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Studying altitude influence on Uludağ fir, scots pine and black pine growth and soil properties in Kastamonu

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Abstract
Main aim of this present study was to investigate the effects of slope position on soil properties, soil organic carbon and total nitrogen content and stock capacities of Black pine (*Pinus nigra*) in Daday, Kastamonu. For this aim, soil samples of Black pine (*Pinus nigra*) were collected from two altitudes (871 m and 1189 m) on the north aspect. The soil samples were taken randomly from 0-5cm, 5-10 cm, 10-15 cm, 15-20 cm, 20-25 cm and 20-30 cm soil depths and analyzed for soil pH, soil texture, bulk density, soil macro and micro nutrient concentrations, soil organic carbon (SOC) and total nitrogen (TN) content. The SOC and TN stock capacity were then calculated by multiplying soil volume, soil bulk density, and the SOC or TN content. Among soil properties, only sand and clay content showed significant differences between altitudes ($P<0.001$). Soil carbon content only showed significant differences between the altitudes. However, soil total nitrogen content had a significant difference either between the altitudes or between the soil depths.

Keywords: Bulk density, soil organic carbon, pH, altitude, Kastamonu

1. Introduction
1.1. Soil Quality
Soil quality is one of the three components of environmental quality, besides water and air quality (Andrews *et al*., 2002). Water and air quality are defined mainly by their degree of pollution that impacts directly on human and animal consumption and health, or on natural ecosystems (Lamma *et al*., 2018) [9]. In contrast, soil quality is not limited to the degree of soil pollution, but is commonly defined much more broadly as "the capacity of a soil to function within ecosystem and land-use boundaries to sustain biological productivity, maintain environmental quality, and promote plant and animal health" (Doran and Parkin, 1994, Doran and Parkin, 1996). As Doran and Parkin (1994) state explicitly, animal health includes human health.
This definition reflects the complexity and site-specificity of the belowground part of terrestrial ecosystems as well as the many linkages between soil functions and soil-based ecosystem services. Indeed, soil quality is more complex than the quality of air and water, not only because soil constitutes solid, liquid and gaseous phases, but also because soils can be used for a larger variety of purposes. (Warkentin & Fletcher 1977) [33].

1.2. The Understanding Soil Formation
Soil formation is a physical and chemical approach. This approach has been made through out decades. During this formation layers are made which caused to process the hydrological and fuel terrestrial cycles. Soil has the best capacity to store water and fuel which are stored by adhesive and cohesive forces. Water is added to soil by precipitation and when the soil exceed the water holding in its content then the exceeded amount are transferred to groundwater cycle or to the surface in which the surface moisture are encountered by sun heat and evapotranspiration occurs and joins the climate cycle and transfers to other places which controls the soil process. Latent heat flux and leaching illustrates the solute flux and soil development that forms the biogeochemical cycling (Chadwick *et al*., 2003) [6]. The soil quality is redundant because everyone know that how and where good soils are found. Quantifying soil based on quality varies based on verities in nature. Based on soil formation and deformation the soil series can be found everywhere (Karlen *et al*., 1997) [29].
For instance, the way the Earth's weather is changing have its noticeable effects on forest ecologists and soil scientists.

The containing of a big amount of carbon and nitrogen in soil could be caused for global warming or bringing difference in precipitation, So for plant growing and litter decomposition moisture and temperature are essentiatiol. (Perry, 1994). In another hand, at the scene scale topography is the primary part to check of both hydrological and soil projection. Spatial data about soil properties are normally a restricting variable for both land handelling and the utilization of spatially disseminated models. (Park & Vlek, 2002) [24]. Data from soil maps are typically low determination and the estimations of soil ascribes are thought to be uniform in spite of the fact that there is frequently awesome variety inside soil units (Zhu, Band, Vertessy, and Dutton, 1997). Be that as it may, for accommodation of our reviews the components of soil arrangement will be taken as five as initially figured by (Jenny, 1994) [27].

These five factors are

- Parent material
- Climate
- Organisms (vegetation and the animals of a particular region)
- Relief (landforms and topography)
- Time

These variables set the conditions that realize the procedures which thus achieve the properties of the soil. (Agbede, Ogunrinde, Ogunrinde, & Sanusi, 2010).

