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Topic	Soil Science and plant nutrition

Temporal effects of organic and conventional farming systems on the chemical properties of vineyard

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Abstract
In this study, It is aim to compare the effects of chemical properties in organic and conventional vineyard farming system for 9 year long between 2000-2009.in Manisa,Salihli, in Aegean Region. The study was carried out in 5 replicates completely randomized design According to soil analysis results, certified fertilizer and green manure and ground pruned branches were applied as plant nutrition material in organic plots. On the other hand, 21% ammonium sulphate, 26% ammonium nitrate, 43% triple super phosphate as P2O5 and 48-52% potassium sulphate as K2O were applied in conventional plots. According to soil analysis results, there were no changes in saturation, salinity and lime values in both farming system. In conventional plots, phosphorus level increased whereas pH level decreaed, suggesting that organic management practices may improve soil properties and sustainability.

Keywords: Organic vineyard, conventional vineyard, soil chemical properties, Aegean Region

Introduction:

Rapid population growth and unconscious and uncontrolled development in industry have brought many problems about human and environmental health. One of the most important problems is widespread use of chemicals to increase production in agriculture. These practices increase agricultural productivity however it also poses a serious threat to human health due to chemical residues of pesticides on crops and chemical leakage of excessive synthetic fertilizers to ground waters. Because of these problems, especially developed countries with high income levels, people with better incomes and conscious consumers have started to demand and prefer products which do not interfere with the natural balance and cause any toxic effects on humans and other living beings (Altındisli 2004(a)Ateş et al.2007, Erdal et al. 2013) . Due to these negative consequences caused by conventional agriculture, many countries, especially countries with high income levels, have become more and more aware and preferred organic agriculture (a.k.a. ecological agriculture or biological agriculture in some countries), an environment friendly and alternative agricultural system.

In Turkey, organic agriculture started in the mid of 1980s as a result of the demand of European importers and was concentrated primarily in the Aegean Region. Raisins (sultanas), apricots and figs are the first products produced by organic farming. Turkey has produced and exported organic raisins since 1986 and is the world leader in organic raisin production. Raisin exports from Turkey have largely increased over the years (Erdal et 2014)

While in the world, 311595 hectares of organic grapes are grown constituting 4.6 percent of the world's grape growing area, In Turkey, 8418 hectares grape are grown organically which constitutes 1.8 % of the total grape production area (Anonymous, 2016).

Organic vineyard was first initiated in İzmir and Manisa region in Turkey (Altındişli, 2000). Although it's been more than 20 years since organic agriculture was first initiated in this crop which has great importance on Turkey's export, it is known that some problems, especially related to plant nutrition has not been solved yet. There have been losses both in yield and quality due to some certain reasons such as unconscious mistake made by the farmers or insufficient research results conducted on this matter (Altındişli et al.)

In organic agriculture the basis of improving the soil and fertilizing it is to increase the organic matter of the soil (Anaç and Okur 1996). The more microbial activity increases, the more nutrition usefulness there is. Conserving soil physical and chemical structure is also a factor increasing fertility (Kacar, 1986). Within the scope of all this knowledge, two different agriculture systems, conventional and organic agriculture were compared in this 9 year project. Differences were determined by analyzing the soil properties.

Materials and Method:

The experiment was carried out in the Gediz Basin (Manisa-Salihli), in the Aegean Region of Turkey . The experiment was conducted in 5 replicates with a completely randomized design over a period of 9 years between 2000 and 2008. As a plant material , Sultanas was used as raisin cultivar Each replicate consisted of three sub-plots. Soil samples were taken at the depths of 0-20 and 20-40 cm. According to soil analysis results, certified fertilizer (7: 3: 3) and green manure (*Vicia villosa* L.) and vineyard pruning waste were applied as plant nutrition material in organic plots On the other hand, 21% ammonium sulphate, 26% ammonium nitrate, 43% triple super phosphate and 48-52% potassium sulphate were applied in conventional plots. Certified products and traps permitted in the related regulations, Bacillious thuringiencis, bordeaux mixture, copper preparations, sulphur were used in the organic plots for disease and pest control. In the conventional system, synthetic pesticides were used as plant protection material against pest and disease in the plots.

