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SOIL QUALITY INVESTIGATION BASED ON BIOLOGICAL AND MICROMORPHOLOGICAL TRAITS UNDER DIFFERENT LAND USES

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Abstract: Soil is a vital resource for producing the food needed to support an increasing world population. Land uses can increase or decrease soil quality dependent on management type. This research work was carried out by investigation of different land use (alfalfa, corn, and apple) effect on soil quality and their comparison with bare soil as a control in Karkaj Agriculture Research Station of Tabriz University. After soil samples preparation, in addition to physical and chemical properties of soil, biological indicators of soil quality such as soil basal respiration (BR), substrate induced respiration (SIR), microbial biomass carbon (MBC), microbial biomass nitrogen (MBN), microbial biomass phosphorus (MBP), metabolic quotient (q_{CO2}), microbial biomass quotient (q_{mic}), Acid and alkaline phosphatases activities (ACPA and ALPA) were determined. Also soil micromorphological properties such as microstructure, voids, organic component and excrement pedofeatures performed and studied as visual indicators in soil quality. Obtained results revealed significant effect of land use on all biological indicators except ALPA and MBP of soil quality. Descending order of soil quality from biological point of view is alfalfa cultivation, apple orchard, corn cultivation and bare soil respectively. Based on soil fabric study, visual quality descending was seen in apple orchard, alfalfa cultivation, corn cultivation and bare soil respectively. Generally, it seems that cultivations are not often lead to decrease soil quality; therefore agricultural practices can be useful to keep bare land from degradation.

Keyword: Karkaj, Land degradation, Land use, Soil biological and micromorphological traits, Soil quality.

1. INTRODUCTION

Soil is linked to everything around us and performs many important roles in sustaining life on the Earth. Environmental degradation caused by inappropriate land use is a worldwide problem that has attracted attention in sustainable agricultural production systems (Vagen et al., 2006; Khormali & Nabiollahy, 2009). Soil as an important part of environmental resources must be taken into consideration for conservation. Land use type and soil management can potentially alter soil quality. Change in land use may markedly affect soil quality. In some cases this change is caused to decrease in soil quality and damage soil health. Szilassi et al., (2010) have investigated the link between soil quality and agricultural land use change and showed that soil quality has a relevant role in shaping rural landscape patterns. It is demonstrated that the soil quality acts as a location factor in the case of arable land use change. Also soil quality influenced by land use in relationship with other environmental conditions (Havlicek & Chrudina, 2013).

Soil quality is the capacity of a specific kind of soil to function within natural or managed ecosystem boundaries, sustain plant and animal productivity, maintain or enhance the quality of water and air, support human health and habitation (NRCS, 2001). Soil quality indicators refer to measurable soil attributes that influence the capacity of soil to perform crop production or environmental functions (Arshad & Martin, 2002). Indicators of soil quality can be categorized into four general groups of visual, physical, chemical and biological one. Visual indicators may be obtained from observation or photographic interpretation and physical one are related to the arrangement of solid particles and pores. Chemical indicators include measurements of soil chemical properties or those that are needed for plant growth and development, while biological indicators include measurements of organisms activity or byproducts (NRCS, 1996).The implementation of environmental criteria through agrarian policies requires the selection of soil quality indicators to measure the success of specific agricultural practices. Studies reported that indexing soil quality indicators based on a combination of soil properties could better reflect the status of soil quality as compared to individual parameters. Biological and micromorphological properties of soil are important soil quality indicators that can be used as evidence of soil organisms activity and soil fabric properties in relation with soil health.

Ruiz et al., (2008) used physical, chemical and biological indicators to compare the soil quality under different environmental conditions and saw that biological properties are more affected rather than others. Also, Januszek (2013) achieved the same results which confirm obtained results by pervious researches. There are many assessing about different aspects of land use impacts on soil quality by biological indicators (Aliasgharzad et al., 2010; Shahbazi et al., 2013; Kuwano et al., 2014). Biological indicators typically include soil respiration, microbial biomass carbon (Jordan et al., 1995) and microbial enzyme activities (Eivazi et al., 2003). Dube et al., (2009) were determined soil microbial respiration and biomass in different land uses and depths and showed positive correlation of soil microbial respiration with microbial biomass C and soil organic carbon, because the different land uses affected the formation of organic matter and microbial biomass C, which in turn will influenced on soil microbial respiration. Microbial enzyme activities reflect metabolic factors and may serve as early indicators of soil quality improvement or degradation in agro ecosystems (Dick, 1994). Land use and land cover associated with organic matter content can alter the soil enzyme activities within the soil profile (Kizilkaya & Dengiz, 2010). Li et al., (2014) investigated the effect of land use on soil enzyme activities and showed that different land uses significantly influenced the enzyme activities.

Micromorphology as a soil science branch is complementary of soil management and genesis study (Ringrose-Voase & Humphreys, 1994), which it can be used as a way to evaluate visual indicators of soil quality. Soil micromorphological analysis were used to determine soil quality in the 1970s and 1980s with soil physics, biology including ecosystems and faunal activity, soil chemistry, environmental chemistry and mineralogy (Mermut, 2005). Then pores, microstructures, excrements, organic components and other pedofeatures as soil micromorphological properties can be used in the role of visual indicators of soil quality.

Land use effect on soil properties can be showed by micromorphological methods. Porosity, aggregation and biological activity are such soil micromorphological properties that can be affected by different agricultural land use (Rampazzo et al., 1999). Kodesova et al., (2006) have reported that soil porosity has influenced by plant roots and soil organism activity. Based on Khormali & Shamsi (2009) researches, land use change influences soil b-fabric. Type and amount of soil organic matter depend on land uses. According to micromorphological investigation the transport, shapes and accumulation of organic matter affected by different vegetation covers (Nikodem et al., 2013). Soil biodiversity is one of parameters referred to soil quality and it can be studied by micromorphological methods. Many studies admitted to relative between land use and evidence of organisms activity such as their body remnants or excrements pedofeatures (Raducu & Eftene, 2013; Davidson & Grieve, 2006; Davidson et al., 2002). Rezaei et al., (2013) stated that micro and macro organisms activity are different in various land uses and this fact is recognizable from their activities evidence by micromorphological observation.