1.2.1. The Properties Of The Parent Material (parent rock)

Parent materials or substrates (substrate types) are defined as the solid material of which the soil are consists of. This includes the weathered and in many cases re-located residuum of the parent rock (regolith) as well as its basis, from which the unconsolidated top has derived. The characterization of substrate type is closely related to essential soil physical and chemical properties as a product of the petrographic conditions of the parent rock as well as its alterations during rock weathering and pedogenesis. The substrate classification comprises substrate genesis, content of carbonate and carbon, overall soil texture, and parent rock. The characteristic of the parent substances (i.e. the piece of the basic mineral testimonies) are basically grain size and subsequently molecule surface region, molecule estimate conveyance, porosity, hardness and compound organization. A higher surface territory of the dirt particles implies higher weathering rate. The porosity, molecule size and appropriation are exceedingly essential for the physical soundness of the dirt, and for the pressure driven conductivity in the soil.

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1.2.2. Climate

Atmosphere have its most influence on soil through temperature and precipitation. And it is more rapid in warm, soggy atmospheres, rocks, minerals and weather. Temperature influences the rate or speed of chemical exercises, the sort of vegetation, and natural (connecting to living beings) exercises. The temperature and regular spreading widely of rainfall, in this way, affect the sorts and development of plants and their quickly decomposing into soil. The yearly amount and regular conveyance of precipitation and solar energy contrasts among environments and also their ecological structure and capacity. Organic matter production and nutrient cycling expanded the rainfall to a higher degree (Schuur, Chadwick, & Matson, 2001) [14]. As a usual yearly rainfall and temperature might be a pointers of soil establishment. High powers of precipitation and high temperature in existence of short times might be the overwhelming elements. Rainfall causes filtering, or the dismissal of soil materials by water coursing through the soil. The measure of water traveling through the soil additionally influences the development of earth particles into the subsoil. The fundamental foundation for a particular climatic soil sort is the nearness of comparable anatomical and morphological attributes that are saved under an assortment of land situations and geographical strata. Regardless of what the parent material or topography, all soil of a given climatic district must have selected climatic local. For example, grows in humid cool atmospheres and happens on rocks, gneisses, diorites, loess, peaty stores, and even on limestones. They are originated on flat topography and on slants, under forests and heath and in addition under vegetation. (Jenny, 1994) [27].

1.2.3. Organisms (vegetation and the animals of a particular region)

Plants, animals and micro-organisms (fungi and bacteria) all influence soil arrangement by generating or donating to humus generation. Soil life forms speak to a vast portion of worldwide earthly biodiversity. They do vital procedures for soil wellbeing and richness in both ecosystems and agricultural systems. This append describe briefly the life forms of soil in biological and ecological ascribe. And, inquired the relationship between vegetation sorts and soil orders, nonetheless, short research was on the extensive analysis of the vegetation–soil–topography relationship, which has been a vital subject of ecological and geographic reviews, and can give important data to such sort of deposed areas to have fruitful strategies in rebuilding and administration. Likewise, this mountainous area encourages to concentrate the vegetation soil topography relegation. (Solon, Degórski, & Roo-Zielińska, 2007) [12].

The gathering of organic entities which need aid living for their exists in the soil constitute the soil sustenance web. Those activities from claiming of dirt organic entities connected to the former, a perplexedly sustenance web with some subsisting ahead living plants and shows What's animals (herbivores Furthermore predators), others ahead dead plant trash (detritivores), ahead growths or ahead microbes, also how existing off yet not eating up each their hosts (parasites). Plants, mosses What's more exactly algea would autotrophs, they expect the and only fundamental makers by using sun built vitality, water with carbon (C) starting with natural carbon dioxide (CO2) to settle and make mixes characteristic Furthermore existing tissues. The claim of breaking down the dirt minerals, through the oxidation for nitrogen (N), sulfur microbes (S), press (Fe) Also c's from carbonate minerals are by lots of autotrophs. Whichever clearly (primary consumers) alternately through delegates (secondary or tertiary consumers) for c's and vitality necessities are grown by microorganisms and actinomycetes would heterotrophs, and they rely on upon natural materials (Bot & Benites, 2005) [5].

