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The Impact of Tobacco Cultivation on the Concentration of Macro and Micro Nutrients in Soil / Case Study

Ya'bad Jenin

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M. Sc. Thesis

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Ya'bad Jenin

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Dedication

"To our Profit Mohammad (Peace and upon him)"

To everyone helped me achieve this dream

To my family

To my love

To my self

Declaration

I certify that this thesis submitted for the degree of Master of Science is the result of my own research, except where otherwise acknowledged, and that this thesis (or any part of the same) has not been submitted for a higher degree to any other university or institution.

Signed ……………..

Saja Mohammad Abdelrahman Ghannam

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Abstract

Tobacco cultivation is widespread in northern Palestine, it's one of the main crops Ya'bad city (study area) because they rely heavily on income and profit. Tobacco cultivation depends on curing leaves to production and marketing, and there are several types prevalent in the study area, the main type is Virginia tobacco. Tobacco plant works to absorb the macronutrients largely, because it is a leave crop that absorbs nutrients, leading to soil erosion. Therefore, the main objective of the study is to evaluate the impact of Tobacco cultivation on the concentrations of macro- and micronutrients nutrients in comparison with non-cultivated soil. Soil samples are collected from two depths, 5 and 10 cm.

No different of Nitrogen contents in 5 and 10 cm depth in tobacco soil 0.25 and 0.26 respectively, but in tobacco soil Nitrogen is lower than of non-treated soil 0.31 and 0.32 in 5 and 10 cm depth. Average phosphorus and potassium contents in tobacco soil in 5 cm depth are 18.1 and 342.6 mg/kg respectively, in 10 cm depth is 18.1 and 341.9 mg/kg, which is higher than the non-treated soil in two depth in Phosphorus is 14.4 and 279.9 mg/kg respectively, and in 10 cm depth in non-treated soil is 14.5 and 279.4 mg/kg, this was due to the addition of phosphate and potash fertilizer which was raised in the tobacco soil.

Calcium contents in tobacco soil is less than non-treated soil, in tobacco 5 cm depth is 1481.1 mg/kg and in 10 cm depth is 1492.3 mg/kg, and non-treated soil in 5 cm is 1615.9 mg/kg, in 10 cm is 1621.8 mg/kg, this could be due to the impact of phosphate and potassium fertilization, which led to calcium deficiency in the soil. The magnesium contents in both depths in the soil of tobacco was lower than the non-treated soil, in tobacco 5 and 10 cm is 332.3 and 333.2 mg/kg respectively, and non-treated soil in 5 and 10 cm depth is 336.9 and 338.8 mg/kg respectively, due to the high percentage of calcium in the soil of the study area, because of the nature of the parent rocks containing calcite. This led to the reduction of magnesium in the both soil and both depth, and also due to phosphate fertilization in tobacco soil, this lead to reduce the proportion of magnesium in tobacco soils. As for sodium, a small percentage in both lands due to lack of irrigation of the land is considered a non-saline land.

Average Micronutrients in two depth in tobacco land was not significantly affected. Iron, boron, zinc, copper, nickel, cadmium, manganese were the ratios of 6.6, 0.55, 0.24, 0.21, 0.21. 0.08, 0.06 mg/kg respectively, while in non-treated soil were iron, boron, zinc, nickel, copper, cadmium, manganese, the ratios were 4.00, 0.36, 0.22, 0.15, 0.14, 0.07, 0.04, respectively. Therefore, tobacco cultivation has a significant impact on the major nutrients. Micronutrients did not have much effect so there were no significant differences between the two lands.

دراسة تأثير زراعة التبغ على المغذيات الكبرى والصغرى في التربة في منطقة يعبد / جنين

إعداد: سجى محمد عبد الرحمن غنام

المشرف: الدكتور عامر مرعي

الملخص

تنتشر زراعة التبغ في شمال فلسطين، وهي واحدة من المحاصيل الرئيسية لمدينة يعبد (منطقة الدراسة) لأنها تعتمد اعتمادًا كبيرًا على الدخل والربح. تعتمد زراعة التبغ على معالجة الأوراق للإنتاج والتسويق ، وهناك عدة أنواع منتشرة في منطقة الدراسة، النوع الرئيسي هو تبغ فيرجينيا. يعمل مصنع التبغ على امتصاص المغذيات الكبيرة إلى حد كبير، لأنه محصول ورقي يمتص العناصر الغذائية بشكل كبير، مما يؤدي إلى تآكل التربة. لذلك فإن الهدف الرئيسي من هذه الدراسة هو تقييم تأثير زراعة التبغ على تركيزات المغذيات الكبيرة والمغذيات الدقيقة مقارنة بالتربة غير المزروعة. يتم جمع عينات التربة من عمقين، 5 و10 سم.

لا يختلف محتوى النيتروجين في عمق 5 و10 سم في تربة التبغ 0.25 و 0.26% على التوالي، ولكن في تربة التبغ يكون النيتروجين أقل من التربة غير المعالجة 0.31 و 0.32% في عمق 5 و 10 سم.

متوسط محتوى الفوسفور والبوتاسيوم في تربة التبغ بعمق 5 سم هو 18.1 و 342.6 ملغم/ كغم على التوالي، وعمق 10 سم هو 18.1 و341.9 ملغم / كغم، وهو أعلى من التربة غير المعالجة. الفوسفور والبوتاسيوم في التربة غير المعالجة في عمق 5 سم هو 14.4 و 279.9 ملغم / كغم على التوالي، وعمق 10 سم في التربة غير المعالجة 14.5 و 279.4 ملغم/ كغم، ويعزى ذلك إلى إضافة الأسمدة الفوسفاتية والبوتاسية التي تم اضافتها في تربة التبغ.

محتويات الكالسيوم في تربة التبغ أقل من التربة غير المعالجة، في تربة التبغ 5 سم 1481.1 ملغم / كغم وعمق 10 سم هو 1492.3 ملغم/ كغم، والتربة غير المعالجة 5 سم هي 1615.9 ملغم/ كغم، في 10 سم 1621.8 ملغم/ كغم، وهذا يمكن أن يكون بسبب تأثير التسميد الفوسفاتي والبوتاسي، مما أدى إلى نقص الكالسيوم في التربة. كانت محتويات المغنيسيوم في كلا العمقين في تربة التبغ أقل من التربة غير المعالجة ، في التبغ 5 و10 سم 332.3 و 333.2 ملغم /كغم والتربة غير المعالجة

بعمق 5 و 10 سم 336.9 و 338.8 ملغم/ كغم على التوالي، بسبب ارتفاع نسبة الكالسيوم في تربة منطقة الدراسة ، بسبب طبيعة الصخور الأم التي تحتوي على الكالسيت. وقد أدى ذلك إلى تقليل المغنيسيوم في كلا الارضين، وأيضًا بسبب تسميد الفوسفات في تربة التبغ ، مما أدى إلى تقليل نسبة المغنيسيوم في تربة التبغ. أما بالنسبة للصوديوم، فإن نسبته صغيرة في كلتا الأرضتين بسبب نقص ري الأرض, وايضا تعتبر أرضًا غير مالحة.

لم يتأثر متوسط المغذيات الصغرى في كلا العمقين في أرض التبغ بشكل كبير. كان الحديد والبورون والزنك والنحاس والنيكل والكادميوم والمنغنيز نسب 6.6 ، 0.55 ، 0.24، 0.21 ، 0.21. 0.08 ، 0.06 ملغم / كغم على التوالي، بينما في التربة الغير معالجة كانت الحديد، البورون، الزنك، النيكل، النحاس، الكادميوم، المنغنيز، كانت النسب 4.00 ، 0.36 ، 0.22 ، 0.15 ، 0.14 ، 0.07 ، 0.04 ، على التوالي. لذلك فإنّ زراعة التبغ لها تأثير كبير على العناصر الغذائية الرئيسية، لم يكن للمغذيات الدقيقة تأثير كبير لذا لم تكن هناك فروق ذات دلالة إحصائية بين الأراضي.

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Chapter one

Introduction

1.1 History of tobacco cultivation

1.1.1 Tobacco cultivation in the world

The history of tobacco cultivation starts around eight thousand years ago, when two species of the plant, Nicotiana rustica and Nicotiana tabacum dispersed by Amerindians through both the southern and northern American continent. Was called the (holy herb) because they used it in medicine to treat dental pain, until the very end of the fifteenth century no one outside the American continents had any knowledge of the cultivated varieties of this plant. Today its grown in more than 120 countries, and its manufactured product are known to virtually everyone (Galloway, 1995).

Tobacco is one of the few crops entering world trade entirely on a leaf crop and is the most widely grown commercial non-food plant in the world. Tobacco is grown as far north as 60° N latitude and south as 40° S latitude in over 100 countries including China, India, Brazil, United States, and Indonesia (Simmons, J., 2004). The statistic of amount of tobacco produce in the worldwide in 2016, in this year, China was the biggest tobacco producer worldwide with an amount of some 2.8 million metric tons of tobacco produced (Table. 1). (Marlene Greenfield, 2016).

In Pakistan, especially in Khyber Pakhtunkhwa, tobacco is major cash crop for the farmers. The chemical composition of tobacco leaf plays a key role in the evaluation of tobacco quality. The absolute and relative amount of these constituents not only depends on crop varieties and maturity, soil, climatic condition and curing process, but also depends on the responsive mineral nutrition of tobacco crop, such as boron (Ali, et al., 2015).

Table 1: Tobacco producing countries worldwide in 2016 (in 1,000 metric tons).

Country	Tobacco production
China	2850.62
India	761.32
Brazil	675.55
USA	285.18
Indonesia	196.15
Zimbabwe	172.27
Zambia	124.64
Pakistan	116.16
United Republic of Tanzania	102.47
Argentina	93.67

Around the world, cultivated tobacco about 3.9 million ha, of which 60% is flue-cured tobacco, 13% is Burley tobacco, and 12% is Oriental. The mineral nutrient requirements of different tobacco types vary according to their specific characteristics, resulting in the need to formulate different fertilization programs in order to maximize the yield, profitability, and quality (Hoyos et al., 2015).

1.1.2 Tobacco cultivation in Middle East North Africa (MNA)

The Middle East and North Africa (MENA) region includes 19 countries: Algeria, Bahrain, Djibouti, Egypt, Iran, Iraq, Jordan, Kuwait, Lebanon, Libya, Morocco, Oman, Palestine, Qatar, Saudi Arabia, Syria, Tunisia, United Arab Emirates (UAE) and Yemen. In 1999, MENA accounted for 3.7% of the world's total cigarette consumption, and 5% of the world's population. So cigarette consumption shows an increasing trend in many MENA countries (East, 2001).

Tobacco remains an attractive crop for farmers. Its cultivation utilizes significant portions of agricultural land in the southwest Asia that might otherwise have been used for much-needed rice or other food crops. Tobacco agriculture is further encouraged by support from the cigarette manufacturing companies and tobacco industry (Guazon, 2008).

1.1.3 Tobacco cultivation in Palestine

Tobacco cultivation in Palestine dates back to the 17th century, spreading from Lebanon during the reign of the Ottoman Sultan Ahmed I in 1603. At that time, the Ottoman authorities dealt with the industry with caution and stringency. They imposed a relatively high tax: 25 percent of the value of the crop paid in kind or in cash. The authorities operated very strict procedures and oversight of tobacco farming and tax evaders. Since then, the cultivation of tobacco became an important source of income for local farmers (Palestine economic policy research institute 2018).

According to historical sources, the cultivation of tobacco arrived in the town of Ya'bad during the 1948 by Farid Darwish from the village of Tarshiha; when he gave his seeds to a number of his relatives from the Hamarsheh family to experiment with their cultivation in their lands. On a small scale and in a few areas, in non-commercial quantities (Information Agency – WAFA 2011)

In the period of sixties of the last century, tobacco farmers in the Palestinian territories, particularly in the Ya'bed region, started to produce tobacco at a commercial level, and sell it to cigarette companies**.** According to the agricultural cooperative association for tobacco cultivation in Ya'bed, the farmers produced in 1969 about 350 tons, sold to the company "Jerusalem cigarettes" and "Dubek" Israeli with low prices.

In 1986, the Israeli military authorities decided to suspend tobacco cultivation, not to commit to marketing it to cigarette companies, and to increase the production of farmers. This led them to search for new markets for their crops, and found a way to expand the market to various areas of the West Bank and Gaza Strip, after it was limited to the province of Jenin (Information Agency – WAFA 2011)

The spread of tobacco cultivation in addition to the town in Ya'bad the "kingdom of tobacco" and the surrounding villages, and some of the territory of the city of Jenin, and introduced farmers new and sophisticated agricultural methods, this is done by moving from manual agriculture to a tractor driven technical, which enables them to cultivate 12-15 dunums per day (Information Agency – WAFA 2011)

According the Ministry of Agriculture (MOA), indicate a steady growth, particularly after 2012 in Jenin district. In 2015 reach 14.000 dunums, and in 2016 decrease to 12.350 dunums were cultivated. The decrease was related to the drought, and severe heat in summer that struck Palestine in May and June, and led to the drying to crop, and the weakening of their growth, as a result the quantities of production decrease significantly. In 2017 has back increase to 13.400 dunums, due to high demand. Figure (1) show the Land cultivated in last three years in Jenin district.

Figure 1: Land cultivated in last three years in Jenin district according to MOA in Palestine .

1.2 Physiology of tobacco plant:

Tobacco plants belong to the genus Nicotiana and encompass a large number of annual, biennial and perennial species. The tobacco plant synthesizes nicotine in its roots and stores it in leaves. Nicotine constitutes 0.3 to 0.5 percent of the tobacco plant's dry weight. Tobacco plants belong to the nightshade family of plants, all tobacco species, including the ornamental ones (Marie-Luise, 2018).

Nicotine is the addictive chemical in tobacco products. Plants use nicotine primarily to ward off predators. Tobacco plants contain high levels of nicotine, but other members of the nightshade family (Solanaceae), which includes vegetables, also produce low levels of nicotine such as tomato. Nicotine production is not confined to the nightshade family, however. The measured of nicotine vary with the growth stage of the plant, the plant part that is used for extraction. Plants primarily use nicotine to ward of predators. In studies at the Max Planck Institute in Germany, published in "PLOS Biology" in 2004, when coyote tobacco (Nicotiana attenuata) plants were engineered to lack nicotine, the plants were more readily devoured by insects than tobacco plants that contained nicotine. Early insecticides often used nicotine as one of their constituents. Interestingly, some creatures that munch on nicotine-containing plants also use nicotine to repel their own predators. Hornworms that feed on nicotine-free plants are more likely to be eaten by spiders than hornworms that feed on nicotine-containing tobacco plants (Marie-Luise, 201)

The leaves are part containing the nicotine. However, the nicotine is manufactured in the plant roots, not the leaves, the nicotine is transported to the leaves via the xylem. Some species of Nicotine are very high in nicotine content; Nicotine rustica leaves, for example, can contain up to 18% nicotine (Wang,et al., 2008).

1.3 Major types of tobacco plants

1.3.1 Flue-cured (Virginia):

One of the early type of tobacco that produced in the early 1800s and later to that they are produced in large amount. It is also known as Bright leaf. These tobaccos came into existence when there was unprecedented demand for tobacco products for high aroma and more specifically it was during the 1812 war. (John D, 2018)

1.3.2 Burley:

First grown in Ohio, America. The process of growing the white Burley tobacco started around in the 1860s. The leaf changes its color from white to light yellow after it is processed and cured. After that, it was largely produced these types of tobacco leaves. Today they are produced globally. (John D, 2018)

1.3.3 Dokha:

Dokha is a common type of tobacco, largely found in the region in and around Arab and Iran. Dokha got its name so as it gives a high, dizzy feeling, but quite contrary to what people think. It is totally free of addiction, and it simply makes the user feel dizzy. Unlike other commercial tobacco products, it is minimally processed. (John D, 2018)

1.3.4 Oriental:

Turks and the people call Turkish tobacco is referred to as the oriental tobacco by the rest of the world. Unlike the other types of tobaccos, the Turkish tobacco is a bit hard to consume as it is highly aromatic and contains more tobacco than cigarettes would usually have. (John D, 2018).

1.4 Fertilization of tobacco

Historically, tobacco is a heavily fertilized crop. The recommendation of fertilizers on the soil report produce high quality of tobacco. The plant's ability to use nutrients depends on adequate lime having been applied, the method and timing of fertilization variety selection and nematode management practices. Low yields and poor quality are seldom related to soil fertility alone (No. C, 2009)

Depends on the FAO database, in January 2012 was conducted study about fertilizers statistics, which shows that the amount of fertilizers used on tobacco is in line with the amount of fertilizers used on other crops. This study was conducted in 40 country use the fertilizers on tobacco and other crop. Table (2): Fertilizer need Kg nutrient/ha in of tobacco some country about FAO.

Table 2: Fertilizer need Kg nutrient/ha of tobacco in some country about FAO.

Country	Year	Land area/ ha	Fertilizer need Kg nutrient/ha		
			N	P	K
Albania	1999	6.7	15.00	10.00	0.00
Argentina	2002/03	65	93.00	74.00	117.0(
Lebanon	1995	3.1	75.00	50.00	100.0(

1.5 Tobacco cultivation in the area study (Ya'bad)

In Ya'bad and the neighboring villages, mainly Arraba, farmer cultivate 6,000 dunums, of which 40% in fertile plain land which is suitable for growing fodder, grain, and legumes, while the remaining 60% is mountainous land. This was the case before 2014. Later, the cultivated areas increased by approximately 15,000 dunums, because of increased demand for land to be used for the cultivation of tobacco, the price for renting one dunum rose from JD 60 to JD 120 in irrigated land. Tobacco cultivation continues to expand at the expense of food crops (Palestine economic policy research institute 2016).

Ya'bad is considered one of the largest cultivated areas of tobacco in Jenin governorate. It occupies an area of approximately 2470 dunums, followed by 1240 dunums in Arabeh land. The local price per kilogram is 50-60 NIS, and exported to Gaza and Israel at a price 200 NIS per kilogram. There are families in the study area depend mainly on their income on tobacco cultivation. There are areas planted with tobacco between olive trees, but their productivity is small compared to those in open and lowlands, because the tobacco crop needs sufficient sunlight, while olive trees block the sun, and does not receive sun to complete the process of photosynthesis, therefore, the productivity is less. Table (3) the land area in all town in Jenin district in 2017 according of the MOA.

Table 3: The land area in all town in Jenin district in 2017 according MOA.

the town	Land Area/ dunum	the town	Land Area/ dunum
Zboba	75	Zbda	402
Rmaneh	75	Ya'bad	2470
Ta'nak	160	Kfert	313
Al-tayba	160	Emreha	105
Arbonah	135	Om altoot	135
Al-jalameh	100	Alshohada'	62
Seelt alharthia	130	Jalqamous	137
Al-sa'ydaa	50	Almeghair	87
A'neen	77	Almotela	27
A'raneh	180	Beer albasha	152
Deer gazaleh	335	Alhofeera	90
Faqoa'a	65	Qabatia	95
Kherbet sroj	39	Araba	1240
Al-yamoon	355	Telfet	154
Om-alrehan	107	Marka	100
Kofrdan	135	Wade da'oq	105
Kherbat abdalla	50	Fahma new	97
Daher almaleh	115	Raba	105
Barta'a	145	Al-mansora	107
Al-arqa	115	Mselia	45
Al-jameelat	40	Al-jarbah	45
Beet qad	95	Al-zababdeh	200
West toor	82	Fahma	155
East toor	122	Al-zaweah	185
Al-hashemya	84	Kofor ra'eh	415
Nazlet zayed	150	alkfeer	190
Al-taram	120	Seer	55
WestKhrbt almntr	50	Aja	243
Jenin	300	Anza	160
Jenin camp	15	Sanoor	150
Jalbon	55	Al-rama	140
A'ba	80	Methaloon	170
Khrbt maso'd	40	Al-jadeeda	36
East khrbt almntr	30	Al-asa'sa	60
Kofor qood	88	Al-atra	95
Deer abod'ef	50	Serees	90
Brqeen	305	Jaba'	60
Om daar	81	Al-fandogomea	70
Al-khljan	81	Seelat-aldaher	200
Wade aldaba'	31	Total	13.400

One of the most common types of tobacco in the area of Ya'bed is Virginia Tobacco, which is drained by ventilation, is called light tobacco, because of the golden or orange color it reaches during treatment, characterized by its taste and light and pure flavor. Flue cured Virginia (FCV) tobacco has a major share in cigarette blends and it also has more export potential. Other types less cultivated called burley tobacco. Topping and suckering are two types of specific cultivation methods use to gain high level of nicotine and more leaves that causes reduce the soil fertility, and farmers in Ya'bed using some types of fertilizers and pesticides these lead to decrease soil fertility.

According to interview some farmers in Ya’bad, Most of the pesticides used are to fight the weeds and wild animals. These pesticides are Jaifonab, Convidor, Rondap, Indofilmancozeb, and ridomil gold to protect the tobacco plant from diseases and produce a good crop.

1.6 Phases of tobacco cultivation

Seeds are sprinkled onto the surface of a sterile seed starting mix and watered in, these tiny seedlings emerge in about 10 days, early March. This is actually about where the plants should be in early April. In May take about a month behind the optimum stage. Flower heads are bagged for seed production. They are covered before the flowers open in order to maintain purity of the variety. For production of leaf, however, the plants are topped and later suckered as required. Early June. Note the plants are beginning to ripen (yellow). This is intended and desired for proper curing in Virginia tobacco. There are some "dark leaf" varieties that cure from green to brown but burley tobacco cures from green to yellow to brown. After that cut, wilted, and ready to stick. That is, using a tobacco spear on the end of a "tobacco stick" that has been driven into the ground, the stalks are pierces and threaded onto the stick. The sticks are then gathered and moved to the tobacco barns. For small scale, personal use growing, tying twine onto the stalk works just fine. Here is a stick ready for the barn. Other areas out of inclement weather and direct sunlight will work fine as well. For example, the rafters of a carport or garage. Before final step Air curing in the barn. The warm days and cool nights of early fall are perfect conditions for curing tobacco leaf. At one week, yellow colors begin to change to varying shades of brown. At eight weeks the air curing process is nearly complete (B. Killebrew et al., 1897).

1.7 Soil types in Palestine

The soil types in Palestine affected by a diversity of factor, the parent material in this area derives from both bedrock and dust. Recent studies expect that more than 50% of soils in the region derive from dust. The main soil types in Palestine are: Lithosols and Desert soils, Terra rossa, Pale rendzina, Brown rendzina and Grumusol. Terra Rossa soil is heavy and clay-rich, are developed on hard calcareous rocks, mainly limestone, dolomite, while Rendzina types are developed on soft calcareous rocks, mainly chalk, chert, and calcrete (Reifenberg, 1947). Soil in this study is Terra Rossa soil. According to Department of Agriculture in 2015, tobacco can be grown in almost every type of soil. However, best soils for tobacco production are deep, well-drained loamy soils with little or no risk of flooding.