This study was aimed to evaluate the consequences of land use type on soil quality indices. Despite the large number of research on soil quality indicators, there is less attention to visual or micromorphological indicators of soil quality. In this research work along biological indicators of soil quality, micromorphological observation as visual indicators of soil quality were performed under different land uses, which can be the objective of the present study.

2. METHODS AND MATERIALS

2.1. Study area

This study was carried out in Karkaj Agriculture Research Station of Tabriz University in East Azarbaijan - Northwest of Iran, which have located on eastern longitude of 46º 23´ to 46º 27´ and northern latitude of 38º 00´ to 38º 02´. Geologically, the region belongs to Plio-pleistocene period and the major geological formation is composed of tuff and volcanic ash (Darvishzadeh, 1991). The study area with less than 1% slope was alluvial plain physiographic unit and according to climatic data from Tabriz synoptic weather forecasting data station, the average annual precipitation and temperature of the region are 242.5 mm and 13.5 °C, respectively (IRIMO, 2011). The soil moisture and temperature regimes are Xeric and Mesic and soils based on soil taxonomy system (2010) are Inceptisols.

Karkaj Research Station with 50 years' experience in agriculture and horticulture is managing by university of Tabriz researchers. In different part of this station all soil forming factors and environmental conditions except land use are almost same. In the present research work, three land uses including corn, alfalfa and apple orchard with a bare soil as control at the nearest distance from the fields were selected. Profiles were dug, described and sampled for physico-chemical, biological and micromorphological analysis (Fig. 1).

2.2. Laboratory analysis

2.2.1. Soil physical and chemical analyses

Soil morphological characteristics were described based on the field book for describing and sampling of soils (Schoeneberger et al., 2012), and soil samples were collected from all soil horizons of the profiles for physical and chemical analyses. In the laboratory after removing large stones, the soil samples were air-dried and passed through a 2 mm (10 mesh) sieve. Particle size distribution and soil texture were determined by the hydrometer method (Gee & Or, 2002). Electrical conductivity (EC) was determined in extract of saturate soil paste using conductivity meter (Rhoades, 1996) and soil pH was measured in saturated soil paste (Thomas, 1996). Organic carbon (OC) was determinated according to the Walkley–Black wet oxidation method (Nelson & Sommers, 1996). Cation exchange capacity (CEC) was determined by saturation with 1 M ammonium acetate at pH=7.0 (Bower et al., 1952). Calcium carbonate equivalent (CCE) was measured by back titration procedure (Loeppert & Suarez, 1996).

2.2.2. Soil biological analysis

For biological analyses, seven soil samples were randomly taken from each land use at 0-20 cm depth. Soils were incubated at 27 °C for two weeks to stabilize microbial activity. For determination of soil basal respiration (BR), carbon dioxide evolved from 10g soil, was trapped in 0.1N NaOH and then determined by back-titration of the excess alkali with 0.1 N HCl (Schinner et al., 1996).Substrate induced respiration (SIR) was measured in 100g soil mixed with 400mg glucose. The soil was incubated in tightly closed jar for 4 hours at 22 °C (Anderson & Domsch, 1978). Carbon dioxide evolved from the soil was determined as described above. Microbial biomass carbon (MBC), microbial biomass nitrogen (MBN) and microbial biomass phosphorus (MBP) were determined based on fumigation-extraction method (Ohlinger, 1996a,b,c). Metabolic quotient (q_{CO2}) was defined as ratio between carbon release in base respiration and microbial biomass carbon, also microbial biomass quotient (q_{mic}) was calculated by diving microbial biomass carbon to soil organic carbon (Martens, 1991).

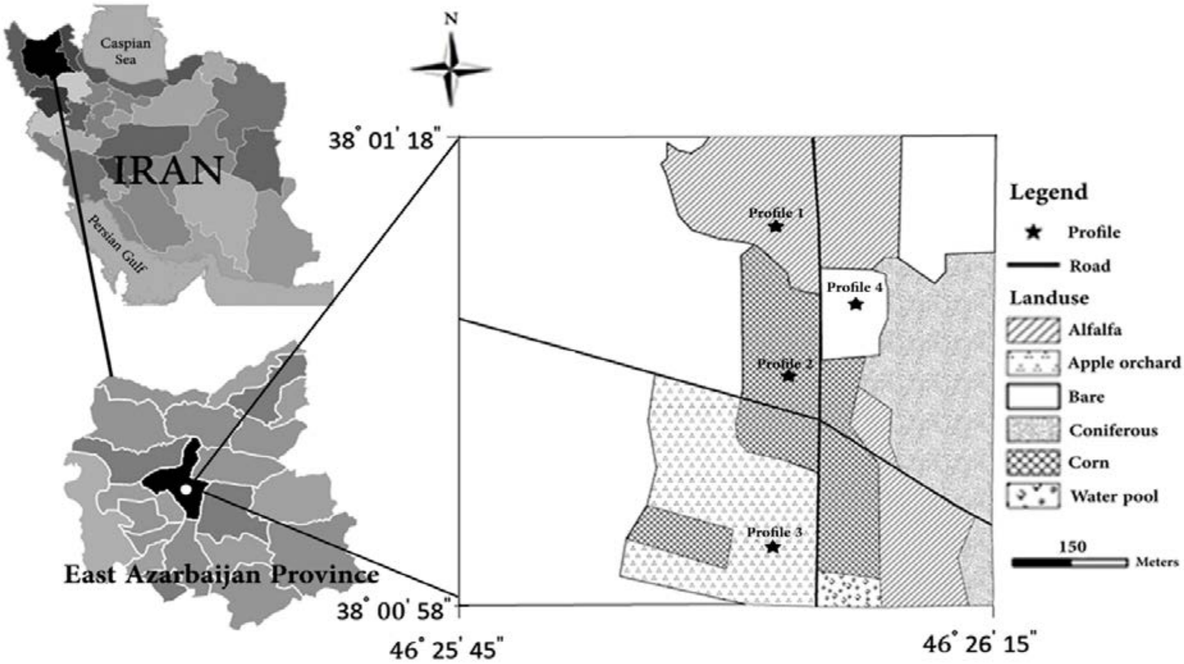

Figure1. Study area in Karkaj Agriculture Research Station, Tabriz, Iran.

