Eurasian Journal of Agricultural Research 2021; Vol:5, Issue:2, pp:146-159

The Importance of Vermicompost in Agricultural Production and Economy

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Abstract

The aim of the study is to reveal the increase in agricultural production caused by the use of vermicompost in various agricultural productions compared to other fertilizers and its contribution to the economy of the farmer and the country depending on this increase. In order to achieve this aim, the results of previous studies and trials were investigated and analyzed. The study has shown that the results obtained with the application of vermicompost alone or in combination with other fertilizers provide an increase in both fruit rate, leaf development and dry matter rate. It has also been determined that it regulates the soil structure and PH value. The positive results of the use of vermicompost, the increase in the quality and quantity of the obtained product, the supply of the products needed by the market, the improvement of the soil structure, the more economical meeting of the plant nutrients that the plant needs are reflected both in the prices of the farmers and in the national economy. Therefore, the use of vermicompost is more economical than chemical fertilizers, the long-term effect on the soil and the increase in yield make a positive contribution to both the farmer and the country's economy

Keywords: Vermicompost, Economic Benefit, Soil PH, Inorganic Fertilizer, Product Quality

Review article
Received Date: 20 October 2021
Accepted Date: 25 November 2021

INTRODUCTION

The soil conditioner and plant feeding material produced by earthworm species such as red worm (Eisenia foetida) on the basis of changing the physical and chemical structures of bovine feces and organic plant materials is called vermicompost. The intensive use of agro-chemicals, which puts both human health and environmental safety at risk, reduces soil quality, and increases pathogen resistance, has caused serious concerns about the safety of natural resources. All this has led scientists to the development of sustainable agricultural production methods that target the use of effective organic products as biological fertilizers and pesticides. In this area, aerobic compost and vermicompost products, which increase soil quality in all respects, have gained great importance.

Vermicompost methods, which are a reliable, economical and sustainable method for the evaluation of various organic wastes, enable the production of products called "Vermicest", which is thought to have a biological suppression effect on plant growth, plant nutrition and rot factors. Vermicompost (worm manure) enables a low-input production system, which is very important for small or medium-sized agricultural producers, and can compensate for the product decline initially observed in the transition from conventional agriculture to organic agriculture. Vermicompost methods are techniques that ensure food safety for humans and animals, support a sustainable agricultural production model that is reliable in terms of environmental health and has high economic value (Demir et al., 2010).

Vermicompost provides aggregate formation in the soil in order to increase productivity. It improves the structure of the soil, increases the porosity of the soil, and ensures that the air intake and water holding capacity are high. These also help the plant to complete root development better. Thus, the plant absorbs useful nutrients in the soil and causes an increase in plant characteristics and yield. In addition, due to the organic nature of the vermicompost applied to the soil, an increase in the nutrients in the soil is provided (Mısırlıoğlu, 2011). Worms significantly affect soil structure, fertility and plant production. Through their feeding and gallery opening activities, they improve the soil balance positively, increase the penetration of water into the soil, accelerate the mixing of organic matter, lime and fertilizers applied to the surface with the soil, and increase soil porosity. In addition, it has been proven by studies that they support plant root development; significantly reduce the rate of root diseases, increase meadow and crop yield and grain quality (Tomati and Gali, 1995).

Many vermicompost tests have been carried out on different plants throughout the world and Turkey. Most of the time, vermicompost was used together with other fertilizers in the experiments and the results were compared according to the control groups. Most of the studies on vermicompost are related to the effect of fertilizer on yield and diseases. Economic research is very limited. The results of some of the trials with different products and different fertilizers are presented below.

