45 | 49.77 | 2.850 | | 1.923 | 20.43 |
| 60 | 79.40 | | 7.17 | 21.35 | 53.81 | 3.120 | | 2.201 | 22.12 |
| Mean | | 67.60 | | 6.28 | 21.65 | 45.09 | 2.44 | | 1.75 | 20.17 |
| LSD. 5 % of protein | | (sg) | | | | | | | | 0.587 |
| Biochar | 0 | 51.65 | | 5.45 | 19.55 | 36.40 | 1.258 | | 1.088 | 16.43 |
| 20 | 72.36 | | 6.47 | 22.88 | 47.52 | 3.102 | | 1.956 | 18.68 |
| 40 | 85.20 | | 7.33 | 25.34 | 53.64 | 3.490 | | 2.341 | 19.81 |
| 60 | 89.42 | | 6.33 | 27.42 | 57.73 | 3.205 | | 2.102 | 20.81 |
| Mean | | 74.65 | | 6.39 | 23.79 | 48.82 | 2.76 | | 1.87 | 18.93 |
| LSD. 5 % of protein | | (sg) | | | | | | | | 0.387 |
| LSD. 5 % Treatments | | 2.056 | | \*\*\* ns | \*\*\* ns | \*\*\* ns | \*\*\* ns | | \*\*\* ns | \*\*\* ns |
| LSD. 5 % Treatments \* Rate | | 2.056 | | \*\*\* ns | \*\*\* ns | \*\*\* ns | \*\*\* ns | | \*\*\* ns | \*\*\* ns |
| LSD. 5 % Interaction | | \*\*\* ns | | \*\*\* ns | \*\*\* ns | \*\*\* ns | \*\*\* ns | | \*\*\* ns | \*\*\* ns |

Data in table (4), the results obtained that, the treatments rates of biochar was **l**upine height (m) and aboveground biomass (No. of branches and No. of pods/plant) were better in biochar as compared with another treatments and control.as a harmony results. maize height (m) and aboveground biomass (fresh and dry weights) were greater by biochar **Abdel-Hamied *et al* (2021) and the** effects of the adding different rates of biochar, compost and mineral fertilizers each one alone on some Lupine of growth parameters as well as (Weight of 100 seeds, Shoot yield and Seeds yield), results showed that , increased in Weight of 100 seeds, Shoot yield by Biochar >Compost>Mineral treatment But Seeds yield was increased by compost treatment as compare all treatment ,respectively increased were from Weight of 100 seeds (33.62, 33.62), Shoot yield(1.180, 3.205)and in compost treatment the Seeds yield was increased (0.952, 2.201) , biochar increased growth and crop yield as well as soil microbial biomass, rhizobia nodulation, and plant nutrients **Biederman. O and W. S. Harpole, (2013)**, So, all results related for nitrogen fertilizer, as recommended dose, compost, biochar respectively as compared by control. this results was arranged by **Fouda .S. S et al (2020),** The values of all cultivated characteristics of wheat such as plant height (cm), spike length (cm), spike count, 1000 grain weight (g), and straw and grain yield weight (ton / acre) increased with the increased by The rate of biochar.at least ,results indicated that all treatments are significant in each treatment lonely ,on other hand ,they are non-significant in each other treatments, The highest mean values of the value in compost was22.12 %, while in Biochar was 20.81 as proteins (%) for plant treated with compost ,Biochar combined with 60 kg/fed N mineral fertilizer as compare than other treatments. The increase of mean value of carbohydrate contents in seeds as affected with inoculation adding biochar to soil was significantly improved plant growth and grain yield production combined with NPK fertilizers in comparison with the NPK-fertilizer without charcoal.  **Badr E.A *et al* (2015)**.