Acid and alkaline phosphatase activities (ACPA and ALPA) in soils were determined using sodium-p-nitrophenyl phosphate as substrate in Modified Universal Buffer (MUB) of pH 6.5 and 11, respectively (Tabatabai & Bremner, 1969).

2.2.3.Soil micromorphological analysis

For micromorphological studies, intact soil samples were taken by Kubiena box from each horizon of selected profiles. The thin sections were prepared from air-dried, intact and oriented samples using standard techniques (Murphy, 1986), then examined under a polarized microscope by using both plane and cross polarized light (PPL and XPL) and described according to the terminology of Bullock et al., (1985) and Stoops et al., (2010).

2.3. Statistical analysis

A nested design with four treatments (three land uses and control) and seven replications in each treatment was used for data analysis of biological properties. Analysis of variance and mean comparison (Dunkan's Multiple Range Test) were performed using MSTATC software.

3.RESULTS

3.1. Morphological and physico-chemical analyses

Morphological properties of soil horizons for the selected profiles are presented in table 1. Soil profiles with five horizons (except profile 4, located under bare soil, with 4 horizons) have Cambic horizons (Bw) with undeveloped condition and accumulation of calcium carbonate which show the evidence of recently development.

The results of soil physico-chemical properties are presented in table 2. The soils mostly were light and had coarse texture except for subsurface soils in corn cultivated area. By increasing soils depth, sand and clay content were increased and decreased respectively soils and had coarse texture classes except profile located under corn cultivation. The electrical conductivity (EC) ranged from 0.64 to 4.16 $dS.m^{-1}$ and maximum average of this parameter was seen in bare soils that can be referred to no-irrigation of this area. The calcium carbonate equivalent (CCE) ranged from 1.02 to 17.4% with maximum amounts of CCE in Bk horizons under bare and corn cultivated soils. This factor affected on pH values and soils reactions were slightly alkaline.

Table 1. Abbreviated morphological properties of selected soil profiles.

Horizon	Depth (cm)	Boundary[a]	Color		Structure[b]	Consistence[c]			Lime[d]
			Moist	Dry		Dry	Moist	Wet	
Profile 1: Located under Alfalfa cultivation.									
Ap	0-27	CS	10YR5/4	10YR6/3	2vfgr	h	fr	so	e
Bw	27-72	CS	10YR5/6	10YR6/3	2fsbk	h	fr	s	es
2C1	72-85	CS	10YR4/4	10YR7/2	sg	-	-	-	es
2C2	85-116	CS	10YR6/4	10YR7/2	sg	-	-	-	es
2C3	>116	-	10YR3/3	10YR7/3	sg	-	-	-	e
Profile 2: Located under Corn cultivation.									
Ap	0-18	CW	10YR5/4	10YR6/3	2vfgr	so	vfr	s	e
Bw1	18-35	CW	10YR5/4	10YR6/3	1fsbk	h	fr	s	e
Bw2	35-57	AS	7.5YR5/6	7.5YR5/4	2cabk	h	fr	s	e
Bk1	57-73	AS	7.5YR5/6	7.5YR5/4	3cabk	h	fr	s	ev
Bk2	>73	-	10YR5/8	10YR7/4	1cabk	lo	lo	s	ev
Profile 3: Located under Apple orchard.									
A	0-15	AS	10YR4/3	10YR5/3	3cgr	sh	fr	so	e
Bw1	15-45	AW	10YR3/3	10YR7/3	2cabk	h	fr	so	es
Bw2	45-81	AS	10YR6/6	10YR7/3	1cabk	sh	fr	so	es
C1	81-113	CW	10YR5/4	10YR7/2	sg	-	-	-	es
C2	>113	-	10YR3/4	10YR6/2	sg	-	-	-	es
Profile 4: Located under Bare soil.									
A	0-18	CW	10YR5/4	10YR6/3	2vfsbk	sh	vfr	s	e
Bw	18-38	AS	10YR3/4	10YR7/3	1vfsbk	sh	vf	s	es
Bk	38-70	AS	10YR7/4	10YR8/3	2fsbk	lo	lo	ss	ev
C	>70	-	10YR4/6	10YR7/3	sg	-	-	-	es

[a)]Boundary: A- abrupt, C- clear, S- smooth, W- wavy. /[b)]Structure: 1- weak, 2- moderate, 3- strong; vf- very fine, f- fine, c- coarse; gr- granular, abk- angular blocky, sbk- sub-angular blocky, sg- single grain. /[c)] Consistence: lo- loose, so- soft, sh- slightly hard, h- hard, vfr- very friable, fr- friable, ss- slightly sticky, s- moderately sticky. /[d)]Lime: e- slightly effervescent, es- strongly effervescent, ev- violently effervescent.

Table2. Physico-chemical properties of selected profiles.