1.2.4. Time

The weathering process on the soil's parent material brings on decomposition over time. The horizon development changes the soil's layers chemically and physically. Elder soil eventually grows nicely, albeit some of them are difficult to notice due to weathering and leaching. Some geological processes create barriers to soil formation, preventing parent material from weathering over in a long period. As a result, the destruction of the inclination eliminates material continuously. As rivers flood, fresh silt is regularly deposited in their courses, spilling over into the floodplain. The process of improving the soil starts with the addition of fresh materials. (Ritter, 2006)

For instance, the erosion of slopes removes material continuously and prevents the progress of soil. As the stream overflows over its floodplain during floods, fresh residue is frequently accumulated along the courses of streams. The continual growth of fresh material restarts the soil formation process.

1.2.5. Relief (landforms and topography)

In local administration of soil, topography is considered as one of soil shaping components. Since of topography many changes in soil sort can happened over little difference in distance. The factors which impact on soil improvement are elevation, slope and aspect (Plaster, 2013) [17]. Firstly, topographic factors (e.g. slope, aspect, elevation) causes to the change of microclimate conditions and indirectly influence the growth and division of land cover. Aspect is a basic part in the dispersion and development of vegetation since it decides the insolation of a surface (over the surface strips parent substances away and hindering soil advancement. Water disintegration is more viable on more extreme, un-vegetated slopes. (Ritter, 2006). McCune and Keon, 2002) [23]. Topography significantly affects soil development as it decides spillover of water, and it's orientation influences microclimate and it influences vegetation. For soil frame, the parent substances want to lie generally not distributed so soil skyline procedures can continue. Water moving.

1.2.5.1. Effects of slope position on soil properties

In a nutshell, some soil characteristics that are impacted by slope location and changes in the range of these characteristics result in the formation of various diagnostic layers and soils along altitudinal transects. As can be observed, the soils in this area had an atypical catenary evolution that revealed the existence of developing soil in high gradient positions and immature soil on gentle slopes. This argument demonstrated that additional environmental elements, in addition to slope location, have a direct or indirect impact on soil formation, with vegetation being the most significant of them. (Rezaei, *et al*, 2015) [19].

1.2.5.2 effects of aspect on soil properties

In a few sites, examples of soil contrasts related to contrasts in perspective. Solid slopes with equator ward angles have a tendency to have soil natural matter levels and occasional impacts like level slants at lower height while poleward perspectives have soil improvement similitudes to level soils at higher rises. Topographical variables impact on soil properties, as a urgent marker regarding soil debasement and feasible land administration in normal ecosystem community, the examination of soil physical and chemical, the spatial variety of soil properties are essentially affected by some ecological components, for example, atmosphere, landscape, including landscape, topography, slant slope and advancement, parent material, and vegetation (Ollinger *et al*., 2002). By Altering of the precipitation sample, temperature and relative humidity normally topography affects town microclimates (Yimer *et al*., 2006). A few factors like climate, landscape features, including landscape position, topography, slope gradient and evolution, parent material, and vegetation cause the spatial variation of soil properties and affect it a lot. (Coble *et al*., 2001).

1.2.5.3. Impacts of slope angle on soil properties

Position is the ascent or fall of the land surface. It is essential for the rancher or irrigator to recognize the inclines on the land. A slant is anything but difficult to perceive in a bumpy territory. Begin moving from the foot of a slope toward the top, this is known as a rising incline. Go downhill, this is a falling slope. The impacts of topography on soil beginning and advancement of soil demonstrate that slope angle and slope length has immediate and roundabout consequences for calcification of mineralization, physical and substance soil properties and stand structure change enormously with points of incline from high to basin floor. Soil thickness, fine soil substance and soil dampness substance are more valuable in basin incline points. And the amount of organic carbon is valuable in the woods floor in high incline points. And the having of organic carbon in the mineral soil is worthier in low points of slope. These adjustments with the help of soil properties propose that upslope diminish deterioration rate. (Burke 1989)

The development of Aspect and slope can be administrate in water and material in a slope slant and add to the spatial contrasts of soil properties. In a backwoods biological community, soil properties are additionally impacted by vegetation creation. Soil dampness substance is influenced by the slope and aspect. (Chih, 2003) [6]. Position has the scene influences the landscape and redistribution of water, supplements, silt, and organic matter. Soils on edges and upper slope will have a tendency to free soil and organic matter that will have a tendency to collect on lower slopes and in abasement. Mostly, soil in lower-slope positions will tend to have a wetter dampness administration for a more extended time. (Brzezińsk 2012).