1.8 Tobacco cultivation and environment

Tobacco cultivation has many negative impacts both on the environment and tobacco growers, but these impact is experienced differently by developed, developing and underdeveloped countries in the world. Developed countries have shifted their tobacco cultivation into developing and underdeveloped countries during last 4 decades. Tobacco production share of developed countries increased from 57% in 1961 to 86% in 2006 and worldwide tobacco cultivated land is increased from 70% in 1961 to 90% in 2006 in the developing and underdeveloped countries (Geist et al., 2009). Tobacco cultivation in Bangladesh, Tobacco cultivation requires a lot of chemical fertilizers, pesticides and enormous care. Its negative environmental impacts of tobacco cultivation and how environmental degradation can reduce soil fertility, increase water pollution, and damage to biodiversity. Research findings revealed that tobacco cultivation has already had widespread negative impacts on agricultural biodiversity, water quality, soil, biodiversity and traditional agricultural practices in the study area (Md. Juel, 2015).

In 2003, the World Health Organization (WHO) adopted the Framework Convention on Tobacco Control (FCTC), an international treaty to reduce demand for tobacco products. In addition to demand reduction strategies, the treaty specified that signatory countries should promote economically viable alternatives to tobacco for farmers; to reduce the amount of land cultivated for tobacco leaf; and to protect the environment and health of farmers (World Health Organization. 2003).

Tobacco is a plant grows fast, like all the natural plants, it consumes heavy metals from the soil. Some of these metals can be naturally found in soils where tobacco plants are grown others were brought in soils through fertilizer and various pesticides during the cultivation of tobacco crops. Tobacco plant absorb and accumulate heavy metal species from the soil into its leaves (Abu-Obaid et al., 2015).

Tobacco is a hungry plant which depletes soil nutrients at a much faster rate than most other crops. For example tobacco consumes 2.5 times the nitrogen, 7 times the phosphorus and 8 times the potassium as maize. This requires a great deal of fertilizers to make up the difference which most small contract tobacco farmers cannot afford. Thus the land is depleted at a much faster rate than traditional crops (Md. Yeamin Ali et al., 2015).

Scientific studies have confirmed in many tobacco-producing countries that the direct negative impact on the soil and its mineral elements has been reduced by a decline of about 20 times compared to other agricultural crops. An analytical study conducted by the Palestine Natural Resources Research Center in 2014 on the impact of tobacco cultivation on agricultural soil indicated three basic elements in the soil, phosphorus, potassium and nitrogen, where phosphorus in non- Four times that of their tobacco-growing counterparts, and six times as much as potash in the soil compared to those cultivated, which means that the soil is actually dying and its production capacity is significantly lost This is a serious indicator that must be stopped to study the causes and economic dimensions, and study what must be done to reduce the magnitude of that disaster on the Palestinian agricultural economic system (Palestine Economy Portal, 2015).

Soil fertility is most commonly defined in terms of the ability of a soil to supply nutrients to crops. It helpful to view soil fertility as an ecosystem concept integrating the diverse soil functions, including nutrient supply (Nancie, 2003).

Soil is the main source of nutrients for crops, and support plant growth in various ways. Knowledge about soil health and its maintenance is critical to sustaining crop productivity. The health of soils can be assessed by the quality and stand of the crops grown. However, this is a general assessment made by the farmers. A scientific assessment is possible through detailed physical, chemical and biological analysis of the soils. Essential plant nutrients such as N, P, K, Ca, Mg and S are called macronutrients, while Fe, Zn, Cu, Mo, Mn, B and Cl are called micronutrients. It is necessary to assess the capacity of a soil to supply nutrients in order to supply the remaining amounts of needed plant nutrients (total crop requirement - soil supply) (Motsara et al., 2008).

Tobacco cultivation in Palestine has been competing with other basic crops such as cereals and vegetables, this has led to shortages of basic crops in northern Palestine, due to the soil in northern Palestine fertile. In addition, the problem of soil poverty caused by tobacco cultivation, because tobacco is a broad-leafed crop that absorbs nutrients largely from the soil. This led to the soil becoming unproductive due to deficient nutrients in soil.

1.9 Research Goals:

The aim of this study is to assess the impact of tobacco cultivation on soil macronutrient (N, P, K, Ca, Mg, Na) and micronutrients (B, Fe, Cu, Cd, Zn, Ni, Mn), and compare its constituent with virgin land in Ya'bad city. To identify and explain the reasons of lack or increase of macro and micro-nutrients in soil.

Chapter two

Literature review

The overview highlights the current lack of scientific research into the environmental impact of tobacco, such as soil infertility and accumulation of heavy metal in the soils due to use of pesticides in huge amounts, there are some studies related to socio-economic impact, this study conducted by the Palestinian Economic Policy Research Institute (MAS 2016), its study Tobacco cultivation on the economy and socially and how it affects food security in Palestine.

An analytical study conducted by the Palestine Natural Resources Research Center in 2014 on the impact of tobacco cultivation on soil. Three basic elements of the soil were studied (Phosphorus, Potassium, Nitrogen), confirming that phosphorus in non-cultivated land is equivalent to four as well as six times the proportion of potash in the soil is not planted with tobacco compared to those cultivated, which means the fact of the death of the soil and the loss of production capacity significantly.

The Ministry of Agriculture in Palestine, soil undergoes the largest adverse effect of growing tobacco. “A considerable part of the most important three minerals (phosphorus, potassium, and nitrogen) is lost. While other crops provide the soil with essential nutrients, tobacco strips the soil of the necessary elements.” Such as phosphorus in non-tobacco-cultivated land is four times that of tobacco-cultivated land, which is the opposite of most other agricultural crops that supply the soil with essential nutrients. "This is a serious indicator of productivity and land fertility (Palestinian Economic Policy Research Institute (MAS), 2016).

“Tobacco absorbs more nitrogen, phosphorus and potassium than other major food and cash crops, and therefore, tobacco growing decreases soil fertility more rapidly than other crops.” (N, Lecours et al., 2012).

A study was conducted entitled Effects of Consecutive Two Years Tobacco Cultivation on Soil Fertility status at Bheramara Upazilla in Kushtia, several factors affecting soil fertility were studied. Two consecutive years were studied in 2015, 2016. Soil was studied before tobacco cultivation and after tobacco cultivation. The results were different, for example average pH value decreased from 7.86 to 7.44 after two consecutive years. This is probably due to use of potassium sulfate as a source of potassium and rapid adsorption of base captions and release of H^+ ions. The organic matter (OM) value decreases from 1.95% to 1.78% for two consecutive years that was significant, in case of potassium the average value decreases from 0.46 meq/100 g before cultivation to 0.32 meq/100 g after cultivation that is 30.5% less, and the average P value decreases from 13.98 ppm to 9.10 ppm that was 34.90%. The available S value decreases from 16.22 ppm to 10.89 ppm that was 32.86% less from the initial value. Finally the Zn status decrease from 0.70 ppm to 0.53 ppm that is 24.58% less. So Tobacco plant requires substantial doses of chemical fertilizers such as TSP, Urea and Potassium sulfate. The use of agrochemicals such as insecticides and herbicides in tobacco plot is another factor that contributes a lot in the accumulation of heavy metals in soil. This study need repeated to evaluate trace heavy metals such as Pb, Cr, Ni, Cu, Cd.. etc (Moula et al., 2018).

Tobacco like other Plants require at least sixteen elements for normal growth and completion of their life cycle. They need relatively large amount of nitrogen, phosphorus, and potassium referred to as primary nutrients usually supplied in fertilizers, the three secondary elements Ca, Mg, and S are virtually required in smaller amounts. Ca and Mg are usually supplied with liming materials while S with fertilizer materials, Contaminants in rainfall supply 4.5 kg to 9.1 kg of nitrogen and sulphur per acre each year depending on the local air quality (World Health Organization. 2017).

A study was conducted in western Kenya by Kisinyo Peter Oloo in 2016. Two plots, first planted with tobacco and the second was just soil. Soil fertility and heavy metals were measured. Soil pH, N, P and organic carbon were significantly higher ($p \leq 0.05$) on virgin lands compared to tobacco farms. Soil exchangeable potassium ($K+$) was higher on virgin land than tobacco farms, Soils in tobacco cultivated farms were more acidic with pH of 4.3-5.2 than virgin lands with pH of 5.7-6.5. This was probably due to rapid absorption of base cations and release of $H+$ ions from their roots leading to soil acidification. Study was conducted in Bangladesh, the pH was acidic and this explains why the tobacco plant leads to acidification of the soil, and k+ About 44% of tobacco farms had low soil K since levels of $K+$ ions < 0.5 cmol/kg are considered low, all tobacco farms had higher heavy metals concentrations than virgin lands. Only the levels of Cd, Pb and Co were significantly higher in tobacco farms compared to virgin lands. All tobacco farms had Cd, Pb, Cu and Co concentrations higher than the acceptable limits since levels of Cd ≥ 0.3, Pb ≥ 0.2, Cu ≥ 1.0 and Co ≥ 0.5 μg/g are considered above maximum permissible limits (MPL). So the tobacco crop is a heavy feeder on soil nutrients and as a result depletes soil nutrient very fast compared to other crops, thereby making such soils unsuitable for healthy plant growth (Trenbath, 1986). Its depletes soil nutrients so much fast such that subsequent food crops do not benefit from the residual fertilizer applications (Geist, 1999).

Growing tobacco has negative impacts on the environment, a literature review published in 2012 showed that tobacco farming, particularly in low- and middle-income countries, leads to deforestation and soil erosion because of the clearing of land for tobacco farming and curing, and the pollution of rivers and streams with agrochemicals such as pesticides and fertilizers that are used extensively. These in turn lead to ecological disruptions (Hu, T. W., & Lee et al., 2015).

In Bangladesh, farmers from their field level experience believe that tobacco cultivation requires more fertilizers. In terms of fertilizer usage compared to other competitive crops, 82.5% of tobacco farmers have supported the notion that tobacco cultivation requires more fertilizers compared to other crops. A high percent of non-tobacco farmers also supported the notion that tobacco crop requires more fertilizers than other competitive crops. A primary reason for using more fertilizer by tobacco farmers is probably the nature of the produce itself (Policy Research Institute of Bangladesh).

The environmental impact of tobacco cultivation and paid particular attention to the issue Soil degradation and plant demise. It noted that 90% of tobacco is grown in dry tropical forests and areas where are densely populated areas in developing countries have a significant biodiversity loss. Tobacco Soil nutrients are depleted much faster than other crops. The tobacco seed itself does not contain Nicotine, and human intervention alone is the one that generates nicotine throughout the growth of the tobacco plant, making tobacco plants absorb a great deal of nutrients (Lecours, N. et al., 2012).

A group of researchers produced a scientific paper on the literary review in the world of the impact of tobacco farming on the environment, collecting more than 57 reports, 45 of which documented the negative effects of tobacco production on the environment. These effects were often associated with health and social problems of intensive use for agrochemicals in low- and middle-income countries. These practices lead to two major environmental consequences: ecosystem disruptions and soil degradation, which consequently lead to loss of land resources, biodiversity and food insecurity (Lecours, N. et al., 2012).

Boron is one of the major deficient micronutrients after zinc in Pakistan, and B not only affects the yield but also affects the marketing value of tobacco leaf. It is apparent from the previous literature that boron may affect other micronutrients in soil and also in the plants. However, literary information on the subject of the effect of boron on the concentration, uptake and transportation of plant nutrients is insufficient. (Ali, F. et al., 2015). In other hand study was conducted with the help of a group of researchers and was conducted in Pakistan. The study focused on the effect of boron on the various nutrient content in tobacco. Six levels of boron (0, 0.5, 1, 2, 3 and 5) were applied. The study showed that NPK concentrations were significantly affected, to balance the concentration of nutrients.

Environmental degradation in Vietnam is also caused by the tobacco plant, by leaches nutrients from the soil, as well as pollution from pesticides and fertilizers applied to tobacco fields (Nguyen, et al., 2009).

In flue-cured tobacco reported in Field experiments were conducted in 2012, 2013, and 2014 near Murray, KY to evaluate response of dark fire-cured tobacco to potassium rate and application method. That increased potassium rate had a positive effect on leaf quality. Other studies have shown no yield or leaf quality response with increased rates of potassium fertilizers in flue-cured tobacco (Richmond et al., 2016).

In Oriental tobacco the concentrations of nitrogen, phosphorus, potassium and calcium decrease during the growing season. However, burley tobacco accumulates relatively greater amounts of nitrogen, phosphorus and potassium during the first half of the growing season relative to dry matter accumulation. Maximum growth per unit leaf weight occurs 14 to 21 days after transplanting, whereas maximum dry matter accumulation per day occurs 50 to 55 days after transplanting. Leaf development including senescence is controlled genetically and decreased chlorophyll and protein and increased nicotine contents are important changes associated with leaf senescence (Bush, et al., 1989).

A study was conducted in Macedonia in title is Accumulation and availability of trace elements from soil into oriental tobacco grown in Macedonia, this study aim to determine the intensity of accumulation of various elements in tobacco plants and to determine possible relationships between certain chemical and physical properties of soils (pH, clay, cation exchange capacity, organic matters and total organic carbon). The average of pH was 7.00, and the EC was 125.6 µS/cm , and available P and K is21.9, 24.6(mg/100 g) respectively, and other element concentration in soil Ca , Mg , Na, Zn , Li , Fe , Ba , Pb , Al , V , Cr , Mn , Ni , and Cu is 1.00%, 0.7%, 0.7 mg/kg , 71.3 mg/kg , 14 mg/kg , 2.9%, 281.3 mg/kg , 14.3 mg/kg , 4.3%, 56,6 mg/kg , 53 mg/kg, 524.3mg/kg,32.6 mg/kg ,and 17.6 mg/kg respectively (Jordanoska, et al., 2018).

Soil pH is an important factor that affects the growth of tobacco plants, its affect the quality and yield of their tobacco leaves. And it determines both the distribution of soil microbes and the nutrient absorption of tobacco. The soil pH for achieving higher quality tobacco is different under different soil and climatic conditions. For example, the best pH for tobacco growth in the United States is 6.0-6.4, while in India, the best pH is 7.5 - 8.5, and in China, the soil pH found in high quality tobacco-growing areas is primarily in the range of 5.0 - 7.0. Currently, the academic community considers the optimal pH for quality tobacco leaf production to be in the range of 5.5 - 6.5 (J. Chem, 2014)

A study was carried out in a village in China that investigated the effect of pH and its difference with the growth of tobacco. The effect of pH on absorption of nutrients in the soil of the tobacco indicates that the higher the pH values of the soil the higher the levels N, P, K, Ca, and Mg in tobacco leaves, with soil at pH 7.0, increasing pH values increased the tobacco leaf levels of N, P by 2.46%-11.47% and 5.88%-11.76%, respectively. Additionally, the levels of Ca and Mg decreased by 2.8%-18.82%, 8.11%-19.63%, respectively (J. Chem, 2014).

Soil electrical conductivity (EC) is a measurement that correlates with soil properties that affect crop productivity, including soil texture, cation exchange capacity (CEC), drainage conditions, organic matter level, salinity, and subsoil characteristics. This publication discusses: How, with field verification, soil EC can be related to specific soil properties that affect crop yield, such as topsoil depth, pH, salt concentrations, and available water-holding capacity (Grisso, R. D. et al., 2005). EC is good at giving a measurement of the strength of the ions in the soil. This helps you to track the nutrients that are available to your plants (Allison Hubbard, 2017).

In 2015 Researchers conducted study about the environmental impact of tobacco agriculture, this study has also shown that tobacco crops deplete soil nutrients by taking up more nitrogen, phosphorus and potassium than other major crops. This depletion is compounded by topping and de-suckering plants, this increase the nicotine content and leaf yields of tobacco plants (Novotny, T. E. et al., 2015).

Tobacco is a sensitive plant to grow, and therefore needs multiple pesticides, fungicides and herbicides are added to the crop throughout its growing seasonal. Some tobacco crops receive up to sixteen applications of chemicals. Tobacco pesticides harm birds and other small animals, and/or cause soil depletion; like methyl bromide, are known to cause ozone depletion. According to the General Accounting Office, every year an estimated 27 million pounds of pesticides are sprayed onto tobacco fields In the United States, and tobacco ranks sixth among all agricultural commodities in the amount of pesticides applied per acre (Aktar, W. et al., 2009).

Study was conducted about Relationships among Soil Nitrate, Leaf Nitrate, and Leaf Yield of Burley Tobacco, Effects of N fertilizer on relationships among leaf yield, Burley tobacco (Nicotiana tabacum L.) requires large amounts of fertilizer N to produce high yields of cured leaf with the quality traits demanded by buyers. However, excessive N use produces air-cured leaves with undesirable levels of NO^{-}_{3}, is uneconomical, and is environmentally unsound if substantial levels of residual soil NO^{-}_{3} remain following harvest (MacKown, C. et al., 1999).

Studies were conducted at Western Kentucky University's Agricultural Research and Education Complex in Bowling Green, Kentucky and a farm in Owensboro, Kentucky to evaluate the influence of poultry litter on dark tobacco growth and soil nutrient concentrations. The results of this study indicate that when applying poultry waste to a piece of soil planted with tobacco can reduce the degree of acidity of the soil in general, the more the changes in poultry increased the pH and because of the high content of food from poultry waste, can affect the use of high content Heavy metals in the soil such as copper and zinc, lead to the accumulation of Phosphorus Pent oxides P_2O_5.

One of the determinants of soil fertility is soil chemical properties. Including in soil chemical properties involve pH, CEC, Base Saturation, C-organic, and the levels of macro nutrients (N, S, P, K, Ca, Mg) and micronutrients (Cu, Co, Mn, Zn, Fe, B, Mo) in the soil. In general, the chemical properties of the soil are closely related to the availability of essential nutrients that play an important role in the growth and development of tobacco plants. When nutrients are met then the metabolism in plants are going well and it leads to good tobacco productivity (Hermiyanto, et al., 2016).

Tobacco farming is increasing gradually with last 15 years in the Kushtia District and results from almost all tobacco plots showed that farming of tobacco in a same land frequently reduces its fertility; therefore the farmers do not get productivity neither from tobacco nor from other food crops latter. Therefore, tobacco cultivation leads to soil fertility depletion.

The intensive nature of tobacco farming quickly leads to soil becoming depleted of its naturally occurring minerals. “Tobacco depletes soil nutrients at a much faster rate than most crops,” exacerbated by specific growing practices such as topping and de suckering (the removal, either by hand or chemical spraying, of young shoots from a tobacco plant in order to ensure the robust growth of large leaves), thus triggering a “massive outflow of nutrients” from the soil.10 Mono-culture farming prevents alternative crops from being able to thrive when tobacco is no longer grown (Novotny, T. E. et al., 2015)

A study was conducted entitled concentration of heavy metals in burley, Virginia and oriental tobacco leaves in the Thessaly region of central Greece, in which the heavy elements were measured in three types of tobacco in the soil and in the leaves, and the study of the relationship between the concentration of the elements in the soil and the leaves. The pH was from 4-8.4. The relation of total concentration of heavy metals and the concentration of heavy metals (DTPA extraction) calculated as a ratio of available concentration to the total concentration for each metal ($C_{dtpa}/C_{aqua\ regia}$ x 100). That percentage of Virginia tobacco the Zn, Cu, Mn, Cd and Pb was as follows: 1.9, 4.4, 1.4, 20 and 4.1. In soils where Virginia tobacco was cultivated the relation between total and available concentration of heavy metals followed the order: Cd> Cu > Pb > Zn > Mn (Golia, 2003).

The amount of quality literature on soil degradation was found to be limited. From an evaluation of what was available it can be concluded that: (a) soil degradation is an issue facing the agricultural sector in general and is not specific to tobacco cultivation, so land is required to be made more productive to meet increasing demands for agricultural commodities; (b) sustainable management of soils is a key building block to the establishment of effective models of sustainable agriculture – again a generic issue; and (c) a number of the larger tobacco companies with leaf operations work with their contracted farmers and third party leaf suppliers aiming to ensure, that appropriate practices are used in soil management. However for the industry as a whole it is difficult to get a true picture of the scale and scope of these mitigating measures. Again, more empirical, independent research needs to be undertaken to provide definitive information on this issue. .” (Adam Pain, 2012)

Chapter three

Materials and methods

3.1 Study site and field experiment

This study was carried out on Ya’bed is one of the largest towns in the Jenin district, located 18 kilometers south-west of the city of Jenin. It is reached by a regional road, which runs through Jenin, Nablus, via the Arraba plain. It rises from the sea surface (390) meters. Its land area is 37405 dunums. (Anan, Aarqa, Kufert, Aarabah, Kufr Rafi, Afraasin, Zubdah, Barta'a and Umm al-Rayhan), The town of Ya'bed is characterized by a climate of the Mediterranean Sea, with terrarosa soil and dark brown soil. The current research is an empirical study to investigate the macro and micro-nutrients of tobacco cultivation in Ya'bad (Fig. 2) Location of the study area. (Fig. 3, 4) samples of two land.

