International Journal of Science and Research Archive
eISSN: 2582-8185
Cross Ref DOI: 10.30574/ijsra
Journal homepage: https://ijsra.net/

(RESEARCH ARTICLE)

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Evaluation of mixing Humic acid with manure on selected soil chemical properties

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International Journal of Science and Research Archive, 2025, 17(03), 894-899

Publication history: Received 17 November 2025; revised on 22 December 2025; accepted on 25 December 2025

Article DOI: https://doi.org/10.30574/ijsra.2025.17.3.2467

Abstract

laboratory study was conducted to evaluate the effect of Humic acid (HA) with mixing of manure (chicken - ChM; cow - CoM) on some soil chemical properties. The soil was amended with 10 t. ha^{-1} of manure and treatments used were: T1 (Control), T2 (HA), T3 (HA + ChM) and T4 (HA + CoM). The soil chemical parameters were analyzed for soil pH, the electrical conductivity (EC), total nitrogen (N), available phosphorus (P), potassium content (K) and soil organic carbon (SOC) after 15-, 30-, 45- and 60-days' incubation period at 28 ˚C. The results demonstrated a significant difference between the control and other treatments. the treatment applications have lowered the soil pH and EC was increase significantly with days of incubation. At 45 days of incubation the total nitrogen, available phosphorus, potassium content and soil organic carbon were increased significantly and decreased thereafter. As a result, the addition of humic acid and manure have significant effect on soil chemical properties.

Keywords: Manures; Humic Acid; Soil Chemical Properties

1. Introduction

Application of Humic Acid can improve the chemical properties of soil. also, nutrients availability such as P, K and boost soil OC and other nutrients (Rayne and Aula, 2020). Also, can affected on a total account of microbes, enzyme activities and cation exchange capacity (CEC), (Fahramand M, et al., 2014). Incorporation of HAs into soils reduce the abiotic stress, increase plants resistant, enhanced plant growth, root hairs and nutrient uptake (Man-hong; Atiyeh RM, et al., 2002). it is very necessary to conducted more research to understand the mechanism of humic acid on plant growth and soil properties.

Previous research results showed that the application of manures have appositive effect on some soil properties (Liu M. et al., 2009). Addition of manure can promote plant growth, increase productivity, yield, and releasing nutrients to the soil during their decomposition (Saka, H.A. et al., 2017). the effect of manure on the soil properties might differ according to source of manures such as chicken manure, cow manure and farmyard manure. The addition organic matter into soils increases nutrient availability like N, P, S and some of micronutrients (Brandon M, et al., 2013). Manure application can increase soil pH and/or soil salinity (Whalen JK, et al., 2000; (Li-Xian et al., 2007).

Therefore, the aim of this study was to investigate the effect of the mixed manure and Humic acid on some soil chemical properties.

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2. Materials and Methods

The study was conducted at Ankara University, Faculty of Agriculture, soil dept., lab, the soil used was taken from research field at depth of 0-30 cm. The Humic acids as powder was added to soil. The fermentation manures (chicken and cow) were applied to soil. The mixed Mixed Humic acid and manure were added into soil at a rate of 10 ton/ha. The experiment of incubation laboratory was conducted in complete randomize design (CRD) with three replicates in four different incubation periods (15, 30, 45 and 60 day). The treatments were as follows: T1: 0 (control); T2: Humic acid (10 ton/ha); T3: humic acid (5 ton/ha) + chicken manure (5 ton/ha); T4: humic acid (5 ton/ha) + cow manure (5 ton/ha). The soil samples were incubated at 28 ˚C. At the end of each incubation period soil samples were collected.

2.1. Soil analyses

The collected soil samples were air-dried, crushed, and passed through a 2-mm sieve for chemical analysis. Soil pH and EC measured by using pH meter electrodes and EC-meter and glass pH meter electrodes, respectively. The total N, phosphorus, and potassium content were determined according to the methods described by (Page, A. L. et al., 1982). Organic carbon (OC) content was determined by Walkley–Black method D.W Nelson, and (L.E. Sommers,1996).

3. Results and Discussion

3.1. Soil use of study

Table 1 Displays the soil pH, EC, N, P, K and O.C analysis of the soil used in this study. According to this results the soil was moderately alkaline and non-saline.