Results and Discussion:

Saturation (%): Saturation percentage of soils depends on their organic and inorganic colloids. That's to say, it is related to organic matter and clay fraction amount and type. During the study there has not been a significant change in saturation percentage (Table 1). It is expected that the saturation level may increase due to organic matter (green manure, pruning waste) added in organic agricultural practices. However, there has not been a significant increase; this can be caused by the fast mineralization and depletion of the organic matter within the soil. Warm climate and irrigation are also considered to improve mineralization conditions.

Table 1. Saturation amount in soil samples taken within 0-20 cm and 20-40 cm depth by years (%)

	Depth (cm)	2000	2001	2002	2003	2004	2005	2006	2007	2008
Conventional	0-20	38,6	38,6	34,6	38,8	40,6	37,4	37,6	36,6	36,6
Organic		38,6	38,6	35,6	38,6	40,2	37,0	37,8	36,4	36,4
Conventional	20-40	39,0	39,0	35,4	38,8	37,8	38,0	38,4	38,0	38,0
Organic		38,0	38,0	36,0	39,0	38,0	37,0	38,0	37,2	37,2

Total soluble salt (%): Initially there was a trace amount of salt however, later it increased enough to be analyzed. The area was easily washed off of salt due to its loamy texture with a sand fraction more than 50%. But through the last years of the study, during the drought, due to low precipitation and salinity caused by irrigation water, salt accumulation is possible. When the salinity is higher than 150 mg per 100 g soil (0,15%) it can hinder plant growth. (Altınbaş et. 2004, Güçdemir 2006). But salinity was not above hazardous level in here. (Figure 1 and 2)

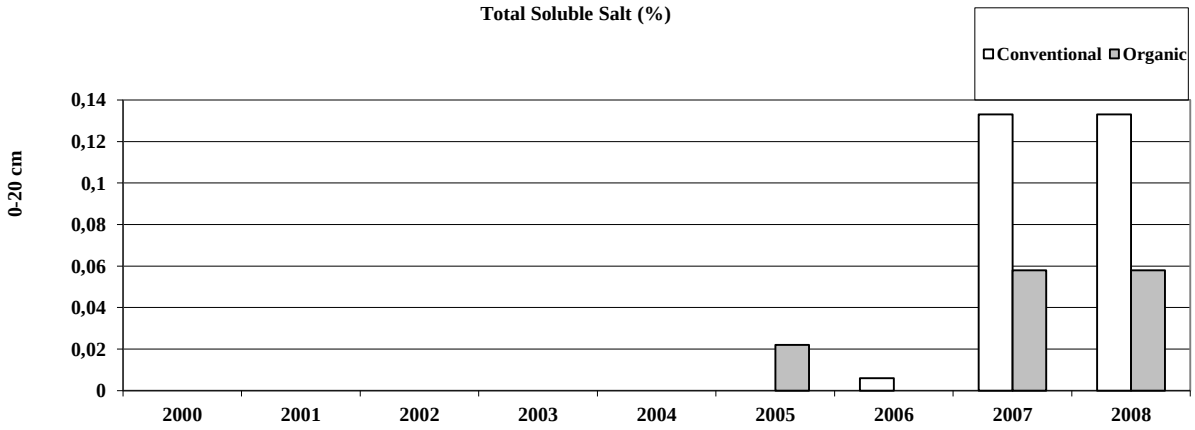

Figure 1. Total soluble salt amount in soil samples taken within 0-20 cm depth by years (%)

