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# COMPARING EFFECTS OF MUNICIPAL SOLID WASTE COMPOST AND MANURE (COW AND SHEEP) ON SOME SOIL PHYSICAL CHARACTERISTICS AND DILL YIELD

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## Abstract

To study the influence of urban compost and livestock manure over some soil physical properties, a CRD-experiment using 15 treatments and 3 replications was done in investigational plots of Sari Agricultural Sciences and Natural Resources (in the form of a three-year plan) in 2016-2017. Manure/fertilizer treatments including: $T_1$: control, $T_2$: fertilizer with 250, 100 and 100 kg/he respectively for levels of N-P-K using Urea, TSP and Potassium Sulfate fertilizers, $T_3$: 15 ton/ha of urban composts, $T_4$: 15 ton/he of sheep manure, $T_5$: 15 ton/ha cow manure, $T_6$: 30 ton/ha of urban compost, $T_7$: 30 ton/ha of sheep manure, $T_8$: 30 ton/he of cow manure, $T_9$: the mixture of 15 ton/ha of urban compost with 15 ton/ha of sheep manure, $T_{10}$: the joint of 15 ton/ha of urban compost with 15 ton/ha of cow manure, $T_{11}$: the usage of 60 ton/ha of urban compost, $T_{12}$: 60 ton/ha of sheep manure, $T_{13}$: 60 ton/ha of cow manure, $T_{14}$: the mixture of 30 ton/ha of urban compost with 30 ton/ha of sheep manure and finally, $T_{15}$: the mixture of 30 ton/ha of urban compost with 30 ton/he of cow manure. Results has showed the application of urban compost and livestock manure (Sheep and cow) have the pronounced effects on major soil properties such as: Bulk Density, Total Porosity, Aggregate Consistency, WHC, HC (saturated), Permanent Wilting Point, Available Water, Liquid Limits moisture content, Plastic Limit moisture content, Plasticity Index, and plant yield (dry/fresh). But there was no significant influence on the field capacity and particle density. Finally, it can be concluded that organic matter has pronounced effects on the physicalproperties of soil and the use of organic fertilizers will definitely improve the most properties of soil.

***Key words :*** Cow and Sheep manure, Soil physical properties, Urban compost, Dill,Yield.

## Introduction

Success in the production of agricultural products requires the presence of suitable soil and sufficient amount of nutrients available to the plant (Rokstrom *et al.,* 2007). Unfortunately, the one-dimensional view of food supply, regardless of environmental issues, has increased the use of chemical fertilizers in an unobtrusive form, and has damaging effects such as soil texture hardening, soil permeability reduction, root growth restriction and, finally, plant growth decline. Due to the undesirable effects of using chemical fertilizers on the environment, the use of organic fertilizers in a sustainable agricultural system is recommended (Asadi *et al.*, 2018).

Inappropriate agronomic management, including dense cultivation and the complete removal of plant residues from soil in arid and semi-arid areas, has resulted in a gradual decrease in soil organic matter. This leads to poor physical properties of the soil. Therefore, increasing soil fertility is one of the most principled methods of increasing agricultural production per unit area. Organic matter is a potential modifier for agricultural soils. The positive effects of organic fertilizers in comparison with chemical fertilizers on soil physical properties are far more than chemical fertilizers (Sharma 2003). Due to the climatic conditions of Iran and the presence of widespread dry and semi-arid areas, the shortage of organic matter

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is evident. On the other hand, a huge amount of waste accumulation is one of the problems of urban management; one of the solutions for managing these wastes is to convert it into compost for use in agriculture.

The results of various researches show that the use of compost fertilizer can be used as a supplier of soil organic matter (Jank *et al.*, 2010). It has been determined that adding organic compost to municipal waste and sewage sludge can cause soil formation and stabilization. Aglidos and Lundra pointed to the positive effects of compost on physical properties of soil, including saturated and unsaturated hydraulic conductivity, water holding capacity, apparent bulk mass, dispersion and pore size, permeability and soil compressibility.

Fath Al-ulumi *et al.*, Using sewage sludge, showed that the total porosity was increased by about 3.62,4.08 and 8.6 % in treatments with 60,120 and180 tons /$m^2$ sludge compared to the control.