Vermicompost is a reliable organic fertilizer because it has a slow release (increasing agricultural production and reducing nutrient loss) feature and provides physical, chemical, biological and microbiological improvements in the soils it is used in. Among its widely known benefits are; It can be counted as having a soil conditioner feature, containing a sufficient amount of useful plant nutrients, controlling some pesticides and plant diseases, increasing the product yield by increasing the soil quality, being an environmentally friendly and economical fertilizer when used in the long term. All kinds of vegetable residues, farm manure, chicken manure, garbage compost and organic industrial wastes can be used to eliminate the lack of biological origin in the soil. These materials provide nutrients to the soil by improving the physical, chemical and biological properties of the soil, thus positively affecting the yield and quality in plant production (Sönmez et al., 2002; Entry et al., 1997; Pascual et al., 1997).

Vermiculture studies are involved in garbage treatment, soil detoxification and regeneration, and sustainable farming practices. Commercial vermiculture activities are concentrated in two areas. The first is vermicompost processing and the other is worm biomass production. Worm biomass production is made for the use of worms in poultry and fish farming as a protein source. On the other hand, vermistabilization is the vermicomposting of sewage, sewage sludge or other similar wastes (Edwards and Arancon, 2004). Earthworms increase plant growth (39%) and grain yield (35%), especially in grain production (Baker, 1994).

While compost applications obtained from various materials are rapidly becoming widespread in our country, vermicompost applications can be considered new for our country. In previous studies with vermicompost, it is emphasized that it improves the physical and biological structure of the soil and has positive effects on plant yield and quality. More recognition of vermicompost in our country and its effects on plant productivity should be revealed with further studies and studies. Studies have shown that organic fertilizers are beneficial for plants, soil, environment and economy. The most important studies are to increase the productivity of plants and to show that better results can be obtained in the long term compared to chemical fertilizers. Bio fertilizer and vermicompost applications to be made in the rhizosphere region, where microbiological activity is higher than other parts of the soil, provide an improvement in both the physicochemical properties of the soil and its biological productivity. Thus, the need for chemical fertilization decreases, and an increase in soil biodiversity and biomass occurs. In a study, worm compost created from waste helped to decrease the soil pH value, while it caused an increase in the amount of dry matter in the corn plant(Ferreira and Merchant, 1992).

(Fosgate and Babb, 1972) used vermicompost for plant nutrition. The researchers reported that vermicompost obtained using barnyard manure is the same as a "special greenhouse flower mix." In a study on rice plant, it was revealed that vermicompost increased the vegetative growth of the plant more than chemical fertilizers (Kale et al., 2013). (Edwards. , 1995) reported that vermicompost increased the germination rate and promoted growth.

(Buckerfield and Webster, 1998) in their study investigating the effect of vermicompost and sand mixtures on plant growth in radish, found that plant weight increased as the vermicompost ratio increased. It has been reported that spinach forms 16-17 leaves until flowering, however, the lower leaves turn yellow over time (Şalk, 1992).

In a study carried out in open field conditions, Matador and Spinoza varieties of spinach were grown in two different growing periods, such as autumn and spring. According to the results obtained, more yieldswere obtained from Matador variety and from sowing in March. In terms of earliness, Matador in autumn cultivation and Spinoza in spring cultivation came earlier to harvest (Deveci and Şalk, 1995).

A study was conducted in August 1992 at the Raichur District Research Institute for the Tompson seedless grape. The experiment was carried out on 2-year-old vines grown with a 1.8 x 1.2 m spacing system. In this study, the effects of different fertilizer applications on NPK uptake and yield were investigated. By applying vermicompost to two experimental plots, 100,000 and 200,000 worms were left. On the other parcels, 300:500:1000 NPK kg/ha was applied at the rates of 75%, 50%, and 25%, respectively. One parcel was left without any application as the control group. It was determined that the NPK level increased and the pH level decreased in the parcels with vermicompost application (Venkatesh et al., 1998).

In a study on sugar beet, the effects of nitrogen fertilizer, barn manure and vermicompost were investigated. According to the results obtained, it was observed that vermicompost used at the level of 10 t/ha formed biomass with more root and leaf growth in sugar beet (Zimny et al., 2001).

