J. Egypt. Acad. Soc. Environ. Develop., 24 (1):75-88 (2023) **(D-Environmental Studies)**
E. mail: easedjournal_egypt@yahoo.com **ISSN 1110-8770**
www.jades.journals.ekb.eg **eISSN 2314-5471 (online)**

Influence of vermicompost and NPK on the growth and quality of barley

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Received: October 2, 2023
Accepted: December 20, 2023

ABSTRACT

This study was carried out during 2022/2023 season in Sof Al-Jin Farm in Bani Walid, Libya, to evaluate the effect of NPK and vermicompost on some vegetative growth and yield and yield components and chemical composition of barley cv. "Giza 132". This experiment consisted of seven treatments arranged in a Randomized complete Block Design (RCBD) design with three replicates for each treatment. The treatments were (Control, 100 % NPK RDF, V.C (vermicompost) 15 t/ ha, 100 % NPK RDF + V.C 15 t/ ha, 75 % NPK RDF + V.C 5 t/ ha, 50 % NPK RDF + V.C 7.5 t/ha, 25 % NPK RDF + V.C 10 t/ ha). Results showed that the treatment of 100% RDF+ V.C 15 t/ ha recorded the higher values of all vegetative growth characters, yield and yield components and chemical composition of barley cv. "Giza 132" e.g. plant height, dry matter accumulation (g/m^2), spike length, number of spikes/ m^2, number of grains/ spike, 1000-grains weights, grains yield (t/ha), biological yield (t/ha), harvest index (%), nitrogen, phosphorus, potassium and protein percentages, followed by V.C 15 t/ ha and 25 % RDF + V.C 10 t/ ha, as compared to control treatment which recorded the lower of plant height, dry matter accumulation (g/m^2), spike length, number of spikes/ m^2, number of grains/ spike, 1000-grains weights, grains yield (t/ha), biological yield (t/ha), harvest index (%), nitrogen, phosphorus, potassium and protein percentages under experimental condition. In conclusion: The explanation could be that adding a significant amount of vermicompost before planting improved the soil properties, which increased the flag leaf area of plants receiving enough light energy and converting it into dry matter, which increased the weight of grains.

Keywords: Barley (*Hordeum vulgare* L.), vermicompost, NPK, yield and yield components, chemical compositions.

INTRODUCTION

Barley (*Hordeum vulgare* L.) a member of the Poaceae family, was one of the first crops cultivated. Barley, which is an annual cereal, was initially used more for human consumption, but with the increase in the consumption of wheat and rice, its use as an animal feed and raw material for malt and beer has become more widespread. Barley is the fourth most important cereal in the world after wheat, maize, and rice. While the world barley production is 152 million tons, 5% of barley production is for human consumption, 67% for animal consumption, and 21% for the malting industry (FAO, 2022). In 2020/2022 agricultural season, European Union is the major producer of barley, which amounted 52.75 million metric tons. Russia was the second largest producer of this crop with 17.5 million metric tons. Barley crop has a good level of adaptability to hard environmental conditions in arid and semiarid regions such as cold, drought, alkaline and salinity soils, poor soils. Also, it is considered tolerance and competitive to weeds compared to wheat and other cereal crops due to its rapid growth and maturity (Giraldo *et al.,* 2019). Most of the barley production, whether in the form of green plants, grains, or straw, is used as animal feed. In addition, it is considered as a healthy food for millions of people, as well as its use as a main source of malting, brewing, starch and biofuels production (Langridge, 2018; Tricase *et al.,* 2018).

Barley grain is characterized by its high contents of starch (65-68%), dietary fiber (11-34%), protein (10-17%), β-glucans (4-9%), free lipids (2-3%), and mineral elements (1.5-2.5%). The percentage of these components is varied according to the varieties and the environmental conditions of each agricultural region (Hussain *et al.,* 2021; Geng *et al.,* 2022).

Barley is one of the most common cereals in the world. It is used mainly to produce groats, beer, and fodder grain. Barley grain contains a lot of dietary fibre and minerals and little fat, making it a valuable component of human and animal diets. Barley flour is one of the wheat flour substitutes available, characterized by similar functional properties while having more beneficial nutritional and pro-health parameters (Hager *et al.,* 2014). Barley flour is differentiated from wheat flour, particularly by its substantially higher dietary fibre content, which is a considerable benefit to people suffering from gastrointestinal ailments or obesity. Another distinguishing quality is lower gluten content, making it better suited for consumption by people suffering from intolerance of this protein. However, the lower gluten content adversely affects the quality of dough made with barley flour and the cohesion of finished baking products (Howitt *et al.,* 2018).

Barley has contributed significantly to the global advancement of agriculture (Alnarp, 2013). It is grown over nearly the whole planet because it is the most dependable crop in regions with alkaline soils, frost, or drought. In terms of area and production, it ranks fourth among the cereals, behind rice, wheat, and maize. Additionally, useful for its covering and cooling properties that facilitate smooth digestion is barley grain. In addition to these traditional applications, it is a significant industrial crop that supplies raw materials to the brewing, whiskey, and beer industries. Barley contain 10.6 mg iron, 31.0 mg vitamin B1, 0.1 mg vitamin B2, and 50.0 ug folate are contained in every 100 g of barley grain (Vaughan *et al.,* 2006).

Fast-growing, cool-season barley is an annual grain crop that can be used as a cover crop to increase soil fertility and as fodder. Light textured soils with low organic matter contents cannot meet their nutritional needs if fertilizers are applied without incorporating any organic fertilizer. Organic matter preserves the soil's beneficial physio-chemical and biological qualities in addition to providing necessary nutrients (Kumawat and Gosens 2016).

Fertilization is an important factor in improving crop quality, reducing crop development time, and improving soil quality (Demirsoy *et al.,* 2020). The use of fertilizers is one of the most important reasons for the 50-75% increase in crop yield. Globally, there is a direct relationship between crop yield and fertilizer use (Polat, 2020). The excessive use of chemical fertilizers leads to rapid decomposition of soil organic matter, deteriorating soil structure, reducing particle aggregation, and diminishing fertilizer use efficiency through nutrient fixation and leaching. This disruption of natural decomposers within agro-ecosystems poses a threat to food security. The decrease in trace element availability, lowering of the water table, pollution, and soil alkalization underscore the urgent need for organic fertilizers to achieve sustainable agriculture (Han *et al.,* 2020).