Water holding capacity is one of the important factors for optimal growth of plants. Utilization of municipal waste compost for three consecutive years of municipal waste compost treatment of 40 ton/he with 50 percent chemical fertilizer on water holding capacity indicates a significant increase of 42.43% of the soil contains municipal waste compost. Thus, with the increase in the amount of municipal solid waste compost, the capacity of water storage increases. (Rahimi *et al.* 2013)

For a long time, the use of fertilizers of animal origin has become customary in agricultural practices. These fertilizers make soil spongye, increase the pores and improve the soil structure and ultimately reduce the bulk density of the soil. The reason for the reduction of the bulk density due to the application of organic wastes is a smaller volume of the material than the soil and the effect of diluting these compounds.

In numerous studies, the reduction of soil bulk density has been reported due to the addition of organic wastes to soil (Zamani Bob Gohari *et al.,* 2011). The use of manure can improve the physical properties of the soil and increase the amount of available elements such as N-P-K, (nitrogen (N), phosphorus (P) and potassium (K)). But using cow manure should be done with caution.

Because of the possibility of transporting pests and diseases, non-compliance with health points in its maintenance, transportation problems and environmental pollution, and its cost-effective lack of waste compost (due to low levels of food elements).

In the study of the effect of fertilizer levels on the amount of soil capacity, it was observed that with increasing the level of municipal waste compost with 50% of fertilizer, this parameter increases (Rahimi *et al.*, 2013). Clicks et alwith utilization of municipal waste compost and manure and N-P-K fertilizerto increase the hydraulic conductivity of soil saturation in manure and compost treatments and stated that the increase in saturated hydraulic conductivity in manure treatment was higher than that of municipal waste compost.

Shivil *et al.*, A research conducted in northern China, reported that the use of organic and chemical fertilizers could affect soil physical properties by changing the organic carbon content of the soil and the chemical composition of the soil solution. Urban waste compost can provide available plant elements in a short amount of time and by stimulating microbial activity, it maintains the reservoirs of nutrients and soil organic matter, which increases the plant's ability to increase the plant's access to high-consumption elements (Rubin *et al.*, 2001).The objective of this study was to investigate the effect of municipal waste compost on improving the physical condition of the soil and its comparison with livestock manure as well as the effect of municipal waste compost and livestock manure on intestinal dill.

## Materials and Methods

This research was conducted in the field of research of Agricultural Sciences and Natural Resources of Sari in 2016-2017. The soil of the studied area has a dominant texture of silty clay and the climate of the region is temperate and wet. Some of the chemical and physical properties of the soil and fertilizers studied are presented in tables 1 and 2.

This experiment was conducted in a completely randomized design with 15 treatments and 3 replications. Treatments were: $T_1$ control, $T_2$, 15 ton $T_3$, 15 ton sheep/ha ($T_4$), 15 ton Cow/ha ($T_4$), 30 ton municipal waste compost In hectares ($T_6$), 30 tons of sheep/hectare ($T_7$), 30 tons of cow per hectare ($T_8$), 15 tons of municipal waste compost per hectare+15 tons of sheep/hectare ($T_9$), 15 tons of municipal waste compost Ha+15 tons of cow manure per hectare ($T_{10}$), 60 tons of municipal waste compost per hectare ($T_{11}$), 60 tons of sheep/hectare ($T_{12}$), 60 tons of cow per hectare ($T_{13}$), 30 tons of urban waste compost per hectare+30 tons of sheep/hectare ($T_{14}$), 30 tons of municipal waste compost per hectare + 30 tons of cow manure per hectare ($T_{15}$). For this experiment, plots with dimensions of 3×2 m were created and hemical and organic fertilizers were added to the appropriate plots before cultivation. The chemical compound consisted of 250, 100 and 100 kg/ha of urea, superphosphate Triple and potassium sulfate.

Physical properties of the soil, including soil texture

by hydrometry (Boyux 1962), the particle density of the specimen by the use of pycnometer, bulk density by intact sampling method, and weighing were measured at 105°C (Kolot and Dirksen 1986), porosity by calculation method according to particle and bulkdensityrelationship (Donelson and Sutherland, 1986), stability of aggregates by wet sieving method (Kamper and Rosseny 1986), saturated hydraulic conductivity by falling head method (Colut and Drykson, 1986), moisture content in field capacity by farm method (Alizadeh, 2004), moisture content at the permanent wilting point in the Briggsvantz method (1912), available moisture content by detracting FC from PWP (Alizade 2004) and the water holding capacity or moisture content in saturated soil paste were determined by weighting method after preparing the saturated soil paste using distilled water (Famaglity 1998).