Horizon	Depth (cm)	Soil particle distribution (%)			Texture[a]	EC[b] (dS. m^{-1})	pH[c]	OM[d] (%)	CEC[e] ($Cmol_c.kg^{-1}$)	CCE[f] (%)
		Sand	Silt	Clay						
Profile 1: Located under Alfalfa cultivation.										
Ap	0-27	54.8	21.4	23.8	SCL	1.56	8.21	0.68	13.33	3.06
Bw	27-72	42.6	24.7	32.7	CL	1.20	8.15	0.42	20.16	10.06
2C1	72-85	89.9	1.7	8.4	S	0.73	8.19	0.4	5.41	3.42
2C2	85-116	87.3	1.8	10.9	LS	0.80	8.22	0.13	7.59	6.98
2C3	>116	92.5	1.6	5.9	S	0.64	8.20	0.13	5.56	2.11
Profile 2: Located under Corn cultivation.										
Ap	0-18	58.1	11.9	30	SCL	2.04	8.05	0.42	17.33	3.08
Bw1	18-35	55.4	14.6	30	SCL	1.62	7.78	0.42	17.26	2.57
Bw2	35-57	35.5	17.7	46.8	C	1.48	7.72	0.27	26.78	5.30
Bk1	57-73	27	15	58	C	1.23	8.02	0.27	22.06	17.40
Bk2	>73	46.5	19.9	33.6	C	1.37	7.91	0.13	17.10	17.37
Profile 3: Located under Apple orchard.										
A	0-15	55.9	23.8	20.3	SCL	1.78	7.81	1.6	13.98	6.60
Bw1	15-45	63.3	11.1	25.6	SCL	1.61	8.20	0.41	10.87	7.36
Bw2	45-81	62.8	13.8	23.4	SCL	1.49	8.38	0.13	12.58	14.53
C1	81-113	89.8	2.6	7.6	S	0.96	8.23	0.27	4.80	6.81
C2	>113	89.9	2.5	7.6	S	1.59	7.91	0.13	4.60	4.34
Profile 4: Located under Bare soil.										
A	0-18	59.7	16.3	24	SCL	1.77	8.03	0.27	11.34	1.02
Bw	18-38	56.8	19	24.2	SCL	1.54	7.95	0.41	12.56	5.18
Bk	38-70	69	16.8	14.2	SL	1.88	8	0.42	15.16	15.81
C	>70	75	8.7	16.3	SL	4.16	7.87	0.13	7.20	5.46

[a)] Texture: C- clay, S- sand, CL- clay loam, SL- sandy loam, LS- Loamy sand, SCL- sandy clay loam./[b)] Electrical conductivity in extract of saturated soil./[c)] pH in saturation soil paste (H_2O)./[d)] Organic matter./[e)]Cation exchange capacity./[f)] Calcium carbonate equivalent.

Table3. Classification of studied soil profiles.

Profile number and land use	Soil classification (keys to soil taxonomy, 2010)
Profile 1: Located under Alfalfa cultivation	Fine-loamy mixed, superactive, calcareous, mesic, Fluventic Haploxerept.
Profile 2: Located under Corn cultivation	Fine, mixed, active, mesic, Typic Calcixerept.
Profile 3: Located under Apple orchard	Loamy, mixed, active, calcareous, mesic, Fluventic Haploxerept.
Profile 4: Located under Bare soil	Fine-loamy mixed, superactive, mesic, Typic Calcixerept.

Maximum contents of organic matter (OM) observed in surface horizons and rapidly decline downwards in all profiles except for profile located under bare area. The cation exchange capacity (CEC) ranged from 4.6 to 26.78 $Cmol_{ch}.kg^{-1}$, which has influenced by clay and organic matter contents and results (Table 2) showed that clay content had more effect than organic matter content in this respect.

According to the results obtained from description of soil profiles, physical and chemical analyses (Tables 1, 2), soils can be classified as Inceptisols on the basis of USDA soil taxonomy system (2010), which have reported in table 3.

3.2. Biological analysis

To evaluate nine biological indices affected by land uses, as mentioned, a nested design with four treatments (three land uses and control) and seven replications in each treatment was used for data analysis. The results of statistical analysis revealed that all of biological indices had significantly ($p<0.01$) difference between land uses except MBP and ALPA. BR in corn cultivation was not significantly ($p<0.01$) different from bare soil. The highest BR was obtained in alfalfa cultivation which was not significantly different from apple orchard. Also there was no significant difference between corn cultivation and apple orchard (Fig.2-

a). The statistical analysis of SIR showed that it was the highest only in alfalfa cultivation ($p<0.01$). The other land uses were not different from bare soil (Fig.2-b). Regarding MBC, the corn cultivation, apple orchard and bare soil had significant difference together but, the alfalfa cultivation had similar status with corn cultivation and apple orchard (Fig. 2-c). The obtained results revealed similar impact on the MBN of apple orchard, corn cultivation and bare soil, but alfalfa cultivation had statistically different effect on MBN (Fig. 2-d).As previously mentioned, land use type didn't have significant effect on MBP. From figure 2-e, it can be calculated that the q_{CO2} in the alfalfa cultivation is quite higher than others. Based on the statistical results, there was no significant difference of corn cultivation and bare soil effect on the described and there was no significant difference between apple orchard and other three treatments. Also obtained results revealed the descending order of q_{mic} from corn cultivation, alfalfa cultivation and apple orchard respectively, that apple orchard had significant difference with other land uses. As well as q_{mic} had statistically differences in bare soil (Fig.2-f). ACPA Statistically influenced by land use type. Alfalfa cultivation had great and significant effect on ACPA rather than other land uses (Fig. 2-g). However the ALPA was affected by land use type but, different land uses didn't have significant influence on this enzyme activity.

3.3. Micromorphologicalanalysis

Micromorphological observation detected different effect of land uses on visual indicators of soil quality, which are in table 4.