In an experiment, vermicompost was used as a fertilizer in tomato, pepper, potato and strawberry cultivation, and it was reported that leaf area, shoot length and market value of strawberries increased greatly in pepper and tomato (Arancon, et al., 2007); (Arancon, et al., 2004) investigated the effects of vermicompost on strawberries. It was concluded that vermicompost had a positive effect on growth and development when applied in different amounts. (Nurhidayati et al., 2016) in another study, lettuce and cabbage were grown by mixing compost and vermicompost in certain proportions. In an experiment, it was determined that vermicompost produced using sheep manure greatly increased the weight of tomatoes, lowered the pH in the soil and increased the solubility of plant nutrients (Gutiérrez-Miceli et al., 2007). As a result of studies on spinach, vermicompost application has been shown to increase nutrient intake (Nagavallemma et al., 2006; Peyvast et al., 2007).

Germination, fruit weight, amount of ascorbic acid and yield were investigated in different ratios of peat and vermicompost mixtures in tomato. According to the results obtained, it was observed that there was an increase in marketable yield with vermicompost application (Roberts et al., 2007). (Azarmi et al., 2008) stated that the application of vermicompost in tomato affects the physical structure of the soil, and there is an increase in the amounts of potassium (K), phosphorus (P), calcium (Ca), organic carbon (C), Manganese (Mn), Zinc (Zn).

(Arancon et al., 2007) demonstrated that vermicompost application partially controlled Meloidogyne incognita nematode in tomato-pumpkin rotation production. Again, (Arancon et al., 2007) stated that vermicompost reduced the number of egg masses and root tumors of Meloidogyne javanica (nematode). It was concluded that vermicompost suppressed fungivorous nematodes more effectively than baktivorous nematodes.

In a study by a group of scientists on tobacco plants, it was observed that worm castings applied in the form of 1 kg/m² suppressed Meloidogyne Incognita attacks. 5 tons/ha, 10 tons/ha and 20 tons/ha of vermicompost were applied to the plots planted with grapes, bell peppers, tomatoes and strawberries. Only inorganic fertilizer was applied to the control plots, and inorganic fertilizer was added to the vermicompost plots to equalize the N level. After these applications, a significant decrease in nematode growth was observed in 3 of the 4 plots where vermicompost was used compared to the one with inorganic fertilizer. On the other hand, it was observed that there was a continuous increase in nematodes in the plots where inorganic fertilizers were used (Arancon et al., 2007).

A study was carried out to observe the effects of various fertilizers on yield and quality parameters of Azarshahr variety of red onion in Azerbaijan. In this study, burnt barn manure, domestic waste compost and vermicompost were applied at different rates on the red onion cultivar. According to the results obtained, the highest yield was observed from the parcel where 6 tons of vermicompost was applied per 10 decares. The lowest deterioration rate with 12% deterioration rate was observed in the plot where burnt barnyard manure was applied. The lowest ascorbic acid concentration was observed in vermicompost with 13.5 mg per 100 g of fresh onions. The application with the highest protein content was observed in the application of 1.49% to 6 tons of vermicompost per 10 decares. The bitterness felt in onions was detected at the lowest rate in 20 tons of burned barn manure. It has been determined that vermicompost has a significant effect on growth and yield. Considering the effectiveness of inorganic macronutrients applied to all plants, it was observed that plant nutrient uptake became easier in plants with vermicompost applied (Bai and Malakout, 2007).

In a study carried out with 0, 10%, 20% and 30% doses of vermicompost in spinach plant under unheated greenhouse conditions, it was determined that vermicompost could significantly increase the number of leaves and leaf height in the plant (Peyvast et al., 2007).

In a study, in order to determine the effect of vermicompost application on yield and quality of strawberry plant, in addition to chemical fertilization, four different amounts of vermicompost, 2.5, 5, 7.5 and 10 t/ha, were applied.

According to the results obtained, dispersion, fiber content, dry matter content and total fruit amount increased in strawberry plant applied vermicompost (Singh et al., 2008). In another experiment, three different vermicompost tea and chemical fertilizers were used in Chinese Cabbage and its growth, nutrient content, mineral and antioxidant activity were analyzed. According to the results of the research, it was determined that there was an increase in the amount of mineral nutrients and phenolic substances (Pant et al., 2009).