It has been reported in various sources that the unconscious and excessive use of chemical fertilizers in agricultural production from the past to the present has caused the soil organic matter content to decrease over time, which is harmful to soil organisms and human health (Aydın Can *et al.,* 2019; Bozkurt, 2019). However, the use of organic fertilizers has been reported to increase soil organic carbon and soil fertility, resulting in higher yield trends compared to balanced chemical fertilizers (Scaglia *et al.,* 2016).

Use of NPK spray on plants caused an increase in the efficiency of fertilization, which increased the development of plants, especially in the early stages of the plant, as well as reducing environmental damage to the soil (Gutierrez *et al.,* 2008).

Organic fertilization is effective ways that raises the productive value of agricultural soil and reduce environmental pollution resulting from excessive use of chemical fertilizers

(Al-Hamd and Al-Jarbou, 2021). It provides the basic requirements of nutrients for plants through the growth stages. The positive effect of organic fertilizer can continue in supplying nutrients after the end of plant growth for subsequent seasons (Mohammed, 2013). Organic matter in the soil plays an important role in improving the physical and chemical properties of various soils. Organic matter application is an important method to increase the availability of both macro- and micro-nutrients (Niel, 2021).

Among organic fertilizers, vermicompost stands out for its potential to significantly enhance crop growth (Wang *et al.,* 2010). Vermicompost is slow-releasing organic manure rich in humic substances, such as fulvic acid, humic acid, and humin, which facilitate various chemical reactions and enhance microbial activity, improving plant growth and suppressing pathogenic activities (Theunissen *et al.,* 2010). It provides a sustained supply of macronutrients nitrogen (N, 2–3 %), phosphorus (P; 1.55–2.55 %), and potassium (K, 1.85–2.25 %) along with growth hormones, micronutrients, and beneficial microbes (Maduwanthi *et al.,* 2021). With a C/N ratio of 15:1, vermicompost is more mineralizable than thermophilic compost, enhancing nutrient retention and absorption due to its high porosity, water-holding capacity, and aeration. Its near-neutral pH, maintained by the production of organic acids and CO_2 during microbial metabolism, further supports soil health (Paczka *et al.,* 2021). Vermicompost also improves soil enzymatic properties by increasing the activity of enzymes such as amylase, protease, urease, β-glucosidase, cellulose, lipase, chitinase, and dehydrogenase, which are crucial for soil fertility and plant health (Olle, 2016; Rekha *et al.,* 2018).

Vermicompost, another source of organic fertilizer, facilitates nutrient uptake by plants, has a porous structure, good aeration, high water-holding capacity, and microbial effects (Yılmaz *et al.,* 2017). Vermicomposting is a cost-effective, eco-friendly, and sustainable technique for converting large amounts of organic waste into a high-quality organic fertilizer through controlled bio-oxidation involving earthworms and associated microbes (Kumar and Gupta, 2018; Abou El-Goud *et al.,* 2021). This process stabilizes organic matter with minimal nutrient loss and reduces pathogens present in organic waste (Ozturkci and Akkopru, 2021).

Therefore, the main objective of this research was to assess the effect of NPK and vermicompost on yield of barley cv."Giza 132"

MATERIALS AND METHODS

This study was carried out during 2022/ 2023 season on barley cv. "Giza 132 ”cultivar was grown in Private farm in Bani Walid, Libya, to evaluate the effect of NPK and vermicompost on some vegetative growth and yield of barley. This experiment consisted of seven treatments arranged in a Randomized complete Block Design (RCBD) design with three replicates for each treatment.

The treatments of this experiment were:

1. Control
2. 100 % NPK RDF (Recommended Dose Fertilizer)
3. V.C (vermicompost) 15 t/ ha
4. 100 % NPK RDF + V.C 15 t/ ha
5. 75 % NPK RDF + V.C 5 t/ ha
6. 50 % NPK RDF + V.C 7.5 t/ha
7. 25 % NPK RDF + V.C 10 t/ ha

Data recorded

A) Yield and yield components

- **Plant height (cm):** At physiological maturation stage, the height of the plants was measured with a ruler from the base of the main stem of the plant to the base of the spike for 20 randomly chosen for each experimental unit.
- **Dry matter accumulation (g/m^2)**
- **Spike length (cm):** It was measured as distance from the base of main spike to the top of spike excluding owns for randomly ten spikes/ plot.
- **Number of spikes/ m^2:** Average grain yield/ were estimated for each plot was calculated.
- **Number of grains/spikes:** It was counted as an average mean of ten main spikes/ plot.
- **1000-grain weight (g):** It was determined by the mean weight of a random l000 grain sample of the plot. The grain yield t/ ha was calculated using the yield obtained from 1meter length of 5 central rows (1m^2).
- **Grain yield (t/ha):** Average grain yield/ (1met. length of 5 central rows) were estimated for each plot and the yield of grains /ha was calculated.
- **Biological yield (t/fad):** was determined using the following formula:
  Biological yield = (Grain yield + Straw yield)
- **Harvest Index (%) =**Economic yield (Grain weight) Biological yield (Total dry weight) × 100 It was expressed in percentage.

B) Chemical composition

- **Total nitrogen:**

Total nitrogen was determined in digested plant material calorimetrically by Nessler`s method (Chapman and Pratt, 1978).

- **Phosphorus:**

Phosphorus was determined by the Vanadomolyate yellow method as given by **Jackson (1973)** and the intensity of color developed was read in spectrophotometer at 405nmat the three growth stages.

- **Potassium:**

Potassium was determined according to the method described by **Jackson (1973)** using Beckman Flame photometer at the three growth stages.

Statistical analysis:

Results of the measured parameters were subjected to computerized statistical analysis using MSTAT package for analysis of variance (ANOVA) and means of treatments were compared using LSD at 0.05 according to Snedecor and Cochran (1990).

