Potential Use of Olive Oil Solid Waste in Agriculture

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ABSTRACT

Olive (*olea europea*) orchards are dominant crops in Mediterranean countries. The main use of olive fruits is the extraction of olive oil. The remaining Olive oil solid waste (OSW) can be a good and available source for soil organic matter in Turkey. One method to use OSW in agricultural practices can be making compost. OSW and OSW compost were evaluated for agricultural use. Olive solid wastes were mixed with soil at the rates of 0, 3, 5 and 7% with and without additional nitrogen and phosphorous sources. Sunflower and corn plants were grown in the pots for two months. Additionally changes in soil physical and chemical properties were observed. Results showed that OSW compost can be used as and organic source for plant growth. This research was supported by TUBİTAK TOVAG project number 106O371.

Keywords: olive oil solid waste, compost, sunflower, corn, nitrogen, soil

INTRODUCTION

During the olive oil production large volumes of wastes are generated that vary in composition depending on which of the three olive oil production systems is used. Approximately volume of olive solid waste is about 50 to 60% of the olive fruit after oil processing. There are two centrifugation technologies during oil olive extraction, which are three-phase and two-phase systems. Three phase system generates oil, waste water and olive oil solid waste (OSW), while the two-phase system produces olive oil and a semisolid by-product called two-phase olive mill waste. Approximately 50-60% of olive by volume is solid waste. This waste or pomace must also be disposed of appropriately. It can be used as stock feed if it is dry and destoned, it can be used as a mulch or separated olive stone can be utilised as a fuel source (Anonymous, 2001). Application of raw olive oil solid waste (OSW) increased soil aggregate stability. Application of OSW at the rate of 8% has significantly increased soil total organic nitrogen contents. OSW applications at the rate of 8% (w/w) significantly increased both mean SOC content (3.5%) and aggregate stability (88%) after 2 months of incubation (Kavdir and Killi, 2008). Another possible use of olive oil solid waste is biosorption of pollutants. In this article possible use of OSW in agriculture will be discussed

Olive Oil Solid Waste Compost and Plant Growth

There are several researches in Mediterranean countries to evaluate effects of OSW compost on plants. Alberuque et al (2007) reported 'alperujo'' compost had no phytotoxicity, had considerable greater organic matter and lignin contents than the other two organic amendments tested. 'Alperujo'' compost which is a solid by-product of the two-phase centrifugation method also had a considerable content of potassium and organic nitrogen but was low in phosphorus and micronutrients. It can be used as an efficient organic amendment, for growing pepper.

In Greece Papafotiou et al. (2004) investigated the possibility of using olive-mill waste compost (OWC) in the production of ornamentals replacing part of the peat in the growing medium. They reported that OWC can replace up to 25% of the peat in a medium with perlite in the production practice of poinsettia. The quality of the plants produced in OSWC medium was as good as that of the control.

Ehaliotis et al., 2005 evaluated the potential of leaves and pomace derived from olive-oil mills to provide root-zone heating for organically grown cucumber plants via a composting process carried out under the plant rooting system during the cultivation period. The process resulted in over 10^{o}C increase in rhizosphere temperature lasted over 2 months without any phytotoxic effects to a variety of cucumber cultivars.

Peredes et al (2005) applied olive mill water (OMW) compost to soil which did not show phytotoxic effects on Swiss chard plants. Plants produced similar yields as those grown in compost without OMW and the inorganic fertilizer. Soil fertility increased with increasing OMW compost application rates. However, the higher dose of OMW compost (60 tonnes ha−1) application increased the soil salinity, and that could be the major concern regarding the use of OMW compost at high rates in soil.