According to the results from micromorphological studies, all of the surface horizons generally had granular microstructure except the surface horizon of bare soil (Fig. 3-a), whereas the different kinds of blocky microstructure were seen in subsurface B horizons (Fig. 3-b), Also spongy microstructure was presented in upper horizons of some profiles (Fig. 3-c). Due to the lack of structure in the bottom C horizons the single grain status can be reported as microstructure for these horizons. Moreover, the influences of different land uses on soil microstructure have seen in the grade of soil pedality (Tab. 4). Micromorphological observations of surface horizons revealed dominant different kinds of packing voids, while in subsurface horizons with structure the more developed voids such as chambers, channels and vughs are presented (Fig. 3-b, 3-d, 3-e). Also, based on the estimated results, surface horizons have a higher porosity than the subsurface ones. Hence, the percentage of voids decreases with increasing of depth (Table 4). The most horizons of the studied soil profiles had porphyric related distribution patterns, although enaulic related distribution patterns were seen in surface horizons due to more effect of land uses (Figs. 3-f, 3-g). B-fabric of studied soils was mostly stipple speckled, undifferentiated, crystallitic, poro-striated with same mineral components. The majority of mineral components were quartz, feldspar, plagioclase and opaques. Also rock fragments were presented in all horizons that their percentages increase with depth. The organ residues, general tissue residues, parenchymatic tissues, lignified tissues and organic mono and polymorphic amorphous were most current organic component in all upper horizons of soil profiles except the profile under bare soil (Fig. 3-h, 3-i, 3-j, 3-k). According to chemical analysis and qualitative observations of organic remnants in thin sections the amounts of organic material in surface horizons were higher than subsurface ones. Also various degrees of organic remnants disintegrations were observed in different depth of each soil profile. The intact remnants were usual in surface horizons, while in subsurface horizons the ratio of intact organic remnants to decomposed form were decreased. Along with presence of organic remnants, intact and aging excrement pedofeatures related to soil surface horizons were observed higher than subsurface horizons in microscopic levels (Fig. 3-l, 3-m). Presence of high organic matter in surface horizons can be involved as an optimal condition for soil organisms. Therefore, in all profiles with depth increasing, the organisms activity have been reduced, because of decreasing in obvious evidence quantity like excrement pedofeatures and decreasing of organic remnants as soil organisms nutrition source. There was no sharp coating in studied undeveloped soils, but there were some weak and thin clay coatings, which mostly have seen around primary particles (Fig. 3-n). Calcite coating around particles and voids were seen in subsurface horizons that describe evidence of calcium carbonate accumulation (Fig. 3-o) and also infilling of calcite, clay and mineral particles in channel voids were observed in subsurface horizons (Fig. 3-p).

4. DISCUSSIONS

Based on results, the effect of land uses on different properties of soils were observed and reviewed, but the main objective of this study was assessing soil quality from biological and visual or micromorphological traits.

Different land uses had significant effect on biological indices. Organic matter has key influence on soil biological attribute. Organic matter provides the food or substrate on which heterotrophic soil microbes fed. The lower rates of BR in the bare soil were most likely due to presence of low organic matters.

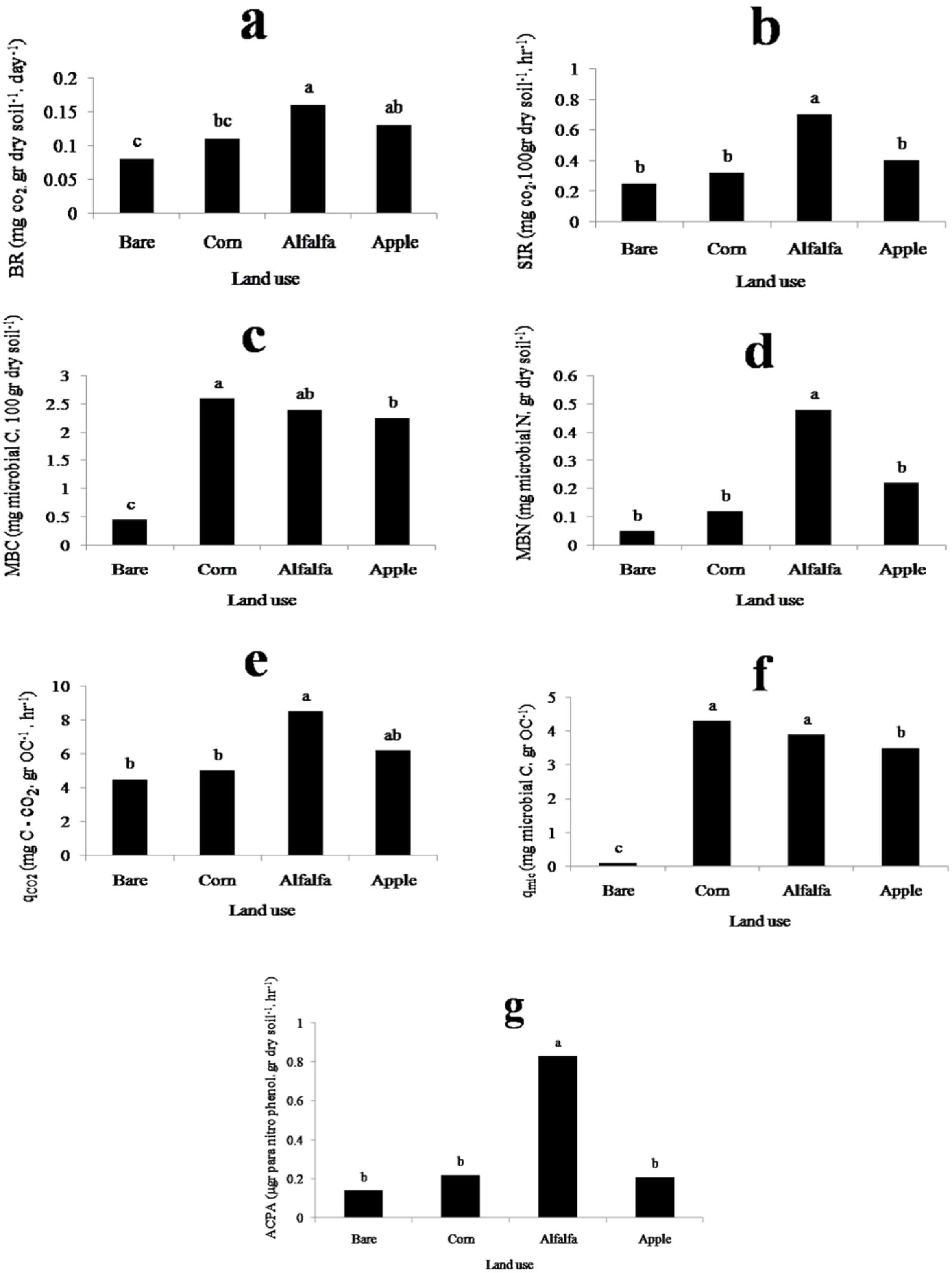

Figure 2. Mean comparison of biological indices.