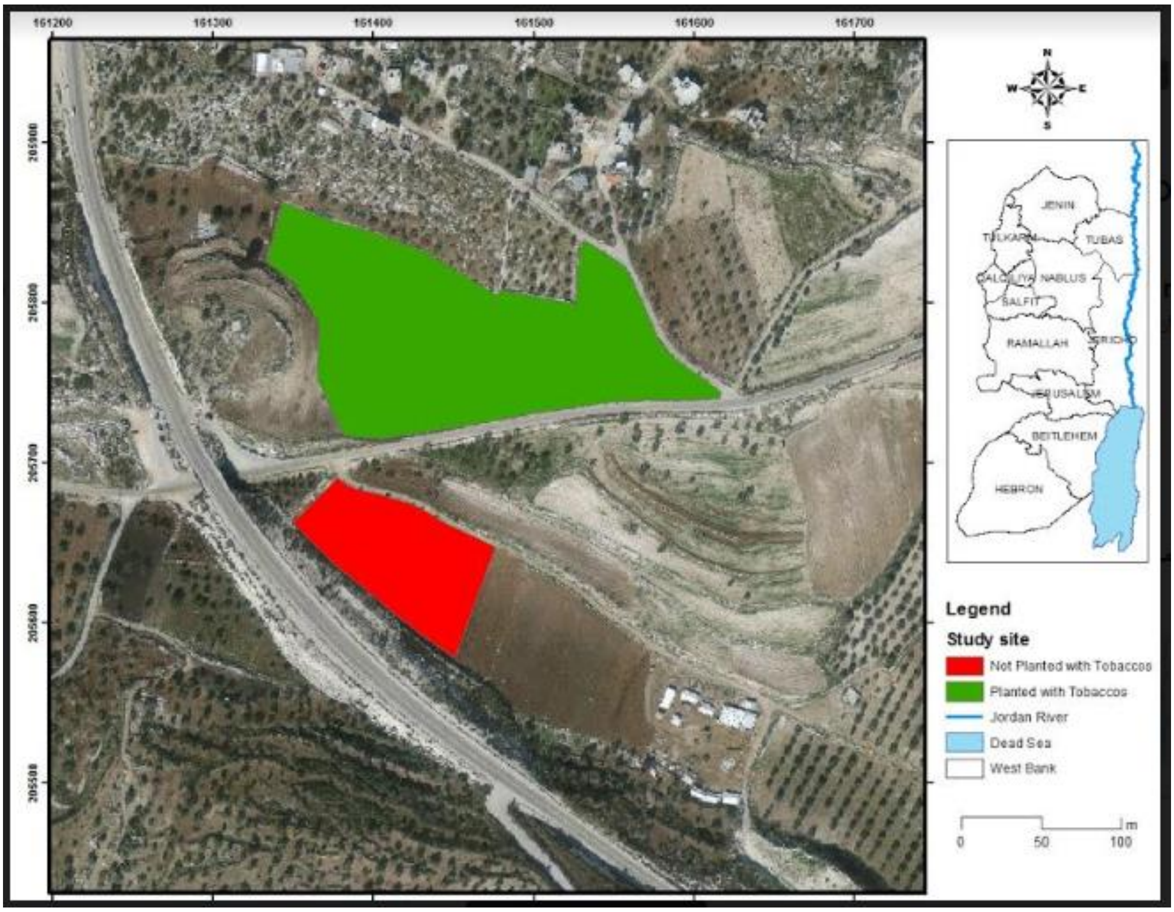

Figure 2: Location of the tobacco and virgin soil sample in study area by GIS

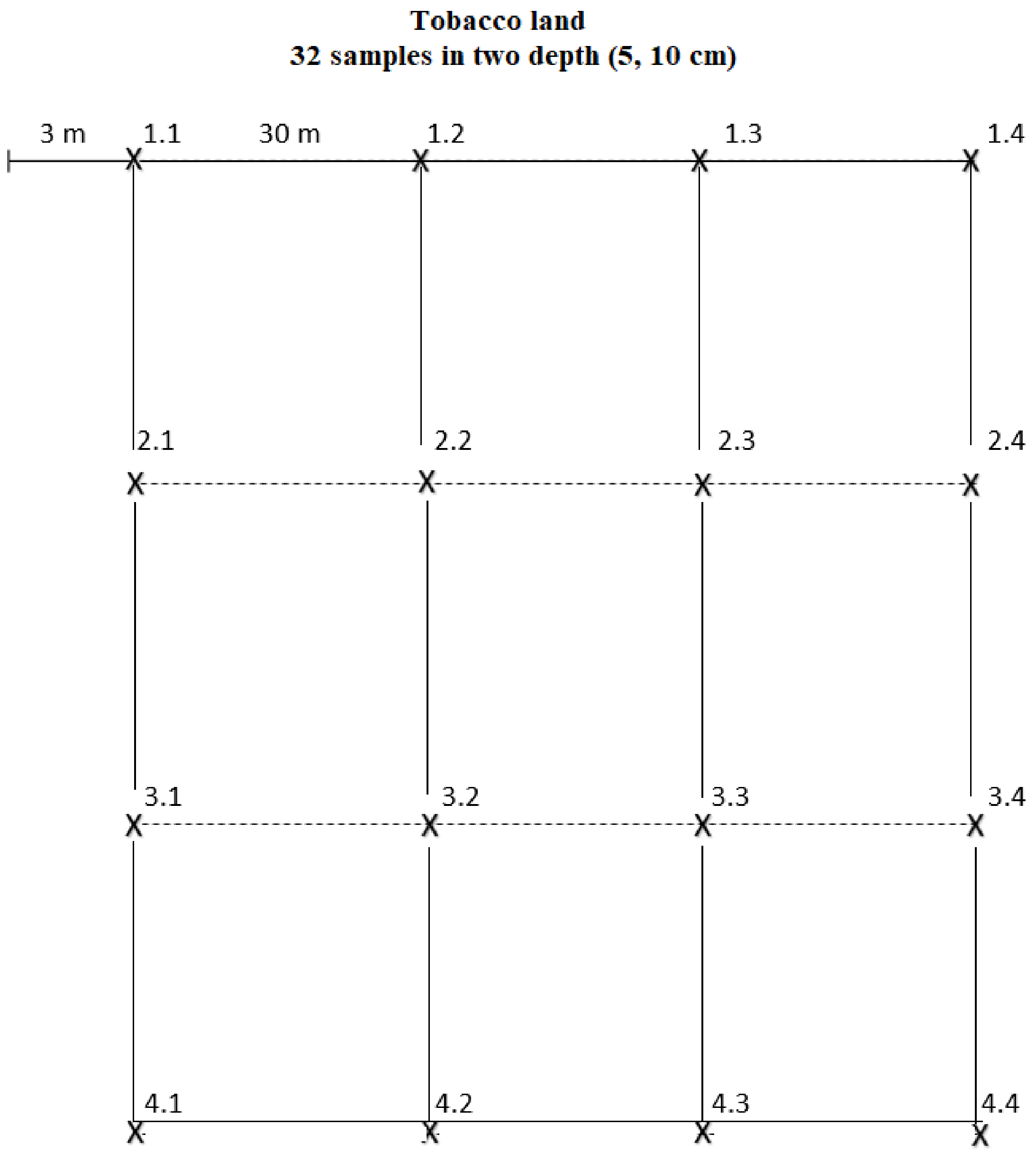

Figure 3: Samples of tobacco soil on 5, 10 cm depth

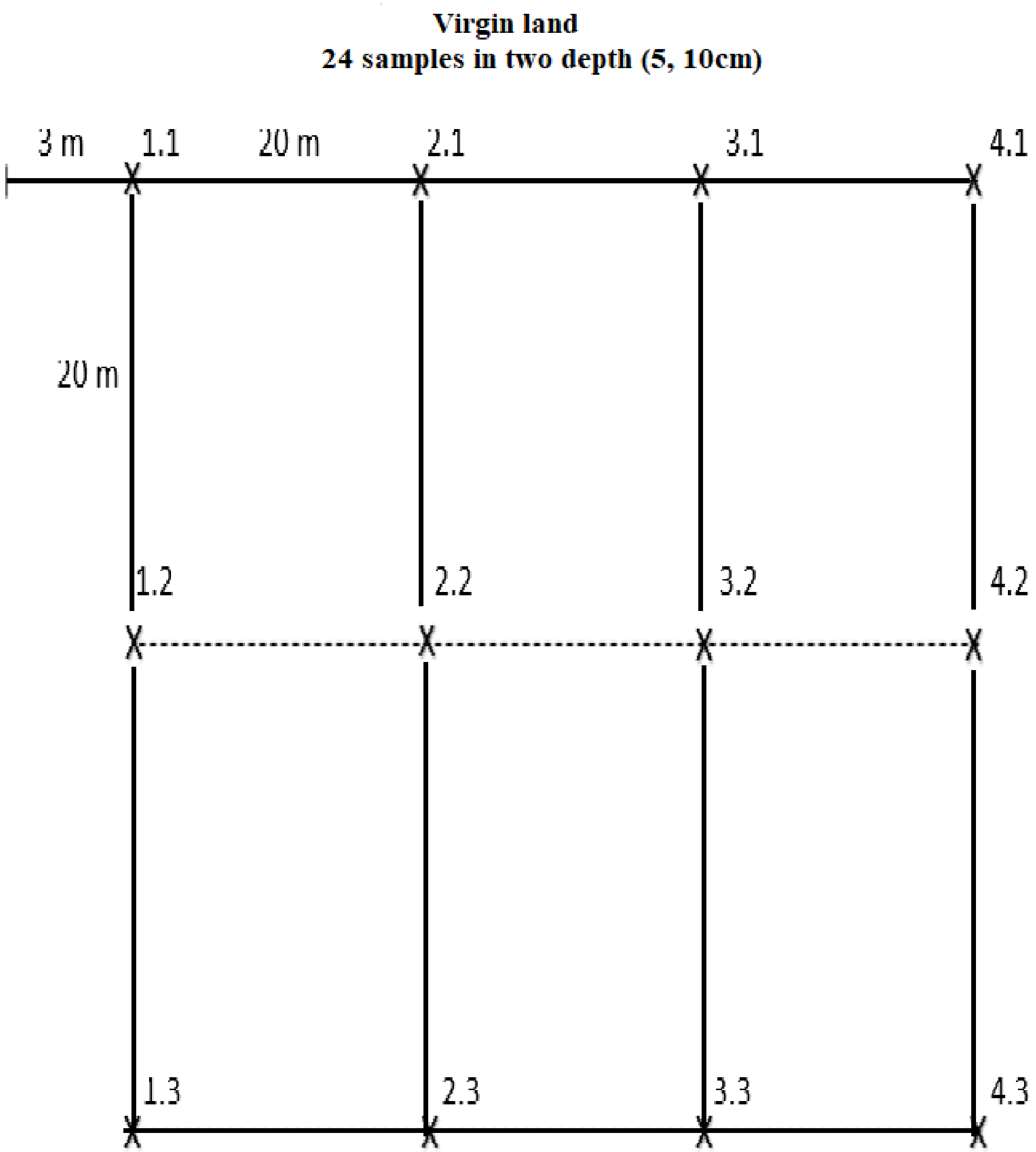

Figure 4: Samples of virgin soil on 5, 10 cm depth.

3.2 Soil sampling and general soil characteristics

Two plots of land were taken, first plot being planted with tobacco, this area was more than 16 dunums and cultivated tobacco for more than 15 years. The samples were taken in squares. 32 samples were taken from 0-5 and 5-10 cm, the area between every sample is 30 meters. Other land is virgin not cultivated, the area of this land about 10 dunums. 24 samples are taken, they were analyzed at Al Quds and AL-Khalil University laboratories for pH and EC by Multi 340i handheld meter, organic matter by heating sample, macro and micronutrient by Atomic Absorption Spectroscopy (AAS) and inductively coupled plasma-mass spectrometry (ICP-MS).

The type of tobacco planted is Virginia and the type of soil is Terra Rossa and the time of sampling was in the second harvest crop, this land was plowed 4 times every year twice deep tillage and twice surface tillage and the root depth of tobacco plant of 10_20 cm. used a variety of pesticides, because of the agricultural pest attacked the plant and these pesticides such as Rodimilu to fight the white on the leaf, to fight the agricultural worm called Meron, and insect is Confidor. The agriculture is rain fed so that the land is not irrigated during the planting season, The use of organic fertilizers of poultry manure in the amount of about 6.66 tons per dunum, added potassium and phosphate before planting the land and before the last plowing of the land, and add little amount ammoniac when cultivating the land,

The last crop was cultivated before 15 years is wheat and barley, after that farmers cultivated this land with tobacco, because any non-tobacco is attacked by pigs and stray dogs, This leads to low productivity and profit. The land is fertilized every two years and this year was fertilized naturally and chemically by the organic fertilizers of the poultry manure and potassium, phosphate fertilizers. The tobacco was sprayed with pesticides last time before collecting the samples by 15/5_2018. And collected samples on 7/7/2018**.**

Virgin land is not planted. It is not added any type of fertilizers, not tillage. The presence or loss of nutrients in the soil will be compared between the land planted with tobacco and other land not planted (virgin soil).

3.3 Lab work

3.3.1 Extractions of soil:

The samples are prepared to check pH, electrical conductivity macronutrient, and micronutrient. This samples are prepared to turn soil into liquid. In order to conduct soil analysis, 10 g of soil sample is weighed and add to 50 g of distilled water (1:6 s/v) and then taken to a machine shaking for an hour, after stirring well, the samples are transported in a test tube and placed in the centrifuge to separate the soil from the liquid, buchner fennel is used to separate it from impurities and thus be ready for analysis (fig. 5).

pH and electrical conductivity are examined after processing the samples and converting them into liquid and measured by Multi 340i handheld meter. These compact precision handheld meter Multi 340i enables you to carry out pH measurements, dissolved oxygen (D. O.) measurements and conductivity measurements quickly and reliably. The Multi 340i handheld meter provides the maximum degree of operating comfort, reliability and measuring certainty for all applications. The proven MultiCal® and OxiCal® calibration procedures and the procedures to determine set up the cell constant support you in your work with the meter. The special AutoRead function enables precise measurements (Karl, 2007)

Figure 5: steps of extraction of soil samples and analyze ph. and EC

3.3.2 Macronutrients:

Micronutrients N, P, K, Ca, Mg, Na, were determined by atomic absorption spectroscopy in Al-Khalil University. The process of atomic absorption spectroscopy (AAS) involves two steps first step is atomization of the sample, second step is absorption of radiation from a light source by the free atoms. The sample, either a liquid or a solid, is atomized in either a flame or a graphite furnace. Upon the absorption of ultraviolet or visible light, the free atoms undergo electronic transitions from the ground state to excited electronic states. (Fig. 6).

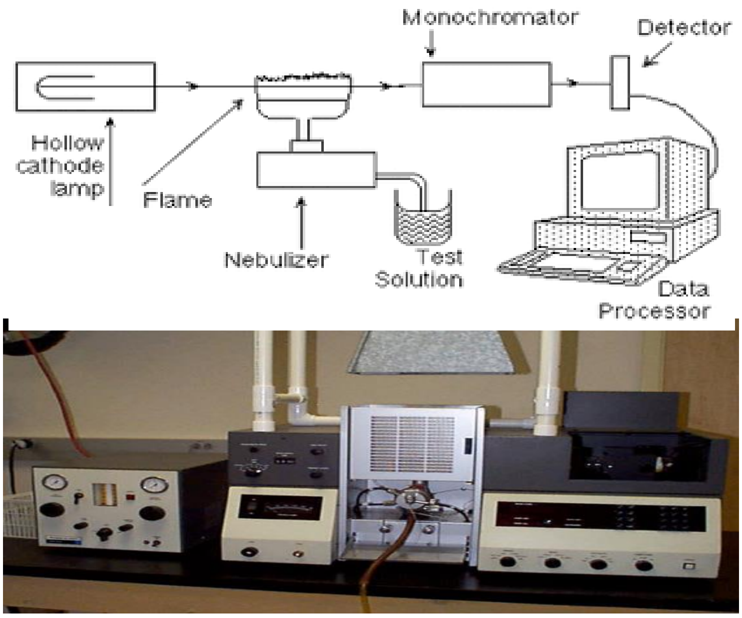

Figure 6: atomic absorption spectroscopy (AAS) machine.

3.1.3 Acidification of samples (micronutrients):

After the extraction of soil, should be acidification of soil to analysis elements (Fe, B, Cd, Cu, Mn, Zn, Ni) in the soil were determined by inductively coupled plasma mass spectrometry (ICP-MS) (Fig7, 8). An ICP-MS combines a high temperature ICP (Inductively Coupled Plasma) source with a mass spectrometer.

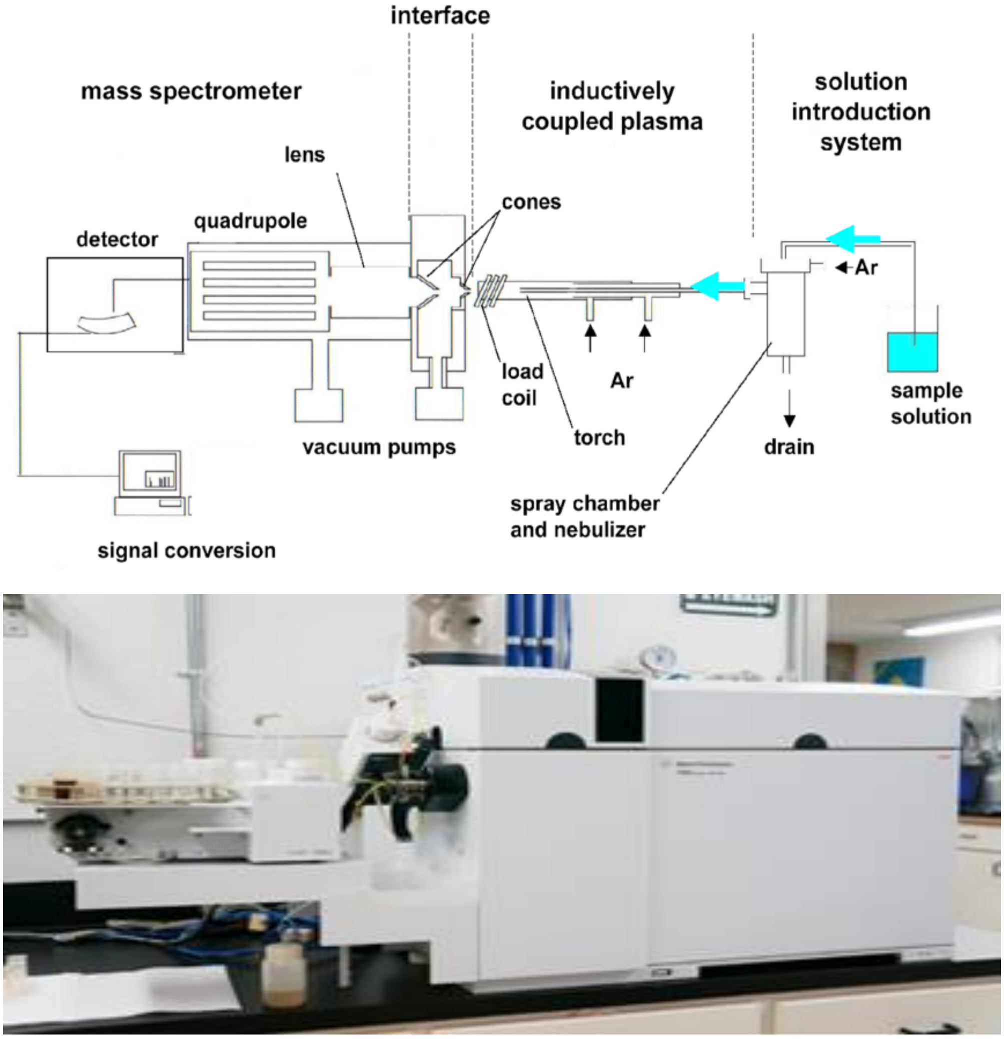

Figure 7: inductively coupled plasma mass spectrometry (ICP-MS) machine.

Figure 8: acidification of soil sample to analyze micronutrient.

3.3.4 Examination of organic materials:

This test is performed to determine the organic content of soils. The organic content is expressed as a percentage of the mass of organic matter in a given of soil to the mass of the dry soil solids.

<u>Test procedure s for each soil sample:</u>

1- Determine the mass of an empty, clean, and dry porcelain dish (M_p)

2- Place around 5 gm of soil in to a porcelain dish to be heated at 360°C in furnace (Fig. 9) for 4 hours

3- Determine the mass of the dish and soil specimen (M_{PDS}) after 4 hours

4- Place the dish and dried soil in a furnace and increase the temperature to 440°C for 5 hours

5- Remove the porcelain dish using tongs and then Determine the mass of the dish containing the ash (burned soil) (M_{PA})

6- Empty the dish and clean it

<u>Data Analysis:</u>

<u>(1):</u> Determine the mass of the dry soil:

$M_D = M_{PDS} - M_P$

<u>(2):</u> Determine the mass of the ashes (burned) soil:

$M_A = M_{PA} - M_P$

<u>(3):</u> Determine the mass of organic matter:

$M_o = M_D - M_A$

<u>(4):</u> Determine the organic matter (content):

$OM = (M_O / M_D) \times 100$

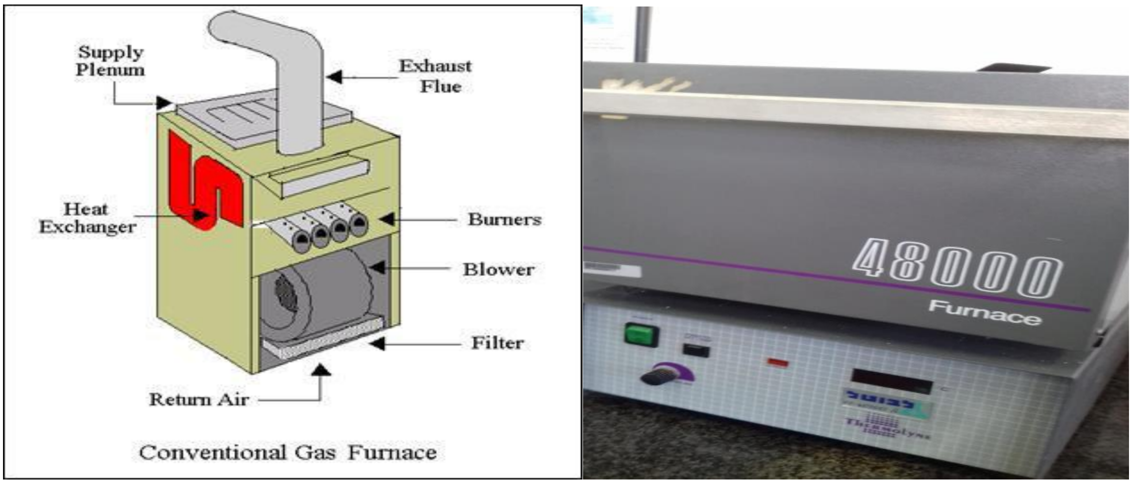

Figure 9: furnace device for heating samples to analyses SOM

3.2 Statistical analysis

The generated soil data were analyzed by using programming R. on Excel to represent data. Standard analysis of variance techniques were used to assess the significance of treatment means the test data are shown as the mean ± one standard deviation. All data were statistically analyzed. The mean of all samples was calculated and represented on the program and the results of the soil were compared tobacco soil with origin soil.

Chapter four

Results and discussion

1.4 Soil pH and EC

1.4.1 Soil pH

Soil pH is influenced by the season of the year, cropping and soil management practices, use of ammoniac fertilizers, acid precipitation, sludge and manure applications, soil organic matter, and biological activity (Smith, J. L. et al., 1996). The academic community considers the optimal pH for quality tobacco leaf production to be in the range of 5.5 - 6.5. (Wang. 1986). In this study the pH mean for tobacco is 7.3, and virgin soil is 7.5 (fig.10), this is slightly Alkaline due to a number of reasons, such as the origin of the rocks that make up the soil, and the soil of the Terra Rosa contains a high percentage of calcite carbonate. Terra Rosa development is the result of carbonate dissolution and subsequent accumulation and transformation of limestone residue (Bronger, 1997).

It may also be attributed to the fact that the farmers added a large amount of fertilizer (Potash Phosphate) to the soil to make the crop successful. This causes the ionic adsorption of the cations, causing the physiological alkaline phenomenon. Finally, the high degree of reaction of the calcareous soil may be due to the fact that calcium carbonate ($CaCo_3$). And weak acid as in the following equation (soil acidity and alkalinity)**:**

$CaCo_3 + H_2O = Ca_2 + HCO_3- + OH^-$

In Bangladesh tobacco soil pH decrease from 6 to 5, is more acidic and it is reducing its fertility. Phosphorous and potassium are toxic elements that come from phosphate and potash fertilizers. Chemical fertilizers reduced and changed the pH of the soil (Williams, 1964). The same reason in this study, tobacco pH soil was less than virgin soil, because large applications of chemical fertilizers that leads to less pH.