RESULTS AND DISCUSSION

A) Yield and yield components

Results in Table (1) and Figure (1) showed that the treatment of 100% NPK+ V.C 15 t/ ha vermicompost recorded the highest value of plant height, dry matter accumulation, spike length, number of spikes/m^2, number of grains/ spike (79.23 cm. 795.66 g/m^2, 7.77cm, 408.75 spikes/ m^2, 45.88), respectively, followed by V.C 15 t/ha (79.23 cm. 689.23 g/m^2, 7.03 cm, 398.35 spikes/ m^2, 38.49), respectively as compared to control treatment which recorded the lower values of plant height, dry matter accumulation, spike length, number of spikes/m^2, number of grains/ spike (57.53 cm. 440.56g/m^2, 5.36 cm, 311.58 spikes/m^2, 27.25), respectively. This may be attributed to gradual mineralization and availability of nutrients along with increased moisture holding capacity of soil by vermicompost. **Getachew, (2009)** reported that the use of organic manures in combination with mineral fertilizers maximized the plant height than the application of inorganic fertilizers alone. Similar results were reported by Pareta *et al.* (2009) and Kumar *et al.* (2018).

Table (1): Effect of NPK and vermicompost on some vegetative growth and yield of barley cv. "Giza 132" during 2022/ 2023 season.

Treatments	Plant height (cm)	Dry matter accumulation (g/m^2)	Spike length (cm)	Number of spikes/ m^2	No. of grains/ spike
Control	57.53	440.56	5.36	311.58	27.25
100% RDF	68.88	605.11	6.27	362.50	32.77
V.C 15 t/ ha	79.23	689.23	7.03	398.35	38.49
100% RDF+ V.C 15 t/ ha	83.45	795.66	7.77	408.75	45.88
75% RDF + V.C 5 t/ ha	63.90	613.55	6.71	365.87	40.99
50 % RDF + V.C 7.5 t/ha	70.74	620.57	6.88	369.77	42.50
25 % RDF + V.C 10 t/ ha	75.27	670.85	6.94	375.09	43.66
LSD$_{(0.05)}$	**2.80**	**28.11**	**1.10**	**25.81**	**2.70**

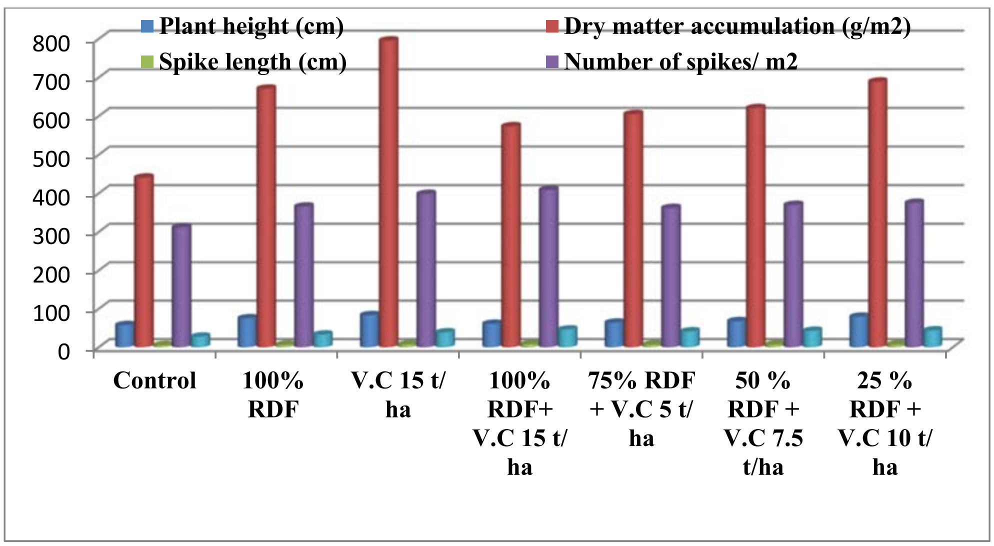

Fig. (1): Effect of NPK and vermicompost on some vegetative growth and yield of barley cv. Giza 132 during 2022/ 2023 season.

More tillers per square meter than in the other treatments most likely resulted from the availability of more nutrients. This may be the result of increased nitrogen application, which improved photosynthetic processes and photosynthetic translocation by plants. Enhancing barley development significantly involves tillering, a feature that is crucial for grain output. The primary factor influencing effective tillering is improved soil physical conditions brought about by the addition of vermicompost (Kakraliya *et al.*, 2018). Applying nitrogen promoted plant tillering and height, which in turn boosted the production of dry matter (Meena *et al.*, 2012). The beneficial effect of FYM is due to its contribution in supplying additional plant nutrients improvement of soil physical conditions and biological processes in soil. Metabolic root activities increased resulting absorption of moisture and other nutrients resulting in to higher dry matter production. Similar results were observed by Pareta *et al.*, 2009; Pareta *et* *al.,* 2009. The use of microbial and organic fertilizers increased the concentration of plant nutrients, promoting better plant development and a greater 1000-grain weight for the barley cultivar. Results confirm the finding (Nayak *et al.,* 2001) and Kumar *et al.* (2014). Significant increase was recorded in the number of productive tillers/m^2, number of grains spike-1and grain weight, above ground dry biomass and grain yield of barley with the combined application of organic and inorganic fertilizers than the application of inorganic NPK alone (Abay and Tesfaye, 2012).

Many studies have confirmed that increasing plant height is due to the positive effect of nitrogen on the activity of meristematic tissues and its role in cell division (Shaba *et al.,* 2006), and it plays a critical role in the vegetative growth of plants, which ultimately leads to an increase in straw and grain yields of wheat plant (Abedi *et al.,* 2011 and Marino *et al.,* 2011). Çiftçi (2019) found that organic fertilizers increased plant height in barley, with the highest height achieved using vermicompost. Özkan *et al.* (2021) found that chicken manure significantly increased plant height compared to other organic fertilizers.

Organic fertilizers promote vegetative growth, help in building strong root systems, and consequently have a positive effect on the plant height. These results are consistent with Abbas *et al.* (2012), who noted that spring wheat plants grew taller when treated with a combination of organic and inorganic fertilizers. This due to the amounts of organic fertilizer applied before planting improved the properties of the soil over time, increasing the leaf surface area of plants that get enough light energy and turn it into dry matter that helps the plant to grow by increasing the weight of its parts. Ibrahim *et al.* (2008) found that adding organic compounds and compost made the grains heavier than they were in the control group.