Table 4. Some micromorphological properties of selected profiles.

Horizon	Micro Structure [a)]	Grade of pedality [b)]	Voids [c)]	Related Distribution [d)]	B-Fabric [e)]	C/F [f)] (20μ)	Mineral component [g)]	Organic component [h)]	Pedofeatures
Profile 1: Located under Alfalfa cultivation.									
Ap	Gr, Sp	S	Sp, Vu	Po, En	Ss	5/5	Qu, Pl, Kf,Op, Ch	Or, Gtr, Pao, Mao, Ot	Clay capping, Clay coating, Excrements, Organic polymorphic amorphous.
Bw	Ab, Sp	M	Vu, Pn	Po	Cr	6/4	Qu, Pl, Kf,Op, Rf	Gtr, Pao, Mao, Ot	Clay coating, Calcitic coating, Excrements,Organic polymorphic amorphous.
2C1	Sg	-	Sp	Po	Cr	9/1	Qu, Kf, Op, Am, Rf	Mao, Pao	-
2C2	Sg	-	Sp	Po	Ss	9/1	Qu, Kf,Op, Ot, Rf	-	-
2C3	Sg	-	Sp	Po	Ss	9/1	Qu, Kf,Op, Ot, Rf	-	-
Profile 2: Located under Corn cultivation.									
Ap	Gr, Sp	M	Cxp, Sp, Pn, Cdp	En	Ss, Un	3/7	Qu, Pl, Kf, Op	Or, Gtr, Pao, Mao, Ot	Organic coating, Organic polymorphic amorphous, Excrements.
Bw1	Sb, Sp	W	Vu, Chn	Po	Ss	4.5/5.5	Qu, Pl, Kf, Op, Rf	Or, Gtr, Pao, Mao Ot	Organic polymorphic amorphous, Excrements.
Bw2	Ab	M, W	Vu, Chn	Po	Ss	6/4	Qu, Kf,Op, PxOt, Rf	Pao, Mao	Organic polymorphic amorphous.
Bk1	Ab	S	Chn, Vu	Ch, Po	Cr	2.5/7.5	Qu, Pl, Kf, Op, Rf	-	Clay coating, Calcitic coating.
Bk2	Ab	W	Vu, Pn, Chn	Po	Cr, Pos	5/5	Qu, Pl, Kf, Op, Rf	-	Clay coating, Calcitic coating, Loose continuous infilling of calcite, clay and mineral particle in the void.
Profile 3: Located under Apple orchard.									
A	Gr	S	Sp, Cxp, Vu	En, Ge	Un, Ss	6/4	Qu, Pl, Kf, Op, Ot	Or, Gtr, Pct, Lt, Pao, Ot	Organic coating, Excrements, Organic polymorphic amorphous.
Bw1	Ab	M	Vu, Sp, Chn	Po	Ss	6/4	Qu, Pl, Kf, Op, Ot, Rf	Or, Gtr, Pao, Mao, Ot	Calcitic coating, Fe nodule, Organic polymorphic amorphous, Excrements.
Bw2	Ab	W	Vu, Chn, Chm	Po	Ss, Gs	4/6	Qu, Pl, Kf, Op, Ot, Rf	Pao, Mao	Clay coating. Organic coating, Loose continuous infilling of clay, Organic matter and mineral particle in the void.
C1	Sg	-	Sp	Po	Cr	9/1	Qu, Pl, Kf, Op, Ot, Rf	Or, Lt	-
C2	Sg	-	Sp	Po	Cr	9/1	Qu, Pl, Kf, Op, Ot, Rf	-	-
Profile 4: Located under Bare soil.									
A	Sb	M	Cxp	Po	Ss	5/5	Qu, Pl, Kf, Op, Rf	-	-
Bw	Sb	W	Pn, Chn	Po	Ss	5/5	Qu, Pl, Kf, Op, Rf	Pao	Loose continuous infilling of mineral particle in the void.
Bk	Sb	M	Chn	Po	Cr	4.5/5.5	Qu, Pl, Kf, Op, Rf	-	Clay coating, Calcitic coating.
C	Sg	-	Sp	Po	Ss	5/5	Qu, Pl, Kf, Op, Rf	-	-

[a)] Micro structure: Gr- Granule, Sb- Sub-angular blockey, Ab- Angular blocky, Sp- Spongy Sg- Single grain. /[b)] Grade of pedality: S- Strongly developed, M- Moderately developed, W- Weakly developed. /[c)]Voids:Sp- Simple packing, Cdp- Compound packing, Cxp- Complex packing, Vu- Vuagh, Pn- Planar; Chn- Channel, Chm- Chamber. /[d)]RelatedDistribution:Ch- Chitonic, Ge- Gefuric, Po- Porphyric, En- Enaulic. /[e)]B-Fabric:Ss- Stipple speckled, Un- Undifferentiated, Cr- Crystallitic, Pos- Poro-striated. /[f)] C/F- the ratio between the parts occupied by the coarse and fine material, respectively. /[g)]Mineral component:Qu- Quartz, Kf- K-feldspar, Op- Opaques, Pl- Plagioclase, Ot- Others, Rf- Rock fragment. /[h)]Organiccomponent:Tf- Tissue fragments, Of- Organ fragment, Pi- Organic pigment,Mao- Organic monomorphic amorphous, Pao- Organic polymorphic amorphous.

