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EFFECTS OF COMPOST AND ORGANIC MANURE ON THE PRODUCTION PARAMETERS OF BARLEY (HORDEUM VULGARE) CULTIVATION UNDER ARID CLIMATE, BISKRA REGION

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ABSTRACT:

Our study was conducted at the Department of Agronomic Sciences at the University of Biskra during the agricultural year 2021-2022, with the objective of comparing the effects of different organic amendments on barley (Hordeum vulgare) cultivation. Specifically, we examined the impact of compost (T1), manure (T2), and a control with no amendments (T0) on various aspects of barley growth and productivity. The results of our study revealed that while all three treatments—compost, manure, and control—exhibited similar influences on the growth parameters and morphological characteristics of barley, there were notable differences in yield outcomes. Manure (T2) produced the highest theoretical yield, averaging 57.99 quintals per hectare (qt/ha). This yield was significantly higher compared to both the control (T0) and the compost (T1) treatments.

Our findings suggest that while compost and manure both contribute positively to barley cultivation, manure is particularly effective in enhancing yield components, making it a potentially more beneficial amendment for optimizing barley production. This study provides valuable insights for agronomists and farmers looking to improve barley yield through sustainable agricultural practices.

Keywords: Compost, manure, barley cultivation, Biskra, growth and morphological characteristics.

1. INTRODUCTION

In arid areas, intensive cropping leads to a decrease in soil fertility, manifested by a loss of stable organic matter and increased plant susceptibility to nutritional imbalances and diseases. To address this issue, permanent use of manure is necessary. In these areas, manure is not only a scarce resource but its quality is also somewhat questionable (Haddad, 2007).
The application of compost promotes an increase in organic matter, elevation of pH, calcium content, as well as microbial biomass, leading to the formation of more stable aggregates and thus improving soil structure, increasing erosion resistance, and reducing leaching (Gerzabek et al., 1995).

Manure, or fertilization, is a semi-solid material composed of various organic waste products, derived from slurry combined with absorbent and structuring litter of a predominantly carbonaceous composition such as cereal straw, ferns, and wood pellets. Fresh manure or composted and transformed manure is spread and incorporated as fertilizer in agriculture. However, in oases, significant quantities of organic by-products are available. Indeed, the increasing mass of waste and its diversity raise awareness of the environmental and health risks associated with their simple disposal in open dumps, now posing a threat to our environment (FAO, 1976). Their recycling through composting allows for the production of compost that can be used for crops.

Johan (2005) defines composting as a biological process that facilitates and accelerates the oxidation of organic matter through aerobic fermentation of certain agricultural or urban waste, in order to recover mineral-rich elements and organic matter, which are then incorporated into agricultural land to enrich it.
Cereals are crops grown for their seeds, belonging to the grass family. Cereals play a crucial role in the development of humanity. In Algeria, barley (Hordeum vulgare L) is well known for its agronomic and socioeconomic importance, adapting to the farming systems practiced in arid and semi-arid zones (Harmouche, 2021).

Cereal cultivation and livestock farming are the main activities in the Biskra region. Conversely, progress made in agronomic research has improved barley production by introducing new adapted techniques and enhancing agricultural practices (Ganry, 1998).
This study aims to determine the effect of palm compost and manure on barley cultivation in the Biskra region.

2. MATERIALS AND METHODS

II-1- Climate

Climatic analysis allows for the establishment of the water balance and the connections between the different climatological parameters characterizing the region.

II-1-1- Precipitation

Based on the values of monthly average rainfall during the periods (2009-2020) (see Figure 1), it is noted that during the hottest month (July) with a minimum rainfall of 0.76 mm, whereas the rainiest month is October with a maximum of 25.25 mm.

