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Some Evaluations about Use of Vermicompost in Agricultural Activity of Thrace Region, Turkey: A Review

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Abstract

Turkey is located in Asian and European continents (Eurasia) and the country's population is nearly 81 million. Thrace Region which exists in European part of Turkey has a very important agricultural potential. Thrace, gateway of Turkey to Europe, also has an important position with its agricultural potential. Therefore, it is of strategic importance. Sunflower, rice, sugar beet and wheat are the major crops grown in the region. The main sources of income of people in Tekirdag, Kırklareli and Edirne provinces are coming from agriculture. In this region, livestock activities also increase day by day and a lot of waste comes out. Vermicomposting is an environmentally-friendly process used to animal and/or vegetal organic waste. The resulting vermicompost has been shown to have many positive effects on soil quality and plant growth. However, many important benefits of vermicompost on soil-plant systems are not yet fully understood. A case study is presented in which the beneficial effects of vermicompost on soil quality and plant growth are evaluated according to previous researches in the Thrace Region, Turkey. The use of vermicompost is important for the sustainability of agriculture. The structure of agriculture and fertilization, related to Thrace Region, is evaluated in this paper. The aim of the paper is to review recent developments, approaches and examples for use of vermicompost in the agricultural activity of Thrace Region, Turkey. The results can be used to manage next year growing strategies such as low chemical fertilizer and other agricultural input requirements.

Keywords: Vermicompost; Soil quality; Plant growth; Thrace Region

Introduction

The vermicompost expression is a word which is used for the final product (humus-like material) of composting procedure of organic waste materials by soil worms. Many organic wastes have been converted into worm manure (vermicompost) by different species of earthworms which include cow manure, horse waste, olive leaves, paper waste, sheep-goat manure, ground rice waste, tea-coffee wastes [1]. Vermicomposting process employing earthworms is increasingly being used for conversion of both municipal and industrial wastes to vermicast with reduced metals content [2]. Vermicompost is described as a perfect soil amendment and more eco-friendly as compared to chemical fertilizers. Vermicompost has been proved as potential technology for converting different organic waste into vauble organic fertilizer in Thrace region in 3 years.

Vermicomposting is an aerobic, bioxidation, stabilization non-thermophilic process [3] that depends on epigeic earthworms to greater effects on soil microbial biomass, and promote soil productivity [4].

Several authors have noted the importance of earthworms in affecting populations of soil organisms and increase organic matter in the soil [5-8].

Most of the references discussed above concern the positive effect of vermicompost on the biodiversity of soil organisms, especially in relation to agricultural production and also soil quality [9-11]. To avoid low yield values in agricultural production and to contribute to the improvement of intensive farming soil, coexistence of chemicals and vermicomposts in fertilization programs will lead to more beneficial results [12]. Baran and Gokdogan [13] reported, organic fertilizers can be used conveniently in crop production, in place of chemical fertilizers, which make up an important part of the inputs in Thrace Region.

General waste management strategies for organic residues, such as composting and vermicomposting, have been implemented in some developed and developing countries to solve the problem of organic wastes [14]. The rapid increase in population accompanied with global economic growth is leading to huge generation of both municipal and industrial wastes [2].

Thrace Region takes part in the north western Turkey which is most important area for Turkish agricultural production and consists of Kırklareli, Tekirdag, Edirne and the European parts of Canakkale and Istanbul cities. Population is increasing day by day in the Thrace Region. In two years, 41000 people have increased. This increase means that domestic waste also increases. On the other hand many cow farms were established in the region in recent years. The wastes of these farms continue to be a big problem. So, the inappropriate disposal of the generated wastes causes serious environmental problems. Because of these reasons, the assessment of wastes is extremely important for the Thrace Region. In recent years, the rapid increase of organic residues has also become a major problem in Turkey. It is necessary to explore effective waste disposal and management strategies. The best way for the sustainable management of wastes is recycling in the region. A biological treatment method such as vermicomposting is the best solution for Thrace Region. For this purpose, many vermicompost production facilities were established in the region. The largest scale of these facilities is operating in the province of Tekirdag in Thrace Region.

There are many research works the effects of a short term vermicompost application on crop production. The longer term effects of vermicompost application need to be assessed, especially in terms of nutrient leaching potential in the agricultural soil of the region.

Over the past five years, a comprehensive research program on vermicomposting has been developed at the Namık Kemal University. This has included experiments investigating the effects of vermicompost on the growth, flowering, fruiting of vegetable and, germination of various seeds, as well as on a wide range of field crops such as wheat, barley, sunflower, canola, sugar beet, rice, corn and clover.