Taher *et al.* (2011) who reported in their research that all treatments in which organic fertilizer was added had an impact on production components of the wheat crop when compared to the control. In this context, we observe that in comparison to the control and chemically fertilized plants, the organically fertilized plants showed the highest dry weight/ m^2. This may be as a result of the cow dung that was added prior to planting was fermented over time and turning into an organic substance that absorbed by the roots, then affected the plant ability to grow and achieve a superior dry weight characteristic/ m^2. This outcome agreed with the findings of Ousman (2021) which showed that applying dry cow dung increased the dry weight of Sorghum plants.

It was obvious from results in Table (2) and Figure (2) that the treatment of 100% NPK+ V.C 15 t/ ha vermicompost recorded the highest values of 1000-seeds weight, grain yield, biological yield, (53.36 g, 3.37 t/ha, 8.11 t/ha), respectively, followed by V.C 15 t/ ha (51.20 g, 3.29 t/ha, 7.83 t/ha), respectively, while the treatment of 50 % RDF + V.C 7.5 t/ha recorded the higher value of harvest index (44.41%), as compared to control treatment which recorded the lower values of 1000-seeds weight, grain yield, biological yield, harvest index (43.61 g, 2.14 t/ha, 5.74 t/ha, 37.28 %), respectively.

Table (2): Effect of NPK and vermicompost on yield of barley cv."Giza 132" during 2022/ 2023 season.

Treatments	1000-seeds weight (g)	Grain yield (t/ha)	Biological yield (t/ha)	Harvest index (%)
Control	43.61	2.14	5.74	37.28
100% RDF	48.60	2.51	6.58	38.15
V.C 15 t/ ha	51.20	3.29	7.83	42.02
100% RDF+ V.C 15 t/ ha	53.36	3.37	8.11	41.55
75% RDF + V.C 5 t/ ha	45.65	2.86	6.71	42.62
50 % RDF + V.C 7.5 t/ha	47.88	3.10	6.98	44.41
25 % RDF + V.C 10 t/ ha	49.55	3.12	7.56	41.27
LSD$_{(0.05)}$	**1.65**	**3.26**	**1.45**	**0.24**

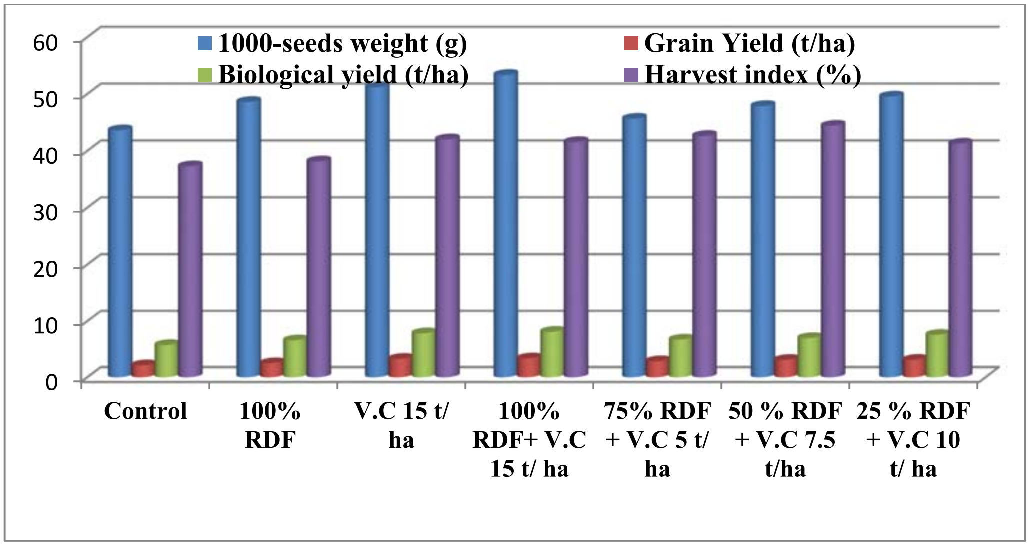

Fig. (2): Effect of NPK and vermicompost on yield of barley cv. Giza 132 during 2022/ 2023 season.

Increasing these characteristics in the plants led to an increase in the productivity of the wheat crop (variety, Somps. 90), and these findings were supported by Cheraghi *et al.* (2016) who explained that adding organic fertilizer to the soil increased the components of wheat crop and ultimately its grain yield. Additionally, vermicompost also increased biomass of plant (Fragaria x ananassa L.) according to the control and chemical fertilizer (Ateş *et al.,* 2019). İlker (2006) stated that spike length, which has significant direct and indirect effects on the grain yield in barley, can be used as a selection criterion. Gürsoy (2011) stated that the number of grains per spike has a direct effect on grain yield, which varies with spike length and number of spikelets/spike. Mutlu (2018) reported that the use of organic manure and organic manure combined with microbial fertilizer increased spike characteristics in barley, with the highest values obtained from cattle manure with liquid manure and compost with liquid manure. In line with the findings of the present study, other researchers have also reported that the maximum and minimum values of spike traits were attributed to the application of conventional manure and various organic manures (Aksu, 2017; Mazhar *et al.,* 2018).

Özdemir *et al.* (2019) reported the highest grain yield of barley genotypes to be 524.5 kg/ha with 160 kg/ha vermicompost, while the lowest yield was obtained in the control group. Researchers have emphasized the need to supplement organic fertilizers with mineral fertilizers to enhance both soil fertility and grain yield (Gopinath *et al.,* 2008). Mutlu (2018) reported a 50-56% increase in barley yield with the use of organic fertilizers in combination with microbial fertilizers. Previous studies have shown positive effects of sheep manure on certain plant nutrients (Hınıslı, 2014). The improvement in yield/plant may be attributed in increase in grain size and number of grains per plant. Organic matter in the fertilizers is an important source of plant nutrients. In addition, organic matter has been reported to have several other beneficial effects on soil physical, chemical and biological properties of soils. Therefore, application of organic substances consequently improved the grain yield and quality of grains. Similar results on the effects of organic fertilizers have been reported by other researchers (Chaturvdi, 2006). This might be due to maximum number of tillers, plant height, leaf area index and crop dry matter accumulation at different crop growth stages recorded more grain and straw yield under these treatments. The similar findings have been also reported by Chaudhary *et al.* (2021).