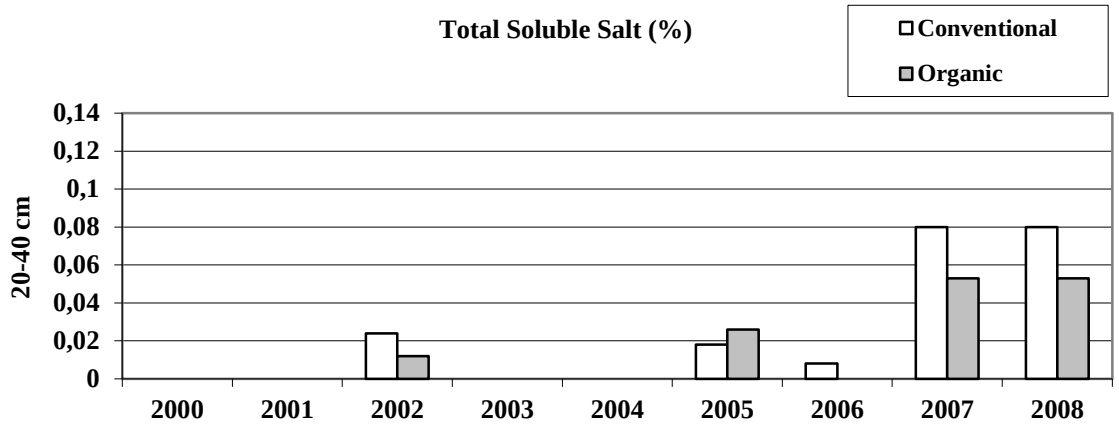

Figure 2. Total soluble salt amount in soil samples taken within 20-40 cm depth by years (%)

pH:pH level decreases in the upper part of the soil in conventional agricultural practices while it tends to conserve its level in organic agriculture. Despite the same irrigation and Sulphur applications, it is considered that pH level stays the same due to the buffer effect of the organic matter. It is known that soil organic matter has a high adsorption level and thanks to that it can adsorb alkaline (Na, K, etc.) and alkaline-earth elements (Ca, Mg, etc.), buffer and manage sudden pH level changes (Altınbaş et, 2004, Renenold 1998). However, in conventional agriculture practices, it is again considered that pH level decreases due to ammonium sulfate fertilizer. In the lower parts of the soil there isn't a significant pH level decrease (Figure 3 and 4).