**Effect of Compost, Biochar and Mineral N on Physio- Chemical properties of the soils after harvesting of lupine: -**

**Table 7. Some Chemical properties of the soils after harvesting of lupine**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Treatments | Rates  of N (kg/fed ) | pH (1:2.5**)** | EC(dS/m1 ) | | OM% | CEC Mol/g |
| Mineral | 0 | 7.85 | | 1.44 | 0.66 | 4.43 |
| 20 | 7.84 | | 1.43 | 0.65 | 4.42 |
| 40 | 7.83 | | 1.43 | 0.66 | 4.43 |
| 60 | 7.85 | | 1.44 | 0.66 | 4.43 |
| Mean | | 7.84 | | 1.43 | 0.65 | 4.42 |
| Compost | 0 | 7.84 | | 1.44 | 0.66 | 4.43 |
| 20 | 7.79 | | 1.43 | 0.68 | 4.45 |
| 40 | 7.74 | | 1.42 | 0.67 | 4.44 |
| 60 | 7.71 | | 1.41 | 0.67 | 4.44 |
| Mean | | 7.77 | | 1.42 | 0.67 | 4.44 |
| Biochar | 0 | 7.85 | | 1.44 | 0.66 | 4.43 |
| 20 | 7.84 | | 1.45 | 0.67 | 4.44 |
| 40 | 7.81 | | 1.44 | 0.68 | 4.45 |
| 60 | 7.82 | | 1.45 | 0.68 | 4.45 |
| Mean | | 7.79 | | 1.44 | 0.67 | 4.44 |
| LSD. 5 % Treatments | | 2.101 | | \*\*\* ns | \*\*\* ns | \*\*\* ns |
| LSD. 5 % Treatments \* Rate | | 2.101 | | \*\*\* ns | \*\*\* ns | \*\*\* ns |
| LSD. 5 % Interaction | | \*\*\* ns | | \*\*\* ns | \*\*\* ns | \*\*\* ns |

**\*Impact of mineral, Compost and biochar with rate of N fertilizer on some chemical properties of soil after harvest(lupine).**

**chemical properties**

**\*Soil pH, EC.**

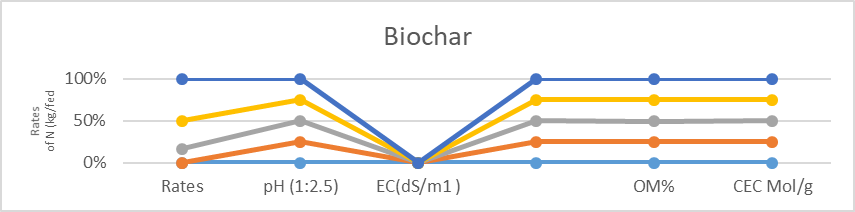
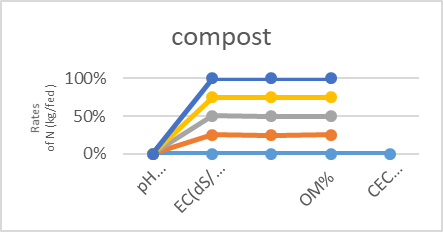
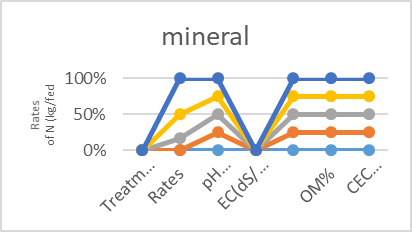
c Soil pH slightly decreased from (7.85 :7.71) as compost treatment and in biochar Soil pH was (7.84 :8.82), the impact of different rates of Mineral, compost and biochar treatment on soil pH by rates of N (0,20,40and 60 kg/fed), the results explained that no significant different between all treatments. So that, the highest reduction of soil pH reductions related to biochar treatment, therefore, this results due two some chemical oxidation and microbial decomposition of charcoal and biochar in soil, resulting in acidic compounds being produced and therefore lowering soil pH, this results are as harmony with reported a decrease in pH upon applying N and compost fertilization**, (Siam *et al*, (2013)**, **Steiner. C, (2015),** **Abed El-Azeim M.M, (2017),** found that the application of biochar on sandy soil was decreased of soil pH Effect microbial activity and increase of organic acid product.EC, results showed that, EC Soil decreased from (1.44 :1.41) as compost treatment but in treatment of biochar Soil EC was slightly increased from (1.44 :1.45) This results was arranged with **El. El. Fouda .S *et a*l (2020)**, **Khiralla A. E. I *et al* (2022)**, EC slightly increased owing to biochar addition. this related to. Pyrolysis temperature influences the functional groups, with increasing temperatures resulting in the elimination of acidic groups such as formyl, carboxyl, or hydroxyl of the basic cations in the biochar. As a result, this can increase the alkalinity of the biochar **Weber. K *et.al* (2018), Naeem, M (2017).**