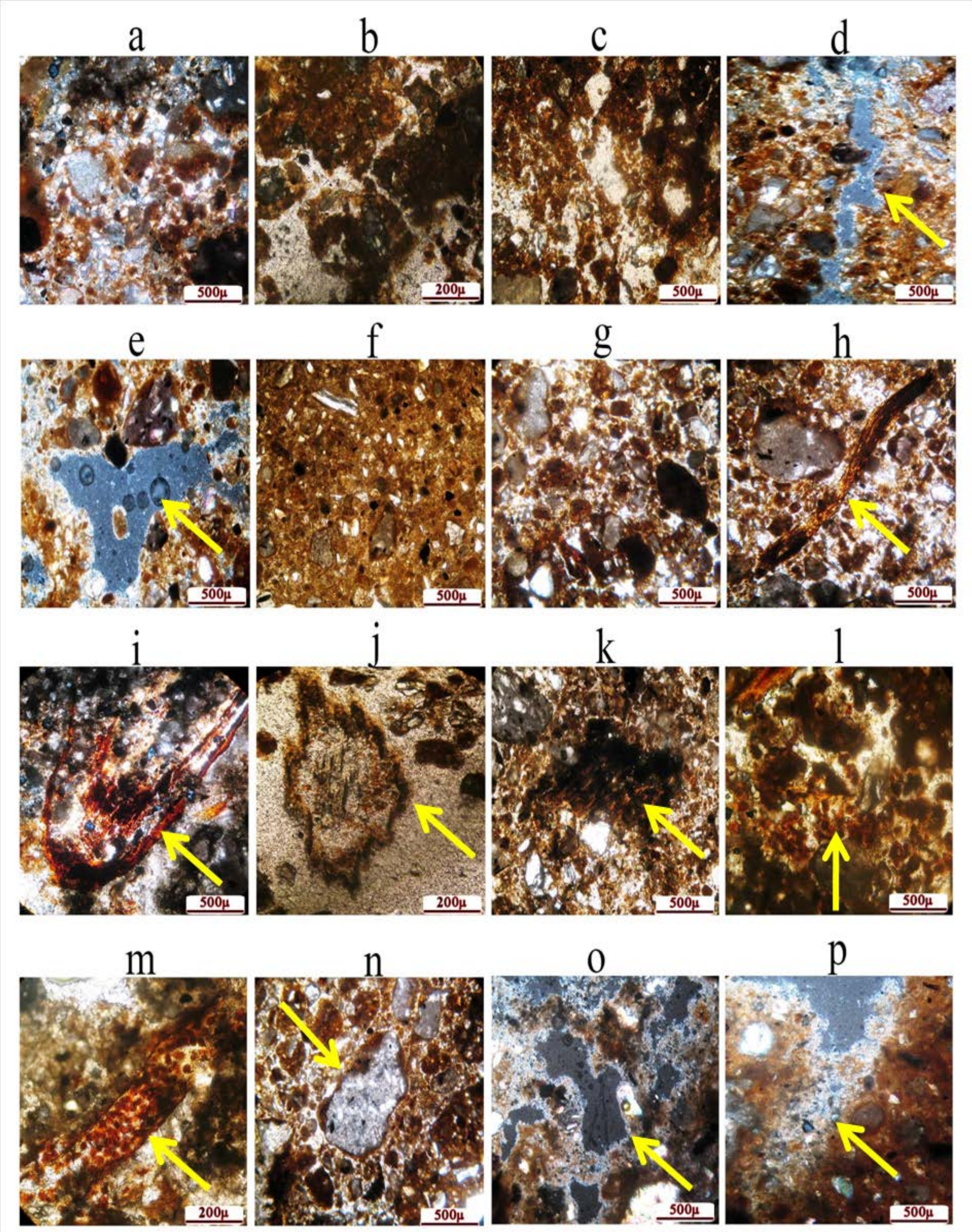

Figure 3. Thin section micrographs of soils in different land uses; a- granular microstructure in P1-Ap horizon (XPL), b- blocky microstructure and chamber in P2-Bw horizon (PPL), c- spongy microstructure in P1-Ap horizon (PPL), d- channel in P2- Bw2 horizon (XPL), e- vugh in P3-Bw2 horizon (XPL), f- porphyric related distribution patterns in P2-Bw2 horizon (PPL), g- enaulic related distribution patterns in P2-Ap horizon (PPL), h- organ residue in P2-Ap horizon (PPL), i- general tissue residue in P3-A horizon (PPL), j- lignified tissue in P2-Bw1 horizon (PPL), k- organic polymorphic amorphous pedofeatures in P1-Ap horizon (PPL), l- aging excrement pedofeatures mixed with organic matter in P1-Ap horizon (PPL), m- intact excrement pedofeatures in P3-Bw1 horizon (PPL), n- thin clay coating around grain in P2-Ap horizon (PPL), o- calcite coating around void in P2-Bk2 horizon (XPL), p- loose continuous infilling of calcite, clay and mineral particles in P2-Bk2 horizon (XPL).

Alfalfa and apple orchard as perennial plants along with minimum tillage and higher organic matter had led to relatively higher BR, while in corn fields higher soil tillage led to increase in soil aeration and organic matter oxidation. Therefore corn cultivation adversely affected the soil BR and are consistent with the Izquierdo et al., (2005) and Bini et al., (2013) findings. The higher SIR in alfalfa field is mainly due to better nutrients status as well as relatively higher population of microorganisms. SIR estimates only aerobic microorganisms that are metabolically active and dead organisms and resting forms are not accounted for this measurement (Anderson & Domsch, 1978). Alfalfa root produces more available nitrogen to support active microbial growth and Sparling (1997) pointed out that organic nitrogen compounds with low molecular weight enhance substrate induced respiration. Soil managements influence on biomass (Follett & Schimel, 1989) and addition of organic fertilizers and plant residues increased the microbial biomass to a significant level (Seneviratne et al., 2011).The results of the present study revealed that, agricultural and horticultural practices due to addition of organic fertilizers and appropriate substrate creation for microbial growth caused MBC increase, that Ratnayake et al., (2014) findings supported this results. Different residues of plant species had various effects on the contents of MBN in soil. Along with Hu et al., (2009) reported results; our finding revealed higher content of N in soil profile under alfalfa cultivation by N fixation capability of this crop and also more effect on MBN. Impress of land use on q_{CO2} was same as BR, because this index related to organic matter and microbial activity. Microbial activity is affected by root exudates (Nannipieri et al., 2008). Also the significant difference of q_{mic} under various land uses referred to different root exudates that able to adjust soil microbial activities. Phosphatase activity is sensitive to environmental perturbations such as organic amendments and tillage. In comparison with bare soil, a slightly increase of ALPA was observed in all three land uses, which are not statistically significant. Therefore it seems that soil microorganisms are main sources for ALPA activity, while plants roots are not involved in production of this enzyme (Tabatabai & Bremner, 1969). The significant difference between amounts of ACPA under various land uses referred to the amount of acid phosphatase exuded by plant roots, that describe between crop species and varieties as well as crop management practices (Wright & Reddy, 2001; Ndakidemi, 2006). Also, according to different reports alfalfa (legume) secrete more phosphatase enzymes than other plants and the soil pH is another factor which influences the rate of this enzyme synthesis, release and stability.