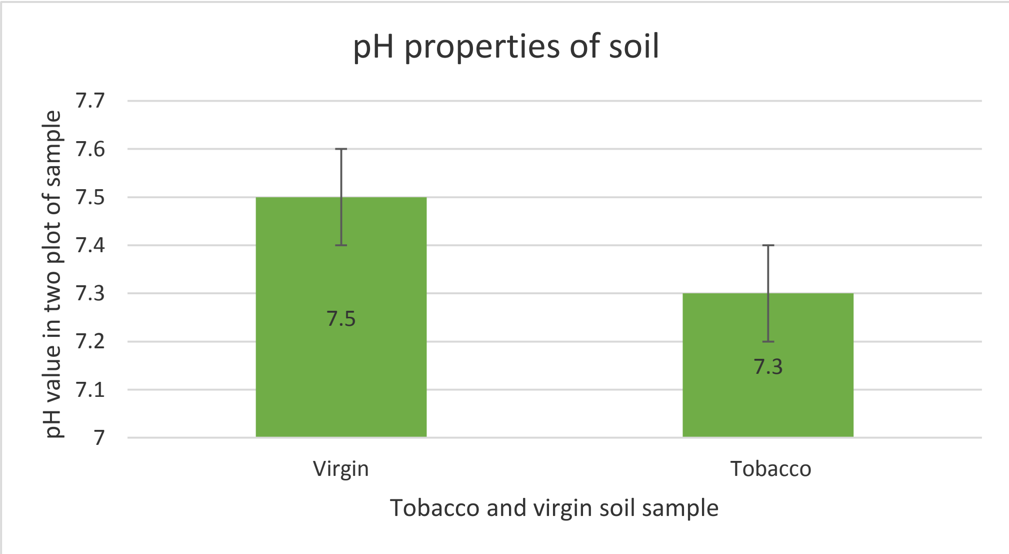

Figure 10: pH properties of tobacco and virgin soil sample. (Black error bars indicate standard deviation)

2.4.1 Electrical conductivity

Soil EC is affected by cropping, irrigation, land use, and application of fertilizer, manure, and compost. Irrigating in amounts too low to leach salts, or with water high in salts, allows salts to accumulate in the root zone, increasing EC. Electrical conductivity also can serve as a measure of soluble nutrients—both cations and anions (Smith, J. L. et al., 1996). Too much fertilizer can increase the salinity, and the depth of the soil can directly affect its electrical conductivity.

Mean EC in tobacco soil is 374.6 µs/cm, and in virgin soil is 222.6 µs/cm (fig.11), both consider non saline but in tobacco soil a little higher than virgin soil, main factor affect in EC in tobacco soil is added many organic and chemical fertilizers so the EC is more than virgin soil. Another factor to low EC in two land is less rainfall occurs or saline irrigation water is used, soluble salts are more likely to accumulate and remain near the soil surface, resulting in high EC (USDA). Therefore in this study site low rainfall in study area and not irrigation so lead to low EC. So the EC in tobacco soil could only affect according to the grade of fertilizer treatment.

A study in Kenya the electrical conductivity values ranged from 0.01 – 0.12 mmho/cm showing the fields to be non-saline, Similar to my studies when converted to mmho/cm, the EC in mmho/cm was 0.03 so also in my study non-saline.

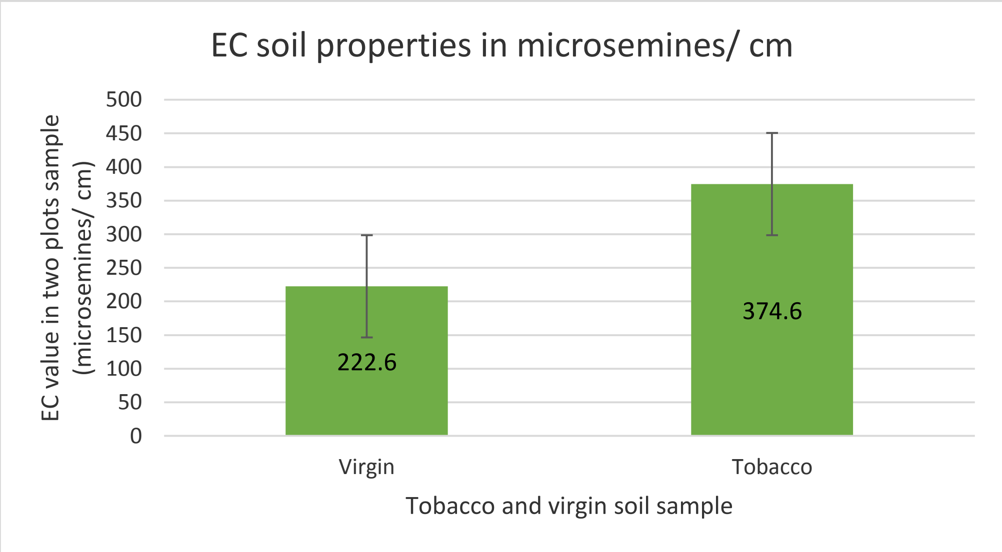

Figure 11: EC properties of tobacco and Virgin soil sample. (Black error bars indicate standard deviation)

2.4 Organic matter content

Mean organic matter content of the tobacco soil is 2% in depth 5 cm, and the mean of virgin soil is 2.1% in same depth (fig.12). The mean organic matter content in depth 10 cm in tobacco and olive trees is 2.7% and 2.4% respectively.

Organic matter is widely regarded as a vital component of a healthy soil. It is an important part of soil physical, chemical and biological fertility. This information examines what soil organic matter consists of and how it can contribute to soil fertility.

In depth 10 cm of tobacco soil higher than others, because added in soil poultry manure this lead to deposition of organic matter in this depth. In the sample number 1.1, at a depth of 10 cm in the tobacco land, the percentage of organic matter content in this sample is 4.8% higher than other samples. This is due to the cultivation of some crops between the tobacco plants, which has accumulation of leaves, thus increasing the percentage of organic matter content. So increasing crop residue by reducing fallow and appropriate fertilization helps increase SOM.

A study in Kushtia District in 2017, the organic matter content value decreases from 1.95% to 1.78% for two consecutive years that was significant. In case of non-tobacco plots, the initial organic matter value was 1.86% before cultivation and at the end of 2nd year it was 1.79% after rabi crop cultivation. In general, the cultivation of tobacco reduces the organic matter content in the soil, but in kushtia not add manure to the soil. So in my study site other factors effects the organic matter content and that led to increase the organic matter content such as added poutry manure.

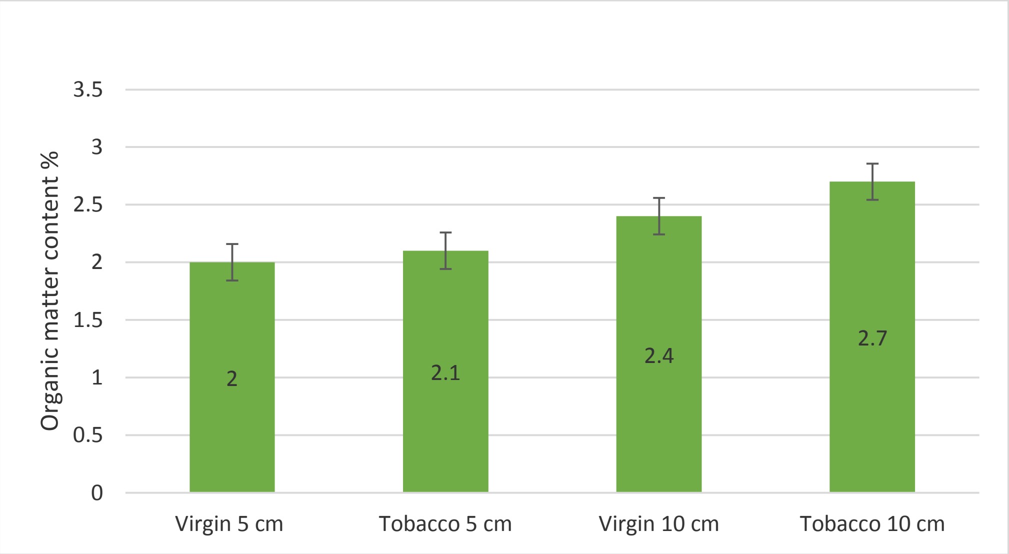

Figure 12: Organic matter content in tobacco and virgin soils. (O.T is controlled soil) (Black error bars indicate standard deviation)

3.4 Macronutrients concentration

1.3.4 Nitrogen:

Total N content of the tobacco soil is 0.25% in depth of 5 cm, and the mean N content in olive trees in the same depth is 0.31% in depth 5 cm, (fig.13). In 10 cm depth in tobacco and olive trees is 0.26% and 0.32% respectively (fig.14). In general there is no significant differences in N-content in both depths.

Organic matter decomposes releasing N more quickly in warm humid climates and slower in cool dry climates, this N release is also quicker in well aerated soils, and much slower on wet saturated soils. In this case study. In my case study climate is semi-arid so release N. Soils that were wet when fertilizers was applied were more likely to dissolve the applied fertilizer than dry soils, but as the soil dries out, dissolved ammonia gas is concentrated in the remaining soil water solution increasing the potential for loss. (Clain Jones, 2013)

In case of my study added manure in tobacco land about 6.6 ton / dunum, but in virgin land don't added any type of fertilizers, so mean Nitrogen more than tobacco soil, one of the main reasons is the nature of the physiological tobacco plant that absorbs the essential elements of the soil and has proved several studies. In this study the absorption of Nitrogen in tobacco soil by 0.06 more than the virgin soil sample, and also increased the proportion of nitrogen at a depth of 10 cm more than 5 cm, due to the deposition of organic matter and ammonium down by the addition of ammonium after that direct tillage and cultivated tobacco crop.

Study in western Kenya the virgin lands showed higher levels of N compared to tobacco farms. (Geist, 1999; Yanda, 2010), similar to my case study in virgin land more N than tobacco soil, since tobacco plants are known to absorb more N, P and K than any other crops. Its high nutrient requirement makes subsequent food crops not to benefit from its residual fertilizer use. Other study in migori Kenya, the Nitrogen content for tobacco sites ranged from 0.17 % to 0.23 %. This range close of my study 0.25%, this confirms that tobacco absorbs the essential nutrients from the soil.

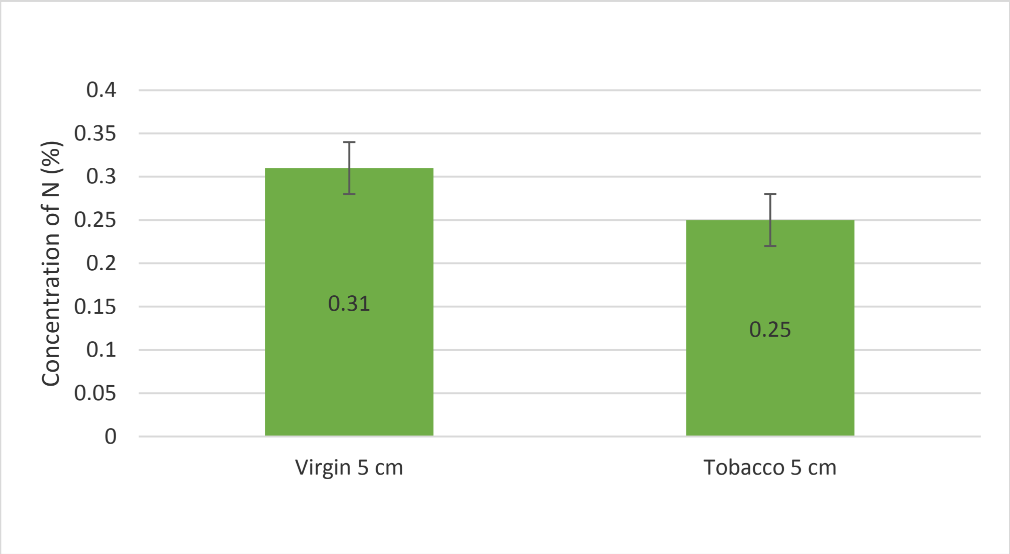

Figure 13: concentration of N in tobacco and virgin soil in depth 5 cm. (Black error bars indicate standard deviation)

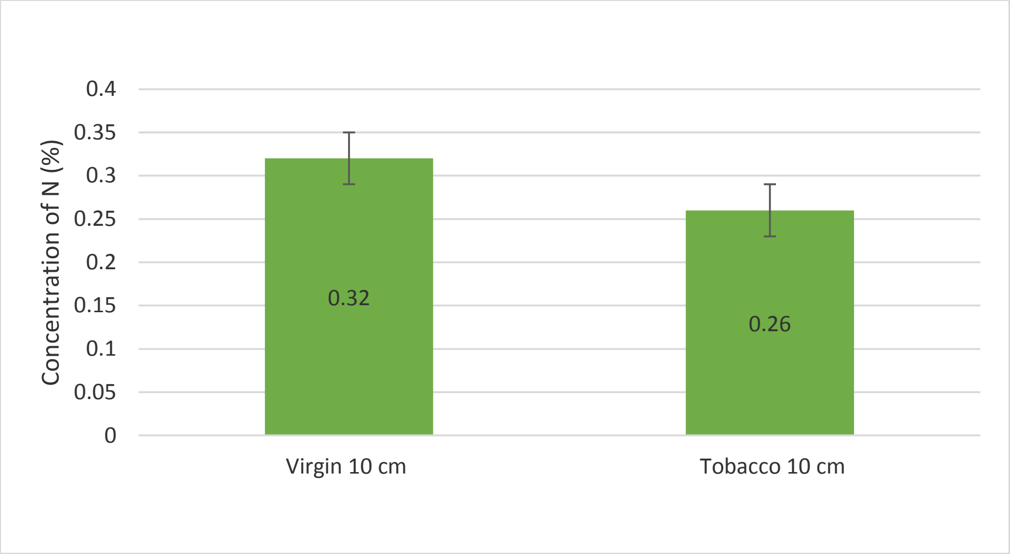

Figure 14: concentration of N in tobacco and virgin soil in depth 10 cm. (Black error bars indicate standard deviation)

2.3.4 Phosphorus:

The average available phosphorus concentration for tobacco in 5 cm depth is 18.21mg/kg, and in virgin soil is 14.55 mg/kg (fig. 15), while at depth of 10 cm, the value is 18.1 and 14.53 mg/kg respectively in tobacco and virgin soil (fig. 16).

Phosphorus in soil is less stable in neutral and alkaline than in acid soils because the diversity and activities of soil organisms decline with increasing acidity. (Menzies, N., & Lucia, S. 2009). According to USDA, Soils with inherent pH values between 6 and 7.5 are ideal for P-availability, while pH values below 5.5 and between 7.5 and 8.5 limits P-availability to plants due to fixation by aluminum, iron, or calcium. But the pH of my study soil range between 6.8 and 7.7(see appendices), so P is more available.

Organic matter decomposes releasing P more quickly in warm humid climates than in cool dry climates. Phosphorus is released faster when soil is well aerated (higher oxygen levels) and in saturated wet soils. In this study in the tobacco land, farmers add organic matter to the soil, so the P content expected to be is more than the control plot. Additional factor is the clay content in the soil, when it increases, sorption capacity increases as well. Clay particles have a large surface area where phosphate sorption can take place (K. Jeschke, 2017). In the two site of sample area the soil is Terra Rossa rich in clay, so the P is available in two sites, but in tobacco site high than control site, because added phosphate fertilizers in tobacco land.

The amount of phosphorus in the soil of tobacco is higher than the virgin soil, due to several reasons that the land planted with tobacco for more than 15 years. Each year is cultivated and fertilized. Phosphate fertilizer or organic fertilizers, successive fertilization helps phosphorus to prove faster in the soil. Its concentration increased to a depth 5 cm more than 10 cm depth, due to the concentration of phosphate fertilizers near the roots of the plant. In this study, the fertilization of phosphate fertilizers with organic fertilizers (in this study the poultry manure) works to convert the phosphate from its triglyceride to its binary and monotonous form, thereby increasing the organic fertilization of the phosphorus availability in the alkaline soil**.**

High temperatures also increase chemical reactions and thus increase the stability of phosphorus. The pH affects the amount of phosphate in the soil so that when the pH rises, the HPO_4 ion prevails (Jianbo Shen, 2011).

In this study, the amount of calcium was very large due to the nature of the soil and parent rock composition, this affect the amount of phosphorus in the soil and reduce the quantity. The phosphorus is usually added to the soil, it is in the form of a super phosphate containing phosphorus that facilitates $Ca(H_2PO_4)_2$ the interaction of calcite $CaCo_3$ and gives $Ca_3(Po_4)_2$.

At a depth of 10 cm we find that the amount of phosphorus is less because of the concentration of organic matter and phosphate fertilizers on the surface of the soil so the amounts of phosphorus larger**.**

A Study in Kushtia district in Kenya, the average P value decreases in non-tobacco land from 13.98 ppm to 9.10 ppm in tobacco land, this is about less 34.90%, becouse not added any fertilizer to land. Compare with my study P in tobacco soil is higher than virgin soil, due to added P fertilizers.

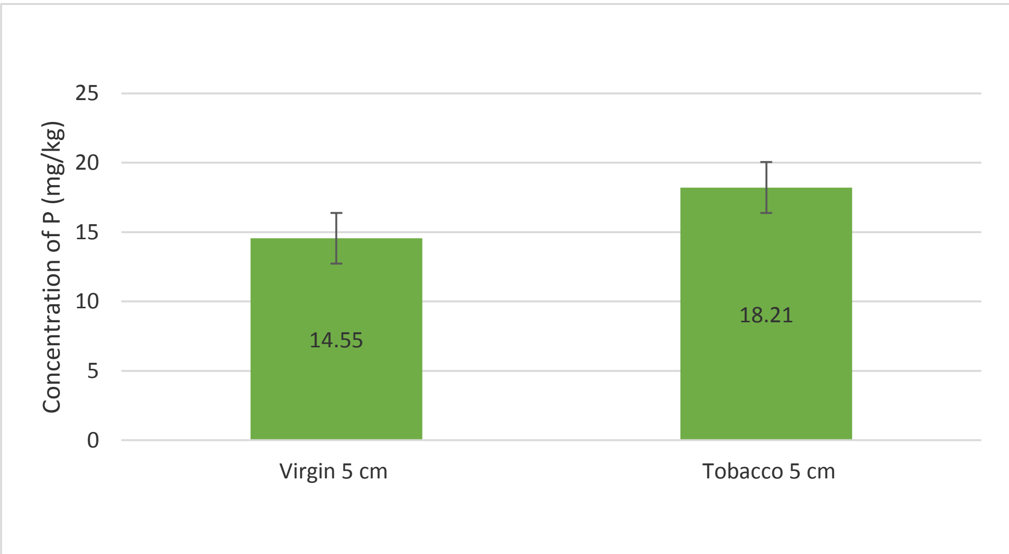

Figure 15: concentration of P in tobacco and virgin soil in depth 5 cm.

(Black error bars indicate standard deviation)

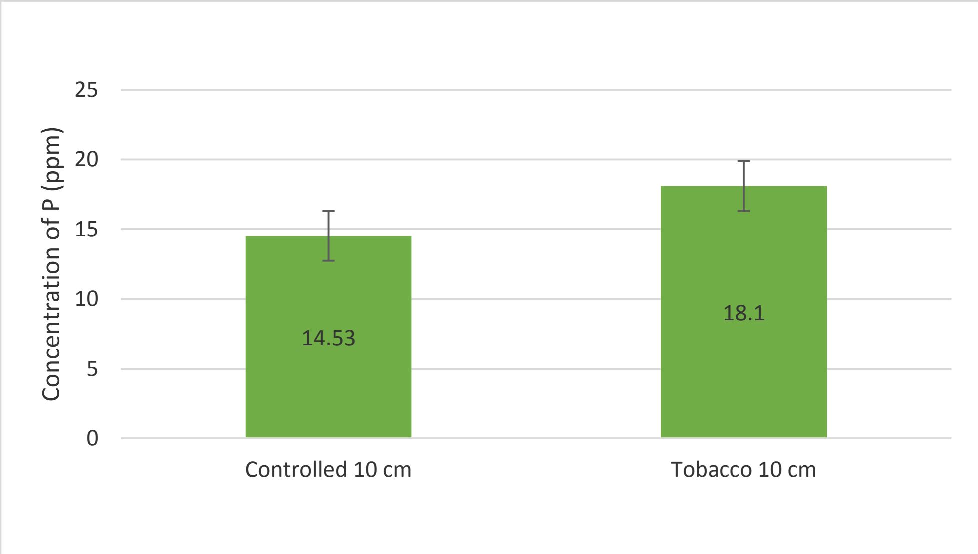

Figure 16: concentration of P in tobacco and virgin soil in depth 10 cm. (Black error bars indicate standard deviation)

3.3.4 Potassium:

The mean of potassium concentration for tobacco soil and virgin soil in depth 5 cm is 342.6 and 279.9 mg/kg respectively (fig. 17), and in depth of 10 cm is 342.9 mg/kg for tobacco, and 279.4 mg/kg in olive trees soil (fig. 18).

During the process of disintegration of the parent rock by physical processes into smaller particles, there is also a slow chemical breakdown of the complex potassium containing compounds into simpler compounds that are soluble and thud available for absorption in to the root hair (Anderson, P. J. et al., 1932). Recommendations for K fertilization rates vary based on soil type, residual soil potassium, application timing, and application method. Potassium demand is supplied by K containing fertilizers due to the naturally low-fertility of the soils in which flue-cured tobacco is commonly produced (Matthew Vann. 2014).

The potassium in organic fertilizers is highly available, because potassium is not organically bound, when the plant dies and decomposes, potassium is released immediately (Robert Parnes, 2013). Such as my case study manure this organic fertilizers added to tobacco soil so the mean concentration in tobacco soil more than virgin plot. In my study add fertilizers potash in tobacco soil before cultivation. But virgin soil is unfertilized.

In literature studies about K concentration, in macdonia the mean K is 246(mg/kg), So the concentration differ from my study soil, these due to some reasons such as soil type, temperature, and other reason that affect in the concentration K in soil.

