The Genetic Parameters Of Several Oats Cultivars Under The Influence Of The Biofertilizer (Humiforte) Spraying

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Abstract. A field experiment was conducted in the fields of the college of Agriculture - University of Anbar (alternative location) during winter seasons in 2015-2016 and 2016-2017. To study the effect of spraying with four concentrations of Humiforte 0, 2, 4 and 6 L.ha$^{-1}$ on growth and yield of four Oats cultivars. The layout of the experiment was split plot design according to RCBD design with three replicates. The results showed the following: The characters of the yield and yield components of oats were studied in terms of performance and variability and calculated the values of genetic and environmental variability and the heterogeneity, phenotypic and inheritance. The highest percentage of genetic variations to the environment 7.2, 10.9 and 13.7 for the flag leaf area and the number of grains by the raceme in both seasons. The highest percentage of heritability was found in flag leaf area reached 87.8%, 91.60 and the number of grains by the raceme which reached 92.72% and 87.36% in both seasons. The concentration of 6 L.ha$^{-1}$ was superior compared to the other concentrations in plant height, leaf area, number of branches per plant, leaf content of chlorophyll, yield components and grain yield 6.01 and 6.29 ton.ha$^{-1}$ in both seasons respectively. Genzaniya and Hamel cultivars gave the lowest number of days to reach the flowering stage, while Genzaniya cultivar gave the highest plant height, leaf area, chlorophyll leaf content, number of grains by raceme and grain yield 5.47 and 6.48 ton.ha$^{-1}$ in both seasons respectively. However, Shefaa was superior in the weight of 500 grains in both seasons respectively. The interaction between the study factors was significant in most of the studied characters. The treatment of Genzaniya at the concentration of 6 L.ha$^{-1}$ gave the highest grain yield reached 6.86 and 7.22 ton.ha$^{-1}$ in both seasons respectively. We conclude from this results that most components of the crop are more influenced by genetics factors. Therefore, we recommend the adoption of the number of grains per raceme in the assessment of productive capacity of the oats grains.

Keywords: Oats, GCV, PCV, heritability ratio, Humiforte.

Introduction

Oats crop Avena sativa L. is one of the most important winter grain crops in the world. It has many uses such as food for humans, and animal feed as grain or green feed (17). The grain production rate in Iraq ranges from 1,200 to 1,800 ton ha$^{-1}$ (16). That the cultivation of this crop in Iraq is in a small scale or at the level of research due to lack of awareness of the importance of this crop by farmers and related departments and the lack of awareness of the guidance of farmers to the importance of this crop, recently, interest in the cultivation of this crop has begun as a result of the world's interest in planting it for its multiple uses in human nutrition, because it contains essential nutrients for the
body and in baby food and the manufacture of biscuits, especially in western countries, because it contains antioxidants. In addition, oats contain B-glucan, starch and protein (4, 9).

The success of any plant breeding and improvement program depends primarily on the size of the genetic variations in the plant community. Therefore, the first step in any plant breeding program is to study genetic variations. The phenotypic variations in any environment can be measured but do not represent the effect of genetic variations only. But also the environmental variations and growth factors as well as the interaction between them and genetic variations, the appearance of the plant is a picture of the genetic and environmental impact and overlap between them (8), the main goal of plant breeders is to increase grain per unit area which is the outcome of a number of characters or components associated with a number of physiological processes and the interaction between them during the plant life cycle. The interest in this crop produced many scientific outputs, the most important of which is the introduction of cultivars of oats and the experience of its ability to produce grains and forage under the conditions of agricultural locations, in a study conducted in India by Ratan et al (19) found significant differences between four genotypes of oats, Kent cultivar exceeded significantly compared to other genotypes in both plant height and grain yield. Experiment conducted by the Elahookie et al. (11) to study the oats crop, they observed Genzania cultivar superiority compared other cultivars (Pimula and Hamel) in the characteris of the number of days to flowering and the number of panicle and number of grains per panicle and grain yield. Alzirgani (6) noted that the genotypes of oats Shefaa, Carlop, Genzania, Algoda differed significantly in growth and yield characters. Genzania was higher in plant height, flag leaf area, number of grains per panicle in both seasons and grain yield in the first season, while the cultivar of Shefaa gave the highest grain yield in the second season. Chemical fertilization should also be carried out and good management to achieve the highest productivity and the best quality of this crop. The use of biocatalysts which containing amino acids and other nutrients has the most important role in reducing the use of chemical fertilizers and the preservation of the environment and the safety of the food product (3, 18). As well as, its role in enhancing the ability of the plant to resist the stresses and improve the vegetative growth and increase the occurrence (12). The lack of studies on this crop as well as biocatalyst use as a foliar application on the plant. Therefore, the aim of this study was to identify genetic variations among four genotypes of oats to explain this information to plant breeders when they wish to improve some of the characteristics of these cultivars.