According to the results of a study conducted with vermicompost and farm manure application in garlic, it was determined that 15 t/ha vermicompost and 50% NPK application had a greater effect on root, leaf and shoot length and fruit weight parameters than other applications (Suthar, 2009). In a trial investigating the effect of vermicompost on marigolds, it was determined that the largest flower diameter was formed at 40% vermicompost dose (Pritam et al., 2010). In another study, they determined that vermicompost increased the growth and development of chickpea and pea plants and increased the number of nitrogen-fixing bacteria (Sinha et al., 2009).

In order to see the effect of plant hormones on germination by a researcher, a laboratory study was carried out with liquid vermicompost containing Cyamophis tertagonoloba, and Trigonella foenum-graecum species. As a result of the experiment using 100% liquid vermicompost, 50% liquid vermicompost, 5% urea solution and distilled water, while the highest germination rate was observed in 50% liquid vermicompost application, when the growth parameters were examined, the best results were obtained from the 100% liquid vermicompost application group (Suthar, 2010).

In a trial, the effect of vermicompost and barn manure application on the growth and soil fertility of spinach (Spinicia oleracea var L.) plant was investigated. In this experiment, which was carried out during the winter months, the effects of various levels of vermicompost, barnyard manure and control applications without any fertilizer on the development and soil content of the spinach plant were investigated. As a result, barnyard manure gave better results on plant growth, yield, mineral content and soil fertility parameters. In addition, it was observed that there were significant increases in vermicompost applications compared to control plots, and that vermicompost application had a positive effect on the iron (Fe) content and calcium (Ca) content of the plant (Çıtak et al., 2011).

In a study carried out to determine the effect of vermicompost on growth and metabolic content of Chinese Cabbage (Brassica campestris ssp. chinensis), an increase was observed in nutrient content, water-soluble dry matter, vitamin C and total phenol (Wang et al., 2006).

(Çıtak et al., 2011) investigated the development of spinach, yield, mineral content and soil fertility criteria in a study conducted under open field conditions in winter to examine the effects of vermicompost and control application at different doses on the development and soil fertility of spinach. According to the results obtained, it was determined that the application of 3 tons of vermicompost per decare was significantly effective. In another study investigating the contribution of vermicompost to yield plant and soil nutrients in wheat, it was determined that the mixtures using vermicompost had a positive effect compared to the control group (Kızılkaya et al., 2012). In an experiment, the growth parameters of vermicompost on two different commercial lettuce varieties Brisa and Daguan were investigated. With the application of vermicompost, nitrate concentration increased significantly in Brisa cultivar, and significant differences were observed between the two cultivars in terms of leaf number and area, fresh and dry weight, and reducing sugar content (Leon et al., 2012).

In order to determine the effect of vermicompost on cauliflower in field conditions, 9 different doses of vermicompost were used in addition to chemical fertilization (6 kg/da N, 3 kg/da P_2O_5, 6 kg/da K_2O). As a result, it has been reported that 200 to 400 kg/da doses of vermicompost are appropriate in addition to chemical fertilization in cauliflower cultivation (Tavalı et al., 2013).

It has been observed that it increases the nutrient uptake in the plants applied with vermicompost (Yourtchi et al., 2013) investigated the effects of applying different amounts of vermicompost to potato plant on NPK uptake. It was determined that as the application amount of vermicompost increased, NPK intake also increased, accelerating plant growth and increasing yield. According to the results of the study, 15 kg/ha nitrogen and 12 tons/ha vermicompost application was recommended in order to obtain high yield and avoid environmental pollution.