In order to study the effect of fertilizer treatments on plant dill, sampling from one square meter of each plot was carried out separately, then samples were transferred to the laboratory and weighed in the laboratory for 72 hours in an oven at 75 °C Celsius. After drying, the samples were weighed again. Statistical analysis was performed by statistical software with SAS 8 software and comparison of meanings by least significant difference (LSD) method at probability level of p = 0.05. EXCEL was used to draw charts.

## Result and Discussion

The results of variance analysis of physical properties of soil for different treatments are shown in table 3. According to the analysis of variance data, it was determined that the effect of choke treatment on all studied characteristics was significant except for the specific gravity and agronomic capacity at 1% level.

Particle density, bulk density and soil porosity according to the results of this experiment, the application of different treatments in the field did not have a significant effect on the true mass of the soil. However, the bulk density and porosity showed a significant difference at the 1% probability level. These results were compared with the results of Babugoughi *et al.,* 2011) also matched.

Comparison of mean of data showed that the highest bulk density was related to chemical fertilizer treatment with 1.39 gr/cm3 ($T_2$) and the lowest apparent bulk mass was $T_{15}$ treatment (30 ton/he municipal solid waste compost + 30 tons of cow per hectare)with apparent bulk mass of 0.91 gr/cm3, which is a percentage reduction compared to the control treatment is 59/32 (Fig. 1). By adding organic fertilizers, the apparent bulk mass of the soil has decreased due to the low volumetric mass of the material compared to the soil, as well as the organic matter

**Table 1 :** Some physical and chemical properties of the studied soil.

| Measured parameters | The unit | Soil |
|---|---|---|
| Clay | percent | 38 |
| Silt | percent | 44 |
| Sand | percent | 18 |
| OC1 | percent | 1/34 |
| N | percent | 0/07 |
| P | mg/kg | 9/1 |
| K | mg/kg | 227 |
| Particle density | g/cm$^3$ | 2/60 |
| Bulk density | g/cm$^3$ | 1/35 |
| pH | -- | 7/80 |
| EC | dS/m | Soil |

**Table 2 :** Some characteristics of used fertilizers.

| Measured parameter | The unit | Municipal waste | Cow manure compost | Sheep manure |
|---|---|---|---|---|
| pH | -- | 7/76 | 7/91 | 7/80 |
| OC | percent | 20/33 | 23/13 | 15/54 |
| EC | dS/m | 4/75 | 2/14 | 6/30 |

improves the building and soil partitioning. Kiyoli *et al.* (2016) stated that the use of cow manure in the soil, it has reduced apparent bulk mass.

It was found that application of 60 ton/he municipal waste compost ($T_{11}$) and combining 30 ton/he of cow manure and 30 ton/he of garbage compost ($T_{15}$) had a more effective role in reducing apparent bulk mass and porosity. Table 3 shows that application of organic fertilizers has a significant effect on soil porosity. The highest porosity was observed for $T_{15}$ treatment, comprised of 30 tons of municipal waste compost and 30 tons of cow manure per hectare with 66.17 percent, which was 34.27 percent higher than the control, and the lowest was for control with 49.28 percent (Fig. 2). Organic fertilizers have a positive effect on the condition of aggregates and soil structure, creating small and medium pores and ultimately increasing total porosity. Rahimi *et al.*, (2013) pointed to the role of most municipal waste compost in increasing soil porosity. In fact, the porosity of a volume of soil that is occupied by vacant pores and is proportional to the apparent bulk mass of the soil, therefore, a higher apparent bulk massthan the actual mass in the soil increases the total porosity.

### Aggregate stability

The tested fertilizer treatments were significant at 1% probability level in aggregate stability. Organic matter is one of the stability factors of aggregates, and it maintains a surface soil structure from direct collisions of rain or

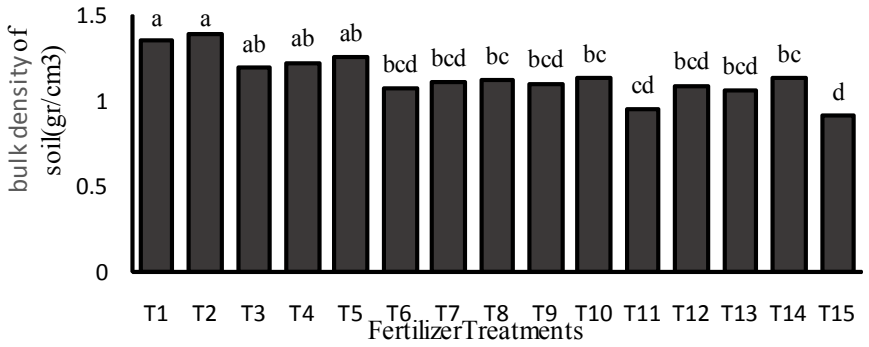


**Fig. 1 :** Effect of different fertilizer treatments on bulk density of soil. Different letters or letters indicate a significant difference at the 5% probability level of the LSD test.