1.3. Soil Properties

According to above description, topographic elements effects on soil properties and forming processes that lead to the forming and evolution of various soil in different parts of landscape.

1.3.1. Soil Reaction (pH)
Soil pH is a standout amongst the most demonstrative estimations of the substance assests of a soil. Whether a soil is acidic, neutral, or fundamental has much to do with the dissolvability of different aggravates, the relative holding of particles to trade destinations, and the movement of different microorganisms.

1.3.2. Soil Bulk density
Bulk thickness is the mass of dry soil per unit volume, including the air space. Mass thickness majorly affects the development of air and water in soils. Soils with high mass densities are regularly compacted. Soil compaction limits establishing of profundity, which diminishes the take-up of water and supplements by plants. Compaction additionally diminishes penetration, along these lines expanding overflow and the danger of water disintegration.

1.3.3. Soil Organic Matter
It is the strong segment of soil which is framed by the plants trash and dead creatures. It expands humus in soil. Such matter expands exercises of living populace i.e. microorganism in the dirt. This matter is helpful to hold dampness in soil and to expand having of water limit in soil. The soil rich in natural matter contain substantially more microbial populace than the disintegrated soil. The measure of organic matter in the soil is profoundly related upon the biological zone in which it happens and also the land utilize and administration of soil. Territory under common woods has higher natural matter than these cleared for plowing. Soil natural matter (SOM) may give valuable data about the period of soil scene and, accordingly, can add to interpret surface of geomorphic progression (Favilli *et al*., 2008).

1.3.4. Total Nitrogen (TN)
Nitrogen in soil is available for the most part in the organic forms, together with little amounts of ammonium and nitrate frames. For instance, Forest soil researchers have for quite some time been worried with soil carbon (C) and nitrogen (N) in light of the fact that these are regularly the ace factors deciding soil richness (Johnson & Curtis, 2001; Pritchett & Fisher, 1987) [28, 18].

1.4. Vegetation of Turkey
Turkey has a variable vegetating due to its topographic and geomorphic features. Its possesses distinctive vegetation reflects difference in climate, geology, topographic soil type and, diversity and human impart. Mostly all the forest in Turkey are natural in origin and has 450 species of trees and shrubs (Kayacık and Yaltırık 197, Akmam 1995) Forest soils are different than agricultural soils.

1.4.1. Black Pine In Turkey
"Black pine is essential to Europe and Asia and stretches out from Spain and Morocco to eastern Turkey, south to Cyprus, and north to northeastern Austria and Crimea, Ukraine. In United States, European dark pine is generally planted in northern states in New England, around the Great lakes, and in the Northwest" (Van Haverbeke and David, 1990) [32]. "Black pine is adjusted to many soil sorts and topographic living spaces. In its local range the species normally is isolated into three geographic combinations: western, focal, and eastern. Sources from southern France and Spain, the western gathering, frequently are not interested in soil sort; sources from Corsica, Italy, and Sicily, the focal gathering, develop inadequately on limestone soils; while sources from the Balkans and the Crimea, U.S.S.R., the eastern gathering, seem to do well on the poorer limestone soils" (Krugman, Stanley L., and James L. Jenkinson. 1974). "In Turkey at present 21.3 million ha of forested land cover 27% of the territory of Turkey, of which 10.9 million ha (51%) are productive forests. The remaining forest land of 10.4 million ha (49%) is forest land either with low yield or no yield at all, consisting of degraded coppice, maquis and shrubs. Conifer forests cover 56% of Turkey's productive forest area. About 45.400 ha, land area in Turkey has been afforested in 2009 in Turkey. Black pine is a standout amongst the most well-known and financially critical local conifers in Turkey. Many reviews have been led in a few sections of Turkey so as to demonstrate the diverse attributes of dark pine. A few reviews concentrate on general vegetation and greenery of dark pine. Anatolian dark pine develops in the gentle moist atmosphere covering the seaside belt of Black ocean, including Black ocean beach front region of Thrace locale, and chilly and sticky atmosphere winning on the bumpy zones of the Northern Anatolia. Marmara climatic locale that is transitional atmosphere between Black ocean atmosphere and Mediterranean atmosphere, and the Backward area of Black ocean portrayed subhumid consider biological variables which decide the conveyance of Black pine in Turkey Black pine backwoods start at rise of 800-1000 m on the south slants, and 500-600 m on the north inclines of the mountains and accomplish 1800-2000 m in the inland part of the district (southern slants of Murat mountains, eastern piece of Aegean district). Bring down belt of dark pine woodlands are made out of some maquis components and particularly oak species in the inland piece of Aegean" (A, I.B.R., 2012).