Materials and methods

A field experiment was conducted in the fields at College of Agriculture - University of Anbar (alternative location) during winter seasons in 2015-2016 and 2016-2017. To study the effect of spraying with four concentrations of Humiforte (0, 2, 4 and 6 L ha\(^{-1}\)) on growth and yield of four cultivars of oats, Avena sativa, (Hamel, Genzania, Shefaa, Shofan 11). The layout of the experiment was split plot design according to RCBD design with three replications. The subplots included the cultivars, while the main plots included the Biocatalyst concentrates. The spraying process was done in three stages, the first at the tillers stage, the second at the grain filling stage and the third at the flowering, the substance of (alzahi) was added to the spray solution to ensure complete wetness of the plant leaves. A random sample of field soil in both seasons was taken to study some physical, chemical properties and analyzed in the laboratories of the General directorate for Agricultural Research as shown in Table 1.

| Table 1. Some physical and chemical properties of experiment soil |
| --- |
| **Character** | **First season** | **Second season** | **Unit** |
| **pH** | 8.3 | 8.2 | ds/m |
| water | 7.9 | 8.0 | |
| soil | 2.4 | 2.4 | |
| (EC) | 4.18 | 4.15 | |
### Available Nutrients

| Nutrient | Amount (PPM) | Amount (%) |
|----------|--------------|------------|
| N        | 58.0         | 60.61      |
| P        | 13.50        | 13.82      |
| K        | 230.0        | 256.0      |

### Texture

| Texture | Amount (cm²) | Percentage |
|---------|--------------|------------|
| Sand    | 6.40         | 7.20       |
| Silt    | 43.2         | 42.33      |
| Clay    | 50.4         | 50.47      |

The experimental soil was plowed twice then was divided into experimental units of 6 m². Each experimental unit consisted of 8 lines with a length of 3 m and the distance between the lines 25 cm. Nitrogen fertilizer was added with a rate of 150 kg N.ha⁻¹ in the form of urea 46% N. With three additions (at emergence, the tillers stage and the grain filling stage). The phosphate fertilizer was added with a rate of 100 kg P.ha⁻¹ in the form of super phosphate (45% P₂O₅) at once.

The experimental field is irrigated immediately after planting, and the irrigation is followed according to the need of plants. The experimental field were cultivated when needed in both seasons. Experimental plants were harvested when they reached full maturity.