In a trial study, the effects of 4 different doses of vermicompost, 0%, 10%, 20%, 40%, on the morphological properties and soil chemical properties of tomato (Solanum lycopersicum L.) were investigated. The highest yield level was reached at 20% and 30% vermicompost doses. Fresh and dry weight, plant height, yield were obtained from the application of maximum 20% vermicompost. The amount of P and K in the soil increased with the increase of the pH dose of vermicompost (Abafita et al., 2014).

A study was conducted to determine the effects of vermicompost and chicken manure on yield and quality as well as the chemical properties of the soil in summer squash. This trial was set up in open field conditions and different levels of both fertilizers were tested. According to the results, it was observed that the application of vermicompost at 400 kg/da had a more curative effect in terms of yield and quality of the zucchini plant and the chemical properties of the soil compared to other applications (Tavalı et al., 2014).

In a study carried out, the effects of mycorrhiza and vermicompost on the growth and mineral nutrition of pepper plants were investigated separately and together. In the trial, doses of 0, 1 and 2 g/pot for mycorrhiza and 0, 2.5, 5 and 10 g/pot for vermicompost were tried. While determining the fresh and dry weights of the pepper plant, the nutrient ratios it contains were examined. When the results were evaluated, it was determined that the application of mycorrhiza and vermicompost had a positive effect on the fresh weight, dry weight and nutrient content of the pepper plant. It has been reported that the highest improvement and the highest nutritional element contents are obtained at the highest doses (Küçükyumuk et al., 2014).

In an experiment conducted by a group of researchers using five different doses of vermicompost and NPK inorganic fertilizer on white head cabbage, it was observed that the yield and quality of cabbage increased as the vermicompost dose was increased (Tavalı et al., 2014). 12 different applications were made in the trials established by the Bangladesh Agricultural Research Institute between October 2008 and March 2009 on the 'snow white' variety of cauliflower. In these applications, in addition to a control plot where no fertilizer application was made, chemical fertilizers at different rates were used for 3 plots, worm manure was used at different rates for 3 plots, and more than one fertilizer combination at different rates was used for other plots. According to the findings obtained from the research, the best results in terms of product quality and productivity were obtained from the plots where vermicompost was used together with chemical fertilizers. It has been observed that vermicompost enables plants to take the nutrients carried by chemical fertilizers more easily (Jahan et al., 2014).

The effects of the use of vermicompost and inoculated seed (biostimulant) on the biomass and growth of the plants were investigated by Ran Agriculture Company in 2012 in the cultivation of the coriander plant. In the established experiment, 4 different levels of vermicompost were applied to the grafted and ungrafted seeds. As a result of the experiments, the highest biomass yield and fresh and dry plant weight were obtained from the plots where 9 tons/ha of vermicompost was applied (Shirkhodaei et al., 2014).

In a study conducted in Diyarbakır between 2010 and 2011, the effect and economic evaluation of 16 different nutrient sources on the yield of organic sweet corn plants. Efficiency, quality and net profitability criteria were evaluated in trials with different fertilizers and fertilizer combinations under the same conditions. According to the results obtained considering the quality and yield criteria, it was concluded that horse manure, horse manure + humic acid and cattle manure + humic acid applications are the most economically profitable fertilizers in organic corn cultivation. In the aforementioned study, damage was determined in peat, peat + humic acid applications, while vermicompost remained at the lowest profitability level (Cihangir and Öktem, 2015).

It has been observed that it has a positive effect on seedling quality and field performance in vegetables such as tomato (Lycopersicon esculentum Mill.), eggplant (Solanum melongena L.), pepper (Capsicum annuum L.). As a result of the research, an increase was observed in pepper and eggplant quality, while a decrease was observed in tomato quality (Ahirwar and Hussain, 2015).