The increase in grain and biological yield might be due to adequate quantities and balanced proportions of plant nutrients supplied by FYM to the crop as per need during the growth period resulting in favourable increase in yield attributing characters which ultimately led towards an increase in economic yield. Similar findings had been also reported by **Fazily *et al.* (2021)**.

B) Chemical composition:

Results in Table (3) and Figure (3) showed that the treatment of 100% NPK+ V.C 15 t/ ha vermicompost recorded the highest values of N%, P%, K%, Protein % (2.13%, 0.445%, 2.39%, 13.31%), followed by V.C 15 t/ ha (1.98%, 0.438%, 2.22%, 12.38%), as compared to control treatment which recorded the lower values of nitrogen, phosphorus, potassium and protein percentages (1.54%, 0.195%, 1.72%, 9.68%), respectively.

Organic matter in the soil plays an important role in improving the physical and chemical properties of various soils. Organic matter application is an important method to increase the availability of both macro- and micro-nutrients (Niel, 2021). Nitrogen is one of the important mineral elements necessary for plant nutrition, growth and development, as the plant needs enough quantities of it compared to other mineral elements, and it is considered a limiting factor for high crop production (Costa Crusciol *et al.,* 2003). The found increases of barley plants content of N, P and K as a result of FYM application attributed to its content of nutrients and also its effect on these nutrients availability as a result of its influence on physical and chemical properties especially the decrease in both soil pH and the content of calcium carbonate (Abou Hussien *et al.,* 2017 and El-Sanat 2018). This might be due to that organic source enabled the plant to absorb largest amount of NPK through their well develop root system. Secondly, the chemical fertilizer not only increase the photosynthesis production but also translocation of source to sink which resulted in increased spike length and it has a positive relationship with grain and straw yield. Similar findings had been also reported by Prakash *et al.* (2011) and Baranwal *et al.* (2018).

Table (3): Effect of NPK and vermicompost on chemical compositions of barley cv. "Giza 132" during 2022/ 2023 season.

Treatments	**N (%)**	**P (%)**	**K (%)**	**Protein (%)**
Control	1.54	0.195	1.72	9.63
100% RDF	1.86	0.373	2.08	11.63
V.C 15 t/ ha	1.98	0.438	2.22	12.38
100% RDF+ V.C 15 t/ ha	2.13	0.445	2.39	13.31
75% RDF + V.C 5 t/ ha	1.78	0.365	1.99	11.13
50 % RDF + V.C 7.5 t/ha	1.88	0.389	2.11	11.75
25 % RDF + V.C 10 t/ ha	1.92	0.414	2.15	12.00
$LSD_{(0.05)}$	**0.04**	**0.01**	**0.03**	**0.25**

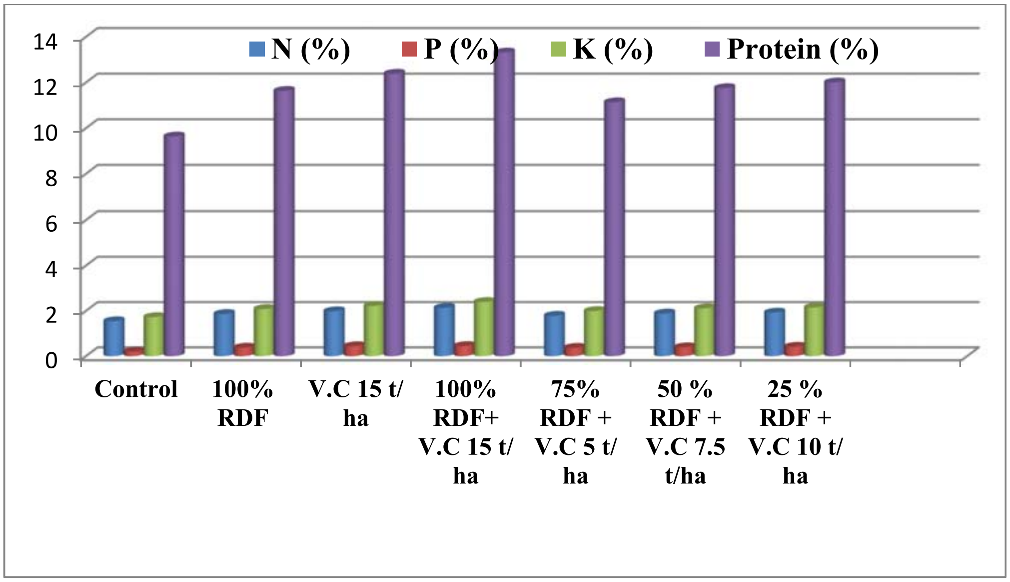

Fig. (3): Effect of NPK and vermicompost on chemical compositions of barley cv. Giza 132 during 2022/ 2023 season.

CONCLUSION

Vermicompost is a kind of organic fertilizers and derived from composting organic waste by using various species of earthworms. Integrated nutrient management helps to render and sustain soil fertility, crop productivity and improves soil health. It may also help to check the emerging deficiency of nutrient other than NPK. Integrated management of the nutrients is required for proper plant growth, as well as effective crop and soil management. It also reduced the need for chemical fertilizers by taking advantages of non-chemical sources of nutrients such as the manures, composts and bio-fertilizers.

EFERENCES

Abay, A. and Tesfaye, D. (2012). Combined application of organic and inorganic fertilizers to increase yield of barley and improve soil properties at Fereze, In Southern Ethiopia, Innovative Systems Designand Eng., 22(1): 25-34.

Abbas, G., Khattak, J.Z.K., Mir, Ishaque, A. M., Hussain, M., Wahedi, H.M., Ahmed, M.S. and Ullah, A. (2012). Effect of organic manures with recommended dose of NPK on the performance of wheat (*Triticum aestivum* L.). J. Anim. Plant. Sci., 22(3): 683-687.