In Turkey, I have developed common fertilizer recommendations for the major crops, vegetables and also fruits. Fertilization programmes usually consisted of chemical fertilizers. I found that some changes and compromises were necessary. This is our first attempt at developing fertilizer recommendations for all cultivated plants. More work is needed on other landscape plants and has already begun. I look forward to the continued development of these recommendations and am confident that they will be of great value to many farmers, academician, consultants and agribusiness associates in Turkey. New fertilization programmes also involve the use of vermicompost. Moreover, vermicompost has become a basic fertilizer in soil where organic agriculture is being conducted.

Thus, the aim of the present study includes evaluation of vermicompost use in the agricultural activities in Thrace Region, Turkey. This study will contribute in better understanding the interaction between soil quality-plant growth and vermicompost and may have important contributions in the large-scale evaluations of organic wastes through vermicomposting system.

Vermicomposting and Vermicompost Properties

Increases in the human population, industrialization and agricultural practices have led to an increased accumulation of wastes. Industry of domestic animals production, mostly dairies have led to produce in large measure organic wastes in the region. Cow manure and vegetal wastes are the most widely used as bed ingredients in closed system for production vermicompost in the region. In Thrace Region, both *E. fetida* and *E. andrei* have been proven to withstand climatic conditions. *E. fetida* and *E. andrei* are thermos-tolerant and so particularly useful. This makes them the best choice for outdoor vermicomposting [15]. Vermicomposting is the most important environment and eco-friendly technique which are primarily used to produce organic fertilizer from different kind wastes. In the region, different methods are used for worm propagation and vermicomposting. A number of academic reports are available on the vermicomposting of different wastes, but the studies on the application of vermicompost prepared from different wastes in fruit growing and field crops are few in the region [6,15,16]. According to Belliturk et al. [17] olive pruning wastes is a good resource for vermicomposting and earthworms (*E. fetida*) can eat to get their food needs. This study of the researchers was made in the province of Tekirdag and lasted for 6 months. Vermicompost and compost also protect plants from pests and diseases [18]. Academic studies on this subject have not yet begun in the region. There are more than 15 companies (small-medium-large sized) that produce vermicompost in Thrace Region. A number of reports are available on the vermicompost analysis results for solid and also liquid produced in these factories in Thrace Region. Some of the results of these analyses of solid vermicompost are shown in Table 1. Only one of the vermicompost producers in the region produces liquid and tea vermicompost. In addition, vermicompost production from olive pruning wastes realized with a project in Namık Kemal University by my research team.

Studies by Belliturk et al. [15] also found that NPK and organic matter values of solid vermicompost processed by *E. fetida* from the same feedstock (cow manure) significantly increases by 3 to 4 times. It also enhances several micronutrients such as available zinc (Table 2).

Contents	Mix food waste vermicompost	Pruning olive waste vermicompost	Cow manure vermicompost	Sheep manure vermicompost
N %	1,95	1,80	1,75	1,60
P %	2,75	0,23	1,29	0,45
K %	1,10	1,74	1,12	0,32
Zn mg kg^{-1}	354,00	545,00	427,00	405,00
Organic matter %	41,00	48,00	51,00	42,00

Table 1: Chemical compositions of different solid vermicomposts which is produced in Thrace Region (on averages in the region).

Vermicompost is a nutritive "organic fertilizer" rich in NPK (nitrogen 160-300%; phosphorus 105-265% and potassium 140-190%), micronutrients and plant growth hormones. Kale and Bano [19] reports as high as 7.37% N and 19.58 P as P_2O_5 in worm's vermicast.

There are two methods for vermicomposting in the region but one of them is very common. Continuous flow automated vermicomposting reactor system are widely using in the region. The earthworm populations in such reactors tend to reach an equilibrium biomass of about 2 to 9 kg/m^2. Such reactors can fully process the whole 60 cm depth of suitable organic wastes they contain about 3-4 months. New studies have shown that such reactors have a much greater economic potential to produce quality plant growth media with few losses and much more efficiently than do windrows or ground beds in Thrace Region conditions. The use of automated continuous flow reactor system is increasing in the region (Figure 1). The system designed and developed by Riverm Company in Tekirdag province. A number of relatively expensive systems based on this system have been marketed, but are less attractive economically. On the other hand, one of the productions of vermicompost is heat treatment application with special devices (Figure 2). Heat treatment application is used initially to prepare worm feed. This machine is developed by Riverm Company

in Tekirdag province. This process is legally required for vermicompost sanitation.

Nutrients	Cow manure compost	Vermicompost
N %	0,30-1,40	1,60-3,00
P %	0,25-0,95	1,05-2,65
K %	0,30-1,00	1,40-1,90
pH	6,50-7,05	6,80-7,89
Organic matter %	22,00-46,00	55,00-69,00

Table 2: Organic matter and NPK values of vermicompost compared with conventional cow manure compost made from cow manure.