**Organic matter (OM) %: -**

Data table (6), results showed that, compost or biochar compost were slightly increase organic matter content as compare with control. this results agree with, **Noor et al (2020)** reported that ,composted materials improved soil structure and organic matter, So ,the highest value of increased OM was found in soil amended with(compost or Biochar)as compare by mineral amended and rates of N, this due to ,Soil organic matter is a main indicator that affects soil health, microbial activity, nutrient cycling, and water retention **Battaglia, M.L.(2021),** Hugh studies mentioned that biochar application can increase soil C content, improve WHC, and increase aggregate formation and stability **Diatta, A.A**.***et al*** **(2020)**, these responses are highly dependent on the feedstock material utilized, the pyrolysis conditions and application rates, and the types of soil where biochar is applied **El-Naggar, A .et al (2018 )** obtained that ,the rate of increases by the OM content of sandy was (42–72%),therefore, Biochar amendment promote of the soil organic carbon (SOC) ,as like all physical and chemical characterizes of soil health, increases are highly related to the feedstock type and the temperature used in the pyrolysis process, **Alkharabsheh.HM. *et al* (2021).**

**Cation exchange capacity (CEC):**

Data table (6), results showed that compost or biochar compost were slightly increase in CEC, this results due to decompose and release more carboxyl and hydroxyl phenolic groups essentially participating in humic material formation and consequently offering higher CEC, **Rocaperez *et al*(2009).** **Kenaw. M. H. M. *et al* (2024),** showed that, theOM, CEC Soil pH values nearly decreased while salinity (EC) values increased by applying the composts at the higher rate of 10.0 Ton ha-1 in descending order E > C > D > B >A. Soil organic matter (OM) content increased with the high rates of compost application as compared to control.



**Fig1. Some Chemical properties of the soils after harvesting of lupine**

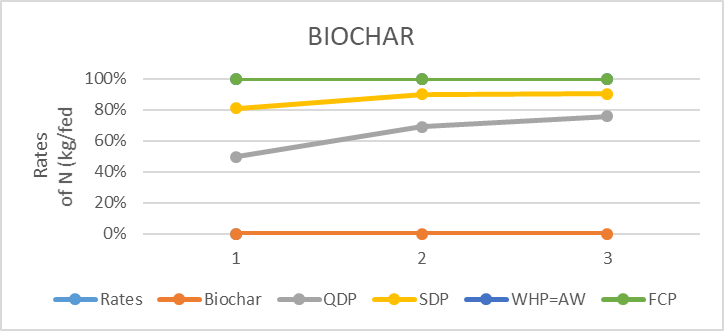
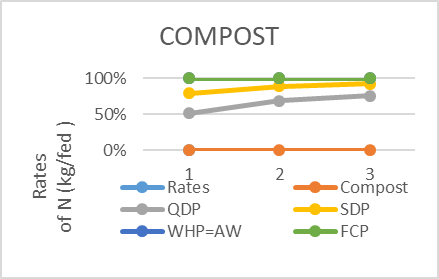
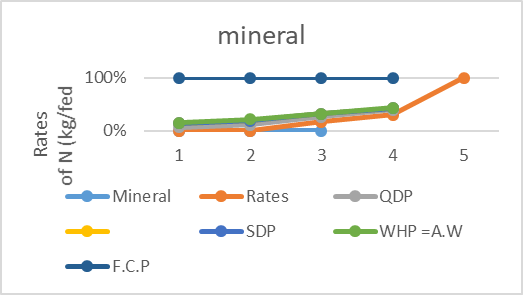
**Table 8. Soil moisture contents (%)by the soil amendments of the studied soils (lupine).**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Treatments | Rates  of N (kg/fed ) | **Soil Tension (Bar)** | | | |
| **0.001** | **0.01** | **0.33** | **15** |
| Mineral | 0 | 86.18 | 80.31 | 74.35 | 73.35 |
| 20 | 105.70 | 93.99 | 85.55 | 85.05 |
| 40 | 101.78 | 89.63 | 83.09 | 82.50 |
| 60 | 93.92 | 80.82 | 76.26 | 75.13 |
| Mean | | 96.74 | 86.19 | 79.81 | 79.01 |
| Compost | 0 | 96.55 | 83.21 | 78.08 | 77.55 |
| 20 | 100.48 | 89.75 | 81.53 | 81.00 |
| 40 | 95.42 | 83.48 | 77.16 | 76.66 |
| 60 | 100.53 | 87.24 | 81.15 | 80.66 |
| Mean | | 98.24 | 85.92 | 79.48 | 78.97 |
| Biochar | 0 | 91.93 | 78.98 | 72.74 | 72.06 |
| 20 | 104.18 | 91.71 | 83.96 | 83.27 |
| 40 | 97.19 | 85.05 | 79.11 | 78.67 |
| 60 | 103.27 | 91.80 | 84.06 | 83.67 |
| Mean | | 99.14 | 86.88 | 79.97 | 79.42 |
| LSD. 5 % Treatments | | 2.101 | \*\*\* ns | \*\*\* ns | \*\*\* ns |
| LSD. 5 % Treatments \* Rate | | 2.101 | \*\*\* ns | \*\*\* ns | \*\*\* ns |
| LSD. 5 % Interaction | | \*\*\* ns | \*\*\* ns | \*\*\* ns | \*\*\* ns |