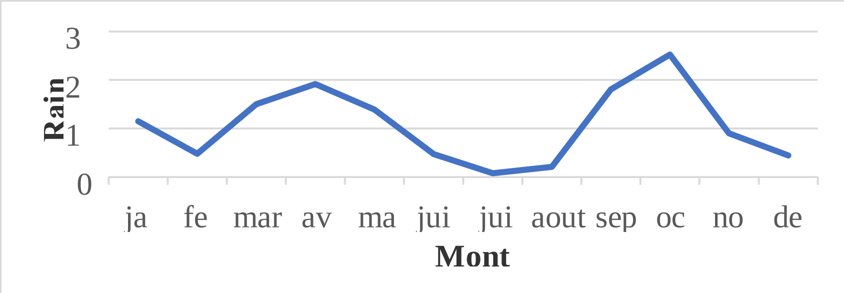

Fig1. Monthly average precipitation (mm) in Biskra (2009-2020).

II-1-2- Temperature:

According to Figure 2, it can be concluded that the Biskra region is characterized by high temperatures, with an average annual temperature reaching 20.91°C between 2009 and 2020. The highest temperature is recorded in July (35.24°C), and the lowest in January (12.34°C).

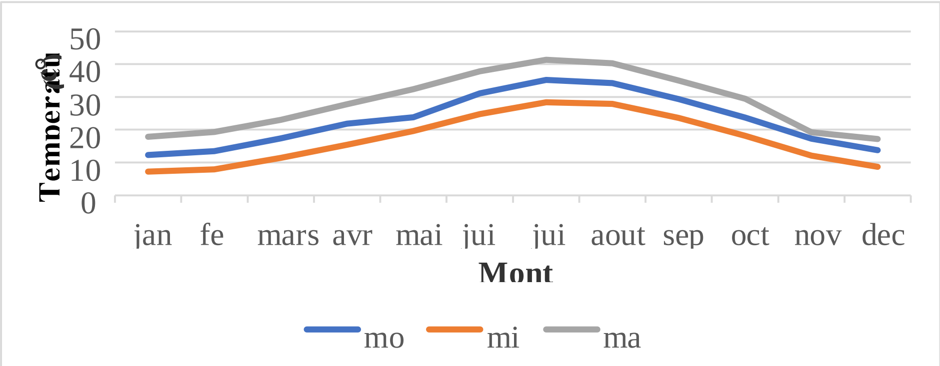

Fig 2. Monthly average temperatures (°C) in Biskra (2009-2020).

3- Relative Humidity:

Figure 3 shows that the relative humidity during the months of November, December, and January is 55.03%, 51.98%, and 56.41%, respectively, while the lowest humidity is observed in July, at 25.62%.

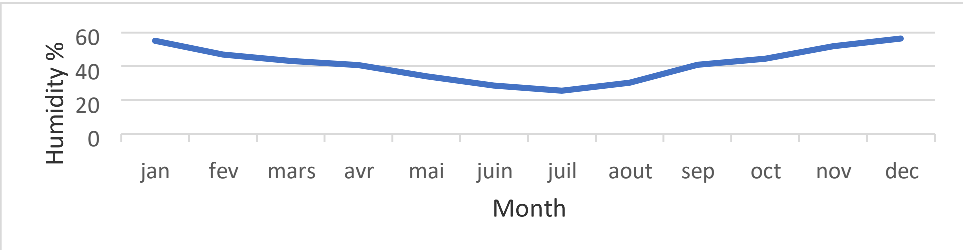

Fig .3 Monthly average relative humidity in Biskra between (2009-2020) (tutiempo, 2019).

II-2- Materials

II-2-1- Variety Selection

The choice of variety is crucial, with yield being the primary criterion for selection. The plant material used is barley cultivation, and the variety is Hordeum vulgare L. This variety is local (Saida) with 6 rows, of the spring type, very sensitive to late frost.

We used compost produced at the palm compost factory located in Chetma, Biskra.

We used cattle manure from the farm located in Chetma, Biskra, at a rate of 3.6 kg/6m², which equates to 60 quintals/ha. This dosage was applied for treatment T2.

II-2-2- Experimental Setup

The trial was set up using a randomized complete block design with 3 replications. The individual plots are 5 m long and 1.20 m wide, resulting in a plot size of 6 m². The spacing between rows is 20 cm, and the spacing between individual plots is 1 m, with a spacing of 1.2 m between blocks (Figure 4).

The factor studied is the type of amendment, either compost or manure applied before sowing, thus we have two treatments and a control without any application (T0 is the control, T1: 70 t/ha = 4.2 kg (compost), and T2: 60 t/ha = 3.6 kg (manure)).