2. Aims of this study
Main aim of this present study was to investigate the effects of slope position on soil properties, soil organic carbon and total nitrogen content and stock capacities of Black pine (*Pinus nigra*) in Daday, Kastamonu. For this aim, soil samples of Black pine (*Pinus nigra*) were collected from two altitudes (871 m and 1189 m) on the north aspect. The soil samples were taken randomly from 0-5cm, 5-10 cm, 10-15 cm, 15-20 cm, 20-25 cm and 20-30 cm soil depths and analyzed for soil pH, soil texture, bulk density, soil macro and micro nutrient concentrations, soil organic carbon (SOC) and total nitrogen (TN) content. The SOC and TN stock capacities were counted by multiplying volume of soil, soil mass density, and the SOC or TN co.

3. Materıal and Methods
3.1. Description Of Sampling Sites
This study was carried out in the Kastamonu province, Daday, north-west of Kastamonu, Turkey, (41°28′43″ N, 33°28′00″ E) (Figure 1), a mountainous region with steep slopes (range from 40% to 60%) and high elevations (up to 3000m). Location of the study area is shown in Figure 2. In the area, both north- and southfacing sites were commonly forested by Pinus silvestris and *Pinus nigra* either pure or in species mixture. Some stands,. Fagus orientalis and Quercus spp can be seen a long with Pinus silvestris and *Pinus nigra*. Basic forest construction sorts developing on these heights in every region were deciduous– coniferous woods (650–

1100 m) and coniferous backwoods (1100–1600 m) (Figure 3). The understory at the lower part of the slant was involved by grasses, ferns and herbs, though the upper part of the slope was commanded by herbaceous plants amid the developing season. In winter, the ground was secured with snow, gathered all the more vigorously on the upper parts of the slope and achieved profundities of up to 2 m. Snow remained longer on the ground at the upper parts than at the lower parts. The north-facing slopes received heavier snow accumulations than the south-facing slopes, but in spring snow melted more rapidly on the south-facing slopes than on the north-facing slopes.