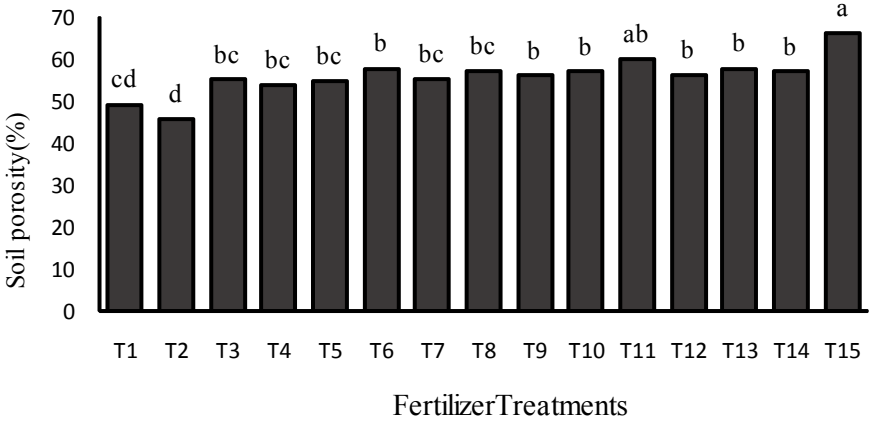


**Fig. 2 :** Effect of different fertilizer treatments on soil porosity. Different letters or letters indicate a significant difference at the 5% probability level of the LSD test.

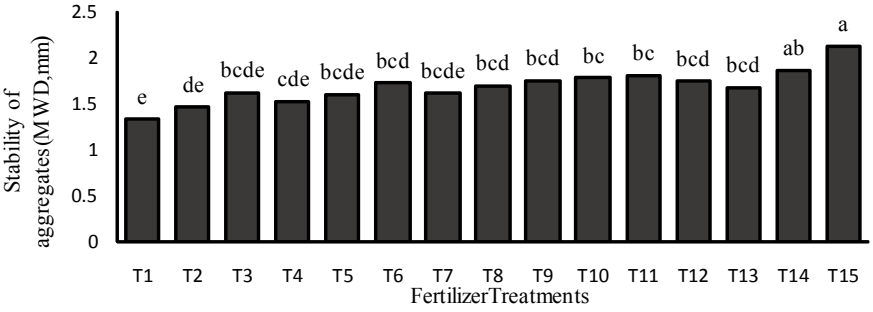


**Fig. 3 :** Effect of different fertilizer treatments on the stability of aggregates. Different letters or letters indicate a significant difference at the 5% probability level of the LSD test.

contact with current water. According to Fig. 3, the stability of aggregates in $T_{15}$ treatment was 30 tons of cow manure + 30 tons of municipal waste manure per hectare had the highest amount compared to control treatment, and in comparison with control treatment, it increased by 15.15 percent. The reason for this increase can be attributed to the presence of a large organic matter and as a result of the accumulation of soil particles. Misra *et al.,* (2010), using fertilizers and combining fertilizers and livestock, showed that the agro-stability rate increased from 69.28% to 73.88%. In another study, Franco *et al.*, (2007) concluded that the use of municipal waste compost would maintain soil stability and prevent its collapse.

**Water Storage Capacity**

Based on the results of this research, water holding capacity increased significantly with the use of compost and livestock manure treatments, so that the highest increase was observed for $T_{13}$ treatment (60 tons of cow manure per hectare), which increased 24.36 percent compared to Treatment was observed (Fig. 4). Due to the increase in the amount of organic matter in the soil and the increase in the volume of pores and soils, the water holding capacity has increased (Akani and Ojani, 2007). Based on the results of Ahmadabad and Qajar (2012), soil water storage capacity Application of fertilizer compost, vermicompost and sewage sludge increased significantly, which was consistent with the results of this research. The reason is increased water holding capacity to high cationic capacity of organic fertilizers, changes in the size of soil porosity and the increase of fine and medium pore porosity.