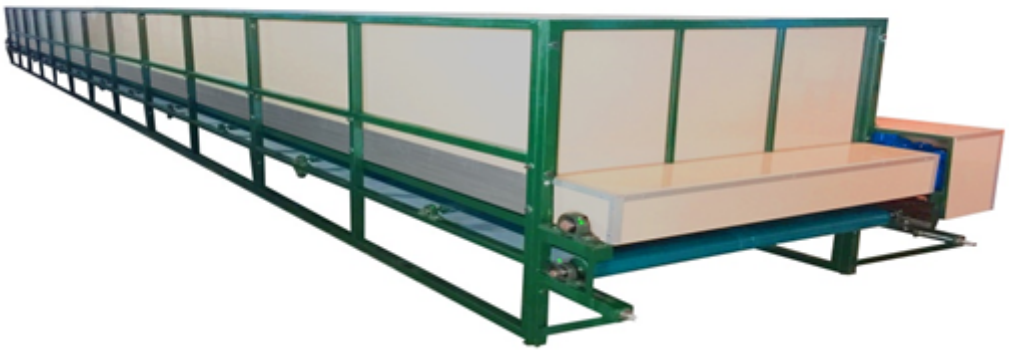

Figure 1: Automated continuous flow reactor system (RHS).

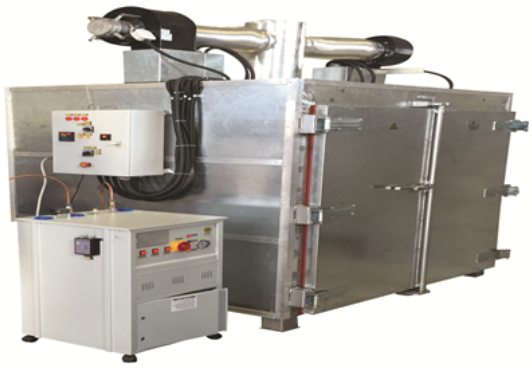

Figure 2: Heat treatment machine developed by Riverm Company.

Vermicomposting can be considered an innovative type of biotechnology that does not call for expensive laboratories or sophisticated industrial equipment. Moreover, vermicomposting is a biological and useful treatment in agricultural activities [20,21].

The Use of Vermicompost in Sustainable Agriculture

Agricultural sustainability is important for the future of the national economy. Today also, increasing human concern about food shortage, over population, environmental safety and soil conservation has led to an important increase in the use of sustainable agricultural practices. Vermicompost is a very valuable resource as an organic fertilizer because it provides macro- and micronutrients for plants and is a low-cost, sanitary, environmentally-friendly, invaluable alternative to chemical fertilizers.

According Adiloglu et al. [22], the use of organic fertilizers in order to meet the nutrient element needs of the plants have been increasing recently. The excessive use of chemical fertilizers has caused the deformation of the nutrient balances of the soils, and has seriously threatened human health by producing unhealthy products. Excessive use of chemical fertilizers can have adverse effects to the environment. Therefore, have look to find ways to reduce the use of over/wrong chemical fertilizers. The use of organic fertilizers is one of the solutions for sustainable agricultural productivity [23]. Heavy metal pollution in soil is one of the hardest removable pollution among the pollutions occurring in soil [24]. Earthworms have the potential to reduce the retention of pollutant and plant essential metals in the organic horizons by decomposing organic matter. Earthworms bioaccumulated

Cu, Cd, Mg and Zn and had potentially hazardous tissue concentrations of Pb and Al elements [25].

Effect of Vermicompost as Soil Conditioner

Vermicompost contains highly enriched nutrients, especially nitrogen, which gradually makes them available to plants [26]. Vermicompost application and also earthworms are promoting the retention of nitrogen and gradual release of P, as well as a reduction in electrical conductivity, thereby producing improved substrates for agricultural use [27]. The plant nutrients such as total nitrogen, available phosphorus, potassium, magnesisum, calcium, zinc, etc. are present in vermicompost that are taken up by all type plants [1,28]. Vermicompost can be useful to apply in enhancing soil chemical, physical, biological and fertility. Considerably, vermicompost works as a "soil conditioner" and its continued application over the years lead to total improvement in the quality of agricultural soil, even the degraded Thrace Region soils. Experiments conducted in Kırklareli at Ziya Organic Farm of Kırklareli province to reclaim "low fertile soil" gave very good results. Application of vermicompost 3 tons/ha resulted in increase of 1,5% organic matter leading to significant improvement in soil quality. In this study was compared with leonardite. The yield of sunflower increased by 80 kg/ha according to the applied area of leonardite. This work has not been published yet. According to Arancon et al. [20], vermicompost usually contain more mineral elements than commercially available soil-less plant growth media. Many of these elements are changed into forms that can be taken up more readily by the plants such as N, P, K, Ca and Mg [3]. The seasonal droughts have had a great effect on water resources and thus on the agricultural sector in Turkey. The economy of the country is dependent on agriculture, making it the largest user of water. Therefore, the greatest pressure is on the agricultural sector in the sharing and efficient use of water resources [29]. It is recommended by researchers to use vermicompost for the solution during such drought periods [1,30]. The application of vermicompost and water treatment residuals to improve the physical properties in the salt affected soils is a promising technology to meet the requirements of plant growth and cost-effective reclamation [31]. Vermicompost increases water retention capacity in agricultural soils.