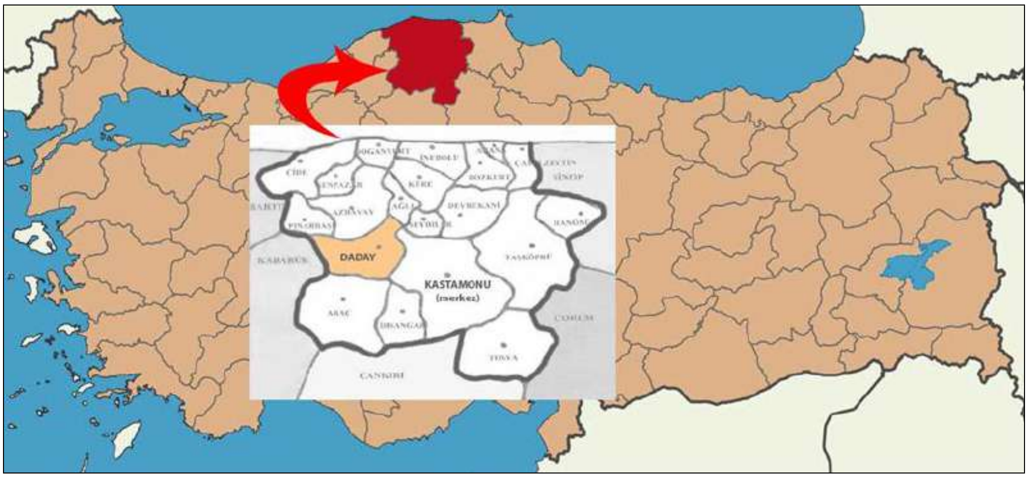

Fig 1: Map site study of Daday

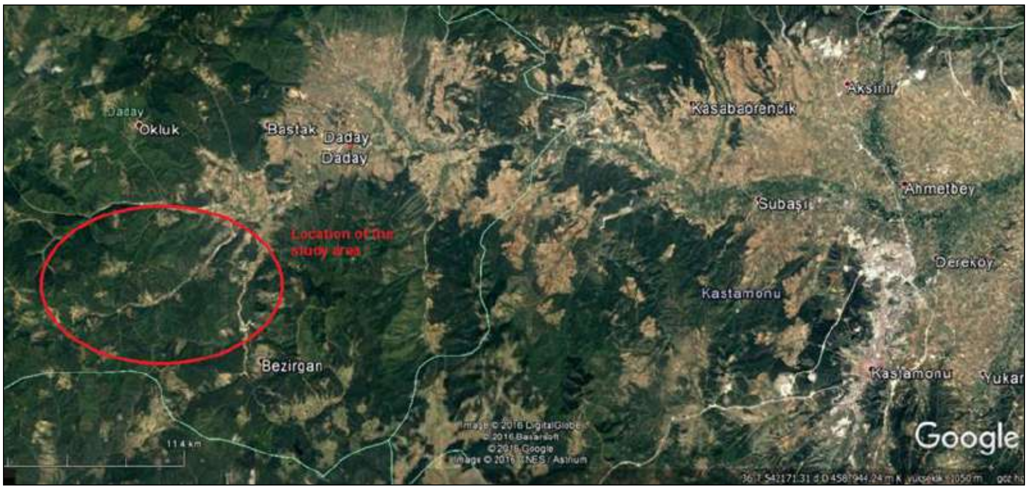

Fig 2: Map place of the study area on Google maps

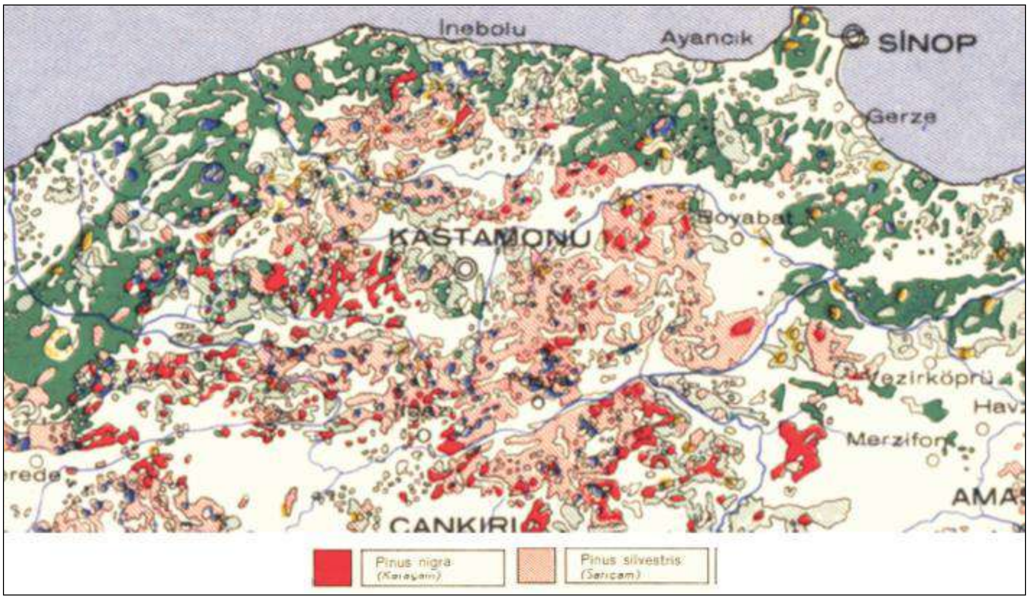

Fig 3: Most common tree species (*Pinus nigra* and Pinus silvestris) distributed in the study area