Olive oil solid waste composts were made with different compositions to evaluate in the agriculture in Turkey (TUBİTAK TOVAG 106O371). Three different ratios of OSW were mixed with manure, alfalfa and straw to make compost under controlled conditions (Kavdir et al., 2007). One of the most important factor for successful compost making is C.N ratio (Poincelot, 1977) and C:N ratio must be 25:1-30:1 while C.N ratios between 20:1-40:1 is also acceptable (Rynk, 1992). Nitrogen contents of OSW showed 38.5% increment after composting where final N concentration of OSWC was 2%. On the other hand, carbon (C) content reduced 13.4% after composting and became 35.8%. As a result C:N ratio of OSWC decreased up to 54.2% compared to initial OSW' s C:N. The final mature compost had black color with sufficient amount of nutrients. In this research initial OSW's C:N ratio was 50 however it reduced up to 18:1 after composting (Figure 1)

Effect of uncomposted OSW on sunflower growth was evaluated by Kavdir et al. 2008. The results showed that direct application of OSW to soil inhibited plant growth. Plant height, sunflower leaf numbers and stem thickness were greater in control (soil with no OSW) treatments than other treatments in the last measurement date. Addition of inorganic sources such as N and P fertilizers did not improve negative effects of OSW. Similarly positive effects of OSWC on corn growth has been observed. Corn development was greater in compost added treatments compared to those in control and OSW treatments (Figure 2 and Tables 1 and 2).

OSW and OSW compost effects on tomatoes growth was evaluated by Killi (2008). Application of OSWC increased tomatoes growth, plant chlorophyll content in Sandy and Loamy soils. The best compost rate was %4 w/w. Compared to olive solid waste, OSWC increased plant length, dry and fresh weight significantly. OSW application significantly increased aggregate stability of Loam soils compared to control treatment. Increase of soil aggregate stability after addition of OSW compost was lower than those of OSW (Figure 3).

Killi (2008) evaluated OSW and OSW compost effects on physical properties of coarse textured soils (Sandy Loam and Loamy Sand). Compost application reduced soil bulk density, increased aeration capacity, field capacity, available water content, hydraulic conductivity. On the other hand OSW application increased soil aggregate stability.

CONCLUSION

Composting is a good alternative method for olive oil solid waste management around olive oil factories and farms. Despite the negative effects attributed to direct use of OSW, results of recent literatures and researches indicated that, applications of olive oil solid waste compost have generally positive effects on plant growth.

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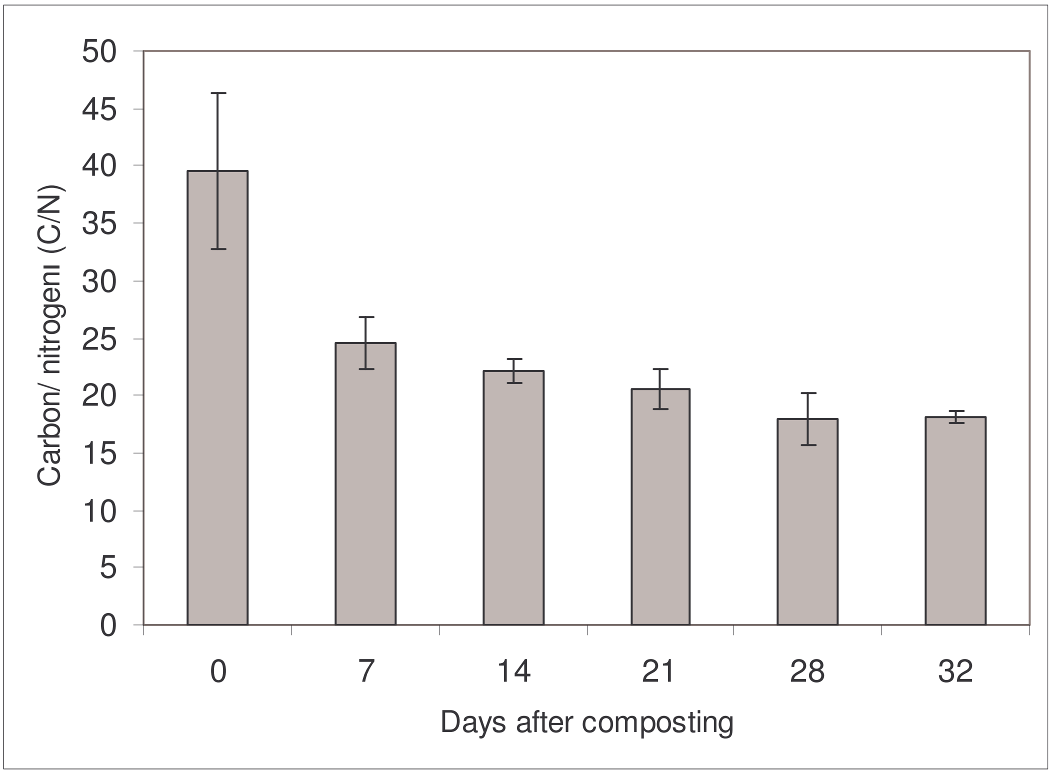