Table 1 Some chemical properties of soil used in this study

Materials	pH	EC (dS/ m)	N (%)	P (%)	K (%)	O.C (%)
Soil	8.15	0.341	0.088	3.48	37.2	0.89

3.2. Soil pH

The application of Humic Acid and mixed manures had a substantial ($p \leq 0.001$) impact on the soil pH. In comparison to the control, the T1 was the highest (8.29) and treatment T3 was the lowest (7.88). That is due the organic matter released acids during the decomposed period that can lower the pH of the soil (Fig. 1). The treatment (T3) was slightly acidic compared with other treatments. These results are similar with (P. Horswill, et al., 2007; R.U. Shah, et al., 2015), who found that pH of cow manure is higher than poultry manure treatment.

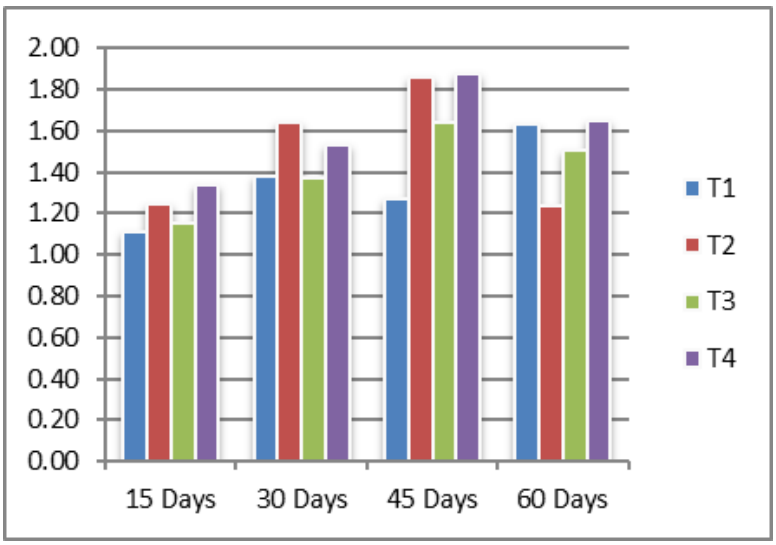

Figure 1 Effect of treatments on soil Ph

3.3. Soil electrical conductivity (EC)

The application of manure significantly affected the electrical conductivity (EC). The treatment T3 was the highest (0.442 dSm^{-1}) and T1 (control) was the lowest (0.340 dSm^{1-}) (Fig. 2).

The soil electrical conductivity (EC) significantly increased with incubation time and at 45 days the peak its reached and at 60 days of incubation periods soil, EC was decreased. The treatment (T4) was the best compared with other treatments. That is due the application of mixed of humic acid and manure will improve the soil physical condition that facilitate the water movement and hence salt leaching (A. Yadav, et al., 2013; J.O. Azeez and W. Van Averbeke, 2012).

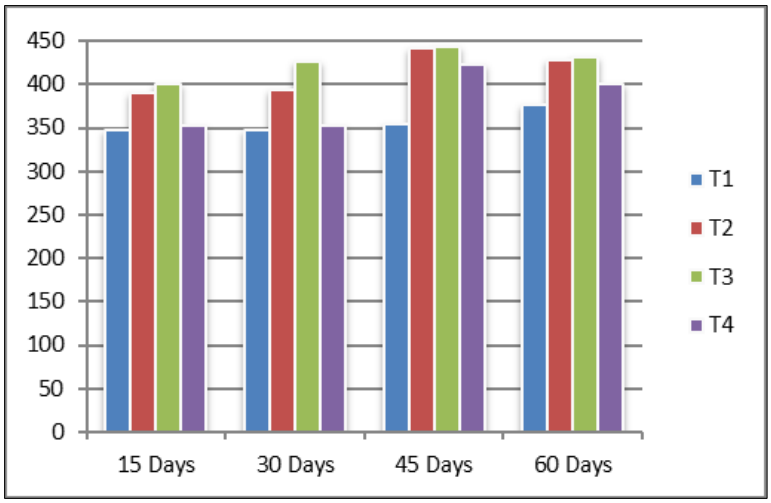

Figure 2 Effect of treatments on EC (dSm^{-1})

3.4. Nitrogen (N%)

The application of mixed of humic acid and manure into the soil have significant effect on soil nitrogen content (N). The treatments showed a significant increase on total nitrogen content (N) compared with the control. This is because applications of mixed of humic acid and manure release (N) upon decomposition.