**Results and discussion**

**Number of days from planting to 100% flowering:**

The response of the genotypes varies as a result of the functional processes response within the plant. When a necessary amount of dry matter is present, the flowering occurs. When the signal of flowering occurs in the plant, the RNA synthesis of the terminal bud increased that helps clone the genes of the flowering is increased (13). The results of table 2 showed that the genotypes of oats differed significantly in this character, as the cultivars of (oats 11) and (Hamel) in first season gave less time to reach that stage (112.35 and 111.41) days respectively. While, Genzanya cultivar gave the longest period reached in both seasons 127.01 and 126.77 days respectively. The variation in the genotypes of oats in the period of arrival at this stage is due to the difference in the nature of their genotypes, which reflected the difference in their response to the prevailing environmental conditions, especially the period of light and temperature. This result in agreement with the results of the Elshaoke et al. (11) who showed significant differences in the genotypes of oats in the period from planting to flowering.
As shown in Table 2, the concentration of the 6 L ha$^{-1}$ was superior in this character which gave lowest period reached 116.80 and 116.83 days, and was significantly different compared to other concentrations. While the control treatment recorded the highest number of days to 100% flowering that reached 122.35 days in both seasons, the reason of this differences may be due to the lack of days with the increase of concentrations of the biocatalyst to contain the biological catalyst a group of nutrients and amino acids, which accelerate the growth and move to the reproduction stage. This result in agreement with the results of Saleh (22) on the sorghum crop. The interaction treatment have significant effect in the second season only as shown in results of Table 2, the plants of cultivar (Hamel) with concentration of 6 L ha$^{-1}$ gave lowest period to reach 109.26 days.

The percentage of genetic variability in the plant society was higher than the environmental variability, especially in second season, which led to a relatively good inheritance ratio of this character. This indicates the response of genotypes to the short duration of flowering with the biocatalyst. This means that there are variations in the rate of this character from generation to other.

**Table 2:** Effect of Humiforti and cultivars in average number of days from planting up to 100% flowering (day) of oats plant in the seasons 2015-2016 and 2016-2017.

| Cultivars (C) | Biofertilizer concentration L ha$^{-1}$ | Mean of C | Biofertilizer concentration L ha$^{-1}$ | Mean of C |
|--------------|------------------------------------------|-----------|------------------------------------------|-----------|
| Shofan 11    | 113,9.45                                 | 113.56    | 113,7.34                                | 113.56    |
| Shefaa       | 113.67                                   | 113.87    | 113.45                                   | 113.77    |
| Hamel        | 113.45                                   | 113.67    | 113.24                                   | 113.56    |
| Genzaniya    | 113,45                                   | 113.67    | 113.24                                   | 113.56    |
| L.S.D        | C                                        | B         | CxB                                      | C         |
| Mean         | h$^2$b.s                                 | %57.09    | 1.107                                    | 0.832     |

**Plant height**

The increase in dry matter may be associated with the increase in plant height when the suitable part for receiving solar radiation by plant leaves (20) in determinate growth crops such as oats, the plant height is determined by the raceme appearance. The Genzaniya was superior in plant height which gave 89.07 and 90.60 cm in both seasons respectively. While, the Shofan11 cultivar had lowest average plant height was 80.62 and 83.82 cm in both seasons respectively. The difference in genotypes in plant height may be due to differences in their genetic nature. This result is consistent with the results of Shah et al. (23) was pointed to the different genotypes of oats in plant height. The higher concentration 6 L ha$^{-1}$ gave the highest plant height reached 88.95 and 89.77 cm in both seasons respectively. The higher level of this compound may be attributed to its important role in the production of GA3 and Auxin which are necessary to elongate the cells and contain a combination of nutrients to the manufacture of these compounds and increase the rate of photosynthesis. And, then increase the volume of vegetative part, which promotes the accumulation of nutrients in the leaves as well as the role of potassium and nitrogen, which were the basic components of the compound (Humiforte), which promotes the division of cells and thus elongation of the internodes which leads to increase the plant height. This result is consistent with results of Fakera and Alshabi (12). The results of table 3 showed that the interaction treatment of Genzaniya cultivar with a concentration of 6 L ha$^{-1}$ gave the highest plant height reached 92.60 cm in first season only, while the genotype Shofan 11 with control treatment gave lowest value reached 77.13 cm and the interaction was not significant in second
season. The percentage of genetic variability among the plants of a plants community was higher than the environmental variability, resulting in a high heritability rate reached 91.5% and 76.7% in both seasons respectively, this results in agreement with Chavan and Mahajan (10) in the study of genetic variances, heritability ratios and genetic and phenotypic treatment. This indicates that the response of genotypes to increase the height of the plant under the biocatalyst and this means that there are variations in the rate of character from generation to other. The plants were highly homogenous among them phenotypically and genetically in plant height with the presence to high level of biocatalyst according to the values of P.C.V and G.C.V, especially in second season.