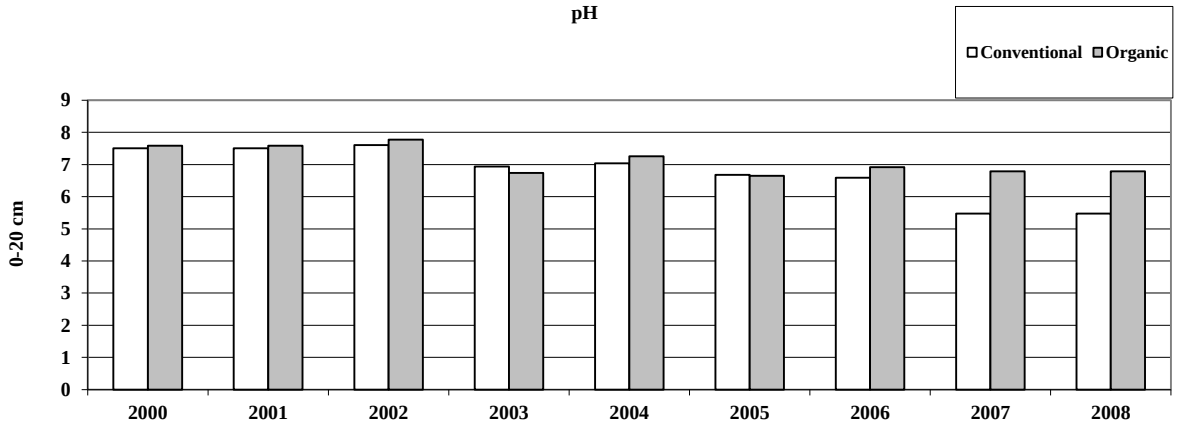

Figure 3 pH levels in Soil Samples taken within 0-20 cm depth by years

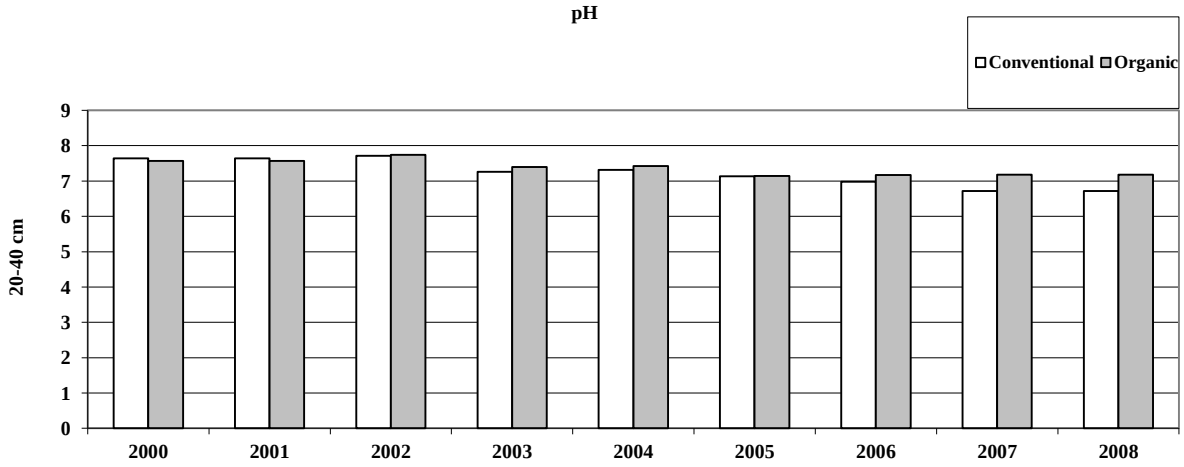

Figure 4. pH levels in soil samples taken within 20-40 cm depth by years

Lime (%): There was a trace amount of lime in study area, it didn't have a significant effect on agricultural practices.

Avaliable Phosphorus (P_2O_5 kg ha^{-1}) : In conventional agriculture, phosphorus tends to increase in both depth levels. It is possible that it increased due to limited mobility of the phosphorus in the soil and also the fact that phosphorus mineral fertilizers could not be completely uptaken by the plants. It is known that 60-90 kg of P_2O_5 per hectare is sufficient (Kacar, 1972, , Güçdemir 2006). Taken into account, it is understood that conventional agriculture parcels didn't have any problem in this matter. During the last for years of the study organic agriculture parcels also didn't have any problem regarding phosphorus. While conventional agriculture parcels also didn't have any problem in the lower parts of the soil, there was deficiency in organic agriculture practices (Figure 5 and 6).

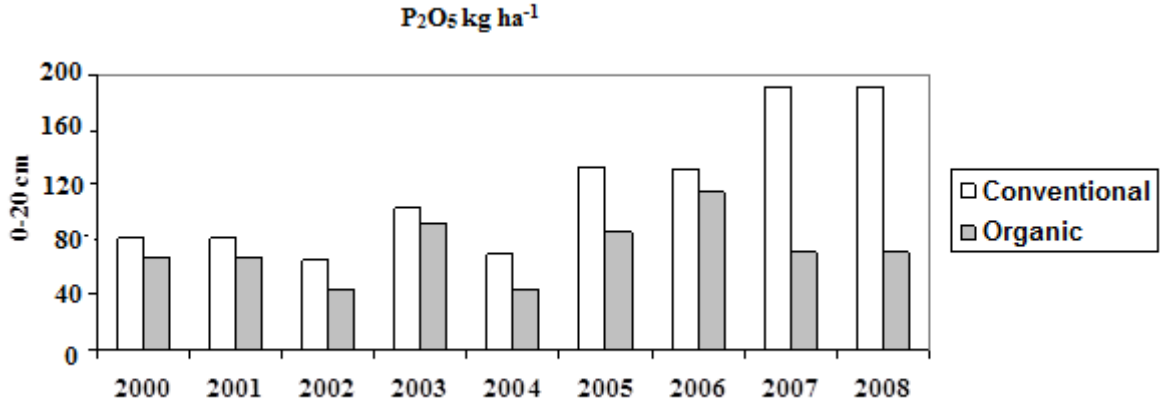

Figure 5. P_2O_5 levels in Soil Samples taken within 0-20 cm depth by years (kg ha^{-1})