In general, soil (N) content was increased with incubation period and the peak at 45 days was reached. In the case of treatment T2 the total nitrogen decreased at 30 days from (0.162 mg kg^{-1}) to (0.134 mg kg^{-1}) at 60 days of the incubation period (Fig. 3). The best application (T4) compared with the other treatments, that is due to amount of organic matter increases total nitrogen (S.O. Ojeniyi, et al., 2007).

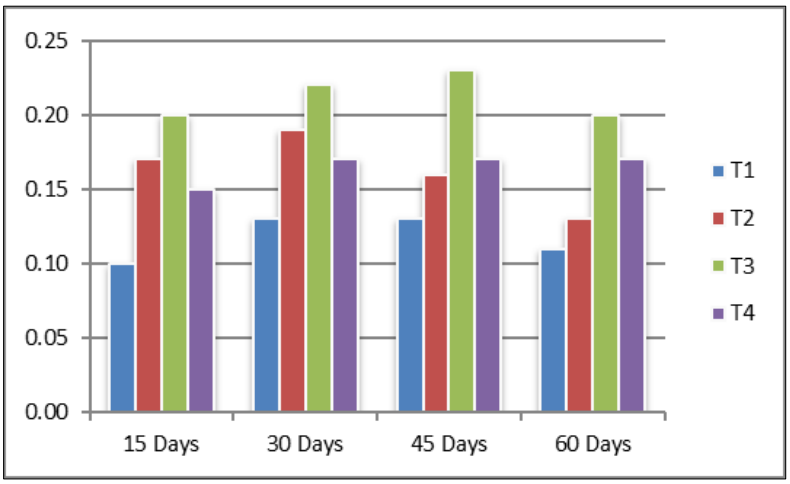

Figure 3 Effect of treatments on total nitrogen (%)

3.5. Phosphorus (P)

The application of Mixed humic acid and manure caused a significant change in the soil's phosphorus content (P). Generally, the P content was increased by incubation time and at the 45 days the peak was reached. The value of P was found to be 6.5% in T2, while in treatment T3 the value was 12.54% (Fig. 4). The best combination treatment was T4 compared with others treatments. That is due to decomposed of manure released more acids and that effect on soil pH. Therefore, the decrease in soil pH will lead to an increase in phosphorus availability. Similar results were obtained by (H.L.S. Tandon, 2000) who found that application of manure or compost increased the phosphorus content of the soil.

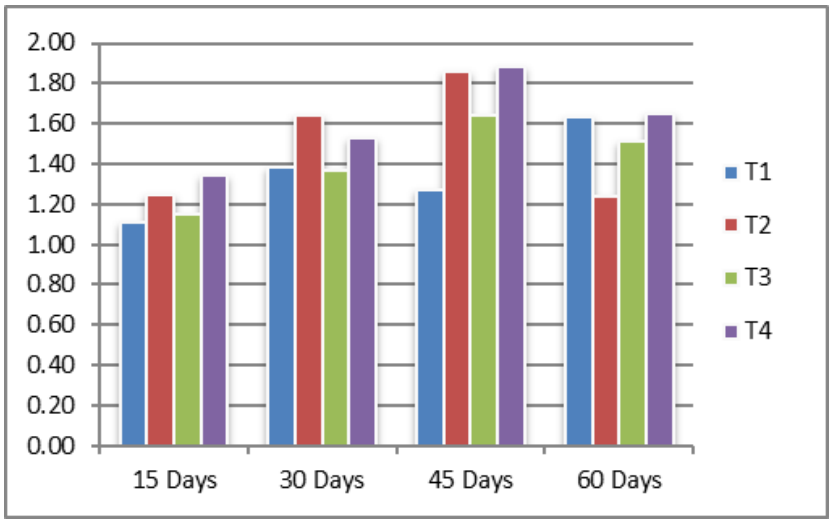

Figure 4 Effect of treatments on phosphorus content (%)

3.6. Potassium (%)

Mixed combining humic acid with manure have significantly affect on soil potassium content. The highest value of potassium content was observed at 45 days of incubation. The treatment (T2) was the highest and the control (T1) was the lowest.