Table 3: Effect of Umiforti and cultivars in plant height (cm) of oats plant in the seasons 2015-2016 and 2016-2017.

| Cultivars (C) | 2015-2016 Season | 2016-2017 Season |
|--------------|------------------|------------------|
| Biofertilizer concentration (B) L.ha⁻¹ | Mean of C | Biofertilizer concentration (B) L.ha⁻¹ | Mean of C |
| Shofan11 | 77.13 | 79.17 | 64.2 | 62.12 | 76.22 | 78.17 |
| Shefaa | 61 | 57.3 | 91.4 | 82.34 | 57.3 | 57.3 |
| Hamel | 78.7 | 74.5 | 84.8 | 80.4 | 84.8 | 80.4 |
| Genzaniya | 81.3 | 87.5 | 93.7 | 84.4 | 87.5 | 84.4 |
| Biofertilizer | 71.5 | 74.5 | 94.5 | 87.5 | 84.4 | 87.5 |
| L.S.D | C | B | CxB | C | B | CxB |
| Mean | 24.4 | 21.3 | 2.48 | 24.4 | 21.3 | 2.48 | 24.4 | 21.3 | 2.48 |
| hᵇ.s | 6° G | 6° E | P.C.V | G.C.V | hᵇ.s | 6° G | 6° E | P.C.V | G.C.V |
| 91.5% | 23.47 | 2.182 | 52.43 | 76.7% | 35.3 | 10.7 | 72.80 | 63.77 |

Flag leaf area:
The genotype of Genzaniya gave the highest value of flag leaf area reached 36.88 and 38.22 cm² in both seasons respectively and differed significantly compared to the other genotypes. While the genotype of shofan11 gave lowest flag leaf area reached 23.73 and 25.00 cm² respectively table 5. The reason of this differences may be due to the difference in genetics structure and varies in their response to environmental conditions and the ability of each genotype to transform the carbohydrates products into the expansion of leaf cells and thus increase in the leaf area. This result is consistent with the results of (23). The results of the same table indicate a significant increase in the flag leaf area with the increase of the concentration of the biocatalyst. The treatment of concentration 6 L ha⁻¹ the gave the highest flag leaf area reached 32.59 and 34.27 cm², which was not significantly different from the concentration of 4 L ha⁻¹. While the control treatment 0 L ha⁻¹ gave the lowest flag leaf area reached 26.78 and 27.64 cm² in both seasons respectively. This increase in the leaf area may be due to the role of biocatalyst as a result of its containment a group of amino acids and nutrients in the biological reactions within the structural cell, which increase the cell division and expansion of the leaves. The interaction treatments between the genotypes and the biocatalyst was significant, the interaction treatment Genzaniya cultivar with the biocatalyst concentration of 6 L ha⁻¹ gave the highest value of flag leaf area reached 40.60 and 41.35 cm² in both seasons respectively. Genetic variations were reached 7.2 equal to double the value of environment variations between the plants of one community in first season and 10.9 times in second season for all genotypes, which led to a high percentage of heritability 87.8% and 91.6% in both seasons respectively, which indicate to high variability in the rate of this characters, especially in second season.
Table 4: Effect of Humiforti and cultivars in flag leaf area (cm²) of oats plant in the seasons 2015-2016 and 2016-2017.

| Cultivar (C) | Biofertilizer concentration (B) L.ha⁻¹ | Mean of C | Biofertilizer concentration (B) L.ha⁻¹ | Mean of C |
|--------------|----------------------------------------|-----------|----------------------------------------|-----------|
|              |                                       |           |                                       |           |
| Shofan 11    |                                       |           |                                       |           |
| Shefaa       |                                       |           |                                       |           |
| Hamel        |                                       |           |                                       |           |
| Genzania     |                                       |           |                                       |           |
| Biofertilizer mean |                               |           |                                       |           |
| L.S.D        |                                       |           |                                       |           |
| Mean         |                                       |           |                                       |           |