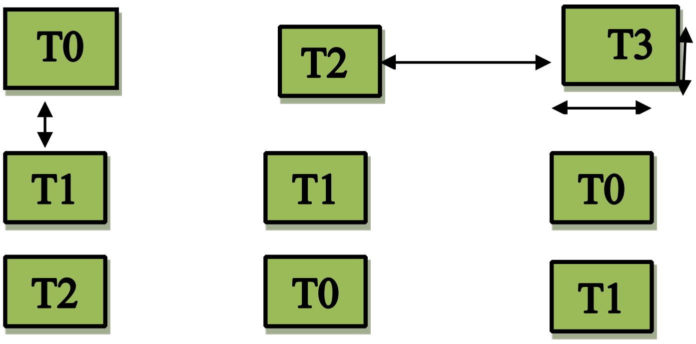

Fig.4 Experimental setup diagram (T0 is the control, T1: compost, and T2: manure).

La dimension de chaque parcelle élémentaire est de 5 m de longueur et 1,2 m de largeur, ce qui donne une superficie de 6 m². L'espace entre les lignes de céréales est de 20 cm, ce qui signifie qu'il y a 5 lignes dans chaque parcelle élémentaire (voir photo 4).

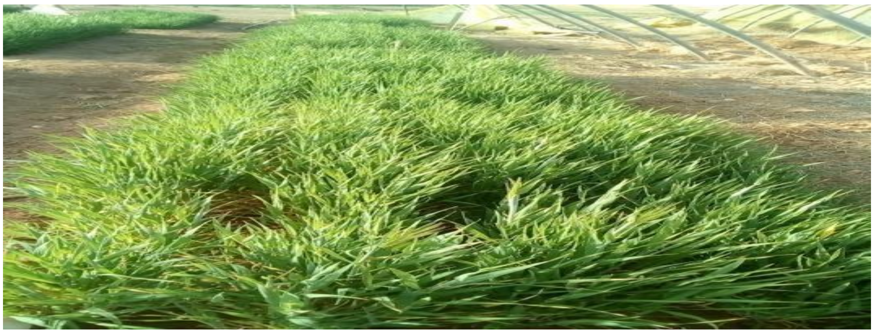

Fig .5 Elementary plot (original photo 2022).

Sowing was carried out manually on December 19, 2021, with a sowing density of 120 kg/ha, equivalent to 72 kg/6m², or 14.5 g per plot. Row spacing was 20 cm, and sowing depth was 3 cm. Irrigation doses were calculated using the CROPWAT 08 software.

II-3- Methods

II-3-1- Growth Measurement

Plant height
Root length
Vegetative stages

II-3-2- Morphological Characteristics

Plant height (PH)
Spike length (SL)
Awn length (AL)

II-3-3- Production Characteristics

Number of spikes per m² (NS/m²)

Number of grains per spike (NG/S)

Thousand grain weight (TGW)

II-3-4- Yield Components

Spike biomass and straw yield Straw yield (SY) (qx/ha)

Theoretical yield (qx/ha) (TY)

The theoretical yield (g/m²) was determined using the following formula: TY = NS x NG x TGW / 1000 (where NS represents the number of spikes/m², NG represents the number of grains/spike, and TGW represents the average weight of a grain in g).

- Harvest index in % (HI)

Grain yield and aboveground biomass are used to determine the harvest index (HI) according to the following formula: HI = Grain yield / Aboveground biomass of 1m² x 100

3. RESULTS AND DISCUSSION

The measurements were carried out during the trial (2021/2022) conducted in the experimental field of the Department of Agronomic Sciences at the University of Biskra. In this study, we investigated the effect of compost and manure on the morphological characteristics and yield components of barley (Hordeum vulgare L.) subjected to two types of treatments (T1 is compost and T2 is manure) and another treatment which is the control (T0 without any application). The aim is to determine whether compost is superior to the treatments (with manure and the control).