**Hydraulic Conductivity of Soil Saturation**

The results of the analysis of variance showed that the effect of different fertilizer treatments was statistically significant at 1% probability level (table 3). $T_{13}$ treatments containing 60 tons of cow manure have the highest saturated hydraulic conductivity, which has a 378.48% increase compared to the control treatment (Fig. 5). The increase of EC soil has reduced the transfer of heavy elements from soil to plant, and as a result the risk of contamination is also reduced. The use of cow manure compost changes the hydraulic properties of the saturated soil. Alcans *et al.*, (2003) point to an increase in the hydraulic conductivity of soil saturation after the addition of compost and cow manure,

**Table 3 :** Analysis of variance for some physical properties of soil. The fertilizer treatments were significant at 1% probability level in agro bacterial stability. Application of organic fertilizers has a significant.

| Sources of changes | Degrees of freedom | particle density (gr/cm3) | bulk density (gr/cm3) | Total porosity % | Aggregate stability | Water storage capacity | Saturated hydraulic conductivity | Field capacity | Permanent wilting point | Available water | Liquid limit moisture | Plastic limit moisture | Plastic index |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Treatment | 41 | 0.006363$^{ns}$ | 0.05002$^{**}$ | 61.7545$^{**}$ | 0.10278$^{**}$ | 34.0005$^{**}$ | 1.82025$^{**}$ | 10.5476$^{ns}$ | 3.42230$^{**}$ | 4.75191$^{**}$ | 19.2591$^{**}$ | 16.7430$^{**}$ | 16.4404$^{**}$ |
| Error | 30 | 0.005573 | 0.01518 | 13.7301 | 0.03274 | 1.1176 | 0.11529 | 8.0664 | 0.32399 | 0.40563 | 1.3459 | 2.2867 | 0.6103 |
| Coefficient of variation % | – | 2.97 | 10.83 | 6.64 | 10.72 | 1.81 | 16.09 | 8.27 | 3.18 | 3.87 | 2.93 | 6.43 | 4.87 |

**: Significant at 1% probability level ns: No significant

which is due to the positive effect of these organic substances Expressed the soil degradation.

**Field capacity, permanent wilting point and available soil water**

Different fertilizer treatments had a significant difference in terms of permanent wilting and available soil water at 1% probability level, but did not show a significant difference in field capacity. $T_{13}$ treatment (60 t ha-1 cow manure) had the highest moisture content at the wilting point of the control, with a permanent wilting point in this treatment 19.65%, which was an increase of 36.24% compared to the control (Fig. 6). Regarding the available water content of $T_{11}$ treatment (60 tons of municipal waste compost), the highest difference was observed in the control treatment and its value is 18.07, which is more than the control (29.25) 6). During the experiment, which Zaitin and Rain (2003) conducted to study the effect of the application of compost on some physical properties of the soil, with increasing compost to the soil, the percentage increase in moisture content at agglutination and wilting points was 31.7% and 24.1% respectively, Also stated that the amount of water available would increase with increasing moisture content at the crop capacity point. Ahmadabadi and Qajar (2012) also indicated that moisture content in field capacity and permanent wilting had a significant effect on fertilizer treatments applied in soils and had the most effect on treatments of 40 tons of compost and 40 tons of sewage sludge per hectare.

**Liquid limit and plastic limit moisture contact and plastic index**

The application of fertilizer treatments based on the moisture content

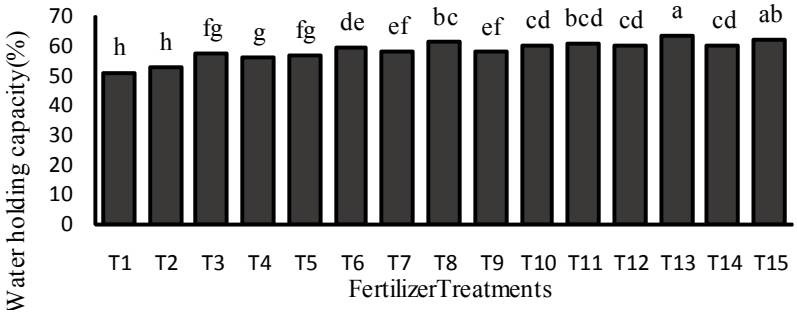


**Fig. 4 :** Effect of different fertilizer treatments on water holding capacity. Different letters or letters indicate a significant difference at the 5% probability level of the LSD test.