Leaves content of chlorophyll:

Table 4 (show) that the phenotypes of oats differed significantly in their chlorophyll content. The cultivars (Hamel and Genzanya) gave the highest chlorophyll content in the leaves reached 50.40 and 54.85 spad in both seasons respectively, and did not differ significantly between them in both seasons. While the cultivar (shofan 11) gave lowest chlorophyll content reached 42.59 and 47.75 spad in both seasons respectively. The foliar application with biocatalyst at concentration 6 L ha⁻¹ gave the highest value of chlorophyll content reached 54.03 and 56.90 spad in both seasons respectively and did not differ significantly from the concentration of 4 L ha⁻¹, but it differed significantly from the two concentrations 0 and 2 L ha⁻¹ table 4. The increase in the chlorophyll content in the leaves may be due to increased concentrations of the biocatalyst and its role in plant processing with iron, nitrogen and manganese. These elements are important in formation the chlorophyll unit and increasing its content in leaves.

A number of researchers indicated that the reason of chlorophyll increase in plant leaves is due to the availability of important nutrients in the construction of chlorophyll (1, 2 and 3). Also, it is noted from the same table data that the cultivars (Hamel and Genzanya) gave the highest content of leaves chlorophyll at the high concentration of the biocatalyst 6 L ha⁻¹ reached 50.40 and 60.24 spad in both seasons respectively. While the interaction treatment of Shofan 11 cultivar with (Zero biocatalyst concentration) gave the lowest content of chlorophyll in leaves which was 37.33 and 41.33 spad in both seasons respectively. Genetic variations equal 6.6 times from environmental variability between the plants of the same community in the first season and 6.7 times in the second season and for all cultivars, which resulted in higher heritability of chlorophyll content indicating high variations in these characters. The results also show that the plants are homogenous genetically and phonetically relative in chlorophyll content according on the values of PCV and GCV, the homogeneity in the first season was relatively more than the second season.

Table 5: Effect of Humiforti and cultivars in Leaves content of chlorophyll (spad) of oats plant in the seasons 2015-2016 and 2016-2017.

| Cultivars (C) | Biofertilizer concentration (B) L.ha⁻¹ | Mean of (C) | Biofertilizer concentration L.ha⁻¹ | Mean of C |
|--------------|----------------------------------------|-----------|----------------------------------------|-----------|
|              |                                       |           |                                       |           |
| Shofan 11    |                                       |           |                                       |           |
| Shefaa       |                                       |           |                                       |           |
| Hamel        |                                       |           |                                       |           |
| Genzanya     |                                       |           |                                       |           |
| Biofertilizer mean |                               |           |                                       |           |
| L.S.D        |                                       |           |                                       |           |
| Mean         |                                       |           |                                       |           |
Number of tillers per m²

The results of table 6 show that the Genzaniya cultivar gave the highest number of tillers in the square meter reached 598.73 and 650.50 tiller.m² in both seasons respectively and was not differ significantly from the Hamel cultivar in both seasons. While the cultivar Shofan 11 gave lowest value reached 481.58 and 470.83 m². The difference among cultivars may be due to their ability to produce tillers to differ in their genetic structure. In this area, many researchers found a significant difference between the genotypes of oats in the number of tillers per square meter (15 and 26). The levels increase of the spraying with the water solution of Humiforte resulted in an increase in number of tillers per square meter to reach the highest level 590.28 and 611.08 tiller.m². The reason of the 6 L ha⁻¹ concentration superiority may be due to the role of this substance (biocatalyst) in supplying the nutrients for plant in a balanced and easily absorbed by the plant, increasing the division of cells thus increasing the number of tillers per unit area. The effect of the interaction between the biocatalyst concentration and the cultivars were significant in this character in second season only table 6. Genzaniya with concentration of 6 L ha⁻¹ gave the highest number of tillers reached 716 tiller.m². Shofan 11 with control treatment gave the lowest number of tillers reached 403 tiller.m² in both seasons. The percentage of environmental variability was higher than the genetic variability, which resulted in a relatively low heritability rate by 48.4% and 47.4% respectively. The plants were highly homogenous and phenotypic in the number of branches with biocatalyst according on PCV and GCV values, especially in first season.