Comparing between treatments T3 and T4 observe that the values of K content was 66.33 mg kg^{1-} in T3, while in T4 it was 59.13 mg kg^{1-} (Fig. 5). During decomposition organic matter increased the availability of potassium content in soil. Similar results were obtained by (S. R. Cooper, et al., 2000), who found that application of manure increase the soil potassium.

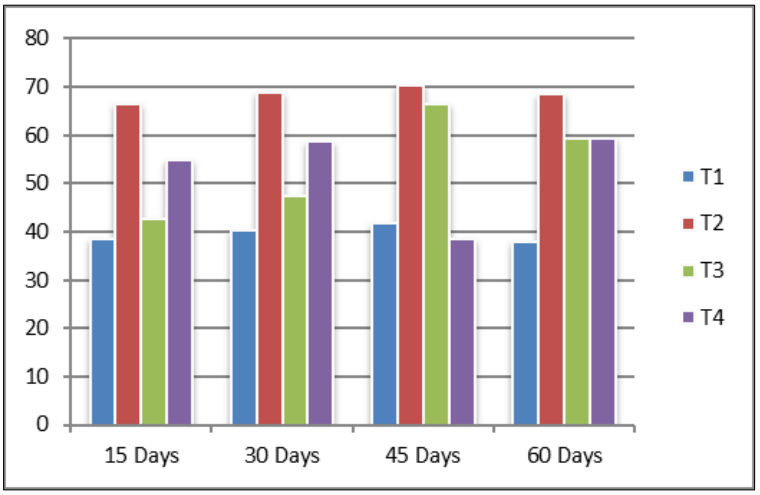

Figure 5 Effect of treatments on potassium content (%)

3.7. Soil organic carbon (%)

Combining manure with humic acid (HA) have significantly improve soil organic matter content (SOM) during the incubation period. Humic acid, a men component of soil organic matter, enhancing nutrient availability. The treatment (T4) was highest and the control treatment (T1) was lowest. In general, the organic matter content ranged from 1.25%, to 1.98% (Fig. 6). The treatment (T4) was the best treatment compared with others.

That could be explained by the fact that mixed HA with manure has shown significant effects, leading to increased soil organic carbon. The results were agreed with (E.A. Elhadi, et al., 2016; B. Eghball, 2002), who found the application of manure is an increase in soil organic carbon.

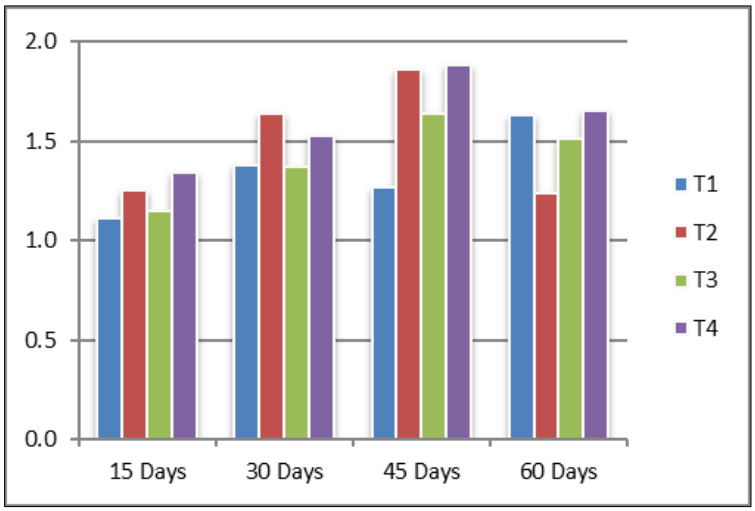

Figure 6 Effect of treatments on soil organic matter content (SOM)

4. Conclusion

In general, the results showed that the application of organic matter had significant effect on soil chemical properties and treatment T4 showed a significant superiority compared with other treatments.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict-of-interest to be disclosed.

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