In an experiment conducted with curly lettuce under unheated glass greenhouse conditions, different doses of liquid vermicompost and agrimol cover were used. As a result of the experiment, values such as head length and diameter, total acidity, pH were examined and it was observed that increasing doses of agrimol cover and vermicompost had a significant effect (Sağlam et al., 2015). In an experiment, the effects of different levels of vermicompost such as 0, 250, 500, 750, 1000 kg/da on yield and some soil properties in lettuce were investigated. As a result of this research, it was concluded that vermicompost applied at different doses was effective on the number of leaves (Özkan and Müftüoğlu, 2015). In an experiment investigating the effects of organic and inorganic fertilizers on yield and quality criteria in head cabbage (Brassica oleracea L. capitata), it was observed that vermicompost provided a significant increase in yield, vitamin C and sugar content compared to the control group (Nurhidayati et al., 2016).

A study was conducted to investigate the effect of vermicompost on the yield and soil of the spinach plant, in which doses of 0, 1, 2, 3, 4, 5 tons were given. As a result of this study, it was concluded that the yield and plant height increased with the dose of vermicompost, and the increase was statistically significant. In addition, it was stated that increasing amounts of vermicompost increased the number of leaves, but it was not statistically significant (Müftüoğlu, 2016). (Maltaş et al., 2017) in open field conditions vermicompost red the effect of the head cabbage plant on yield and quality parameters was investigated. Among the doses applied, 400 kg/da dose was found to be the most appropriate dose in red head cabbage cultivation.

The effect of different doses of vermicompost 0, 250, 500, 750, 1000 kg applied per decare on yield and quality of chard was investigated by a research group. In this study, it was determined that 1000 kg vermicompost application provided the highest plant fresh weight and number of leaves, and 750 kg application provided the widest leaf width (Aksu et al., 2017).

In a trial conducted under field conditions, different doses of chemical fertilizer and vermicompost were applied in the cultivation of red head cabbage (Brassica oleracea var. capitata f. rubra). According to the findings, it was determined that the application of vermicompost in increasing doses positively affected the yield, quality parameters and mineral nutrition values of cabbage, and it provided an increase of approximately 50% in yield and quality compared to the control group. In addition to chemical fertilization, a dose of 400 kg/da vermicompost has been suggested to producers in terms of economy (Maltaş et al., 2017).

In a trial conducted under field conditions, different doses of chemical fertilizer and vermicompost were applied in the cultivation of red head cabbage (Brassica oleracea var. capitata f. rubra). According to the findings, it was determined that the application of vermicompost in increasing doses positively affected the yield, quality parameters and mineral nutrition values of cabbage, and it provided an increase of approximately 50% in yield and quality compared to the control group. In addition to chemical fertilization, a dose of 400 kg/da vermicompost has been suggested to producers in terms of economy (Maltaş et al., 2017).

Five different doses of vermicompost (0, 250, 500, 750 and 1000 kg/da) were applied to chard (Beta vulgaris L. var. cicla) plant grown under greenhouse conditions by a group of researchers. According to the data obtained, it was observed that vermicompost positively affected plant growth parameters and it was stated that it could be an alternative to chemical fertilizers in terms of sustainability (Köksal et al., 2017).

In a trial study, a pea plant (Pisum sativum cv. Bonneville) was treated with vermicompost-HARV with 85% high humic acid content, a recommended dose of chemical fertilizer (NPK), and a vermicompost containing approximately 40% humic acid. Soil microbial structure was investigated by using DGGE (Denature Gradient Gel Electrophoresis) and PCR in soil samples taken at 0, 12, 30 and 60 days. As a result of the findings, it was seen that the bacterial and fungal diversity and rate of the vermicompost group containing high humic acid was the highest, and the microbial presence was lower in the samples with chemical fertilizer application compared to the control group. In addition, it was determined that organic fertilization increased the number of nodules and AMF amounts in the roots, and vermicompost with high humic acid content improved plant growth and soil structure (Maji et al., 2017).

In an experiment, organic cocktail tomato variety grown under greenhouse conditions was tested in negative and positive control groups. In this experiment, green parts and fruit yield characteristics were investigated. In the study, molasses-based liquid organic fertilizer (N 7%, P 7%, K 7%), synthetic fertilizer (N 10%, P 8%, K 5%), liquid vermicompost (N 1%, organic matter 5%, humic fertilizer) and fulvic acid (10%) were applied. Liquid organic fertilizer was applied twice during the seedling planting and flowering stages with mycorrhiza. As a result of the findings, no significant statistical difference was observed in fertilizer applications, but the highest tomato yield was with liquid organic fertilizer and vermicompost given with mycorrhiza obtained (Ulusu and Yavuzaslanoğlu, 2017).