III-1- Growth Parameters

III-1-1- Plant Height

Figure 5 shows the evolution of aboveground length during the trial period. It is noted that the length is nearly the same for all three treatments during the first two months after sowing. However, in the subsequent months, there is an acceleration in height for treatments T1 and T0 (with values of 50.85 cm for T0 and 51.19 cm for T1, respectively) compared to treatment T2 (with a value of 42.67 cm at the end of the cycle).

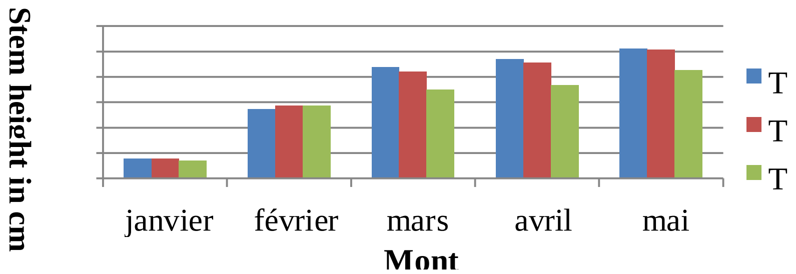

Fig 6. Evolution of plant height in cm for the different treatments.

III-1-2- Root Length

According to Figure 6, it is observed that the evolution of root length for treatments T0 and T1 is stable until the month of March after sowing, then it increases to values of 6.63 cm and 6.45 cm, respectively, at the end of the cycle, compared to treatment depth T2, which is low in February, then the root depth reaches a value of 5.69 cm at the end of the cycle.

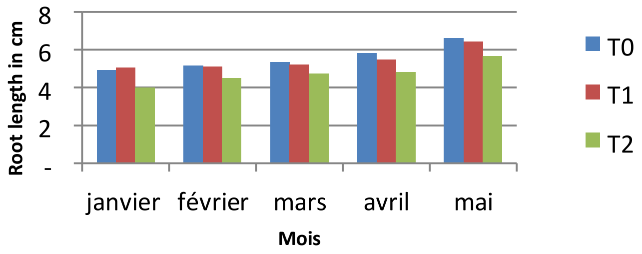

Fig.7 Evolution of root length in cm for the different treatments.

III-2- Morphological Characteristic

III-2-1- Stem Height

Figure 7 illustrates the effect of different treatments on stem height at maturity. It is noted that the greatest length is observed for treatment T2 with a value of 55.43 cm, while the height of T0 is the lowest with a value of 50.15 cm.

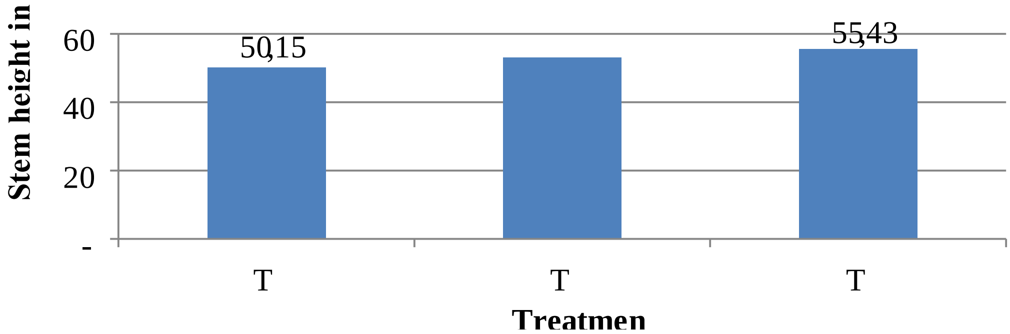

Fig. 8 Effect of different treatments on stem height.

Statistical analysis has shown a highly significant difference (see Appendix 4) between the means of the different treatments. Comparing the means using the Newman-Keuls method at 5% significance level resulted in treatments being grouped into two homogeneous groups: Group A includes T2 and T1, and Group B includes T1 and T0 (see Table 3).

Table 3 .Comparison of means using Newman and Keuls method at 5% significance level.

Traitements	Homogeneous groups	
T2	**A**	
T1	**A**	**B**
T0		**B**

III-2-2- Spike Length

Figure 8 illustrates the effect of different treatments on spike length at maturity. It is noted that the lengths are almost the same for the different treatments T0, T1, and T2, with respective values of 5.03 cm, 4.91 cm, and 4.21 cm.