Table 6: Effect of Humiforti and cultivars in number of tillers (tiller.m²) of oats plant in the seasons 2015-2016 and 2016-2017.

| Cultivar (C) | Season | Biofertilizer concentration (B) L.ha⁻¹ | Mean of C | Season | Biofertilizer concentration (B) L.ha⁻¹ | Mean of C |
|-------------|--------|----------------------------------------|-----------|--------|----------------------------------------|-----------|
| Shofan 11   |        | 0                                      | 7         | 0      | 7                                      | 7         |
| Shefaa      |        | 10                                      | 7         | 10     | 7                                      | 7         |
| Hamel       |        | 20                                      | 7         | 20     | 7                                      | 7         |
| Genzaniya   |        | 30                                      | 7         | 30     | 7                                      | 7         |
| Biofertilizer mean |        | 50                                      | 7         | 50     | 7                                      | 7         |
| L.S.D       |        | C                                      | 50.7      | B      | 50.7                                   | 50.7      |
|             |        | C×B                                    | ns        | C×B    | ns                                     | ns        |
| Mean        |        | 6⁴G                                    | 50.7      | 6⁴E    | 50.7                                   | 50.7      |
|             |        | P.C.V                                  | 50.7      | G.C.V  | 50.7                                   | 50.7      |
|             |        | h²b.s                                  | 50.7      | G      | 50.7                                   | 50.7      |
|             |        | %G₄₆                                  | 50.7      | %G₄₆   | 50.7                                   | 50.7      |

Number of grain per raceme

The results of table 7 show that Genzaniya cultivar was superior by giving highest number of grains reached of 61.07 and 55.50 grain.raceme⁻¹ and differed significantly from the other cultivars in both seasons respectively, except Hamel cultivar, which was not differ significantly in second season. While, Shofan 11 and Shefaa gave the lowest number of grains per raceme reached 47.95 and 48.79 grain.raceme⁻¹ in both seasons respectively. The superiority of Genzaniya cultivar may be attributed to its superiority in leaf area and the chlorophyll content tables 4 and 5, thus providing more processed food for grown seeds to reduce abortion. This result is consistent with the results of (6). As shown in the results of table 7, the concentration of the 6 Lha⁻¹ biocatalyst gave the highest number of grains reached 55.62 and 53.45 grain raceme⁻¹ in both seasons and were not differ significantly from
concentrations 2 and 4 L ha\(^{-1}\) but differed significantly from the control treatment zero L ha\(^{-1}\), which gave the lowest grain number reached 51.14 and 50.51 grains in both seasons. The increase in the number of grains with increase the concentration of the biocatalyst may be due to the role of this substance in increasing the flag leaf area table 5 and the survival of the leaf area is more effective in the plant life due to the role of this compound in increasing the ability of the plant to tolerate the inappropriate conditions and provide it with nutrients which is positively reflected in the increased processing of the emerging flowers with their requirements, which contributes to increase the percentage of fertility in the flowers then increase the number of grains per raceme. The interaction between the cultivars and the biocatalyst concentration was not significant in both seasons.