Phosphorus and Potassium in the land of tobacco was higher than the land of controlled, because of the retention of the element of potassium depends on the presence of silt and organic matter, and the land of tobacco is the attention by added fertilization and the addition of organic materials, has been added fertilizer called Potassium Phosphate before the last plowing and before cultivation. This has contributed to the increase of the potassium in the soil, in addition to the residues of the crops that were planted between the tobacco plant, its degradation leads to increase the percentage of potassium, and also the quality of Terra Rossa soil containing a high percentage of dissolved potassium, and the quantity and type of clay, Potassium is mediated by clay minerals within the hexagonal gap in the Tetra hydra silica layer, and the soil content of the moisture increases the potassium levels in the soil**.**

In the virgin soil, the proportion of potassium is lower and this due to neglect of the land and lack of care for several years, it contributed to the lack of phosphorus and potassium necessary. In the depth of 5 cm in tobacco soil land is higher than depth 10 cm. because added mineral fertilization, and fertilization organic materials treated accumulate of K on the surface of the soil**.**

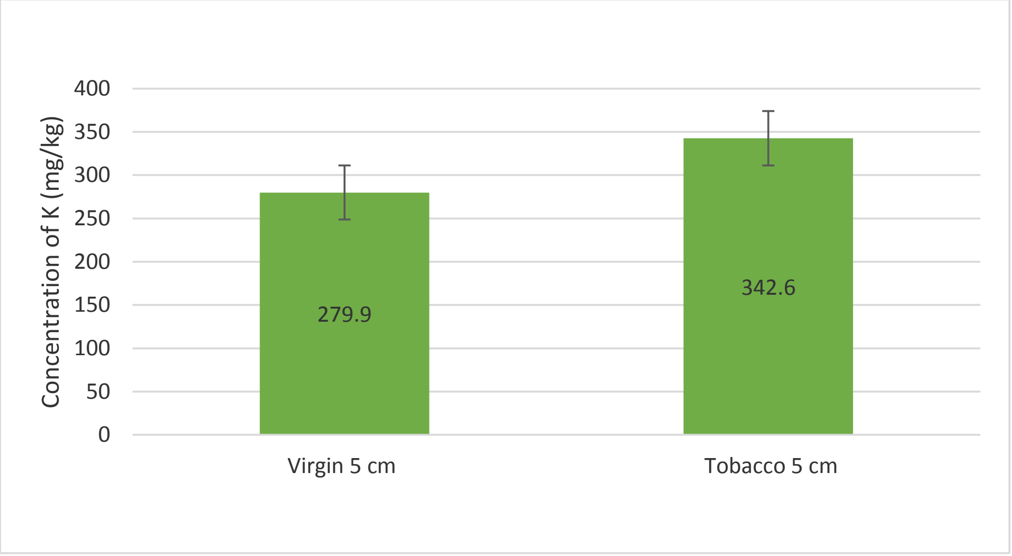

Figure 17: concentration of K in tobacco and virgin soil in depth 5 cm.

(Black error bars indicate standard deviation)

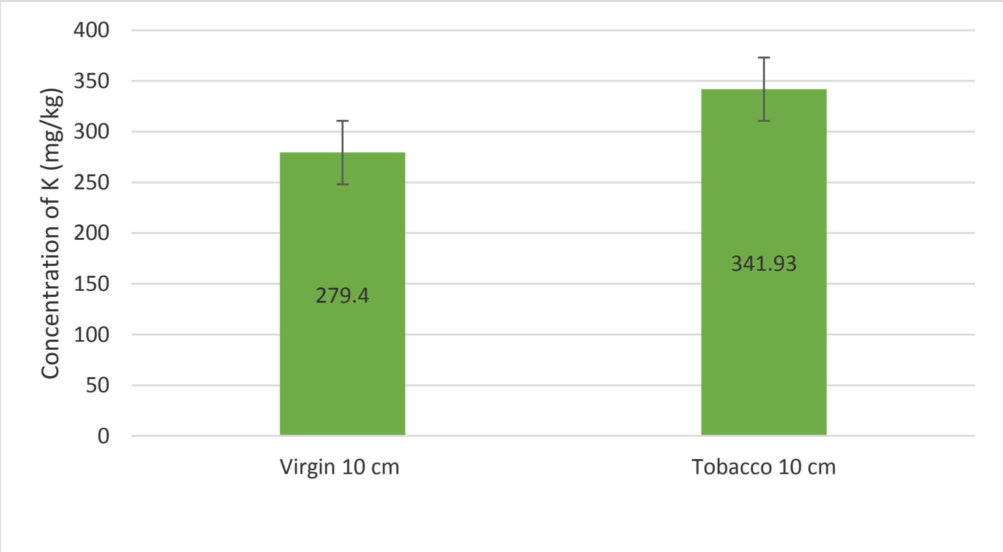

Figure 18: concentration of K in tobacco and virgin soil in depth 10 cm. (Black error bars indicate standard deviation).

4.3.4 Calcium:

The mean Calcium concentration in tobacco soil in depth 5 cm is 1481.9mg/kg, and in virgin soil is 1615.9 mg/kg (fig. 19). While in 10 cm depth in tobacco soil and virgin soil is 1492.3 and 1621.8 mg/kg respectively (fig. 20).

Calcium is an alkaline metal of Group II A on the periodic chart, and is the fifth most abundant element in the earth's crust while being widely distributed in nature. The electronic structure of the calcium cation makes it a unique element that is ideally suited to assist in plant growth. The need for Calcium in agricultural soil has been scientifically proven for many years. The proper levels of calcium need in soils has been questioned by those that benefit from its deficiency in soil (Jim Halbeisen, 2019).

Spectrum Analytic search about Ca^{+2} in soil, and find the reason for Ca available such as the Soil pH, acid soils have less Ca, and high pH soils normally have more. As the soil pH increases above pH 7.2, due to additional Ca, the additional "free" Ca is not adsorbed onto the soil. Much of the free Ca forms nearly insoluble compounds with other elements such as phosphorus (P), thus making P less available. In the land of virgin soil, where the high Calcium ratio is linked because the soil contains calcite significantly and soil origin material, and in the land of olive increase calcium worked to raise the pH to 7.5, Calcium and Phosphate trend to form insoluble Calcium Phosphate salts under alkaline soil conditions. In alkaline soils, Calcium soluble trioxide is also increased, with alkaline calcium increasing between 10-70%, while Ca is an essential element for all plants.

Another reason of high levels of Ca, other cations such as Magnesium, ammonium, iron, aluminum and especially potassium, will reduce the Calcium uptake in some crops. A common misconception is high pH, adequate Calcium is present. This is not always true (TETRA Technologies, Inc. 2018). the K and P in tobacco soil, This is lead to deficiency of Ca^{+2}, also add over doses of K and P fertilizers increase it concentration in the tobacco soil. Then leads to deficiency of Ca.

Generally calcium element there is a significant shortage of tobacco soil. The rates is vary widely. This is due to the fact that the soil of tobacco has been largely fertilized, for example, Potassium fertilization reduces the percentage of Calcium in the soil. There is an inverse relationship with the higher Potassium, Nitrogen and Manganese Soil less Calcium element**.**

In the virgin soil, where the high calcium ratio is linked because the land does not fertilize, so the proportion of calcium in it, and also the soil contains calcite significantly, because of the soil origin material, and in the land of controlled increase calcium worked to raise the pH to 7.5. “Calcium and Phosphate tend to form insoluble calcium phosphate salts under alkaline soil conditions” (Hopkins, B. et al., 2005).

Calcium has been increased with a depth of 10 cm, this possibly due to the deposition of calcite to the soil at this depth, and may be due to the presence of the original material CaO^{-}_{3} significantly in this depth.

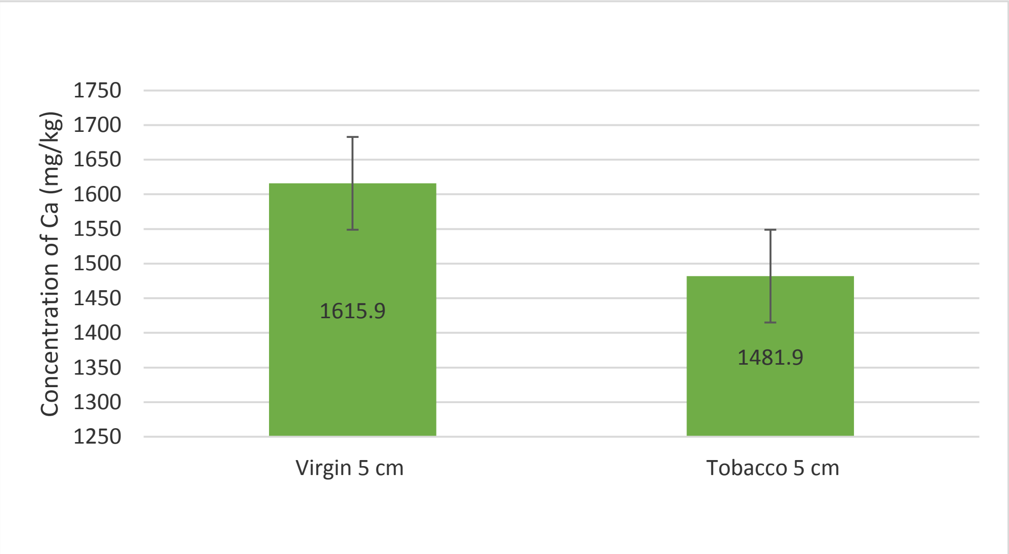

Figure 19: concentration of Ca in tobacco and virgin soil in depth 5 cm. (Black error bars indicate standard deviation)

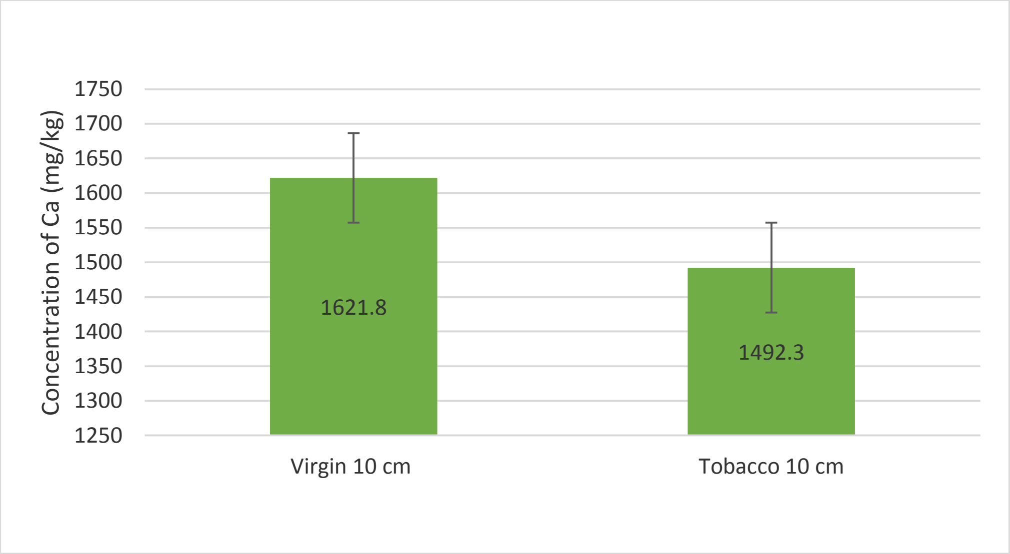

Figure 20: concentration of Ca in tobacco and virgin soil in depth 10 cm. (Black error bars indicate standard deviation)

5.3.4 Magnesium:

The mean of Magnesium concentration in tobacco and virgin soil is 332.2 and 336.9 mg/kg respectively for the 5cm depth (fig.21), while at depth 10 cm (fig.22), in tobacco it was contain 333.2 mg/kg, virgin soil is 338.8 ppm. The Magnesium content the same trend with calcium.

The positive-charged ions, such as Potassium and ammonium may also compete with magnesium and reduce its uptake and translocation from the roots to upper plant parts (Farhat, N., Elkhouni, A. et al., 2016). Therefore, excessive applications of these nutrients might prompt magnesium deficiency.

In my study the percentage of Magnesium in the tobacco soil is less than that of virgin soil. This is due to several reasons and explanations, the most important one is the heavy Potassium fertilization, which works on the absorption of Magnesium, that's prove If excessive Potassium fertilization has induced magnesium deficiency, Epson salts are the best source. (E.E. Shulte. 2004). And the increase in calcium leads to the emergence of symptoms of Magnesium deficiency. In the tobacco soil, the Calcium ratio is very large. This led to lack of Magnesium in the soil.

No enough study conduct analyze the Mg and Ca, just in macdonia, the Calcium was examined in the soil of tobacco was 00.7%. At 5cm depth is less in 10 cm, due to the concentration of fertilizers on the surface of the soil, when fertilizer is added, the ratio of Magnesium in the soil is low.

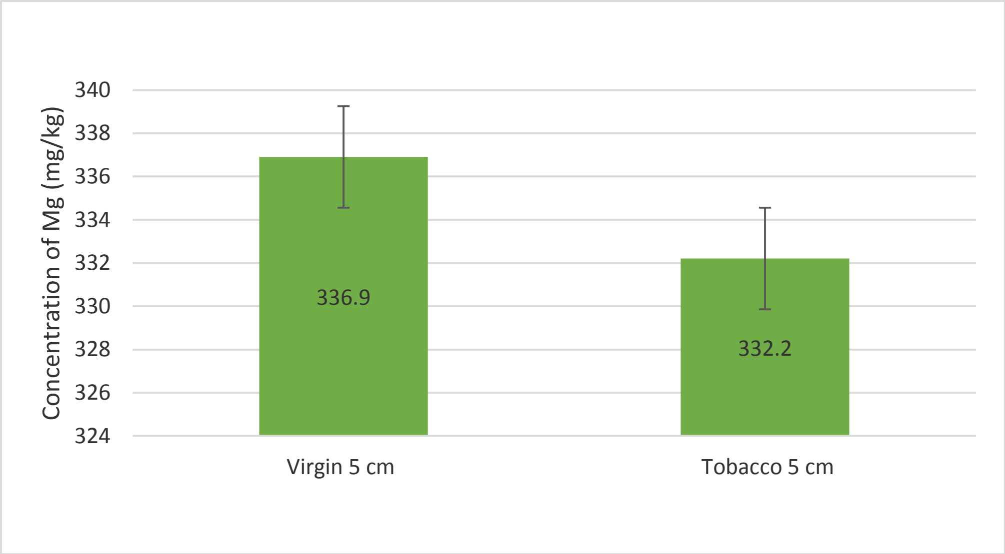

Figure 21: concentration of Mg in tobacco and virgin soil in depth 5 cm. (Black error bars indicate standard deviation)

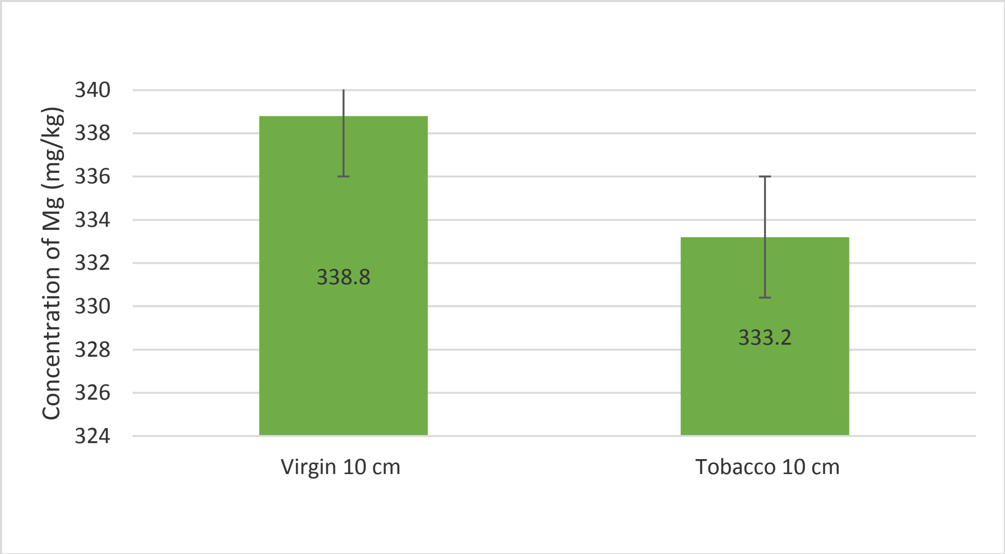

Figure 22: concentration of Mg in tobacco and virgin soil in depth 10 cm. (Black error bars indicate standard deviation)

6.3.4 Sodium:

The mean concentration of Sodium in tobacco and virgin soil is 30.4 and 37.2 mg/kg respectively in 5cm depth (fig. 23), while at the in 10 cm depth (fig. 24), in tobacco soil is 30.7 mg/kg, virgin soil is 37.3 ppm respectively. In both depth 5 cm and 10 cm, the Na concentration in virgin soil is higher than in tobacco.

Soil provides Sodium to plants, there is a natural accumulation of Sodium in soil from fertilizers, pesticides, run off from shallow salt-laden waters and the breakdown of minerals which release salt, excess Sodium in soil gets taken up by plant roots and can cause serious vitality problems in your garden. Let's learn more about sodium in plants. A few varieties of plants need sodium to help concentrate carbon dioxide, but most plants use only a trace amount to promote metabolism. (Bonnie L. Grant. 2019)

For healthy and productive soil, sodium concentration should be less than 1.0 meq/100g (K. M. Wade. 2017). In my study calculate the percent base saturation for Na by calculate the CEC (Table 4, 5). So in tobacco soil concentration of Na is 0.9 meq/100g, that is less than 1.0 meq/100g, so the acceptable percent, but in virgin soil the concentration is 1.7 meq/100g, this is more than 1.0 meq/100g, because increase concentration of Ca in virgin land.

Ken Clancy is a Professional Agrologic specializing in turf grass fertility with Fusion Turf Nutrition, conduct as soil Sodium levels increase led to calcium levels decrease. And its soluble calcium gives soil its friable, loamy, permeable structure. A continued decline in soluble calcium brought on by ever increasing soil Sodium causes the soil to lose these favorable structural properties, resulting in impaired drainage and increased compaction. But In this study the Ca in tobacco soil is decreased at the same time decrease the Na, this is because the add K, P fertilizers that lead the decrease the Ca.

Generally, Sodium is needed by the plant as an essential element, but in limited quantities. Because increasing it causes salinity problems in the ground. The Sodium component is also related to the electrical conductivity of the soil, EC is low lead to decrease Na in tow land. Another reason most salts such as sodium and Boron come originally from irrigation water, and land of tobacco or the land of virgin is not irrigation**.** And at a depth of 5 cm less than the Na level in depth 10 cm. It can be due to sodium accumulation around the root area.

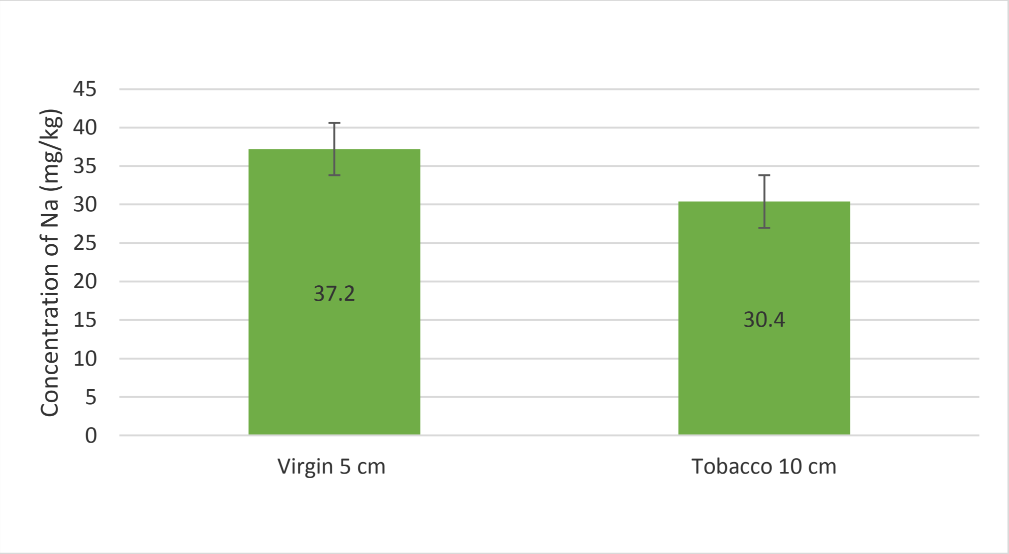

Figure 23: concentration of Na in tobacco and virgin soil in depth 5 cm. (Black error bars indicate standard deviation)

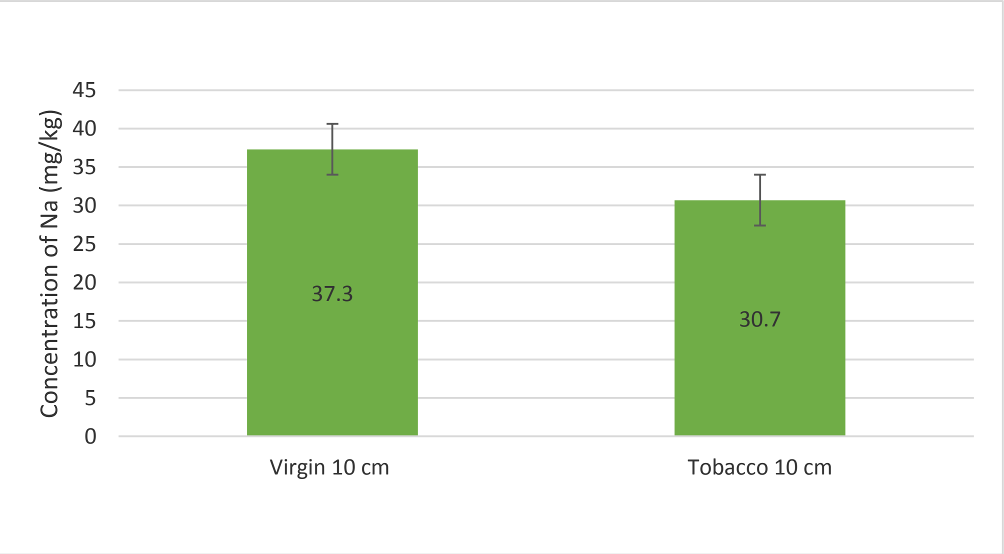

Figure 24: concentration of Na in tobacco and virgin soil in depth 10 cm. (Black error bars indicate standard deviation)

7.3.4 CEC and nutrient, pH

Organic matter has a very high CEC ranging from 250 to 400 meq/100 g (Moore 1998). A higher CEC usually indicates more clay and organic matter is present in the soil. High CEC soils generally have greater water holding capacity than low CEC. The lower the CEC of a soil, the faster the soil pH will decrease with time. Clay soil particles and organic matter carry a negative charge on their surfaces. Cations are attracted to the negatively-charged particles by electrostatic forces. The Percent Base Saturation is then calculated from these values by dividing the milliequivalents (ARIT EFRETUEI & FILED UNDER SOIL, 2016). Soil Science Society of America determine CEC in a soil by multiply ppm of K, Mg,Ca, Na on 390, 120, 200 and 230 The following is the Millequivelent weight of K, Mg, Ca and Na in 2,000,000 pounds of soil. Then these value. Finally calculate percent base saturation as follows.