The spike has a significant photosynthetic function during grain filling (Febrero et al., 1990), its contribution to the overall plant photosynthesis varies from 13% to 76% (Biscope et al., 1975).

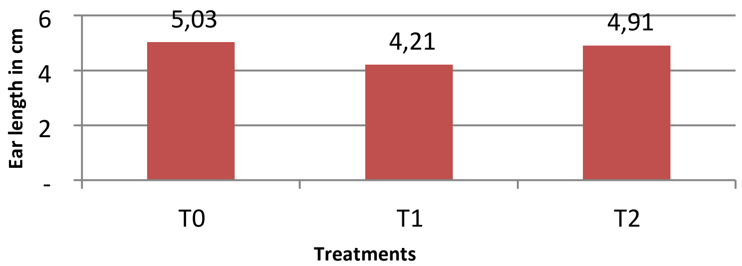

Fig.9 Effect of different treatments on spike length.

Statistical analysis showed that there is no significant difference (see Appendix 4) between the means of the different treatments for spike length.

III-2-3- Awn Length

The measured data is provided in Appendix 3. Figure 9 illustrates the effect of different treatments on awn length at maturity. It is noted that the lengths are almost the same for the different treatments T0, T1, and T2, with respective values of 11.47 cm, 11.40 cm, and 10.40 cm.

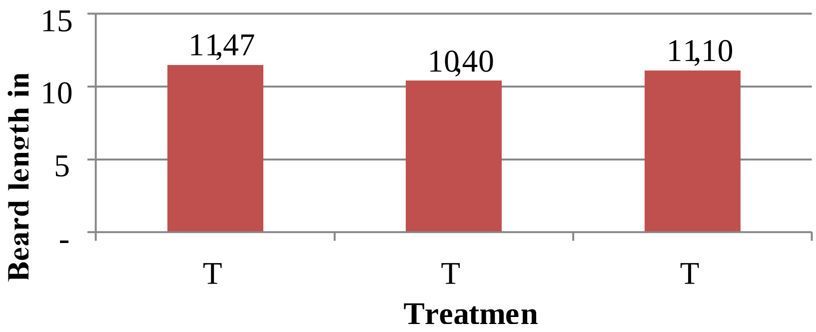

Fig. 10 Effect of different treatments on awn length.

Statistical analysis showed that there is no significant difference (see Appendix 4) between the means of the different treatments for awn length. **III-3- Production Characteristics**

III-3-1- Number of spikes per m² (NS/m²)

Figure 10 illustrates the effect of different treatments on the number of spikes per m². It is noted that the values are almost the same for the different treatments T2, T1, and T0, with respective values of 368 spikes, 321 spikes, and 303 spikes.

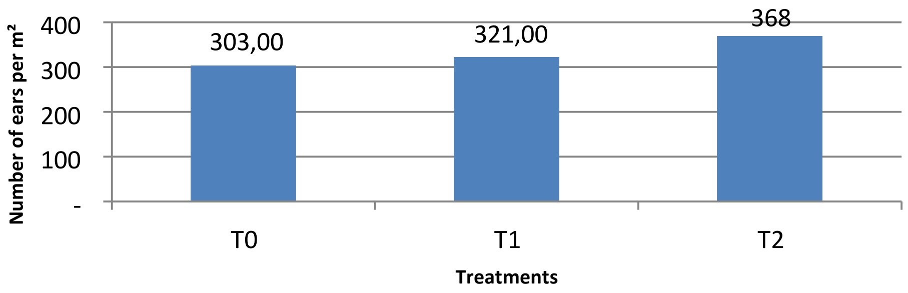

Fig.11 Effect of different treatments on the number of spikes per m².

Statistical analysis showed that there is no significant difference (see Appendix 6) between the means of the different treatments for the number of spikes per m².

III-3-2- Number of grains per spike (NG/S)

According to Figure 11, it is observed that the number of grains per spike for the different treatments is almost the same for treatments T0, T1, and T2, with respective values of 31 grains, 30 grains, and 29 grains.