Abedi, T.; Kazemeini, S.A. and Alemzadeh, A. (2011). Effect of organic and inorganic fertilizers on grain yield and protein banding pattern of wheat. Aust. J. Crop Sci., 4(6): 384-389.

Abou El-Goud, A.K.; Al-Masoodi, F.R.; Elzopy, K.A., and Yousry, M.M. (2021). Performance of potato cultivars in an organic farming system using organic fertilizers, vermicompost and azolla. Aust. J. Crop Sci., 15(7): 1081–1088.

Abou Hussien, E.A.; Nada, W.M. and Elgezery, M.K. (2017). Evaluation efficiency of sulphur fertilizer in calcareous soil amended by compost. Minufia J. Soil Sci., 2 (1): 59 – 72.

Aksu T. (2017). The effects of different nitrogen and farm manure doses on yield, quality and antioxidant activity of bread wheat (*Triticum aestivum* L.). M. Sc. Thesis, Adnan Menderes University, Graduate School of Natural and Appli. Sci., Aydın, Türkiye, 62.

Al-Hamd, M and Al-Jarbou, M. (2021). The effect of several levels of fermented sheep manure, nitrogen fertilization and their combination on growth and productivity of the wheat plant (*Triticum aestivum* L.) (variety: Sham.6). Syrian Soc. Agric. Res., 8 (3):220-235.

Alnarp, (2013). Doctoral thesis on barley genetic resources Swedish University of Agricultural application to an organically managed crop rotation, Zemdirbyste Agric., 104(4).

Ateş, K.; Demirkıran, A.R. and İnik, O. (2019). Toprağa bazı doğal ve yapay gübre ilavelerinin çilek bitkisinin verim parametreleri üzerine olan etkileri. Türk Doğa Fen Derg., 8(2): 23-28.

Aydın, C.B.; Ünal, M. and Can, O. (2019). Farklı yarasa gübresi uygulamalarının marul yetiştiriciliğinde verim ve kalite üzerine etkileri. Uluslararası Tarım Yaban Hayatı Bilim Derg., 5(1): 18-24.

Baranwal, A.; Srivastava, A.; Kumar, P.; Bajpai, V.K.; Maurya, P.K. and Chandra, P. (2018). Prospects of nanostructure materials and their composites as antimicrobial agents. Frontiers in Microb., 9: 309424.

Bozkurt, S.B. (2019). Kapya tipi biber (*Capsicum annuum* L.) yerleştiriciliğinde kullanılan organik gübrelerin bitki gelişimi ve meyve kalitesi üzerine etkileri. Yüksek Lisans Tezi, Uludağ Üniversitesi, Fen Bilimleri Enstitüsü, Bursa, Türkiye, ss: 71.

Chapman, H.D. and Pratt, P.F. (1978). Methods of analysis for soils, plants and water. Division of Agricultural Sciences, California, USA.

Chaturvdi, M. (2006). Effect of phosphorus levels alone or in combination with phosphate-solubilizing bacteria and farm yard manure on growth and nutrient uptake of wheat (*Triticum aestivum* L.). J. Agric. Soc. Sci., 2(2): 96-100.

Chaudhary, N.; Weissman, D. and Whitehead, K.A. (2021). mRNA vaccines for infectious diseases: Principles, delivery and clinical translation.Nature reviews Drug Discovery., 20(11): 817-838.

Cheraghi, Y.; Mohyedi, F.A. and Kalhor, M. (2016). Effects of organic and chemical fertilizers on yield components of common wheat (*Triticum aestivum* L.). Inst. Integrative Omics App. Bio-Tech. J., 7(8): 82-86.

Çiftçi, T. (2019). Organik gübrelerin tritikale ve arpa üzerine etkileri. Yüksek Lisans Tezi, Harran Üniversitesi, Fen Bilimleri Enstitüsü, Şanlıurfa, Türkiye, 73.

Costa-Crusciol, C.A.; Mauad, M., Filho, H.G. and Corre, J. C. (2003). Nitrogen and silicon rates fertilization of Upland rice. Sci. Agricole. 4: 761-765.

Demirsoy, M. and Aydın, M. (2020). The quantitative effects of liquid vermicompost and seaweed practices on the seedling quality of organic tomato (*Solanum lycopersicum* L.). Int. J. Environ. Trends, 4: 17-27.

El-Sanat, G. M.A. (2018). Impact of subsoiling, organic manure and nitrogen sources on some soil properties and sugar beet productivity. Menoufia J. Soil Science. 3 (February): 1-16.

FAO, (2022). Food and agriculture organization. URL: http://www.fao.org. (accessed date: June 21, 2023).

Fazily, T.; Thakral, S.K. and Dhaka, A. K. (2021). Effect of integrated nutrient management on growth, yield attributes and yield of wheat. Int. J. Adv. Agric. Sci. Tech., 8(1):106-118.

Geng, L.; Li, M.; Zhang, G. and Ye, L. (2022). Barley: a potential cereal for producing healthy and functional foods. Food Quality Saf., 6: 1-13.

Getachew, A. (2009). Ameliorating effects of organic and inorganic fertilizers on crop productivity and soil properties on reddish-brown soils. In: Proceeding of the 10 Conf. the Ethiopian Soc. Soil Sci., 127-150.

Giraldo, P.; Benavente, E.; Manzano-Agugliaro, F. and Gimenez, E. (2019). Worldwide research trends on wheat and barley: A bibliometric comparative analysis. Agron., 9(7): 352.

Gopinath, K.A.; Saha, S.; Mina, B.L.; Pande, H.; Kundu, S. and Gupta, H.S. (2008). Influence of organic amendment on growth, yield and quality of wheat and on soil properties during transition to organic production. Nutrient Cycling in Agro-ecosys., 82: 51-60.

Gürsoy, M. (2011). Bazı iki sıralı arpa (*Hordeum vulgare* L.) hat ve çeşitlerinde farklı azot dozlarının verim ve kalite ögelerine etkileri. Ecol. Life Sci., 6(4): 114-123.

Gutie´rrez-Miceli, F.A.; Rosales Reiner, G. R. C.; Miguel, A.; Marcos, O.L.; Cruz, J.G. and Dendooven, L. (2008). Formulation of a liquid fertilizer for sorghum (*Sorghum bicolor* (L.) (Moench) using vermicompost leachate. Bio resource Techn., 99: 6174–6180.