Table 9. Pore size distribution by **the soil amendments of the studied soils (lupine).**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Treatments | Rates  of N (kg/fed ) | Pore size distribution | | | | |
| **QDP** | | **SDP** | **WHP =A.W** | **F.C.P** |
| Mineral | 0 | 5.87 | 5.96 | | 1 | 73.35 |
| 20 | 11.71 | 8.44 | | 2.26 | 83.29 |
| 40 | 12.15 | 6.54 | | 0.59 | 82.50 |
| 60 | 12.50 | 4.56 | | 1.13 | 75.13 |
| Mean | | 10.55 | 6.37 | | 1.24 | 78.57 |
| Compost | 0 | 13.34 | 5.13 | | 0.53 | 77.55 |
| 20 | 10.73 | 8.22 | | 0.53 | 81.00 |
| 40 | 11.94 | 6.32 | | 0.50 | 76.66 |
| 60 | 13.29 | 6.09 | | 0.49 | 80.66 |
| Mean | | 12.32 | 6.44 | | 0.51 | 78.97 |
| Biochar | 0 | 12.95 | 6.24 | | 0.68 | 72.06 |
| 20 | 12.47 | 7.75 | | 0.69 | 83.27 |
| 40 | 12.14 | 5.94 | | 0.44 | 78.62 |
| 60 | 11.47 | 7.74 | | 0.39 | 83.67 |
| Mean | | 12.25 | 6.91 | | 0.55 | 79.42 |
| LSD. 5 % Treatments | | 2.101 | \*\*\* ns | | \*\*\* ns | \*\*\* ns |
| LSD. 5 % Treatments \* Rate | | 2.101 | \*\*\* ns | | \*\*\* ns | \*\*\* ns |
| LSD. 5 % Interaction | | \*\*\* ns | \*\*\* ns | | \*\*\* ns | \*\*\* ns |

QDP: Quickly drainable pores (> 28.8 u), SDP: Slowly drainable pores (28.8-8.62 u), WHP: Water holding pores (8.62 - 0.19 u), FCP: Fine capillary pores (<0.19 u).