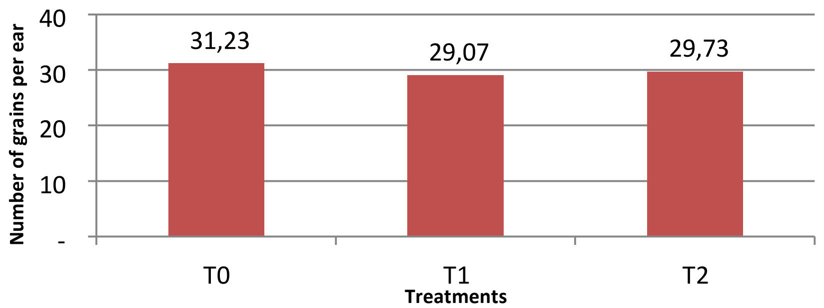

Fig.12 Effect of different treatments on the number of grains per spike.

Statistical analysis showed that there is no significant difference (see Appendix 6) between the means of the different treatments for the number of grains per spike.

III-3-3- Thousand Grain Weight (TGW)

The measured data is provided in Appendix 4. Figure 12 illustrates the effect of different treatments on thousand grain weight. It is noted that the thousand grain weight is higher for treatment T2 with a value of 53g, while treatment T0 has the lowest thousand grain weight with a value of 37.67g.

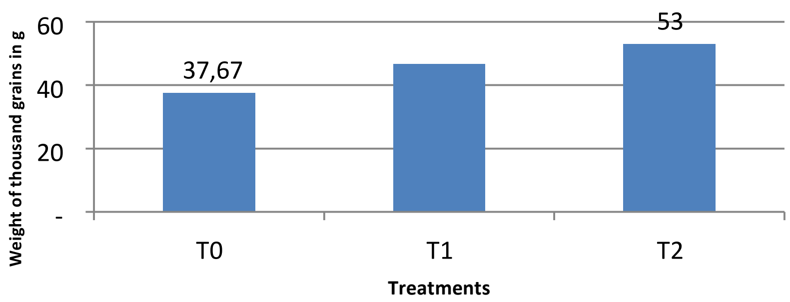

Fig.13 Effect of different treatments on thousand grain weight in grams.

Grain weight is formed through photosynthetic activity and translocation of reserves acquired and stored during stem elongation, primarily at the stem level (GATE et al., 1990).
Statistical analysis showed a highly significant difference between the means of the different treatments. Comparing the means using the Newman-Keuls method at 5% significance level resulted in treatments being grouped into three homogeneous groups: Group A includes T2, Group B includes T1, and Group C includes T0 (see Table 4).

Table 4. Comparison of means using Newman and Keuls method at 5% significance level.

Traitements	**Homogeneous groups**		
T2	**A**		
T1		**B**	
T0			**C**

III-4- Yield Components

III-4-1- Straw Yield

Figure 13 illustrates the effect of different treatments on straw yield. It is noted that there is a difference between treatments. The highest yield is observed for treatment T0 with a value of 90.3 qt/ha, while the lowest yield is observed for treatment T2 with a value of 73.8 qt/ha.

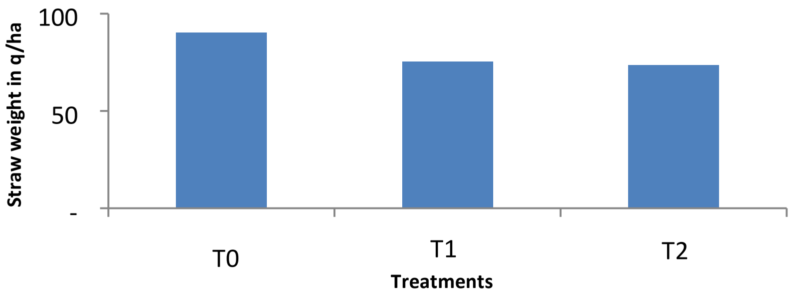

Fig.14 Effect of different treatments on straw yield in qt/ha.

III-4-2- Theoretical Yield (qx/ha) (TY)

Figure 14 illustrates the effect of different treatments on theoretical yield. It is noted that there is a difference between treatments. The highest yield is observed for treatment T2 with a value of 57.99 qt/ha, while the lowest yield is observed for treatment T0 with a value of 35.65 qt/ha.