Hager, A.S.; Taylor, J.P.; Waters, D.M. and Arendt, E.K. (2014). Gluten free beer-A review. Trends Food Sci. Tech., 36: 44-54.

Hınıslı N. (2014). Vermikompost gübresinin kıvırcık bitkisinin gelişmesi üzerine etkisinin belirlenmesi ve diğer bazı organik kaynaklı gübrelerle karşılaştırılması. Yüksek Lisans Tezi, Namık Kemal Üniversitesi, Fen Bilimleri Enstitüsü, Tekirdağ, Türkiye ss: 50.

Howitt, C.A., Larkin, P.J. and Colgrave, M.L. (2018). Gluten reduction strategies for wheat and barley. Cereal Food World, 65: 184-187.

Hussain, A.; Ali, S.; Hussain, A.; Hussain, Z.; Manzoor, M.F.; Hussain, A. and Hussain, M. (2021). Compositional profile of barley landlines grown in different regions of GilgitBaltistan. Food Sci. Nutri., 9(5): 2605-2611.

Ibrahim, M.; Hassan, A.U.; Ibal, M. and Valeem, E.E. (2008). Response of wheat growth and yield to various levels of compost and organic manure. Pake. J. Bot., 40(5): 2135-2141.

İlker, E. (2006). Arpa melezlerinde verim ve verim özellikleri arasındaki ilişkiler. Ege Üniversitesi Ziraat Fakültesi Dergisi, 43(3): 1-11.

Jackson, M.L. (1973). Soil chemical analysis. Prentice-Hall, Inc.Englewood Cliffs, N. J. New Delhi.

Kakraliya, S.K.; Kumar, S.; Kakraliya, S.S.; Choudhary, K.K. and Singh, L. K. (2018). Remedial loptions for the sustainability of rice-wheat cropping system. J. Pharmac. Phytochem., 7(2):163-171.

Kumar, A. and Gupta, R.K. (2018). The effects of vermicompost on growth and yield parameters of vegetable crop radish (*Raphanus sativus*). J. Pharmacogn. Phytochem., 7(2): 589-592.

Kumar, P.; Singh, F.; Kumar, R.; Singh, V. and Singh, A. P. (2014). Effect of integrated nutrient management on productivity and soil fertility in wheat-based cropping system. Int. J. Eng. Res. Techn., 3(5): 632-635.

Kumar, S., Stecher, G., Li, M., Knyaz, C., Tamura, K. and Mega, X. (2018). Molecular evolutionary genetics analysis across computing platforms. Mole. Biol. Evolution., 35(6):1547.

Kumawat, K. and Gosens, R. (2016). WNT-5A: Signaling and functions in health and disease. Cellular and Molecular Life Sci., 73:567-587.

Langridge, P. (2018). Economic and academic importance of barley, In: Stein, N., Muehlbauer, G. (eds), The barley genome. Compendium of Plant Genomes. Springer, Cham., 1-10.

Maduwanthi, A.; Karunarathna, B. and Wickramasingha, I. (2021). Impact of vermicompost as a base fertilizer for radish (*Raphanus sativus* L.) cultivation. J. Trop. Forestry Environ., 11(1): 61-68.

Marino, S.; Tognetti, R. and Alvino, A. (2011). Effects of varying nitrogen fertilization on crop yield and grain quality of emmer grown in a typical Mediterranean environment in central Italy. Euro. J. Agron., 34(3): 172-180.

Mazhar, S.A.; Nawaz, M.; Khan, S. and Irshad, S. (2018). Impact of urea and farm yard manure on nitrat concentration in soil profile and productivity of wheat crop. J. Plant Nutr., 41: 2683–2691.

Meena, L.R., Mann, J.S. and Meena, S.L. (2012). Effect of levels and mode of nitrogen application on dual purpose barley (*Hordeum vulgare* L.) under semi-arid condition. Indian J. Agron., 57(2):168-170.

Mohammed, I.J. (2013). Evaluation of the effect of organic and chemical fertilization on some soil properties and the growth of *Cucumis melo* var flexuos Nauds. Master's Thesis. Faculty of Agriculture, Basra Univ., 113.

Mutlu A. (2018). The Effect of organic fertilizer on spike characteristics of barley (*Hordeum vulgare* L.). J. Curr. Res. Engin. Sci. Tech., 4(2): 125-134.

Nayak, S.; Gautam, V.S. and Kushwaha, B.B. (2001). Response of sorghum to Azospirillum with and without FYM at different levels of nitrogen. J. Maha. Agric. Univ., 26(3): 341-345.

Niel, E.M. (2021). Effect of organic and nitrogen fertilizers on soil fertility and wheat productivity in a newly reclaimed sandy soil. Alex. Sci. Exch. J., 42(3):573-582.

Olle, M. (2016). The effect of vermicompost-based growth substrates on tomato growth. J. Agric. Sci., 1(27): 38-41.

Ousman, H.A. (2021). Evaluation of twelve genotypes of sorghum under effects of Striga infestation and the response of the variety of crop to the parasite and organic fertilization. PHD Thesis, Crops Sci. Department, Fac. Nat. Reso. Environ. Stud., Univ. Kordofan, 76-77.

Özdemir, B.; Oral, E. and Altuner, F. (2019). Arpada (*Hordeum vulgare* L.) vermikost dozlarının bazı verim ve verim unsurları üzerine etkisi. ISPEC Uluslararası Tarım ve Kırsal Kalkınma Kongresi, 10-12 Haziran, Siirt, Türkiye, ss: 747-759.

Özkan, R.; Bayhan, M.; Yorulmaz, L.; Öner, M. and Yıldırım, M. (2021). Effect of different organic fertilizers on bread wheat (*Triticum aestivum* L.) productivity. Int. J. Agric. Environ. Food Sci., 5(3): 433-442.

Öztürkci, Y. and Akköprü, A. (2021). Effects of solid and liquid vermicompost application on bean growth and common bacterial blight disease in different growth medium. Int. J. Agric. Wildlife Sci., 7(1): 30-40.