% base saturation = (Ca + Mg + K + Na) / CEC x 100

The following tables is the CEC for tobacco and controlled soil in K, Mg, Ca, Na and pH=7.3.

Table 4: The CEC and Percent Base Saturation for tobacco soil in K, Mg, Ca, Na at pH=7.3.

Tobacco soil	K	Mg	Ca	Na	Total
CEC	0.97	2.77	7.4	0.1	11.2 meq/100 gm
Percent Bas Saturation	8.6%	24.7%	66%	0.9%	-

Table 5: The CEC and Percent Base Saturation for virgin soil in K, Mg, Ca, Na at pH=7.5.

Controlled so	K	Mg	Ca	Na	Total
CEC	0.77	2.8	8.1	0.2	11.9 meq/100 gm
Percent Bas Saturation	6.5%	23.5%	68%	1.7%	-

Soils with a low CEC are more likely to develop deficiencies in potassium (K+), magnesium (Mg2+) and other cations while high CEC soils are less susceptible to leaching of these cations (CUCE 2007). In tobacco soil CEC is 11.2 less than virgin soil 11.9, but small different, some nutrient defecincy in tobacco soil sach as Ca, Mg, and others nutrient such as K deficient in virgin soil.The result (Table 4,5) show the largest factor in the calculation is that of calcium. Soil exchange sites contain mostly calcium; however, in higher pH value large amounts of free calcium may also be present in soil solution which may also be extracted in the test reflecting a higher holding capacity than what the texture analysis would actually indicate.

4.4 Micronutrient and heavy metals

Many heavy metals are essential for plants and animals when present in the growing medium in low concentrations (micronutrients: Cu, Zn, Fe, Mn, Mo, Ni, and Co); they become toxic only when a concentration limit is exceeded (in which case the term 'heavy metals' rather than 'micronutrients' is used). Micronutrient are important for gene expression, biosynthesis of proteins, nucleic acids, growth substances, chlorophyll and secondary metabolism, stress tolerance, etc. micronutrients are also involved in the structural and functional integrity of various membrane and other cellular components. (Rengel, Z. 2004). My study study will concentrate on B, Fe, Cu, Cd, Zn, Ni and Mn.

1.4.4 Boron:

The mean concentration of B in tobacco soil and virgin soil is 0.59 and 0.34 mg/kg respectively in 5cm depth (fig.25), and in 10 cm depth (fig.26), in tobacco soil is 0.51 mg/kg and virgin soil is 0.29 mg/kg.

Boron in soil solution as boric acid and borate ions. The Boron in soil solution is available to plants (mainly as boric acid). The ratio between the Boron concentration in the soil solution and the Boron adsorbed to soil particles is affected by clay minerals, free oxides and organic matter, other factors such as type and concentration of salts in the soil, pH and temperature. Availability / solubility of boron is pH dependent, boron deficiency is a problem on alkaline soils (Soil pH >7.0). Boron is easily leached from the soil. In my case study the soil is alkaline, there is deficiency of B. (Ahmad, W., Zia, M. H., et al 2012).

Soluble salts are leached out, available B is largely held in the organic matter. Organic matter can assist in reducing B loss from soils and at the same time hold the element in an available form. Although organic matter does influence B availability it is greatly conditioned by such factors as moisture content of soil, the pH status and the degree of decomposition of the organic matter (Bot, A. et al., 2005). In my case study in the tobacco soil 5 cm higher than 10 cm depth, because added organic matter and some fertilizers so greater availability of B than the 10 cm depth. In the virgin soil is less than tobacco soil because some research indicates severe nitrogen deficiency may reduce a plant's ability to uptake boron. (K. M. Wade. 2017).

Increase pH leads to low boron (Sá, A. A. D, et al., 2016), such as the virgin and tobacco soil pH is 7.5 and 7.3, so boron is. At a depth of 5 cm increased more than 10 cm depth due to the concentration of fertilizer on the surface so boron increases.

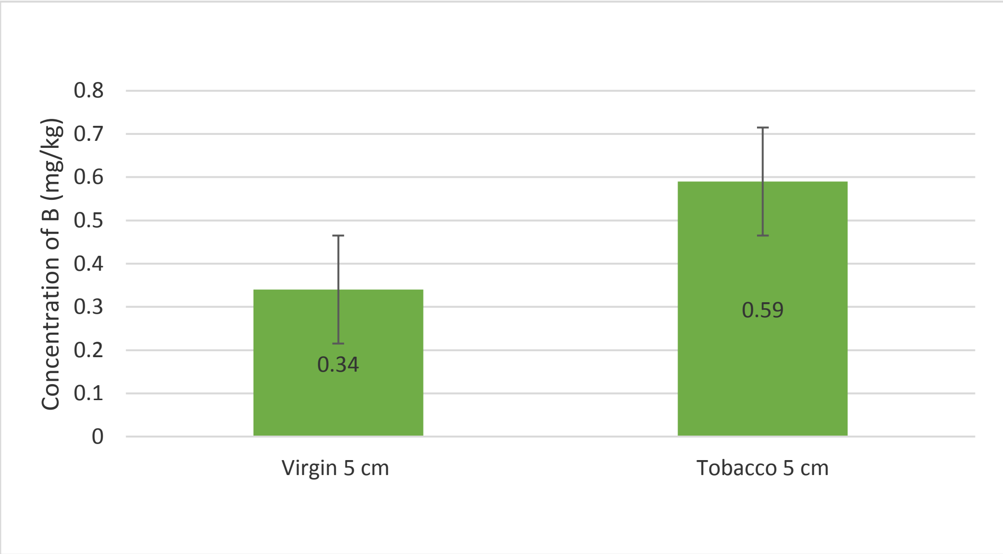

Figure 25: concentration of B in tobacco and virgin soil in depth 5 cm. (Black error bars indicate standard deviation)

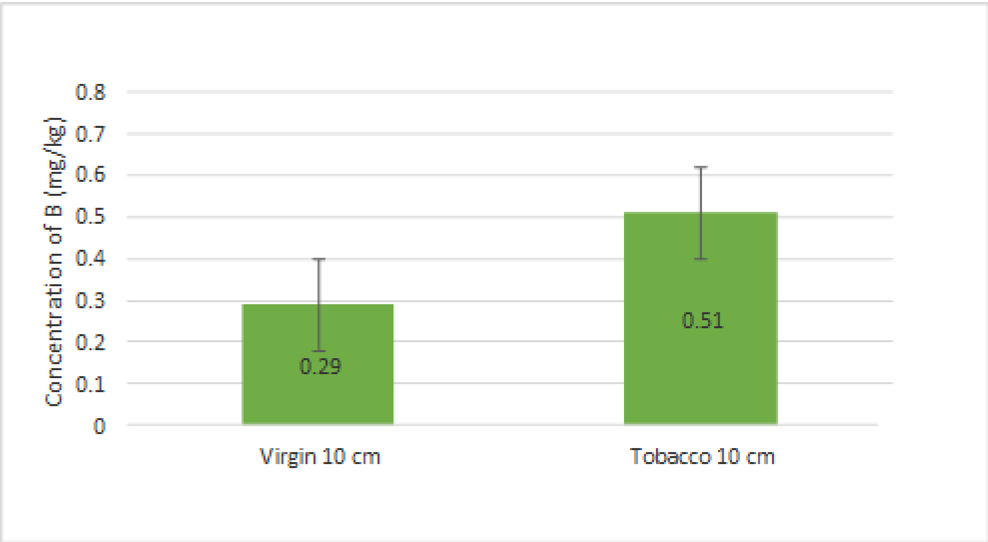

Figure 26: concentration of B in tobacco and virgin soil in depth 10 cm. (Black error bars indicate standard deviation).

2.4.4 Iron:

The mean value of iron concentration in tobacco and virgin soil in depth 5 cm is 7.79 and 4.82 mg/kg (fig. 28), and in 10 cm depth the mean value in tobacco is 5.38 mg/kg and virgin soil is 3.24 mg/kg (fig. 29). In the surface soil high value than the subsurface soil.

In the Palestinian territories, iron is highly monolithic, but it is found on the non-absorbable image, because the ratio of solubility or reciprocity is very low, especially in neutral or alkaline soil. Iron is found of tobacco soil much larger than virgin soil, the best concentration of iron is 4.5 mg/kg (Irmak, et al., 2008). The reason for the high percentage of iron in the tobacco soil is due to phosphate fertilization, which transforms dissolved iron into an insoluble image, because of the union of iron with phosphate ion.

The tobacco plant can be physiologically unable to absorb iron, and there may also be many of retention reactions such as adsorption and sedimentation, although the total concentration of the iron element in most calcareous soils significantly exceeds the requirement of the plant (Fageria, 2001).

Many organic matter can also be source of iron (E. E. Schulte. 2004), such as in my study added poultry manure. At the depth of 5 cm, iron ratio greater than in 10 cm depth due to the accumulation of phosphate fertilizer and other organic materials in 5 cm depth.

Generally, high pH reduces iron availability, low pH increases it. Soil that is alkaline or has had too much lime added often causes an iron deficiency in the plants in the area. This correct it easily by adding an iron fertilizer, or evening out the pH balance in the soil by adding garden sulfur. In my study soil is alkaline, so the low availability of iron, but in tobacco soil due to use of phosphate fertilizers lead to high Fe.

The result in this study agree with the macdonia study Influence from the open coal deposit in was detected by higher concentrations of Fe, above 5 %, measured. These values are higher than the Fe content in European topsoil average of 2.2 % (Salminen et al., 2005).

Relationship between Fe and other element different from element to other, but in general, excessive amounts of soluble P, or high rates of P fertilizer, have been demonstrated to inhibit Fe uptake in many crops, and high Zn availability reduces Fe uptake. K appears to play a very specific, but poorly understood role in the utilization of Fe. Some research indicates that low K availability can result in increased Fe uptake (Morgan, 2013). This all case matching my study.

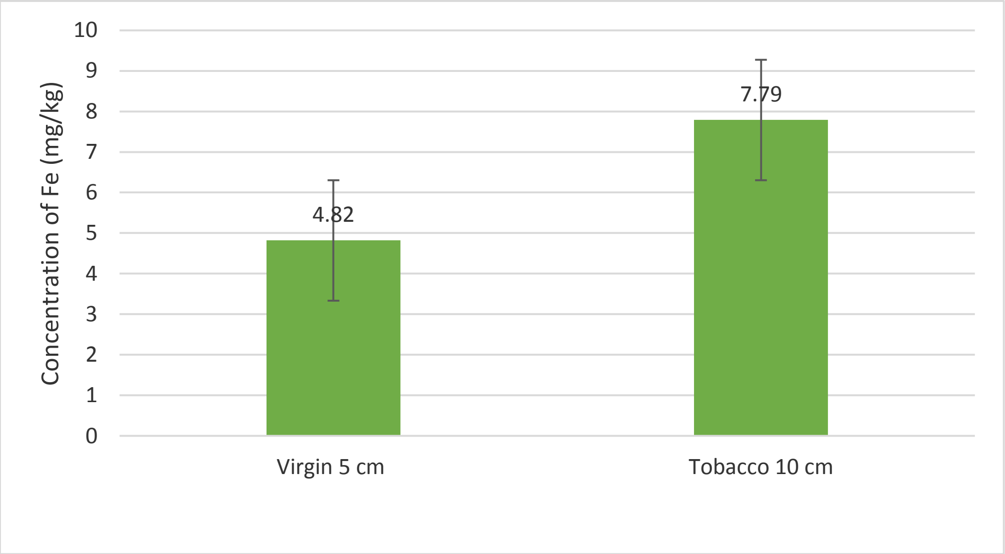

Figure 27: concentration of Fe in tobacco and virgin soil in depth 5 cm. (Black error bars indicate standard deviation)

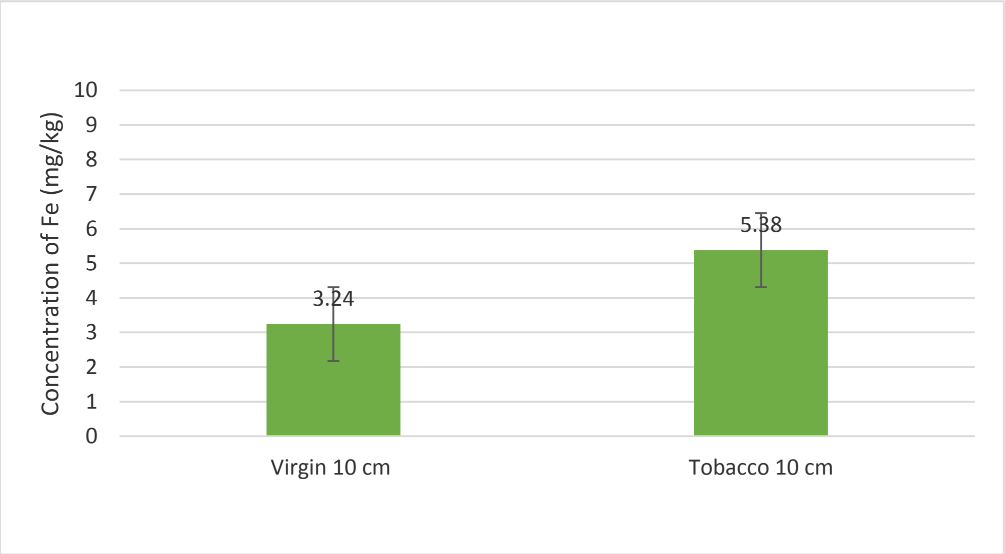

Figure 28: concentration of Fe in tobacco and virgin soil in depth 10 cm. (Black error bars indicate standard deviation)

3.4.4 Cu, Cd, Zn, Ni and Mn:

The mean concentration in order Zn, Cu, Ni, Cd, Mn in tobacco soil (5 cm depth) is 0.22, 0.24, 0.27, 0.06, 0,05 mg/kg respectively, in tobacco soil (10 cm) is 0.27, 0.18, 0.15, 0.1, 0.07 mg/kg respectively (fig.30, 31). In virgin land the mean concentration in 5 cm depth in order Zn, Ni, Cu, Cd, Mn is 0.24, 0.18, 0.16, 0.1, 0.04 mg/kg respectively, in virgin soil depth 10 cm is 0.2, 0.12, 0.12, 0.04, 0.05 mg/kg respectively.

Organic matter and soil pH are the predominant factors influencing Copper availability Soils that already have high alkaline content (above 7.5), as well as soils pH levels increased, result in lower copper availability (Harter, 1983). In my study the pH value in both plots is less than 7.5. The soil studied during the investigation was sufficient in available Copper content as per the critical limit of 0.2 ppm (Lindsay and Novell, 1979). The accumulation of the available Copper content in the treated alkaline soils as compared to the untreated alkaline soil might be due this could describe to the presence of considerable amount of Copper in the paddy husk ash (Srimurali, M., et al., 2014). In tobacco plot Cu concentration is 0.24, but this is due to the soil is treated by fertilizers, manures, and use pesticides this lead to this concentration.

Copper levels also drop when amount of organic matter is increased. Organic matter usually hampers the availability of copper by reducing soil mineral fixation and leaching, However once organic matter has sufficiently decomposed, and adequate copper can be released into the soil and taken up by plants. (Harter, 1983). So in my study in the tobacco plot was added organic matter (manure) but concentration of Cu is close to the critical limit.

Excess Phosphorus can reduce copper uptake (K. M. Wade. 2017), in this study agree with this, the P in tobacco soil was deficiency in P so the Cu increase than from virgin soil. It was excess P in virgin soil lead to Cu less than in tobacco soil. Few study conduct the concentration of Cu in tobacco soil, some of these agree with my study, and other don't agree with my study. Such as in western Kenya the concentration of Cu is 1.67 mg/g. This value is more than my study but close of it. In this study heavy metals such as copper and zinc have been shown to affect the concentration of beneficial metal such as calcium and magnesium.

Cadmium in soils is derived from both natural and anthropogenic sources, natural sources include underlying bedrock or transported parent material such as glacial till and alluvium. Anthropogenic input of cadmium to soils occurs by aerial deposition and sewage sludge, manure and phosphate fertilizer application. Adsorption and distribution in soils are pH, soluble organic matter content, hydrous metal oxide content, clay content and type, presence of organic and inorganic ligands, and competition from other metal ions (OECD 1994). The use of Cadmium-containing fertilizers and sewage sludge is most often quoted as the primary reason for the increase in the cadmium content of soils over the last 20 to 30 years in Europe (Jensen and Bro-Rasmussen, 1992).

In tobacco land add phosphate fertilizers led to concentration of Cd in depth 10 cm (0.1 mg/kg) more than the control plot (0.04 mg/kg). In case of the depth 5 cm, the concentration of Cd is high in control plot (0.1 mg/kg) than the tobacco plot (0.06 mg/kg). This is because vehicle traffic that causes the accumulation of cadmium from burning fuel or it could be because of the coals worshiped where it spread in a city worshiping the coal industry and was leading to the production of harmful gases and minerals and their accumulation in the soil.

In western Kenya the concentration of Cd is 1.57 mg/g. and in Bulgaria the concentration Cd is 1.3 mg/kg. This due to different in soil type and human activity and other factor.

Soil acidity pH influences the availability of Zinc more than any other factor (E.E. Shulte. 2004). Availability of zinc decreases with increasing soil pH due to increased adsorptive capacity, when rapidly decomposable organic matter, such as manure, is added to soils, Zinc may become more available because the formation of soluble organic Zinc complexes which are mobile and probably capable of absorption into plant roots (Alloway, 2008)

High levels of phosphorus may decrease the availability of Zinc or the onset of Zinc deficiency associated with phosphorus fertilization may be due to plant physiological factors. Higher concentrations of copper in the soil solution, relative to Zinc, can reduce the availability of Zinc to a plant (Alloway, B. J. 2004).

In this study in tobacco soil the pH is the alkalinity, result in my study vary from tobacco plot and control plot. In the topsoil the concentration of Zn in olive trees 0.24 mg/kg (control plot) is more than the tobacco plot 0.22 mg/kg. This is due to excess in Ca in control plot. But in subsurface (in depth 10 cm) the concentration of Zn in tobacco soil 0.27 mg/kg is more than control plot 0.2 mg/kg. This is due to accumulation of fertilizer and organic matter in this depth resulted from tillage, or due to higher concentration in Cu in this depth more than subsoil.

All manures contain Zinc derived from the original animal diet (e.g. grass, hay, cereals etc), but additional amounts of Zinc may have been intentionally added to livestock diet. Some compounds used as fertilizers can contain significant amounts of zinc. Superphosphate is the fertilizer which has been found to contain the highest concentrations of zinc (< 600 mg Zn kg-1) (Alloway, B. J. 2004). In this study don’t add superphosphate.

In general, factors influenced the Zinc content are pH, organic matter content, clay content, calcium carbonate content, redox conditions, microbial activity in the rhizosphere, soil moisture status, concentrations of other trace elements, concentrations of macro-nutrients, especially phosphorus and climate (Alloway, B. J. 2004).

In western Kenya the concentration of Zn is 0.76 mg/g, metals contained in the agrochemicals used during tobacco production such as reported in this study (Kibwage et al., 2008). Some metals on the plants sprayed with pesticides (Maobe et al., 2012). In this study use agrochemical and pesticides such as rodemel and confidore. Other reference conduct the same range The soil content of Nickel may be as low as 0.2 mg kg^{-1} or as high as 450 mg kg^{-1} (Ahmad and Ashraf, 2011).

In case of my study original rock is sedimentary include calcium carbonate, so the Ni is low. In the tobacco soil in two depth is high than the virgin soil although the same soil type, but in soil tobacco added some fertilizers and pesticides, it’s led to increase the concentration of Ni in depth 5 cm from 0.27 mg/kg to 0.18 mg/kg, and in depth 10 cm from 0.15 mg/kg to 0.12 mg/kg. In 5 cm depth high than 10 cm depth, because fertilizer added in surface soil. The lowest contents of Ni are found in sedimentary rocks that comprise of clays, limestones, sandstones and shales, while the highest concentrations exist in basic igneous rocks (Kabata-Pendias and Mukherjee, 2007).

Soil pH is the major factor controlling Nickel solubility, mobility and sorption, while clay content, iron- manganese mineral and soil organic matter being of secondary importance. (Iyaka, Y. A. (2011). In my study the soil is alkalinity. In soil, the most important sinks for Nickel other than soil minerals are amorphous oxides of iron and manganese. The mobility of Nickel in soil is site-specific, depending mainly on the soil type and pH. The mobility of Nickel in soil is increased at low pH (Richter and Theis, 1980)

Study in Western Kenya the concentration of Cd is 0.81 mg/g. Second study was in Bulgaria the concentration Ni is 56.7 mg/kg. This due to different in soil type and human activity and other factor. Such as anthropogenic influence in these areas, and due to low levels of clay.

The last micronutrient is Manganese, Plant is available in low quantities Mn when the soil is saturated with water The Manganese available for plant increases with the increasing concentration of hydrogen ion down soil pH Alkaline soil reduces plant absorption of Manganese nitrates accumulate in plants where the concentration of Manganese is increased Manganese reactions in soils are quite complex. (Adriano, 2001). The amount of available manganese is influenced by soil pH, organic matter content, and moisture and soil aeration. Manganese availability increases as soil pH decreases. Manganese toxicity is common in acid soils below pH 5.5. On the other hand, manganese deficiency is most common in soil with a pH above 6.5. So in my study the pH is above 6.5, so the Mn is deficiency. So Manganese deficiency is most common on alkaline and poorly drained soils as well as those high in available iron (K. M. Wade. 2017).

Soils with high organic matter (more than 6.0%) and pH (above pH 6.5) may be cause deficient in manganese. As the organic matter content increases, the amount of exchangeable Mn decreases due to the increased formation of organic matter and Mn complexes, also soil microorganism appear to reduce the availability of Manganese by oxidizing manganese to less available forms and competing with crops for available Manganese (E.E. Shulte. 2004), in my study added organic matter so the Mn deficiency.

And the Interaction with other elements, such as excess iron reduces manganese uptake by plant, this case similar in this case study. In this study excess iron in control plot, so the Mn less than tobacco plot. Other element low nitrogen levels can reduce manganese uptake by plants, it’s the same this study the N is deficiency, so the Mn is very low. Excessive Ca and P in the diet interfere with the absorption of Mn (Welch et al., 1991).

There is no big difference in the concentration of manganese either in tobacco soil or control soil. However, manganese tobacco soil is higher due to the addition of fertilizers and pesticides containing manganese**.**

In Western Kenya the concentration of Cd is 0.69 mg/g. Second study was in Thessaly region the concentration Mn is 1.4 mg/kg. This due to different in soil type and human activity and other factor. This is because different soil type and other factors. Such as anthropogenic influence in these areas, and due to low levels of clay.