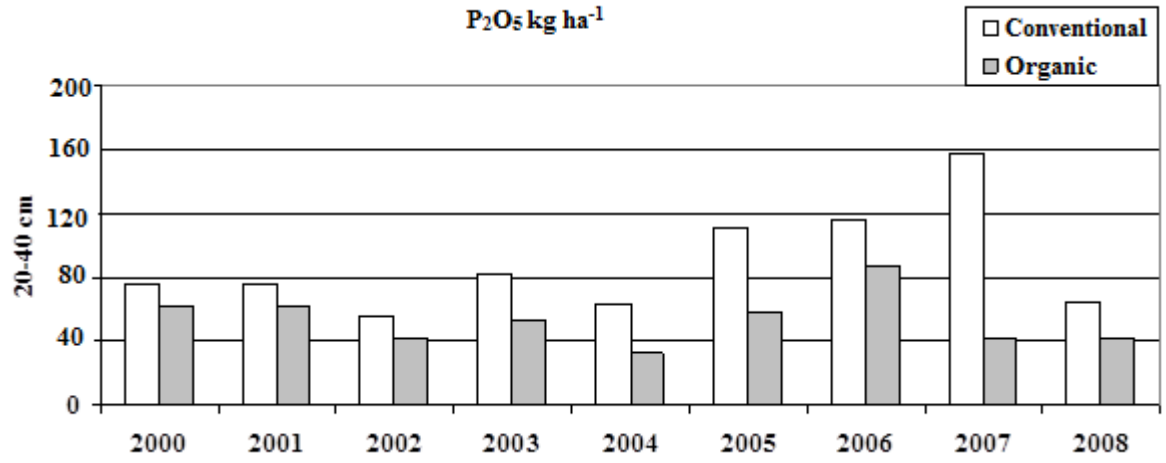

Figure 6. P_2O_5 levels in Soil Samples taken within 20-40 cm depth by years (kg ha-1)

Avaliable Potassium (K_2O kg/da): As seen in the Figure 7 and 8 uptakeable potassium seems sufficient in both depth levels and practices. In the upcoming years of the study, potassium level increased in both agricultural systems. Considering 300 – 400 kg of K_2O is sufficient per hectare (Kacar, 1972) there seems to be no potassium deficiency (Figure 7 and 8).

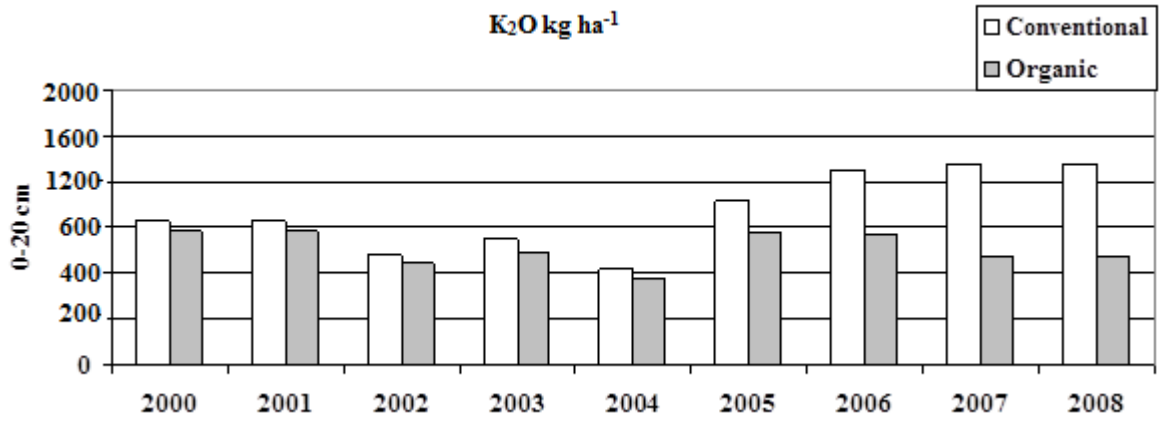

Figure 7. K_2O levels in Soil Samples taken within 0-20 cm depth by years (kg ha-1)