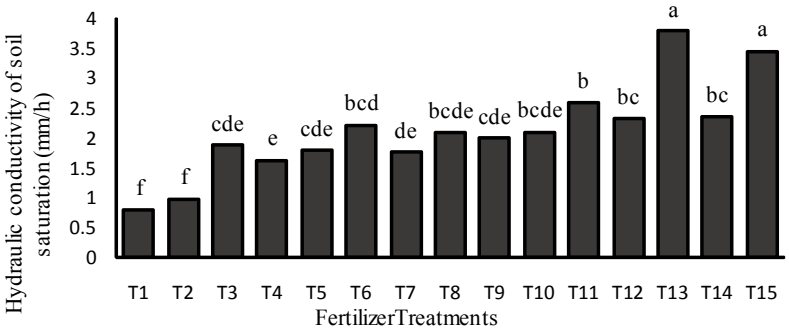


**Fig. 5 :** Comparison of the mean hydraulic conductivity of soil saturation in different fertilizer treatmentsDifferent letters or letters indicate a significant difference at the 5% probability level of the LSD test.

**Table 4.** Analysis of variance of dill in different fertilizer treatments.

| Sources of changes | Degrees of freedom | The fresh | Plant dry weight weight of the plant |
|---|---|---|---|
| Treatment | 14 | 10484.9** | 901.273** |
| the danger | 30 | 10.9 | 4.172 |
| Coefficient of variation(%) | -- | 1.29 | 3.10 |

**: Significant difference at 1% level

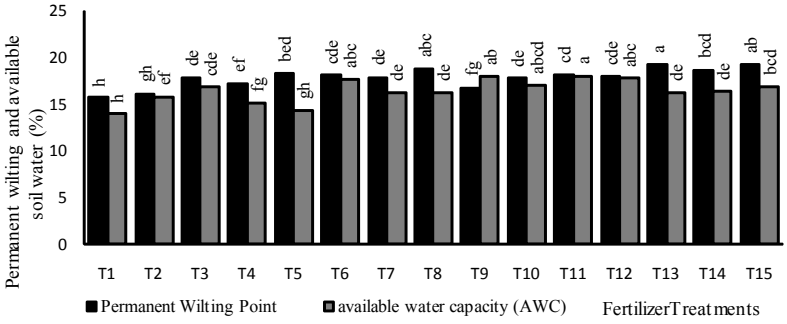


**Fig. 6 :** Effect of various fertilizer effects on permanent wilting and available soil water. Different letters or letters indicate a significant difference at the 5% probability level of the LSD test.

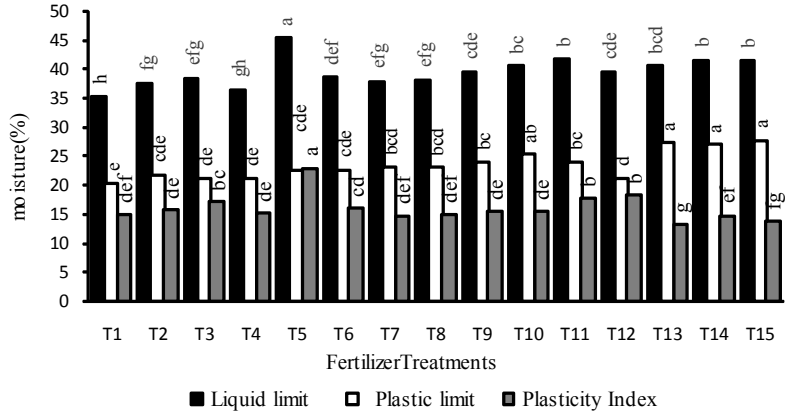


**Fig. 7 :** Effect of different treatments on liquid limit and plastic limit moisture content and plastic index. Different letters or letters indicate a significant difference at the 5% probability level of the LSD test.