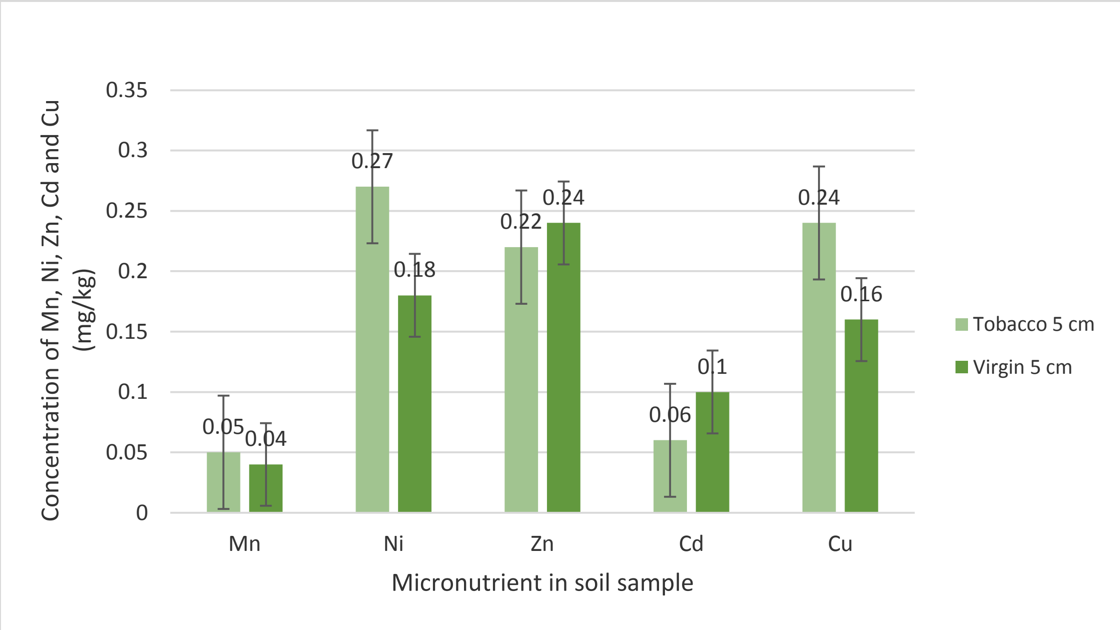

Figure 29: concentration of Cu, Cd, Zn, Ni and Mn in tobacco and virgin soil in depth 5 cm. (Black error bars indicate standard deviation).

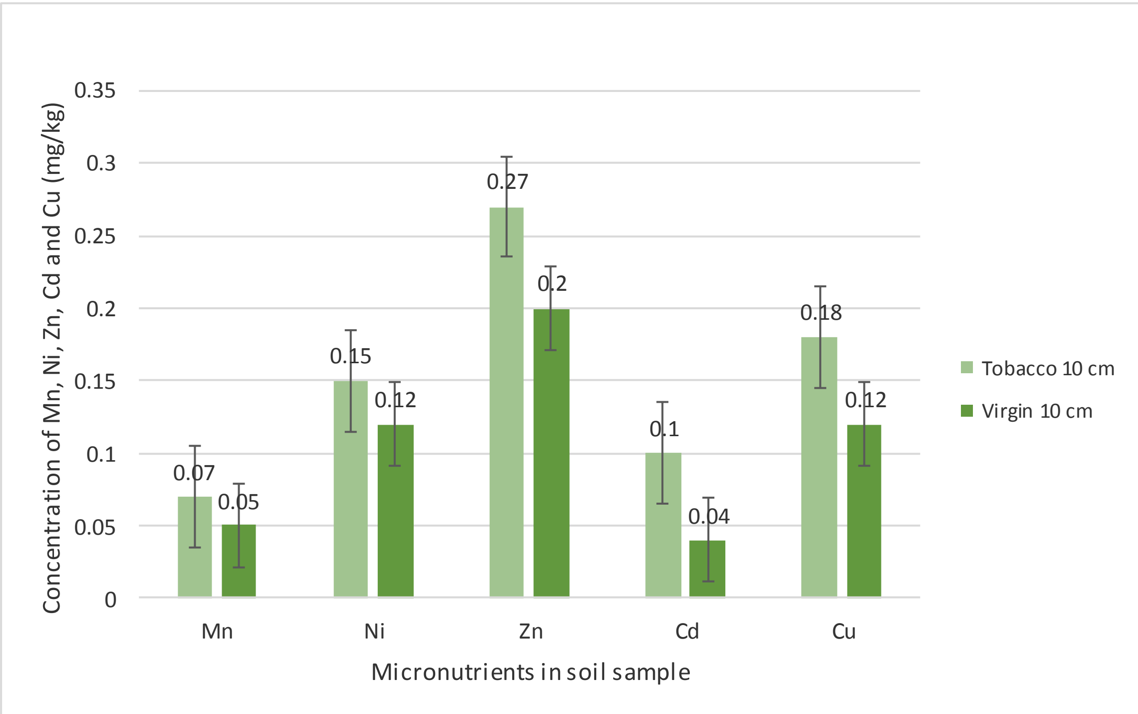

Figure 30: concentration of Cu, Cd, Zn, Ni and Mn in tobacco and virgin soil in depth 10 cm. (Black error bars indicate standard deviation)

In general, the chemical properties of the soil are closely related to the availability of essential nutrients that play an important role in the growth and development of tobacco plants. (Hermiyanto, et al., 2016). So comparing the 5 cm and 10 cm depth (fig. 32) (fig.33), we find that there are differences in the concentrations of micro and macronutrients increases or decreases, at a depth of 5 cm concentrated organic materials and fertilizers and there is an accumulation of pesticides. The main nutrients P and K, increase on the soil of controlled plot, the first reason is that the soil of tobacco is fertilized with phosphate fertilizers in large quantities, so its concentration on the 5 cm depth more than 10 cm depth, and the second reason for the lack of concentrations of these elements, although the olive crop is recommended to grow, especially in alkaline soil, but in olives soil not fertilized or add organic matter, not plowed and weeded so there is a lack of these elements (P, K).

Nitrogen is the element that has the highest effect on the growth and quality of 'flue-cured' tobacco (Parker, 2009). In this study Nitrogen deficiency in the soil of tobacco compared to controlled soil, this is due to soil of tobacco is not sufficiently fertilized with ammonia, so the tobacco soil needs to fertilize large, and 10 cm depth higher than the 5 cm depth. Due to accumulation of fertilizer in previous years.

Calcium, magnesium are also clearly lacking in tobacco soil, the main reason being the addition of potassium phosphate fertilizers (Cecilio Filho. et al., 2017). Also the lack of sodium is due to the fact that the soil is alkaline, so the soil is not salty. These elements are also at a depth of 10 cm higher than the 5 cm.

Boron is most readily available for plant uptake at soil water pH between 5.0 and 7.0. Above a pH of 7.0 is when most B deficiency cases have been observed. This occurs because un dissociated boric acid, $B(OH)_3$, is the predominant form of plant available B at pH between 5.0 and 7.0 (Raven, 1980), so in general boron is low in my study, due to pH alkalinity. But there is higher amount of boron at a depth of 5 cm in the soil of tobacco than the 10 cm depth, although several studies have shown the accumulation of boron in the soil grown by tobacco**.**

The percentage of Iron in the soil of tobacco is much higher than the control soil, because of the addition of phosphate fertilizer, which combines with iron atoms (Fink, Inda, et al., 2016). It is possible that the nature of the physiological plant is unable to absorb iron. Although addition of organic fertilizers in tobacco lead higher Fe. Increase the pH in the soil reduces the availability of iron as in the control plot.

In the tobacco soil, the concentration of Zinc was increased at a 10 cm depth than a 5 cm depth. The accumulation of Zinc was in 10 cm deep due to the organic matter concentrate in this depth. In depth 5 cm the concentration of Nickel increased in tobacco soil due to the addition of pesticides that increased the concentration of Nickel on the surface**.**

The lowest percentage is Manganese and Cupper in literature studies have shown, and the ratios are low in both deep in the tobacco and the control site, because it increases the concentration of Manganese in lower pH. In this case the alkaline soils have very little focus. And also because the organic matter in the soil increases its concentration to about 6.0%. The pH is approaching to the neutral occurring in the Manganese deficiency. And Cadmium in study area the main reason is coal industry and this leading to the production of harmful gases and minerals and their accumulation in the soil.

At a depth of 10 cm, all the proportions of the micro elements in the tobacco soil were higher than the olive soil. There was a difference in both depths, where Zinc and Cadmium were at a depth of 5 cm less in the tobacco soil.

Conclusion:

All living things are made from the chemical elements, in a pretty narrow range of proportions, so whether they be plants or animals, if they are deficient in one or more of the elements / nutrients they won't thrive, or worse they will become sick, and even die From my study conclude that the cultivation of tobacco in Palestine has an effect on some nutrients, there is a significant decrease and other nutrients that have no effect. The use of fertilizers whether chemical or natural, soil type, pH and cation exchange capacity, has a great effect on the results. K and P were higher in tobacco soils because of farmers concentration on the addition of potassium and phosphorus compost, while N is less in tobacco soil than virgin soil, due to added ammonia but slightly, in spite of the addition of manure soil machine, which increases the proportion of nitrogen in the soil, but there was a shortage of nitrogen because of the large absorption of nitrogen by tobacco plant, where the tobacco plant leaf crop, work on the absorption of nitrogen because it contributes to the process of photosynthesis, and also Ca and Mg has been a shortage of tobacco soil and this was due to fertilization The large phosphate potash reduces the calcium and magnesium in the soil. Na in the soil is low and the yield depends on irrigation. Here, the crops are not irrigated in either case. B percentage in tobacco soil was higher due to the addition of fertilizers containing boron, and also due to alkaline soil. Fe was higher in tobacco soil due to the addition of manure, which led to an increase in the proportion of iron in the soil of tobacco, finally Zn, Cu, Ni, Cd, Mn did not have significant statistical differences between the two lands. But tobacco is slightly higher, this indicates that continued cultivation of tobacco can work on the accumulation of heavy metals.

There are several criteria that must be taken, these necessary for the soil's sustainability. These criteria include land attention, regular tillage, crop rotation, good standard soil fertilization and pest control, result of that success of crop and the sustainability of soil, in the study area is the focus on the conservation of tobacco land and fertilize enough, because it belongs to the community economic benefit.

Recommendation:

- Cultivation of the tobacco crop should be within the soil health standards, and the commitment to grow crops rotation after tobacco cultivation to restore soil fertility.

-Farmers' commitment to appropriate fertilization programs when cultivation of tobacco. So there is need Study in Palestine about tobacco fertilization index.

-Do not neglect the land, whatever the type of crop because it affects the productivity of crops, and reclamation of soil

- Nitrogen requires careful management, as it is very susceptible to being lost from soils. Nitrogen can be lost from the soil through leaching, denitrification, erosion and surface volatilization. Nitrogen is more readily leached in sandy soils than in fine texture soils. If not properly applied, nitrogen loss can account for up to 50-60% of the applied amount. So focus on fertilizing the soil of tobacco with ammonia. And use of fertilizers containing essential nutrients with a proportion of micronutrients such as N_{15}, P_{15} ,$K_{15.}$

- Conduct a study to reverse this study, the land is not fertilizers planted with tobacco, other land is fertilized planted with another crop to obtain accurate results.

- Calcium is most nutrient effect of tobacco cultivation in case of my study, so should to reduce uses of phosphate and potassium fertilizers to maintain calcium in appropriate average. And add Calcium nitrate

-Results of this study recommended that for increasing crops productivity of tobacco could be achieved by improving the soil chemical properties such as CEC, total N and available P.

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Appendixes

A. Description statistics for elements in tobacco soil samples (Extract)/Concentration element in mg/kg

	depth	B	Fe	Mn	Ni	Cu	Zn	Cd
Mean	0-5	0.59	7.79	0.05	0.27	0.24	0.22	0.06
	5-10	0.51	5.38	0.07	0.15	0.18	0.27	0.10
Standard Error	0-5	0.04	0.91	0.01	0.06	0.05	0.04	0.02
	5-10	0.03	0.55	0.02	0.02	0.01	0.05	0.06
Median	0-5	0.59	7.21	0.04	0.17	0.18	0.16	0.02
	5-10	0.49	4.95	0.03	0.13	0.15	0.17	0.01
Mode	0-5	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
	5-10	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Standard Deviation	0-5	0.15	3.66	0.03	0.24	0.22	0.18	0.09
	5-10	0.13	2.21	0.10	0.07	0.05	0.19	0.23
Sample Variance	0-5	0.02	13.37	0.00	0.06	0.05	0.03	0.01
	5-10	0.02	4.87	0.01	0.01	0.00	0.19	0.05
Kurtosis	0-5	-0.97	5.83	1.07	1.70	12.19	10.88	4.54
	5-10	-0.49	0.61	7.33	1.87	-0.60	0.58	11.51
Skewness	0-5	-0.23	1.91	1.28	1.68	3.36	3.17	2.16
	5-10	0.06	0.89	2.74	1.47	0.79	1.45	3.31
Range	0-5	0.45	16.36	0.10	0.75	0.91	0.73	0.31
	5-10	0.44	8.43	0.36	0.26	0.17	0.54	0.91
Minimum	0-5	0.35	2.70	0.02	0.09	0.11	0.10	0.01
	5-10	0.28	1.81	0.01	0.08	0.11	0.12	0.01
Maximum	0-5	0.80	19.05	0.12	0.84	1.02	0.84	0.31
	5-10	0.73	10.24	0.37	0.34	0.28	0.66	0.91
Sum	0-5	9.46	124.7	0.74	4.39	3.88	3.55	0.95
	5-10	8.11	86.05	1.05	2.45	2.80	4.26	1.63
Count	0-5	16.00	16.00	16.00	16.00	16.00	16.00	16.00
	5-10	16.00	16.00	16.00	16.00	16.00	16.00	16.00

B. Description statistics for elements in control plot (olive trees) soil samples (Extract)/Concentration element in mg/kg

	depth	B	Fe	Mn	Ni	Cu	Zn	Cd
Mean	0-5	0.34	4.82	0.04	0.18	0.16	0.24	0.10
	5-10	0.29	3.24	0.05	0.12	0.12	0.20	0.04
Standard Error	0-5	0.05	7.76	0.01	0.05	0.02	0.03	0.08
	5-10	0.02	4.11	0.02	0.04	0.01	0.02	0.01
Median	0-5	0.32	48.21	0.04	0.14	0.13	0.20	0.02
	5-10	0.29	31.59	0.04	0.12	0.12	0.20	0.03
Mode	0-5	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
	5-10	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Standard Deviation	0-5	0.16	26.87	0.03	0.16	0.06	0.11	0.26
	5-10	0.06	13.64	0.07	0.12	0.04	0.07	0.04
Sample Variance	0-5	0.03	721.95	0.00	0.03	0.00	0.01	0.07
	5-10	0.00	186.16	0.00	0.01	0.00	0.00	0.00
Kurtosis	0-5	7.10	4.24	8.42	7.71	0.02	-0.97	10.84
	5-10	0.80	0.37	10.24	10.25	-0.87	0.60	5.38
Skewness	0-5	2.42	1.76	2.75	2.61	0.43	0.85	3.28
	5-10	0.73	1.03	3.15	3.16	0.23	1.13	2.14
Range	0-5	0.64	101.57	0.12	0.58	0.22	0.30	0.86
	5-10	0.22	44.65	0.24	0.42	0.23	0.22	0.14
Minimum	0-5	0.17	19.71	0.02	0.05	0.06	0.13	0.01
	5-10	0.20	20.32	0.01	0.05	0.07	0.12	0.00
Maximum	0-5	0.81	121.28	0.14	0.63	0.28	0.43	0.87
	5-10	0.42	64.97	0.25	0.47	0.18	0.34	0.14
Sum	0-5	4.13	603.19	0.47	1.98	1.73	2.63	1.12
	5-10	3.21	405.92	0.60	1.29	1.34	2.20	0.41
Count	0-5	11.00	11.00	11.00	11.00	11.00	11.00	11.00
	5-10	11.00	11.00	11.00	11.00	11.00	11.00	11.00

C. Description statistics for Major elements for tobacco soil samples (AAS):

	depth	N	P	K+	Ca+	Mg+	Na+
Mean	0-5	0.25	18.21	342.56	1481.90	332.23	30.45
	5-10	0.26	18.10	341.93	1492.30	333.18	30.73
Standard Error	0-5	0.01	0.29	4.90	21.20	3.17	1.47
	5-10	0.01	0.31	4.90	21.80	3.29	1.49
Median	0-5	0.26	18.13	349.82	1486.30	335.10	29.67
	5-10	0.26	17.95	349.29	1495.75	335.60	29.97
Mode	0-5	0.26	17.07	319.90	1565.04	348.03	23.64
	5-10	0.24	17.07	319.90	1565.04	348.03	23.64
Standard Deviation	0-5	0.05	1.62	27.29	118.06	17.64	8.19
	5-10	0.05	1.72	27.30	121.39	18.32	8.30
Sample Varianc	0-5	0.00	2.63	744.81	13937.83	311.04	67.11
	5-10	0.00	2.97	745.38	14735.45	335.69	68.83
kurtosis	0-5	-0.62	0.10	-1.15	-0.93	-0.04	4.93
	5-10	-0.70	0.01	-1.15	-0.95	-0.15	4.25
skewness	0-5	-0.40	0.65	0.04	0.07	-0.72	1.96
	5-10	-0.33	0.52	0.11	-0.01	-0.69	1.80
range	0-5	0.16	6.55	92.39	429.92	68.16	37.20
	5-10	0.18	7.25	92.39	429.92	72.39	37.20
minimum	0-5	0.16	15.65	301.52	1276.85	287.59	19.88
	5-10	0.16	14.95	301.52	1276.85	287.59	19.88
maximum	0-5	0.32	22.20	393.91	1706.77	355.75	57.08
	5-10	0.34	22.20	393.91	1706.77	359.98	57.08
sum	0-5	7.85	564.64	10619.40	45938.76	10299.26	943.80
	5-10	7.93	561.11	10599.72	46261.42	10328.62	952.68
count	0-5	31.00	31.00	31.00	31.00	31.00	31.00
	5-10	31.00	31.00	31.00	31.00	31.00	31.00

D. Description statistics for Major elements for control plot (olive trees) soil samples (AAS):

	depth	N	P	K+	Ca+	Mg+	
Mean	0-5	0.31	14.55	279.90	1615.95	336.31	37.24
	5-10	0.32	14.53	279.40	1621.84	338.12	37.27
Standard Error	0-5	0.02	0.21	6.21	21.27	3.28	2.09
	5-10	0.02	0.20	6.27	21.40	3.08	2.09
Median	0-5	0.30	14.77	271.60	1595.75	339.33	35.69
	5-10	0.30	14.59	271.60	1598.11	340.32	35.69
Mode	0-5	0.39	15.12	267.93	#N/A	#N/A	#N/A
	5-10	0.28	15.12	267.93	#N/A	#N/A	#N/A
Standard Deviation	0-5	0.08	0.98	29.80	102.01	15.72	10.04
	5-10	0.08	0.98	30.09	102.61	14.76	10.03
Sample Variance	0-5	0.01	0.97	888.05	10406.84	247.05	100.72
	5-10	0.01	0.97	905.57	10529.09	217.92	100.52
kurtosis0.07-0.71-0.600.58-0.42-0.87	0-5	-1.08	-0.40	0.67	-0.34	-0.82	0.06
	5-10	-0.87	-0.42	-0.58	-0.60	-0.71	-0.07
skewness	0-5	-0.18	-0.45	0.61	0.83	-0.19	0.68
	5-10	-0.23	-0.40	0.63	0.66	0.27	0.67
range	0-5	0.28	3.71	125.98	351.19	54.73	36.75
	5-10	0.28	3.71	125.98	351.19	50.75	36.75
minimum	0-5	0.17	12.47	225.41	1481.57	308.73	22.29
	5-10	0.17	12.47	225.41	1481.57	312.71	22.29
maximum	0-5	0.45	16.18	351.39	1832.76	363.46	59.04
	5-10	0.45	16.18	351.39	1832.76	363.46	59.04
sum	0-5	7.18	334.54	6437.65	37166.78	7735.14	856.63
	5-10	7.25	334.18	6426.11	37302.22	7776.68	857.24
count	0-5	23.00	23.00	23.00	23.00	23.00	23.00
	5-10	23.00	23.00	23.00	23.00	23.00	23.00

E. Concentration of macronutrients of tobacco soil samples in 5 cm depth.

ID Sample	Depth	N	P	K+	Ca+	Mg+	Na+
1.1	0-5	0.259	18.48	351.65	1362.9	330.62	29.07
1.2	0-5	0.168	17.42	321.73	1486.3	323.91	25.9
1.3	0-5	0.315	18.84	351.92	1495.8	328.63	24.7
1.4	0-5	0.231	17.42	304.67	1582.4	342.81	23.64
2.1	0-5	0.245	18.13	359.53	1497.3	335.1	29.67
2.2	0-5	0.294	19.54	371.6	1413.9	355.25	30.42
2.3	0-5	0.224	20.25	360.84	1343.8	313.21	21.23
2.4	0-5	0.238	19.19	307.82	1276.9	287.59	23.64
3.1	0-5	0.259	18.48	381.05	1586.3	337.09	33.13
3.2	0-5	0.263	16.71	320.42	1590.2	340.07	35.69
3.3	0-5	0.28	18.84	393.91	1448.5	352.01	33.73
3.4	0-5	0.322	22.2	349.82	1365.8	304	27.71
4.1	0-5	0.196	17.07	319.9	1435.1	315.45	30.12
4.2	0-5	0.175	16.89	301.52	1645.4	348.03	32.98
4.3	0-5	0.308	16.18	352.18	1605.2	355.75	57.08
4.4	0-5	0.322	15.83	338.53	1706.8	352.51	36.6

F. Concentration of macronutrients of tobacco soil samples in 10 cm depth

ID Sample	Depth	N	P	K+	Ca+	Mg+	Na+
1.1	5-10	0.266	17.95	349.29	1355.9	325.4	28.01
1.2	5-10	0.161	17.07	319.9	1505.2	320.67	24.85
1.3	5-10	0.303	19.01	356.12	1477.6	334.85	25
1.4	5-10	0.238	17.95	302.31	1565	345.55	23.04
2.1	5-10	0.261	17.07	356.38	1508.4	330.12	31.02
2.2	5-10	0.287	20.07	373.18	1397.3	348.03	29.97
2.3	5-10	0.217	20.96	359	1316.2	318.43	19.88
2.4	5-10	0.247	19.01	311.76	1297.3	298.28	21.99
3.1	5-10	0.27	18.31	376.33	1565	341.07	34.04
3.2	5-10	0.252	17.24	314.12	1563.5	335.6	33.43
3.3	5-10	0.262	18.31	387.35	1478.4	349.78	35.09
3.4	5-10	0.308	21.49	357.43	1346.1	309.73	26.96
4.1	5-10	0.203	16.54	314.65	1401.3	323.16	28.92
4.2	5-10	0.185	16.54	310.97	1686.3	346.04	31.17
4.3	5-10	0.294	15.65	343.52	1632.8	350.52	55.12
4.4	5-10	0.336	14.95	331.97	1685.5	359.98	37.95

G. Concentration of macronutrients in olives soil samples in 5 cm depth.

ID Sample	Depth	N	P	K+	Ca+	Mg+	Na+
1*1	0-5	0.213	14.77	268.71	1561.1	308.73	33.43
1*2	0-5	0.28	14.59	267.93	1492.6	340.32	51.51
1*3	0-5	0.287	15.65	351.39	1731.2	352.76	57.38
2*1	0-5	0.217	13.88	312.55	1534.3	342.56	39.31
2*2	0-5	0.371	13.53	255.59	1832.8	335.1	37.2
2*3	0-5	0.168	15.12	306.51	1527.2	357.24	35.69
3*1	0-5	0.315	15.3	271.6	1693.4	330.62	26.96
3*2	0-5	0.392	14.95	277.11	1614.7	332.11	31.48
3*3	0-5	0.448	13.88	296.27	1598.1	358.23	37.35
4*1	0-5	0.378	12.82	268.98	1550.9	312.96	44.73
4*2	0-5	0.364	15.12	225.41	1595.8	313.96	22.89
4*3	0-5	0.294	15.3	267.93	1685.5	341.82	32.08

H. Concentration of macronutrients in olives soil samples in 10 cm depth.

ID Sample	Depth	N	P	K+	Ca+	Mg+	Na+
1*1	5-10	0.231	14.24	259.53	1546.1	312.71	30.42
1*2	5-10	0.297	15.12	274.75	1481.6	345.55	50.15
1*3	5-10	0.277	15.3	337.74	1789.5	348.03	59.04
2*1	5-10	0.203	13.53	305.72	1517.8	340.57	38.25
2*2	5-10	0.392	13.18	261.63	1807.6	333.61	35.39
2*3	5-10	0.175	16.01	298.64	1553.2	363.46	34.94
3*1	5-10	0.301	14.59	259.79	1712.3	331.62	24.85
3*2	5-10	0.406	14.77	286.3	1605.2	339.33	30.12
3*3	5-10	0.427	14.24	288.4	1620.2	352.01	38.4
4*1	5-10	0.399	12.47	262.94	1539.8	323.16	42.77
4*2	5-10	0.343	16.18	232.23	1576.1	318.68	22.29
4*3	5-10	0.28	14.41	257.17	1696.5	350.27	34.04

I.Concentration of micronutrients in olives soil samples in two depths.