In another study on cucumber, the effect of increasing doses of vermicompost such as 0%, 3%, 5%, and 7% on heavy metal concentration in cucumber was investigated. According to the results obtained, it was determined that increasing vermicompost doses caused a decrease in heavy metal concentration (Adiloğlu et al., 2018)

Kumar and Gupta, (2018) conducted a study on the effect of vermicompost and chemical fertilizer on the yield and quality of radish plants. The highest plant height, dry matter, tuber weight, root length were obtained from vermicompost application. It was determined that the yield increased more in vermicompost application compared to the control group. Vermicompost increases the organic matter content of the soil, allows the soil to breathe, increases the water holding capacity and facilitates the uptake of plant nutrients, as well as positively affects the yield in such factors. At the same time, since root development is one of the factors affecting yield, vermicompost increases soil porosity, spreads more easily on the roots, and root development is more, which leads to an increase in yield (Jackson, 1967).

In a study conducted by 2 scientists in Australia, vermicompost obtained from grape waste was used as fertilizer at the bottom of the same vine plants, and a 20-50% yield increase was achieved in the first harvest of the plants using vermicompost (Yağmur and Eşiyok, 2019). In the comparison of vermicompost and chemical fertilizers, the studies showed that although the effectiveness of the fertilizer disappeared after 1 month in the area where chemical fertilizers were used, the effectiveness of the vermicompost continued (Alam et al., 2007). It fights harmful bacteria in the soil (Demir et al., 2010). Vermicompost significantly improves the physical, chemical and biological properties of the soil as well as plant nutrition (Edwards & Bohlen, 1995). According to the research results of Rivasol, it is recommended to reduce the use of chemical fertilizers by up to 30%, provided that Liquid Vermicompost is used together (Rivasol, 2021).

CONCLUSIONS

Since vermicompost is included in the organic fertilizers group, is produced naturally and does not leave waste in the soil, it attracts the attention of many producers, institutions and organizations interested in sustainable and organic agriculture around the world.
Some features and benefits of worms and vermicompost can be listed as follows.

- Increases plant resistance and accelerates its development, providing early harvest. It provides about 15-20 days of earliness in approximately harvest.
- With its granular structure, it regulates the soil structure, increases the water holding capacity, and provides aeration of the soil.

• It makes the soil more productive by allowing the nitrogen in the air to be easily taken up by the plants and improved by the nitrogen fixing bacteria, thanks to the nitrogen fixing bacteria.
• It improves the soil and increases its productivity by giving mobility to the soil structure.
• As it facilitates the uptake of plant nutrients present in the soil that cannot be taken by plants, it increases the solid matter ratio of the products and ensures that they are of high quality.
• It contains substances such as enzymes, amino acids, growth hormones and vitamins in the fertilizer as a result of mixing with the excrement of the worm secretion and provides profitability by increasing the yield at a high rate.
• It does not contain weed seeds and it is more economical as the use of pesticides and fungicides in the products is reduced.
• It reduces fertilizer costs as it limits the use of chemical fertilizers.
• It reduces plant stress due to pesticide use.
• It increases the germination rate of seeds and prevents plant losses as it ensures healthy growth and becomes more profitable by increasing yield.
• Regulates the pH of the soil.
• It creates resistance against plant diseases and protects plants from frost thanks to the body fluids (coelom liquid) that worms pass into manure.
Due to the above benefits, the use of vermicompost in agricultural production is economically beneficial. According to the results, the use of vermicompost by farmers reduces production costs and increases profitability.

ACKNOWLEDGMENT

We would like to thank the reviewers, editors and all scientists who contributed to the processing of the article.

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