Fig. 1. Changes in carbon (C) and nitrogen (N) contents during OSW composting.

Fig.2. Corn plant development . 1: OSWC application 2: OSW application 3: Control (from left to right)

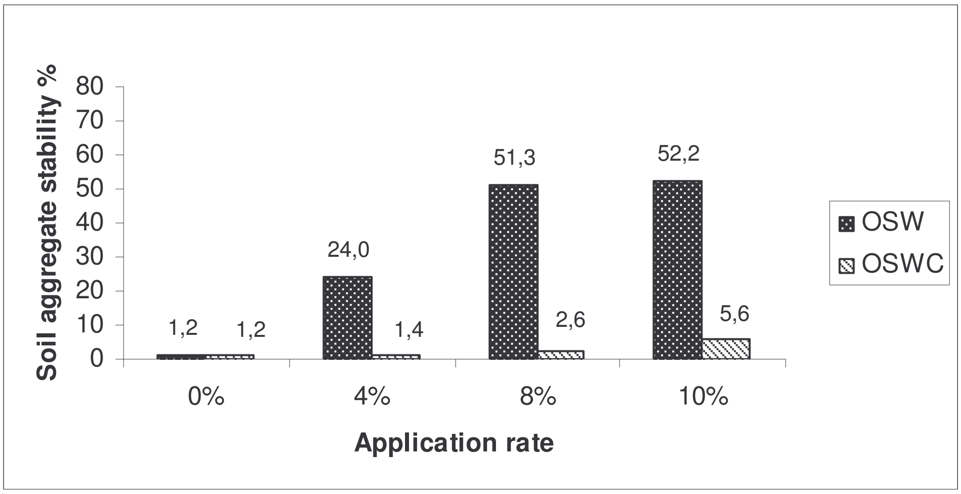

Fig.3. Effects of OSW and OSWC application on soil aggregate stability

Table 1 . Effects of OSWC application on corn development.

Treatments	Plant height (cm)	Stem thickness (cm)	Fresh weight (gr)	Dry weight (gr)	Leaf numbers
Control	40,10 ± 3,09	6,69 ± 0,43	5,87 ± 1,31	0,64 ± 0,14	6,00 ± 0,00
3% OSW Compost	56,28 ± 0,22	13,19 ± 0,19	25,45 ± 1,25	2,63 ± 0,11	7,50 ± 0,29
5% OSW Compost	56,88 ± 1,72	13,97 ± 0,33	25,22 ± 2,69	2,71 ± 0,26	7,75 ± 0,25
7% OSW Compost	53,30 ± 0,64	12,88 ± 0,47	23,52 ± 2,74	2,49 ± 0,32	7,25 ± 0,25

Table 2 . Effects of OSW application on corn development.

Treatments	Plant height (cm)	Stem thickness (cm)	Fresh weight (gr)	Dry weight (gr)	Leaf numbers
Control	40,10 ± 3,09	6,69 ± 0,43	5,87 ± 1,31	0,64 ± 0,14	6,00 ± 0,00
3% OSW	33,33 ± 4,02	5,36 ± 0,47	3,26 ± 0,85	0,34 ± 0,09	5,25 ± 0,25
5% OSW	38,56 ± 1,50	5,17 ± 0,40	3,37 ± 0,59	0,34 ± 0,06	5,75 ± 0,25
7% OSW	32,75 ± 3,07	5,06 ± 0,33	2,57 ± 0,42	0,27 ± 0,04	5,25 ± 0,25

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