	11 B [1]		57 Fe [1]		27 Al [2]		55 Mn [2]		60 Ni [2]		63 Cu [2]		66 Zn [2]		111 Cd [2]	
Sample Name	Conc. Mg/kg	Conc. RSD	Conc. Mg/kg	Conc. RSD	Conc. Mg/kg	Conc. RSD	Conc. Mg/kg	Conc. RSD	Conc. Mg/kg	Conc. RSD	Conc. Mg/kg	Conc. RSD	Conc. Mg/kg	Conc. RSD	Conc. Mg/kg	Conc. RSD
d5 1.1	0.55	2.17	7.09	1.31	0.36	2.82	0.04	0.59	0.16	1.76	0.11	0.70	0.10	2.89	0.01	4.35
d5 1.2	0.71	1.50	7.32	0.96	0.40	1.41	0.02	3.36	0.10	0.63	0.13	0.63	0.15	1.07	0.06	6.12
D5 1.3	0.66	1.83	9.05	1.04	0.57	2.00	0.02	3.22	0.57	0.24	0.21	0.36	0.38	1.46	0.02	1.50
d5 1.4	0.72	1.97	19.05	1.05	0.94	1.10	0.05	1.79	0.77	2.06	0.27	2.16	0.19	1.48	0.17	2.96
d5 2.1	0.80	0.34	8.37	0.19	0.57	1.32	0.02	2.89	0.11	6.03	0.14	2.52	0.12	6.50	0.01	38.47
d5 2.2	0.77	1.15	10.52	2.41	0.51	1.72	0.02	0.92	0.31	2.32	0.29	1.27	0.15	3.62	0.31	0.72
d5 2.3	0.57	1.68	8.81	1.72	0.65	1.33	0.03	4.93	0.12	1.52	0.14	2.63	0.20	4.83	0.01	3.41
d5 2.4	0.47	1.77	5.80	0.44	0.97	3.15	0.05	1.28	0.14	1.95	0.14	1.75	0.16	2.80	0.16	1.17
d5 3.1	0.78	0.77	6.97	0.69	0.68	2.66	0.07	2.65	0.12	2.33	0.20	1.20	0.21	1.41	0.01	4.28
d5 3.2	0.43	1.62	5.12	1.79	0.25	4.17	0.02	0.84	0.22	1.46	0.18	1.05	0.19	5.67	0.01	7.76
d5 3.3	0.56	0.66	6.54	0.28	0.42	1.16	0.08	3.46	0.22	1.20	0.21	1.11	0.15	3.62	0.03	7.81
d5 3.4	0.36	1.06	2.70	2.75	0.70	2.07	0.04	0.59	0.84	1.99	0.18	2.56	0.15	2.94	0.01	5.10
d5 4.1	0.60	1.12	9.12	1.32	0.61	1.81	0.09	2.32	0.18	1.45	0.13	0.21	0.14	3.46	0.03	4.51
d5 4.2	0.64	1.50	8.91	1.75	0.77	2.17	0.04	2.38	0.28	1.57	0.38	2.30	0.27	2.14	0.01	8.08
d5 4.3	0.35	2.70	5.23	0.81	0.69	2.91	0.04	2.82	0.09	2.35	0.14	0.97	0.14	2.20	0.07	1.90
d5 4.4	0.50	1.94	4.09	1.91	1.37	0.90	0.12	0.92	0.16	1.02	1.02	1.21	0.84	0.74	0.02	4.33
d5 1*1	0.27	0.39	3.59	0.91	0.62	2.11	0.04	1.01	0.63	2.70	0.13	1.90	0.39	2.31	0.08	2.80
d5 1*2	0.30	1.88	5.60	0.73	0.18	5.62	0.02	2.79	0.05	2.43	0.07	3.63	0.04	7.90	0.00	9.43
d5 1*3	0.32	1.75	7.25	1.01	0.73	3.36	0.04	3.20	0.19	2.24	0.20	1.70	0.20	1.18	0.87	1.35
d5 2*1	0.24	2.11	3.44	1.79	0.51	1.48	0.02	1.82	0.10	1.07	0.10	1.01	0.16	1.62	0.01	5.73
d5 2*2	0.43	1.56	4.76	1.51	0.46	1.06	0.02	0.67	0.15	0.82	0.12	0.85	0.14	3.32	0.01	9.67
d5 2*3	0.23	1.23	3.80	1.35	1.29	0.85	0.14	1.96	0.06	1.66	0.13	1.12	0.26	0.96	0.01	6.28
d5 3*1	0.33	1.99	3.99	0.67	0.58	1.55	0.04	3.01	0.14	3.07	0.18	0.38	0.18	0.35	0.02	3.71
d5 3*2	0.17	3.10	1.13	3.77	0.43	4.04	0.05	1.79	0.05	5.41	0.06	3.74	0.15	4.93	0.02	6.60
d5 3*3	0.38	1.90	5.50	2.18	0.67	3.07	0.04	3.42	0.14	0.90	0.22	1.68	0.38	2.43	0.03	5.90
d5 4*1	0.34	1.70	4.04	1.42	0.59	3.43	0.05	1.15	0.18	1.05	0.19	0.92	0.43	2.69	0.01	8.77
d5 4*2	0.31	2.10	5.14	1.80	0.79	3.45	0.03	2.12	0.11	3.25	0.13	1.36	0.13	3.98	0.03	3.01
d5 4*3	0.81	1.92	10.35	1.67	0.79	0.30	0.03	1.69	0.24	2.44	0.28	0.78	0.21	2.10	0.02	4.50

J. Concentration of micronutrients of tobacco soil samples in two depths.

	11 B [1]		57 Fe [1]		27 Al [2]		55 Mn [2]		60 Ni [2]		63 Cu [2]		66 Zn [2]		111 Cd [2]	
d10 1.1	**0.67**	**1.58**	**9.22**	**1.33**	**1.48**	**2.40**	**0.08**	**1.19**	**0.34**	**0.62**	**0.28**	**1.11**	**0.29**	**0.65**	**0.04**	**2.36**
d10 1.2	**0.61**	**2.59**	**4.97**	**1.66**	**0.14**	**11.76**	**0.02**	**1.98**	**0.10**	**0.93**	**0.13**	**0.83**	**0.21**	**1.04**	**0.01**	**16.10**
d10 1.3	**0.39**	**0.49**	**3.31**	**0.71**	**0.46**	**2.38**	**0.03**	**1.12**	**0.10**	**3.00**	**0.13**	**0.73**	**0.16**	**3.76**	**0.01**	**19.88**
d10 1.4	**0.45**	**0.86**	**4.05**	**2.22**	**1.30**	**0.33**	**0.22**	**1.97**	**0.21**	**2.39**	**0.23**	**2.90**	**0.66**	**2.52**	**0.03**	**6.01**
d10 2.1	**0.47**	**0.80**	**5.12**	**0.96**	**0.68**	**2.07**	**0.04**	**3.39**	**0.21**	**0.54**	**0.16**	**0.88**	**0.12**	**4.14**	**0.02**	**4.30**
d10 2.2	**0.50**	**1.54**	**4.46**	**2.01**	**0.24**	**0.86**	**0.01**	**2.19**	**0.10**	**5.30**	**0.14**	**0.90**	**0.16**	**2.40**	**0.01**	**11.23**
d10 2.3	**0.32**	**1.62**	**3.52**	**2.18**	**0.53**	**1.84**	**0.03**	**3.38**	**0.08**	**3.18**	**0.11**	**2.96**	**0.13**	**3.67**	**0.01**	**12.40**
d10 2.4	**0.46**	**0.73**	**4.04**	**0.97**	**0.37**	**1.62**	**0.03**	**1.64**	**0.12**	**3.61**	**0.12**	**0.65**	**0.18**	**2.53**	**0.91**	**0.98**
d10 3.1	**0.49**	**0.51**	**4.63**	**1.16**	**0.55**	**2.40**	**0.03**	**0.27**	**0.16**	**0.63**	**0.13**	**1.22**	**0.14**	**1.56**	**0.01**	**8.06**
d10 3.2	**0.50**	**1.60**	**8.06**	**0.43**	**1.77**	**2.94**	**0.05**	**1.34**	**0.08**	**1.01**	**0.21**	**1.76**	**0.19**	**2.32**	**0.01**	**7.33**
d10 3.3	**0.73**	**1.82**	**10.24**	**1.68**	**0.90**	**0.70**	**0.04**	**1.66**	**0.13**	**1.58**	**0.20**	**2.19**	**0.63**	**0.58**	**0.14**	**3.68**
d10 3.4	**0.28**	**0.91**	**1.81**	**2.69**	**0.29**	**4.98**	**0.01**	**2.80**	**0.15**	**0.81**	**0.14**	**0.62**	**0.16**	**2.51**	**0.33**	**1.19**
d10 4.1	**0.59**	**2.22**	**4.94**	**1.71**	**5.02**	**1.29**	**0.37**	**1.12**	**0.09**	**1.68**	**0.17**	**0.79**	**0.61**	**1.08**	**0.05**	**3.86**
d10 4.2	**0.42**	**2.19**	**6.23**	**0.81**	**0.46**	**2.41**	**0.03**	**1.07**	**0.11**	**3.51**	**0.15**	**1.93**	**0.16**	**1.38**	**0.01**	**10.02**
d10 4.3	**0.67**	**0.50**	**6.31**	**0.67**	**0.39**	**0.59**	**0.03**	**1.99**	**0.16**	**2.17**	**0.23**	**2.12**	**0.13**	**6.64**	**0.01**	**19.37**
d10 4.4	**0.55**	**1.76**	**5.15**	**0.84**	**0.37**	**3.57**	**0.03**	**4.76**	**0.27**	**1.50**	**0.27**	**0.96**	**0.33**	**2.66**	**0.05**	**6.49**
d10 1*1	**0.30**	**0.59**	**3.56**	**1.98**	**0.50**	**2.07**	**0.04**	**1.31**	**0.07**	**4.15**	**0.10**	**1.63**	**0.16**	**2.38**	**0.00**	**14.61**
d10 1*3	**0.28**	**0.19**	**2.28**	**1.78**	**0.71**	**2.64**	**0.04**	**2.61**	**0.09**	**1.91**	**0.12**	**1.83**	**0.20**	**3.76**	**0.01**	**5.84**
d10 2*1	**0.26**	**2.61**	**4.04**	**3.25**	**1.10**	**1.06**	**0.03**	**2.16**	**0.07**	**2.63**	**0.18**	**0.36**	**0.20**	**2.38**	**0.03**	**7.78**
d10 2*2	**0.33**	**1.76**	**5.06**	**1.12**	**0.82**	**1.00**	**0.02**	**1.51**	**0.47**	**0.53**	**0.12**	**0.84**	**0.13**	**3.46**	**0.06**	**2.50**
d10 2*3	**0.20**	**1.76**	**1.81**	**1.15**	**0.95**	**2.09**	**0.05**	**0.89**	**0.10**	**2.75**	**0.13**	**1.46**	**0.21**	**2.53**	**0.14**	**0.89**
d10 3*1	**0.29**	**1.95**	**2.85**	**2.70**	**0.62**	**2.47**	**0.05**	**2.92**	**0.07**	**1.76**	**0.09**	**2.10**	**0.15**	**3.61**	**0.00**	**12.55**
d10 3*2	**0.23**	**4.55**	**3.70**	**2.54**	**0.22**	**4.35**	**0.01**	**2.53**	**0.05**	**3.08**	**0.07**	**1.73**	**0.34**	**3.49**	**0.04**	**8.14**
d10 3*3	**0.35**	**1.49**	**3.57**	**1.65**	**0.57**	**1.26**	**0.03**	**2.97**	**0.12**	**0.27**	**0.17**	**1.25**	**0.12**	**2.54**	**0.02**	**9.86**
d10 4*1	**0.42**	**2.85**	**3.03**	**1.94**	**0.65**	**1.44**	**0.04**	**1.95**	**0.07**	**0.73**	**0.13**	**1.09**	**0.21**	**0.32**	**0.03**	**4.04**
d10 4*2	**0.24**	**1.40**	**2.69**	**0.79**	**0.97**	**1.94**	**0.25**	**2.05**	**0.08**	**3.88**	**0.09**	**0.53**	**0.17**	**0.45**	**0.05**	**2.71**
d10 4*3	**0.29**	**1.96**	**3.07**	**0.82**	**1.05**	**1.39**	**0.04**	**0.43**	**0.10**	**2.88**	**0.15**	**0.51**	**0.31**	**1.68**	**0.01**	**2.94**

K.pH and EC in soil samples

Lab ID	Date	place	Depth	Crop	Soil type	EC µS/cm	pH
1.1	7-July-2018	Ya'bad-Jenin	0-5cm	Tobacco	Terra rossa	397	7.66
1.1	7-July-2018	Ya'bad-Jenin	5_10cm	Tobacco	Terra rossa	399	7.68
1.2	7-July-2018	Ya'bad-Jenin	0-5cm	Tobacco	Terra rossa	416	7.50
1.2	7-July-2018	Ya'bad-Jenin	5_10cm	Tobacco	Terra rossa	232	7.30
1.3	7-July-2018	Ya'bad-Jenin	0-5cm	Tobacco	Terra rossa	476	7.14
1.3	7-July-2018	Ya'bad-Jenin	5_10cm	Tobacco	Terra rossa	311	7.22
1.4	7-July-2018	Ya'bad-Jenin	0-5cm	Tobacco	Terra rossa	357	7.32
1.4	7-July-2018	Ya'bad-Jenin	5_10cm	Tobacco	Terra rossa	162	7.50
2.1	7-July-2018	Ya'bad-Jenin	0-5cm	Tobacco	Terra rossa	401	7.55
2.1	7-July-2018	Ya'bad-	5_10cm	Tobacco	Terra	272	6.91

		Jenin			rossa		
2.2	**7-July-2018**	**Ya'bad-Jenin**	**0-5cm**	**Tobacco**	**Terra rossa**	**432**	**7.13**
2.2	**7-July-2018**	**Ya'bad-Jenin**	**5_10cm**	**Tobacco**	**Terra rossa**	**387**	**7.06**
2.3	**7-July-2018**	**Ya'bad-Jenin**	**0-5cm**	**Tobacco**	**Terra rossa**	**655**	**7.40**
2.3	**7-July-2018**	**Ya'bad-Jenin**	**5_10cm**	**Tobacco**	**Terra rossa**	**295**	**7.51**
2.4	**7-July-2018**	**Ya'bad-Jenin**	**0-5cm**	**Tobacco**	**Terra rossa**	**462**	**7.16**
2.4	**7-July-2018**	**Ya'bad-Jenin**	**5_10cm**	**Tobacco**	**Terra rossa**	**268**	**7.65**
3.1	**7-July-2018**	**Ya'bad-Jenin**	**0-5cm**	**Tobacco**	**Terra rossa**	**375**	**7.41**
3.1	**7-July-2018**	**Ya'bad-Jenin**	**5_10cm**	**Tobacco**	**Terra rossa**	**315**	**7.77**
3.2	**7-July-2018**	**Ya'bad-Jenin**	**0-5cm**	**Tobacco**	**Terra rossa**	**285**	**7.11**
3.2	**7-July-2018**	**Ya'bad-Jenin**	**5_10cm**	**Tobacco**	**Terra rossa**	**327**	**7.55**
3.3	**7-July-2018**	**Ya'bad-Jenin**	**0-5cm**	**Tobacco**	**Terra rossa**	**558**	**6.94**
3.3	**7-July-2018**	**Ya'bad-Jenin**	**5_10cm**	**Tobacco**	**Terra rossa**	**232**	**7.01**

3.4	**7-July-2018**	**Ya'bad-Jenin**	**0-5cm**	**Tobacco**	**Terra rossa**	**374**	**7.44**
3.4	**7-July-2018**	**Ya'bad-Jenin**	**5_10cm**	**Tobacco**	**Terra rossa**	**306**	**7.27**
4.1	**7-July-2018**	**Ya'bad-Jenin**	**0-5cm**	**Tobacco**	**Terra rossa**	**488**	**7.35**
4.1	**7-July-2018**	**Ya'bad-Jenin**	**5_10cm**	**Tobacco**	**Terra rossa**	**426**	**7.00**
4.2	**7-July-2018**	**Ya'bad-Jenin**	**0-5cm**	**Tobacco**	**Terra rossa**	**361**	**7.36**
4.2	**7-July-2018**	**Ya'bad-Jenin**	**5_10cm**	**Tobacco**	**Terra rossa**	**453**	**7.44**
4.3	**7-July-2018**	**Ya'bad-Jenin**	**0-5cm**	**Tobacco**	**Terra rossa**	**600**	**7.01**
4.3	**7-July-2018**	**Ya'bad-Jenin**	**5_10cm**	**Tobacco**	**Terra rossa**	**416**	**7.22**
4.4	**7-July-2018**	**Ya'bad-Jenin**	**0-5cm**	**Tobacco**	**Terra rossa**	**327**	**7.08**
4.4	**7-July-2018**	**Ya'bad-Jenin**	**5_10cm**	**Tobacco**	**Terra rossa**	**221**	**7.17**
1*1	**7-July-2018**	**Ya'bad-Jenin**	**0-5cm**	**Olive tree**	**Terra rossa**	**229**	**7.55**
1*1	**7-July-2018**	**Ya'bad-Jenin**	**5_10cm**	**Olive tree**	**Terra rossa**	**196**	**7.11**
1*2	**7-July-2018**	**Ya'bad-**	**0-5cm**	**Olive**	**Terra**	**337**	**7.01**

		Jenin		tree	rossa		
1*2	7-July-2018	Ya'bad-Jenin	5_10cm	Olive tree	Terra rossa	143	7.71
1*3	7-July-2018	Ya'bad-Jenin	0-5cm	Olive tree	Terra rossa	377	6.98
1*3	7-July-2018	Ya'bad-Jenin	5_10cm	Olive tree	Terra rossa	178	7.39
2*1	7-July-2018	Ya'bad-Jenin	0-5cm	Olive tree	Terra rossa	235	7.35
2*1	7-July-2018	Ya'bad-Jenin	5_10cm	Olive tree	Terra rossa	169	7.96
2*2	7-July-2018	Ya'bad-Jenin	0-5cm	Olive tree	Terra rossa	166	7.50
2*2	7-July-2018	Ya'bad-Jenin	5_10cm	Olive tree	Terra rossa	275	6.95
2*3	7-July-2018	Ya'bad-Jenin	0-5cm	Olive tree	Terra rossa	265	7.34
2*3	7-July-2018	Ya'bad-Jenin	5_10cm	Olive tree	Terra rossa	198	7.13
3*1	7-July-2018	Ya'bad-Jenin	0-5cm	Olive tree	Terra rossa	201	7.30
3*1	7-July-2018	Ya'bad-Jenin	5_10cm	Olive tree	Terra rossa	162	7.57
3*2	7-July-2018	Ya'bad-Jenin	0-5cm	Olive tree	Terra rossa	190	7.88

3*2	**7-July-2018**	**Ya'bad-Jenin**	**5_10cm**	**Olive tree**	**Terra rossa**	**278**	**7.88**
3*3	**7-July-2018**	**Ya'bad-Jenin**	**0-5cm**	**Olive tree**	**Terra rossa**	**262**	**8.17**
3*3	**7-July-2018**	**Ya'bad-Jenin**	**5_10cm**	**Olive tree**	**Terra rossa**	**179**	**7.24**
4*1	**7-July-2018**	**Ya'bad-Jenin**	**0-5cm**	**Olive tree**	**Terra rossa**	**207**	**7.46**
4*1	**7-July-2018**	**Ya'bad-Jenin**	**5_10cm**	**Olive tree**	**Terra rossa**	**249**	**7.51**
4*2	**7-July-2018**	**Ya'bad-Jenin**	**0-5cm**	**Olive tree**	**Terra rossa**	**266**	**7.76**
4*2	**7-July-2018**	**Ya'bad-Jenin**	**5_10cm**	**Olive tree**	**Terra rossa**	**164**	**7.99**
4*3	**7-July-2018**	**Ya'bad-Jenin**	**0-5cm**	**Olive tree**	**Terra rossa**	**254**	**7.56**
4*3	**7-July-2018**	**Ya'bad-Jenin**	**5_10**	**Olive tree**	**Terra rossa**	**164**	**7.38**