Effect of Vermicompost on Plant Growth

Vermicompost application causes early germination in many plant seeds. Belliturk et al. [32] described that curly lettuce seeds germinated earlier than other organic fertilizers with vermicompost application in the pots. This may be due to the higher nutrient availability of vermicompost earlier in the application process. Zahmacıoglu et al. examined the irrigation and fertilizer requirements of broccoli (*Brassica oleracea L.*) in Tekirdag province. They have reported that fertilizer activity increased with irrigation practices, chemical fertilizer applications contributed to yield; also, vermicompost applications have been seen to contribute to soil in respect of leaf and soil nutrients. Several studies have reported the positive effects of vermicompost on growth, yield and quality of field-vegetable crops parameters in the region [33-35]. The application of vermicompost significantly increased the content of Mg in onion and garlic plants and this study set up in greenhouse conditions in Tekirdag province [33]. The result of use of vermicompost is in close agreement with the findings of Patil et al. [36]. Eker [34] has reported that vermicompost has positive effects on the quality of ornamental plants. It is recommended that additional studies should be conducted under field and greenhouse conditions with variations in soil type and environmental conditions on different crops, vegetables and includes data on production yield. Vadiraj et al. [37] reported that application of vermicompost produced herbage yields of coriander cultivars that were comparable to those obtained with chemical fertilizers. Similarly, a positive response was obtained with the application of vermicompost to other field crops such as sorghum (*Sorghum bicolor*) [38].

Effect of Vermicompost on Soil Microbiological Properties

Composting and vermicomposting are two of the best-known processes for the biological stabilization of solid organic wastes [39]. Vermicompost not only increase the soil fertility through the addition of plant growth hormones and increased levels of soil enzymes [40]. Vermicomposts also have been reported to contain biologically active substrates such as plant growth regulators in Thrace Region soils [41,42]. Soil organic matter is an important source of nutrients and can help increase microbial activity in the soil. Organic amendments including vermicompost can foster beneficial microorganisms, which in turn facilitate soil enzymatic activities [6,43,44]. Vermicomposts are rich in microbial activity and contains antagonistic organisms to control plant pathogens; therefore it is an effective and important biocontrol agent [45]. Soil organisms and earthworms are organisms that help to the nature in maintaining nutrient flow from one system to another and minimize environmental degradation. Earthworms are natural bioreactor in the ecosystem [46].

Conclusions

The principal advantage claimed for vermicomposting process is the low capital cost involved to convert various wastes into valuable community resources and also environmentally-friendly material. Concluded that increase in growth, yield and quality of culture and landscape (vegetable-field crops etc.) and landscape plants with addition of solid-liquid vermicompost as compared to using chemical fertilizers. Addition of these vermicompost into agricultural crop field with N, P, K nutrients could be very effective response on the growth of plants. Such an option becomes more attractive, economically and environmentally in the region. Effects of vermicompost in farm are being studied in the region. More field trials with different crops need to be conducted in the future.

This work on vermicompost continues increasingly in the region. Regional farmers in Thrace region cannot solve their problems because of the lack of true information in terms of agriculture and production. Data available on organizations, industries and provinces using vermicompost but the treatment capacity is not known in the region. Agricultural extension should only be increased with correct academic information on vermicompost in the region. The result of the present study clearly showed that vermicompost can be used easily in agricultural and landscape areas of Thrace Region.

In summary, vermicomposting offers several benefits such as enhanced soil fertility and water holding capacity, nutrient supplying capacity of soil, thereby increased agricultural productivity, improved soil biodiversity, the development of resistance in plants to pests and diseases, and also reduced other ecological and environmental risks. The utilization of vermicompost results in several benefits to farmers, academics, industries, environment and overall national economy.

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Conflict of Interest

I disclose that I do not have any potential sources of conflict of interest with respect to this manuscript.

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