3.2. Climate Of The Study Site

In the review territory, Kastamonu weather temperature in summers are short and warm winters are cold, snowy and takes lots of time, while. The seasonal and daily temperatures indicate extensive qualities and precipitation is low. Climate information for the period 1975-2010 (Kastamonu Meteorology Station, 800 m a.s.l.) (Table 1) demonstrates that precipitation midpoints 489 mm annually, with the highest sums in May (71.1mm), and the least sum in February (25.8 mm). Normal month-to-month temperature extended from 20.2 oC in July to - 0.8 oC in January.

Table 1: Meteorological data between 1975-2010

Meteorological data	Months												
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**Yıllık**
Mean Temperature	-0,8	0,6	4,3	9,5	13,8	17,4	20,2	19,8	15,5	10,4	4,5	0,6	9,6
Max. Mean Temperature	11,0	14,3	21,4	25,6	28,6	32,0	34,3	34,5	31,5	26,7	18,2	12,6	24,2
Min. Mean Temperature	-12,7	-12,3	-8,3	-3,0	0,8	4,9	8,3	7,8	3,2	-1,1	-5,7	-10,4	-2,4
Mean Precipitation	30,9	25,8	32,1	56,3	71,1	61,6	37,2	33,6	32,3	38,4	32,3	37,6	489,0
Daily Max. Precipitation	10,3	8,8	10,5	15,7	18,8	18,5	15,2	16,6	14,2	16,5	10,8	13,0	18,8
Mean Humidity	75,5	70,7	66,5	65,5	65,1	63,1	59,8	60,8	64,9	71,0	75,6	77,6	68,0
Min. Humidity	41,5	35,3	25,7	25,7	27,0	26,3	25,1	23,8	25,7	28,0	37,6	41,9	23,8
Day covered with snow	15,6	10,4	5,3	2,0							2,7	10,0	46,0
Number of frosty days	25,3	22,0	16,8	4,2	1,7					3,4	13,2	21,8	109,0
Number of foggy days	6,4	2,3	1,6	1,3	1,9	1,0	3,0	1,0	3,0	2,4	4,5	7,6	35,9
Fastest Wind Direction and Speed	SWW 4,3	SW 4,8	SWW 5,4	SWW 5,4	SWW 4,6	SWW 4,5	NWW 4,3	N 4,0	SWW 4,1	SWW 3,9	SW 4,0	SW 4,3	SWW 5,4
Mean wind speed	1,0	1,2	1,4	1,4	1,4	1,3	1,3	1,3	1,2	1,0	1,0	1,0	1,2

3.3. Geology Of The Study Site

The study area is Daday near Kastamonu in the southern passive margin of the oceanic western Black Sea basin, it is part of the Central Pontides of Turkey. This is related to the Arach-Daday unit, the rocks of this unit is different in the basement and at the top covered by the rocks of Mesozoic age. This basin bisected length wise during the mass Tristian forming the Zonguldak basin in the North West and the Ulus basin in the south west. Both of these basins were deform in the early Cenozoic to the east of the Arac -Daday shear-zone the northerly deepening Sinop basin dominates the architecture of the pontides in the north. Consist of Daday-geology there are many types of rocks Metamorphic nearly before ancient age Cambrian there are consist of five geology that consist rocks the position geology in the region are consist of type of rocks Metamorphic. Parent material of the studied region was basicly a stone/quartz blend. Geomorphology and tree species circulation at the review site is appeared in Figure 3.