Discussed biological indicators of soil quality except ALPA and MBP showed effect of land use on soil quality. ALPA and MBP are not significant affecting by land use. Therefore they aren't useful indices for land management planning to change soil quality based on land use chosen. In this research work according to biological indices, descending order of soil quality by land use is: alfalfa cultivation, apple orchard, corn cultivation and bare soil.

According to results, agriculture and horticulture practices caused to change soil micromorphological properties. Comparison of bare soil fabric with cultivated conditions showed that there was no more effect of farming on microstructure of subsurface horizons. In contrast, land uses had significant effect on microstructure of surface horizons that led to change and improve their condition. Presence of strong granular and spongy microstructure in surface horizons of different land uses relevant to plants root, organic matter and biological activity (Stoops, 2003). Consequence of physical and biological activity of various crop species roots, amount and kind of their residues and tillage system on aggregation led to ranking effect of different land uses on soil microstructure quality. Observation of Enaulic related distribution patterns in surface horizons of cultivated treatment point to role of land use in aggregation too.

Moreover agricultural practices compacted surface horizons and led to dominant packing voids, because of mix up plant residues and organic matter with soil and more biological activities, they had higher porosity rather than subsurface horizons (Arocena et al., 2010). Existing of developed voids in subsurface horizons related to plant roots action (Kemp et al., 2004) and micromorphological observations showed that, the best and worst statuses of porosity and voids were found respectively in apple orchard and corn cultivation. Many previous researches have confirmed this result and indicated that land uses with maximum amount of organic matter and minimum tillage had higher porosity and developed voids (Kodesova et al., 2006; Veiga et al., 2008; Moreno et al., 2012).

All upper horizons had higher organic matter and remnants which decreases with depth due to adding them to soil surface except bare soil. Because of land use type consequences, kind, shape, form and amount of accumulation, degree of disintegration organic remnants status were different. Biological activity, tillage and nature of plant residues are the most important factors that affect on organic remnants and matter conditions in different land uses.

Faunal activity was much higher in cultivated than bare soil similar to those reported by Elgar (2008). Presence of plant remnants mostly in decomposed form under alfalfa and corn land uses and dominant intact situation in apple orchard indicated high disintegration rate of plant remnants in crop covers than tree covers. Suitability of crop tissues for nutrition and activity of microorganisms was the cause of high disintegration rate. In apple orchard, the main assignment of decomposition was done by macroorganisms because of the special condition of plant tissues. Firstly these remnants must be fragmented by macroorganisms and then they can be used by microorganisms. In microscopic study, along with presence of organic remnants, excrement pedofeatures were observed in thin sections related to soil surface horizons higher than subsurface one. Existence of more organic matter in surface horizons can be involved as optimal condition for soil organisms. In all profiles with increasing depth, the organisms activity have been reduced because decreasing of soil organisms nutrition source (Plant remnants) that decreasing in obvious evidence quantity, like excrement pedofeatures confirmed these results. This finding also has been confirmed by Chernikov (2000). The high percentage of excrement pedofeatures in tree land use compared to crop land uses showed the importance of macroorganisms and the reason of high amount and activity of them in tree land use. Microorganisms activity compared to macroorganisms were high in crop land uses (alfalfa and corn) and inverse situation in tree land use (apple orchard). One of the reasons can be existence of plant remnants with suitable condition as nutrition source for each of organisms types. In bare soil due to lack of nutrition source, activity of both groups of organisms (macro and microorganisms) were low.

Coatings of calcite in subsurface horizon appear to have two main origins, formed by evaporation or mechanical translocation, the latter related to biogenic activity due to respiration of plants and soil organisms that led to the production of carbon dioxide (Seghal & Stoops, 1972).

Despite the same parent material under all treatment, presences of different horizons in various depths showed the effect of different land uses on parent material and soil evolution. Although parent materials and soils that have affected by land uses, there is no difference between mineral components of all treatment. This fact showed that land uses cannot impress on mineral component in short time period.

Generally microstructure, voids, organic component and excrement pedofeatures are the main evidence, which are reviewed in this study to evaluate soil visual quality, but in mature soils other evidence from soil fabric can be observed. Micromorphological results showed descending order of soil visual quality in apple orchard, alfalfa cultivation, corn cultivation and bare soil.

Different rank of apple orchard with alfalfa cropping system in biological and visual quality show the importance of use combination of soil quality indices to exact evaluate. Then investigate of physical and chemical indices of soil quality can help us to solve this problem.

According to results, land uses with minimum tillage and maximum organic matter soil quality can be better than others. However, plant type and residues component have effective role in this regard. Therefore land use chosen and management have important role to raise soil quality and prevent from degradation.

5. CONCLUSIONS

The objective of present study is introducing micromorphological observation along biological traits to evaluate soil quality. A large number of studies revealed effect of different land uses and agricultural practices on decreasing of soil quality, but we saw, in bare lands when soils can't improve their quality due to less of vegetation and environmental limitation, cultivation is useful act that lead to improve soils quality. Based on obtained results, it can be concluded that agricultural and horticultural practices have significant positive effect on biological indices (Br, SIR, MBC, MBN, q_{co2}, q_{mic} and ACPA) and micromorphological indicators (microstructure, voids, organic matter component and excrement pedofeatures). Finally according to micromorphological and biological results we can achieve to this point that, cultivation is not only effective on soil quality improvement but also can be useful to keep bare land from degradation.

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