Table 7: Effect of humiforti and cultivars in number of grains per raceme (grain.raceme\(^{-1}\)) of oats plant in the seasons 2015-2016 and 2016-2017.

| Cultivars (C) | 2015 Season | Mean of C | 2016 Season | Mean of C |
|--------------|-------------|-----------|-------------|-----------|
|              | Biofertilizer concentration (B) | L ha\(^{-1}\) | Biofertilizer concentration (B) | L ha\(^{-1}\) |
| Shofanl1     | 49.77       | 48.77     | 49.77       | 48.77     |
| Shefaa       | 49.77       | 48.77     | 49.77       | 48.77     |
| Hamel        | 49.77       | 48.77     | 49.77       | 48.77     |
| Genzaniya    | 49.77       | 48.77     | 49.77       | 48.77     |
| Biofertilizer | 49.77       | 48.77     | 49.77       | 48.77     |
| L.S.D        |             |           |             |            |
| C            | 1.03        | n.s       | 1.03        | n.s       |
| B            |             |           |             |            |
| C×B          |             |           |             |            |
| Mean         |             |           |             |            |
| h\(^{-1}\)    |             | 0.84      |             | n.s       |
| G            | 0.21        |           | 0.21        |           |
| E            |             |           |             |            |
| P.C.V        | 0.51        |           | 0.51        |           |
| G.C.V        | 0.51        |           | 0.51        |           |
| h\(^{-1}\)    | 19.1        | 1.06      | 19.1        | 1.06      |
| %h\(^{-1}\)    | 0.49        | 0.29      | 0.49        | 0.29      |

It is possible to say that the behavior of the genotypes was the same as the behavior of the increase of the biocatalyst. Where the concentration of the biocatalyst increases, the number of grains increases that the factors are independent in their response to the character. Genetic variability among plants was higher than the environmental variability 12.7 and 6.9 times in both seasons respectively and affected in the number of grain. This explains the high heritability rate of grains number in the raceme and existence high variations in the rate of this quantitative character. These results in agreement with results of Refay (21) on genetic variations in several characters of barley.

**Weight of 500 grains:**
The results of table 8 show that the Shefaa cultivar gave highest value of 500 grain weight reached 15.63 and 15.09 gm in both seasons respectively, while Hamal cultivar in the first season and Genzaniya cultivar in the second season gave lowest grains weight. The concentration of 6 L ha\(^{-1}\) the highest grain weight reached 14.57 and 14.83 gm, which was not differ significantly from the concentration of 4 L ha\(^{-1}\). While it was different significantly with the two concentrations 0 and 2 L ha\(^{-1}\) which the treatment of the 0 L ha\(^{-1}\) concentration (control treatment) gave lowest value reached 13.65 and 13.70 gm in both seasons respectively. The superiority of concentration 6 L ha\(^{-1}\) may be attributed to a reduction in the number of days from planting to 100% flowering table 2, which increases the period of reproduction growth thus increased the period of transfer of the carbohydrates manufactured in the leaves to the seeds that started to fill then increase their weight. These results in agreement with Shahryari and Khayatenezhad (24) results on wheat crop. The genetic variations between plants were less than the environmental variations in both seasons, which reflected in heritability rates by 15.96% and 11.06% in both seasons respectively.
The results of table 8 also indicate that the plants were homogeneous phenotypically genetically interrelated in grain weight according to the values of P.C.V and G.C.V in the table.