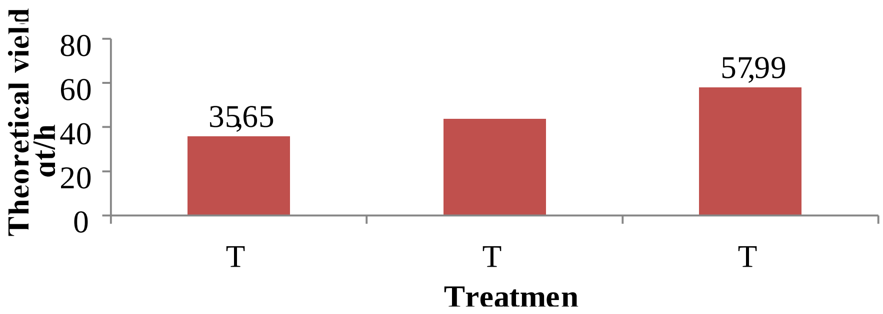

Fig.15 Effect of different treatments on theoretical yield.

III-4-3- Harvest Index in % (HI)

Figure 15 illustrates the effect of different treatments on the harvest index. It is noted that there is a difference between treatments. The highest index is observed for treatment T2 with a value of 33.61%, while the lowest value is for treatment T0 with a value of 28.26%.

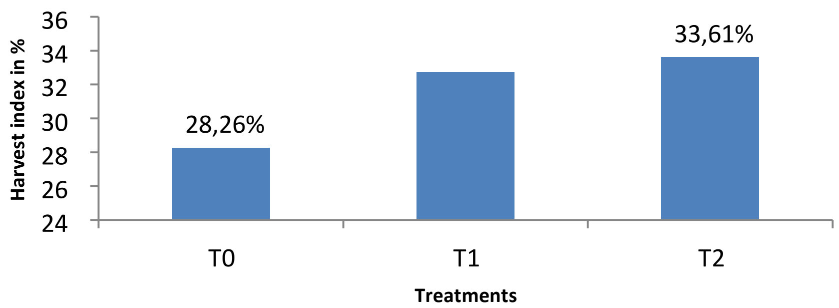

Fig. 16 Effect of different treatments on the harvest index.

4. CONCLUSION

The results obtained from the study on the effect of compost and manure on barley production parameters are as follows:
During the vegetative cycle, treatments T1 and T0 had almost the same plant height (with values of 50.85 cm and 51.19 cm, respectively) compared to treatment T2 (with a value of 42.67 cm). For root length, similar values were obtained for all treatments (T0, T1, and T2).
The highest stem height was observed for T2 (manure) with a value of 55.43 cm, while the lowest height was observed for T0 with a value of 50.15 cm. Statistical analysis showed a highly significant difference between the means of the different treatments, and the comparison of means using the Newman-Keuls method at a 5% significance level resulted in two homogeneous groups: Group A includes T2 and T1, and Group B includes T1 and T0. Spike length and awn length at maturity were similar for all treatments (T0, T1, and T2).
The number of spikes per m² and the number of grains per spike were almost the same for all treatments T2, T1, and T0, while the thousand grain weight (TGW) was higher for treatment T2 (manure) with a value of 53g and lower for T0 (control) with a value of 37.67g. The comparison of means resulted in three homogeneous groups: Group A includes T2, Group B includes T1, and Group C includes T0.
Regarding straw yield, treatment T0 (control) yielded the highest straw yield with a value of 90.3 qt/ha compared to other treatments. For theoretical yield, treatment T2 yielded the highest theoretical yield of 57.99 qt/ha, while the lowest yield was observed for T0 (control) with a value of 35.65 qt/ha.
Finally, the harvest index showed that treatment T2 yielded the highest harvest index with a value of 33.61%, while the lowest value was observed for treatment T0 with a value of 28.26%.
These results from this modest study lay the foundation for further research and improvement. Future studies could focus on evaluating the cost-effectiveness of compost compared to manure with the aim of developing cereal cultivation in Algeria.

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