**Fig2. Pore size distribution by the soil amendments of the studied soils (lupine).**

Data represented in **table 1. Fig 2**, showed that, the main Effect of mineral, compost and biochar obtained in physical properties soil, the extra influence total prosity was in compost (96.55,100.53) and biochar (91.93, 103.27) the soil total porosity values as compared with mineral (86.18, 93.92) and control and The effect of Mineral-N was followed the pattern of **N60> N40  > N20 > N0,**So,the results obtained that, Biochar treatment is significantly affected, but all treatments, there are no significant pairwise differences among the means. the total porosity and capillary porosity increased in the plow layer of soil this related to the biodegradation of dead organic matter, containing carboxyl and phenolic so that it behaves functionally such as phenomenon of organic acidification **El-Maaz E.I .*et.al* (2021.** This results are arranged with, **Herath *et al* (2013), Mukherjee *et al* (2013)** they reported that, similar effects for silt loam soil, they indicated that improved physical quality of biochar-amended soil is correlated with biochar treatment. However, the results observed that, the values of drainable pores (DP) and water holding pores (WHP) were higher value in compost (0.53, 0.49) and biochar (0.68, 0.39) than the other pores in compost, Biochar treatments. The results also found that the effect of physical properties on slowly drainable pores (SD) and (FC)field capacity were are no significant pairwise differences among the means, this results as harmony with **Jindo** ***et al***., **2020;** **Ulyett** ***et al***., **2014**, **Zhang *et al***., **2016)** they observed that, a large surface area and porosity of biochar able to adsorb nutrients and water, also increase the specific surface area of coarse-textured soils to increase water retention. **Yoo** ***et al* (2020)**. showed that, the biochar only also mechanism function as a macro aggregate and increased aeration under the excessive water condition. Under the changing water condition, the micro pores of biochar may retain the available water for plant roots and soil microbes.

**Table 10. Soil Hydraulic conductivity (cm h-1)** by **the soil amendments of the studied soils (lupine).**

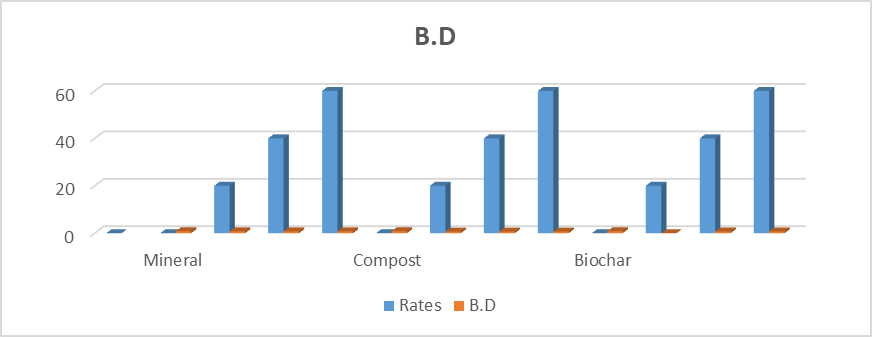
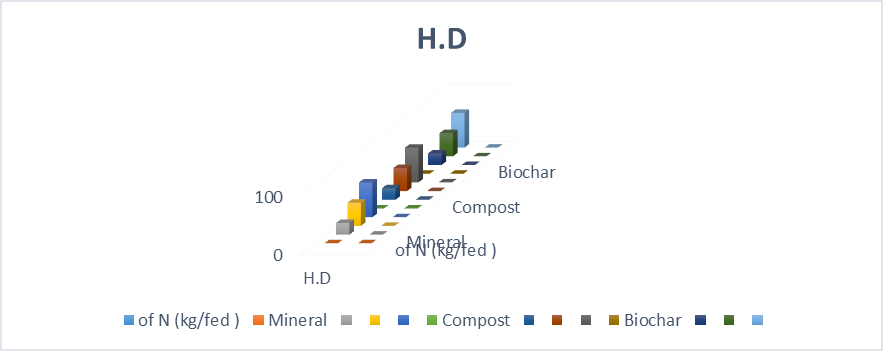
|  |  |  |
| --- | --- | --- |
| Treatments | Rates  of N (kg/fed ) | H.D |
| Mineral | 0 | 0.00090 |
| 20 | 0.00091 |
| 40 | 0.00092 |
| 60 | 0.00092 |
| Mean | | 0.00091 |
| Compost | 0 | 0.00090 |
| 20 | 0.00093 |
| 40 | 0.00096 |
| 60 | 0.00096 |
| Mean | | 0.00093 |
| Biochar | 0 | 0.00090 |
| 20 | 0.00093 |
| 40 | 0.00094 |
| 60 | 0.00094 |
| Mean | | 0.00092 |
| LSD. 5 % Treatments\*H.D | | 9.19E-04\*\*\* sg |
| LSD. 5 % Treatments \* Rate | | 2.101 \*\*\* ns |
| LSD. 5 % Interaction | | \*\*\* ns |