Pączka, G.; Mazur-Pączka, A.; Garczyńska, M.; Kostecka, J. and Butt, K.R. (2021). Garlic (*Allium sativum* L.) cultivation using vermicompost-amended soil as an aspect of sustainable plant production. Sustainability, 13, 13557.

Pareta, D.K.; Ojha, R.K. and David, A.A. (2009). Response of N and Zn on physio-chemical properties of soil and yield of wheat under alluvial soil condition. Environ. Ecol., 27(4B):1895-1898.

Polat, H. (2020). Türkiye'de kimyasal azotlu gübre tüketim durumunun ve toprak analizi zorunluluğunun azotlu gübre kullanımına etkilerinin değerlendirilmesi. Toprak Su Derg, 9: 60-71.

Prakash, S.; Rodes, L.; Coussa-Charley, M. and Tomaro-Duchesneau, C. (2011). Gut microbiota: Next frontier in understanding human health and development of biotherapeutics. Biologics: Targets Therapy., 71-86.

Rekha, G.S.; Kaleena, P.K.; Elumalai, D.; Srikumaran, M.P. and Maheswari, V.N. (2018). Efects of vermicompost and plant growth enhancers on the exo-morphological features of *Capsicum annum* (Linn.) Hepper. Int. J. Recycl. Org. Waste Agric 7:83–88

Scaglia, B., Nunes, R.R., Rezende, M.O., Tambone, F. and Adani, F. (2016). Investigating organic molecules responsible of auxin-like activity of humic acid fraction extracted from vermicompost. Sci. Total Environ., 562(1): 289-295.

Shaba, K.Y.; Hala, A.; Mohammed, Y.; Ali, J.I. and Esraa, H. (2006). The effect of nitrogen and phosphorus levels on the growth of wheat (*Triticum aestivum* L) yield under different irrigation systems. Agric. J. Iraqi. 11(3): 24-33.

Snedecor, G.W. and Cochron W.G. (1990). Statistical Methods 7th ed. Iowa state Univ., Press, Ames, Iowa.

Taher, M.; M. Ayub; H. M. R. Javeed; M. Naeem; H.U. Rehman; M. Waseem and Ali, M. (2011). Effect of different organic matter on growth and yield of wheat (*Triticum aestivum* L.). Pak. J. Life Soc. Sci., 9(1): 63- 66.

Theunissen, J.; Ndakidemi, P.A. and Laubscher, C.P. (2010). Potential of vermicompost produced from plant waste on the growth and nutrient status in vegetable production. Int. J. Phys. Sci., 5(13): 1964-1973

Tricase, C.; Amicarelli, V.; Lamonaca, E. and Rana, R.L. (2018). Economic analysis of the barley market and related uses. Grasses as food and feed, 10: 25-46.

Vaughan, J.G.; Judd, P.A. and Bellamy, D. (2006). The Oxford Book of Health Foods; At:http://books.google.co.in/books

Wang, D.; Shi, Q.; Wang, X.; Wie, M.; Hu, J.; Liuand, J. and Yang, F. (2010). Influence of cow manure vermicompost on the growth, metabolic contents, and antioxidant activities of Chinese cabbage (*Brassica campestris* ssp. chinensis). Biol. Fertil. Soils 46: 689-696.

Yılmaz, O.; Doğuş, İ. and Yılmaz, Z.S. (2017). Kırmızı solucan gübresi kimyevi gübreye alternatif olabilir mi? 1st Int. Symp. Multidisciplinary Stud. Innov. Techn., Tokat, Türkiye, 243.

تأثير الفيرموكمبوست، NPK على نمو وجودة الشعير

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المستخلص

أُجريت هذه الدراسة خلال موسم 2023/2202 في مزرعة سوف الجين في بني وليد، ليبيا، لتقييم تأثير NPK والفيروكمبوست على بعض صفات النمو الخضري والمحصول ومكونات المحصول والصفات الكيميائية للشعير صنف "جيزة 132". تكونت هذا التجربة من سبع معاملات مرتبة في تصميم القطاعات كاملة العشوائية (RCBD) مع ثلاث مكررات لكل معاملة. كانت المعاملات هي (الكنترول، 100% NPK، 15 طن/هكتار فيرموكمبوست، 100% NPK +15 طن/هكتار فيرموكمبوست، 75% NPK +5 طن/هكتار فيرموكمبوست، 50% NPK +7.5 طن/هكتار فيرموكمبوست،25% NPK +10 طن/هكتار فيرموكمبوست).أظهرت النتائج أن المعاملة 100% NPK+15 طن/هكتار فيرموكمبوست سجلت أعلى القيم لجميع صفات النمو الخضري، والمحصول ومكوناته، والتركيب الكيميائي للشعير صنف "جيزة 132" مثل ارتفاع النبات، تراكم المادة الجافة (جم/ م²)، طول السنبلة، عدد السنبيلات/م²، عدد الحبوب/سنبلة، وزن 1000 حبة، محصول الحبوب (طن/هكتار)، المحصول البيولوجي (طن/هكتار)، دليل الحصاد (%)، النسبة المئوية للنيتروجين، الفوسفور، البوتاسيوم والبروتين، تليها المعاملة 15 طن/هكتار والمعاملة10 طن/هكتار فيرموكمبوست، مقارنةً بمعاملة الكنترول التي سجلت أقل ارتفاع للنبات، تراكم المادة الجافة (جم/م²)، طول السنبلة، عدد السنبيلات/ م²، عدد الحبوب/سنبلة، وزن 1000 حبة، محصول الحبوب (طن/هكتار)، المحصول البيولوجي (طن/هكتار)، دليل الحصاد (%)، النسبة المئوية للنيتروجين، الفوسفور، البوتاسيوم والبروتين تحت ظروف التجربة. الخلاصة: يمكن أن يكون التفسير هو أن إضافة كمية كبيرة من الفيرموكمبوست قبل الزراعة قد حسنت خصائص التربة، مما زاد من مساحة الورقة العلموية للنباتات التي تتلقى طاقة ضوئية كافية وتحولها إلى مادة جافة، مما زاد من وزن الحبوب.

الكلمات المفتاحية: الشعير(*Hordeum vulgare* L.)، الفيرموكمبوست، NPK، المحصول ومكوناته، المحتوى الكيميائي .