Grains yield:
The results of table 9 indicate that the cultivar of Genzaniya was superior by giving highest grains yield reached 5.47 and 6.48 ton.ha⁻¹ in both seasons respectively, which did not differ significantly from the Shefaa cultivar in both seasons and from the Hamel cultivar in the first season. While, Shofan11 gave the lowest grains yield reached 4.37 and 4.80 ton ha⁻¹. The superiority of Genzaniya cultivar may be due to its superiority in number of grains per raceme Table 6. This result in agreement with the results of (11, 27). It is noted from results of table 9 that the grains yield increased by increasing the concentrations of the biocatalyst on the oats cultivars to reach the highest yield at concentration (6 L ha⁻¹) which reached 6.01 and 6.29 ton ha⁻¹ in both seasons respectively which was not differs significantly from concentration of 4 L ha⁻¹ in the second season. However, the concentration of 0 L ha⁻¹ gave the lowest value of the grains yield reached 4.20 and 5.00 ton ha⁻¹ in both seasons respectively. The superiority of highest level of the biocatalyst in grains yield may be due to its superiority in the number of grains per raceme table 7 and grain weight table 8. This result is consistent with the results of (22) on the sorghum crop. The results of the same table showed a significant effect of interaction treatments in both seasons table 9. The interaction treatment of Genzaniya cultivar with concentration of 6 L ha⁻¹ gave the highest value reached 6.86 and 7.22 ton ha⁻¹ in both seasons respectively. While the Shofan11 cultivars with concentration of Zero (control treatment) gave the lowest value reached 3.88 and 4.10 ton ha⁻¹ in both seasons respectively. The genetic variability among plants were 3.7 and 3.4 times from environmental variability in both seasons respectively thus affected significantly in the grain yield, which explains the high heritability rate of the grain yield by 78.97% and 77.25% in both seasons respectively, there is a large response to oats cultivars by giving high grains yield in area unit. The grains yield is the most important field criterion for the cultivar because it reflects the final yield of the plant's biological activities, which is mainly related to the genetic factor and its interaction with the available growth factors. However, the heritability ratio was high in most characters in both seasons. The characters may be different among the different cultivars as real difference not genetically or statistically in its nature and decrease the environmental effect (25). Therefore, these characters can be relied upon as selection criteria based on the descriptive expression of the character. The character may be under the additive gene action (20). Thus, the selection of these characters is a way to improve the superior varieties of oats. The high heritability rate is an important criteria in selection programs to improve desirable characters.

Table 8: Effect of humiforti and cultivars in weight of 500 grains (gm)
of oats plant in the seasons 2015-2016 and 2016-2017.

| Cultivars (C) | P.C.V | G.C.V | C×B | C×B | L.S.D | C×B | C×B |
|--------------|-------|-------|-----|-----|-------|-----|-----|
| Shofan11     | 14.24 | 14.78 | 14.97 | 15.74 | 14.74 | 14.74 | 14.74 |
| Shefaa       | 14.24 | 14.78 | 14.97 | 15.74 | 14.74 | 14.74 | 14.74 |
| Hamel        | 14.24 | 14.78 | 14.97 | 15.74 | 14.74 | 14.74 | 14.74 |
| Genzaniya    | 14.24 | 14.78 | 14.97 | 15.74 | 14.74 | 14.74 | 14.74 |
| Biofertilizer| 14.24 | 14.78 | 14.97 | 15.74 | 14.74 | 14.74 | 14.74 |

The results of table 8 also indicate that the plants were homogeneous phenotypically genetically interrelated in grain weight according to the values of P.C.V and G.C.V in the table.
Table 9: Effect of humiforti and cultivars in grains yield (ton ha\(^{-1}\)) of oats plant in the seasons 2015-2016 and 2016-2017.

| Cultivars (C) | Biofertilizer concentration (B) | Mean of C | Biofertilizer concentration (B) | Mean of C |
|--------------|-------------------------------|-----------|-------------------------------|-----------|
| (A)          | (A)                           | (A)       | (A)                           | (A)       |
| Shofani      | 0.04                          | 0.04      | 0.04                          | 0.04      |
| Shefaa       | 0.04                          | 0.04      | 0.04                          | 0.04      |
| Hamel        | 0.04                          | 0.04      | 0.04                          | 0.04      |
| Genzaniya    | 0.04                          | 0.04      | 0.04                          | 0.04      |
| L.S.D        | C                             | B         | C×B                           | C         |
|              | Mean                          | Mean      | Mean                          | Mean      |
| h\(^b.s\)    | h\(^b.s\)                     | h\(^b.s\) | h\(^b.s\)                     | h\(^b.s\) |
| %h\(^b.s\)   | %h\(^b.s\)                    | %h\(^b.s\) | %h\(^b.s\)                    | %h\(^b.s\) |

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