Values of soil hydraulic conductivity after harvested **lupine** crop as effect by different treatments are presented in Table 9. The results obtained that the application of all amendments decreased soil HC (cmh-1) values when compared to the control. the results observation that compost>Biochar>minerals and The effect of Mineral-N was followed the pattern of **N60> N40  > N20 > N0,**as results showed that, all two means are significantly different from one another, but with rate is non-significant, this results arranged by, **Cooper *et al*** (**2020),** results shown that, a significant interaction effect of the factors biochar and compost on water holding capacity for the surface soil and a significantly higher water holding capacity for the high-rate versus low-rate compost treatments in the subsurface soil between the low and high addition rates. Biochar addition obtain a higher soil porosity and water holding capacity, it was progress aeration water and nutrient retention, and promote microbial activity. Porous structure of biochar creates a new colonization for soil microorganisms **Jatav *et al (*2021)**, **Hemdan. N. A. *et al* (2022**), Obtained results show that soil pores were positively influenced by applying biochar and compost combined Soil Ground Fertility reclamation amendments. Drainable pores, water holding pores and non-useful pores were boosted. Biochar and compost as soil amendments increased the micro pores i.e. water holding pores and none useful pores in the expense of macro ones i.e. drainable pores.

**Table 11. Soil Bulk density (Mg m-3) by** **the soil amendments of the studied soils (lupine).**

|  |  |  |
| --- | --- | --- |
| Treatments | Rates  of N (kg/fed ) | B.D |
| Mineral | 0 | 0.811454 |
| 20 | 0.760242 |
| 40 | 0.770242 |
| 60 | 0.770242 |
| Mean | | 0.778045 |
| Compost | 0 | 0.811454 |
| 20 | 0.678854 |
| 40 | 0.689667 |
| 60 | 0.689667 |
| Mean | | 0.7174105 |
| Biochar | 0 | 0.811454 |
| 20 | 0.7434 4 |
| 40 | 0.74365 |
| 60 | 0.74365 |
| Mean | | 0.76625 |
| LSD. 5 % Treatments | | 0.8088\*\*\* ns |
| LSD. 5 % Treatments \* Rate | | 2.201 \*\*\* ns |
| LSD. 5 % Interaction | | \*\*\* ns |

**BC= Bulk density. 1.1: density Bulk soil Sandy, ((Mg 3-m) density.**



A

B

**Fig. 3. A. Soil Hydraulic conductivity (cm h-1) s and B. Soil Bulk density (Mg m-3) of the studied soils (lupine).**

The Data present in Table11 and Fig. 3B obtained that, the value of bulk density is decreased by adding treatments compost was (0.811: 0.689), biochar was (0.811: 0.743) but minerals treatment was (0.811: 0.770) there are no significant pairwise differences among the means, this results obtained the effect of compost ,biochar on improving sandy loam soil ,morethan,The effect of Mineral-N was followed the pattern of **N60> N40  > N20 > N0.**As arranged result, **Aidee, *et al* (2015) and Ali .M, M. E** ***et al* (2018)**are reported that, the positive effects of rice biochar amendment on physiochemical properties. Results obtained that Compost slight decrease soil bulk density and pH at two stages of growth and two times application. **Mohamed M.S *et al* (2020).**These results are in harmony with **El-Maaz EIM (2021)**, showed that, the maximize value of bulk density low is these nutrients more mobile and available to plant root systems. **Kamel. G.H *et.al* (2024),**reported that, the value of bulk density is decreased by adding the application of all amendments as organic –fertilizer, but , they found that, the total porosity and capillary porosity increased in the plow layer of soil.

**Conclusion**

This study aims to evaluate the effects of mineral, compost and biochar application can have a main impact on soil pH, bulk density, aeration, porosity, CEC, WHC, nutrient balances, and other parameters of soil quality due to its intrinsic structure and physicochemical properties and either impact on specific physical -chemical characteristics of sandy Loamy soil, as well as their impact on lupine productivity. The application of compost and biochar with Rates of mineral nitrogen fertilizer increased the macronutrients and micronutrient, soil fertility and Lupines productivity, in line with pervious discussion, it can goal to increase the soil water and nutrient retention of sandy loamy soil by adding treatments compost > biochar > minerals. ,Furthermore that, improved soil's physical and chemical characteristics as well as lupine productivity.

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