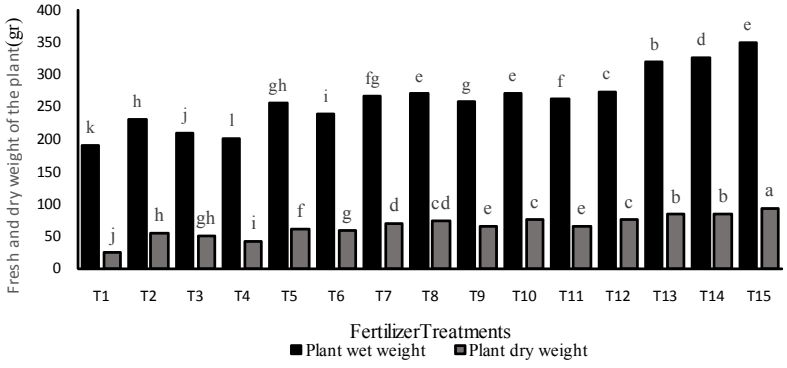


**Fig. 8 :** Effect of different fertilizer treatments on dill. Different letters or letters indicate a significant difference at the 5% probability level of the LSD test.

of liquid limit, plastic limit and the soil plastic index at the 1% probability level were significantly different. Soil stability and consistency are soil characteristics that show the behavior or resistance of the soil against the forces applied to it in a moisture range and are of the properties of fine-grained soils (medium and microfiber) (Hemat *et al.*, 2010). The minimum moisture content of the liquid and plastic limit, moisture content and the soil plastic index of the control treatment were 35.31, 20.45 and 14.86%, respectively. The highest moisture content of the liquid limit moisture and soil plastic index were related to $T_5$ treatment (15 tons of cowmanure per hectare) with 45.51 and 22.95 percent, the percentage increase compared to the control treatment was 28.88 and 54.44, and the highest moisture content of the plastic limit was 27.81 percent for the $T_{15}$ treatment (30 tons of municipal waste compost +30 tons of cowmanure per hectare), which is a percentage increase compared to the control treatment (99.35) (Fig.7). Soil moisture boundaries depend on factors such as the amount of organic matter deposited. The compost has cavities that can potentially absorb and maintain water in the soil; the results of Behnam *et al.*, (2017) confirm this.

## Dill yield

The results of analysis of variance of data showed that the applied fertilizer treatments on the dill yield (fresh weight and dry weight) had a significant difference at the probability level of 1% (Table 4). Comparison of the average dill of the plants showed that the control treatment had the lowest fresh weight and Dry matter of the plant and the highest fresh and dry weight of the plant is related to $T_{15}$ treatment (30 tons per hectare of municipal waste compost+30 tons per hectare of cattle), which is an increase of 83.66 and 264.84 percent, (Fig. 8). Pirdashti *et al.*, (2010) showed that the use of 40 tons of sewage sludge and chemical fertilizer increased the dill of Dead Seasoybean yield. Increased use of organic fertilizers improved the performance of green beans (Nouriani 2018). Utilization of various levels of municipal waste compost and vermicompost increased the dill of rapeseed and its growth indices (Rashtibari

and Alikhani 2014).

## Conclusion

Regarding the study of the sources and the study of the research, it can be concluded that the use of organic fertilizers improves the physical properties of the soil. Organic matter is recognized as one of the soil fertility pillars due to the effect of formations on soil physical, chemical, biological and soil fertility. Advantages of using compost to improve soil condition include improving the physical structure of the soil, absorbing and maintaining moisture, increasing porosity, increasing air-to-soil penetration, improving the quantity and quality of agricultural products. The highest amount of bulk density reduction, soil porosity increase, aggregate stability, moisture content, and wet and dry weight of the plant (the Dill yield) were observed in the combined treatment of 30 tons of municipal waste compost and 30 tons of cow manure per hectare. The application of organic fertilizers in soil has increased the hydraulic conductivity of soil saturation, with the highest increase in 60 ton/heof cattle manure. Also, the highest amount of organic matter, soil reaction, moisture at the point of permanent wilting and water holding capacity related to treatment of 60 ton/heof cow manure.

The amount of electrical conductivity of soil with application of 30 ton/heof municipal waste compost + 30 ton/he of sheep had the highest increase compared to the control treatment. The highest amount of soilliquid limit moisture content and plastic index were related to treatment of 15 ton/he of cow manure. With the use of organic fertilizers, the greatest reduction in the particle density, increasing the moisture content of the field capacity and available water is related to treatment of 60 ton/he of urban waste compost. According to the results of this study, 60 ton/he treatments for cow manure and so combining 30 ton/he cow manure with 30 ton/he municipal waste manure compost are the best treatments proposed.

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