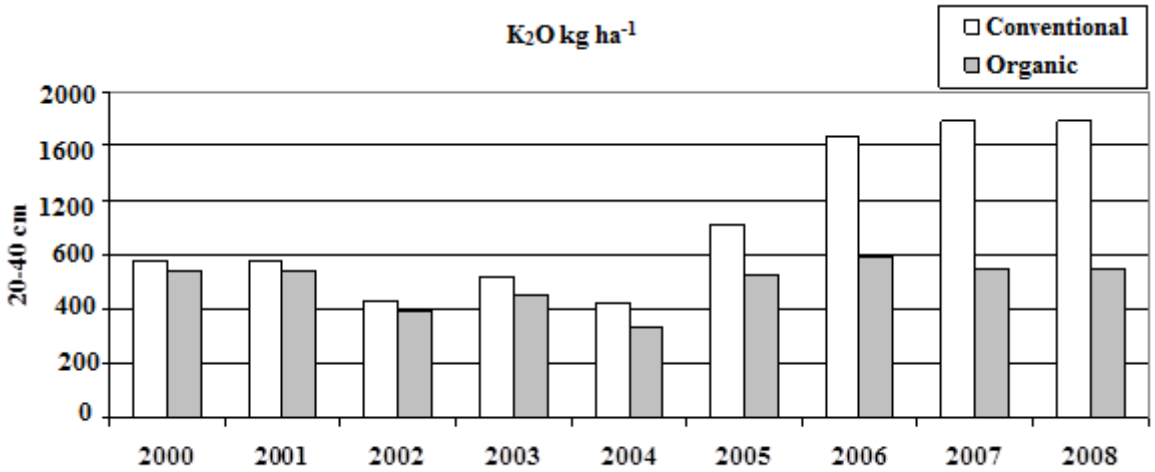

Figure 8. K_2O levels in Soil Samples taken within 20-40 cm depth by years (kg ha-1)

Conclusion:

According to analysis results, evaluating these 9 years it is seen that saturation and lime levels have not changed significantly. Plant growth is closely related to soil hydraulic conductivity, water retention capacity, aeration conditions, plant nutrition availability and microorganism activity. Organic and inorganic colloids, sesquioxide and lime are some of the most important elements in soil structure formation. Climate conditions and agricultural practices are important factors in their soil activity. It is a rather long process to determine a positive change in soil for plant cultivation. However, this parameter has not shown a significant difference in both systems although the study took 9 years it may still be not long enough (Güçdemir,2006).

Salinity, however has increased a little, is on a minimal level. In conventional agriculture parcels. It is also expected for lime not to change both in organic and conventional parcels as the project area is not subject to erosion and washing off (excessive rain). In the initial years of the project, there was not a significant change in total soluble salt. But ratio increase in the last two years poses a limiting factor in plant cultivation. This increase can be caused by the drought of 2007 and 2008 and also indirectly by the increased amount of evaporation. In conventional parcels there was a significant decrease in pH levels within 0-20 cm depth but not for 20 – 40 cm depth. Namely, it is mostly caused by cultural practices. This decrease is considered to derive from acidic fertilizer application such as ammonium sulfate. However, in organic parcels there was no such decrease. The reason behind is that organic fertilizers have neutral pH level and also helps improve microbial activity. As it is well known soil microorganisms have relatively lower activity levels in acidic soils Phosphorus has increased in conventional agriculture but in organic agriculture, despite sufficient levels on in the upper part of the soil, there has been a deficiency of phosphorus in the lower part. Despite proper application of phosphorus according to the results of soil analysis, there was a certain amount of phosphorus which could not be taken by the plant and in years this may cause accumulation. Lower phosphorus levels in organic parcels within 20-40 cm depth are because there is no organically certified phosphorus fertilizer and that’s why it could not be applied. This phosphorus deficiency

may cause yield losses in phosphorus favoring plants cultivation.. Potassium, while it's been sufficient in both systems, it has even increased in conventional agricultural parcels. Although potassium was applied according to the results of soil analysis, there was an accumulation through the end of the project..

Consequently, in spite of optimum agricultural practices in conventional agriculture, it is seen that organic agricultural practices have improved soil sustainability. This positive effect also improved soil fertility without harming any living creatures or environment or unbalancing anything.

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