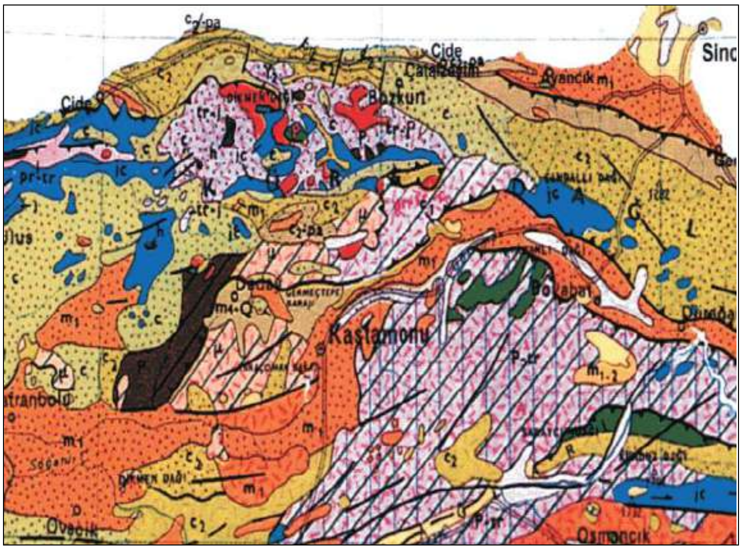

Fig 4: Geomorphology of the study site

3.4. Soil Sampling In The Field

Two slope positions were selected at the top (1189m) and bottom (871m) on north and south aspects. The slope angles of the sites ranged from 40% to 50%. At the top slopes on the north-facing site were commonly dominated by Black pine trees, but Scots pine trees were also seen around (Photo 1). At the bottom slopes on the north- and south-facing sites were covered by Black pine trees (Photo 2).

Soil samples of Black pine (*Pinus nigra*) were collected from two altitudes (871 m and 1189 m) on the north aspect. In each site, age of few mature and taller trees were measured for height, diameter (diameter at breast weight) and tree architecture was noted. Canopy cover was determined in the field by visually estimating the amount of cover in each site. The soil samples were taken randomly from "0-5cm, 5-10 cm, 10-15 cm, 15-20 cm, 20-25 cm and 20-30 cm soil depths by digging three soil pits at each sampling site " (Photo 3, Photo 4 and Photo 5). Two core samples from each soil pit were also taken and averaged to obtain representative bulk density.

Photograph 1: Study site in Black pine stand at altitude of 1189 m

Photograph 2: Study site in Black pine stand at altitude of 871 m

Photograph 3: Digging soil pits to take soil samples according to different soil depths by using soil cores

Photograph 4: Soil pit under Black pine site at the altitude of 1189 m

3.5. Preparation of Soil Samples And Analysis

The samples were air-dried, ground and pass through 2 mm mesh-sized sieve. They placed into marked plastic pags and kept in a fridge until chemical analysis (Photo 6). The soil samples were analyzed for soil pH, soil texture, bulk density, soil macro and micro nutrient concentrations, soil organic carbon (SOC) and total nitrogen (TN) content. The SOC and TN stock capacity were then calculated by multiplying soil volume, soil bulk density, and the SOC or TN content.

Photograph 5: The sieved the exemplary soil put in small pacakges and numbered

3.6. Analysis of Soil Samples

3.6.1. Soil pH

Soil pH is a standout amongst the most characteristic estimations of the chemical properties of a soil. Whether a soil is acidic, neutral, or basic has much to do with the solubility of different compounds, the relative holding of particles to commerce, and the movement of different microorganisms.

Soil pH was measured by mixing 10 g of field moist soil with 25 ml of deionised water in 50 ml beakers. The pH of the soil suspension was measured after 30 min. using a combined glass calomel electrode fitted to a Origon 420 digital pH meter. pH meter calibrated using pH 4 and 7 buffer solutions.

3.6.2. Soil Texture

Soil texture is indicated in the laboratory by a method in light of the fall of partical velocity in a medium fluid, which is straightforwardly corresponding to the square of the span of the molecule and conversely to the consistency (a fluid's internal resistance to flow) of the fluid (Stokes' Law, Hillel 1980). Rates of sand, Clay, and earth are dictated by either "pipette strategy" or "hydrometer technique" (Day 1965). Soil textural class names can be gotten from the "USDA textural triangle" (Figure 2).

"Soil molecule size was dictated by the Boycouos hydrometric technique (Bouyoucos, 1962) in a soil suspension of 50 g of soil in 1L of H_2" (Gülçür 1974 changed by Bouyoucos after damaging organic matter (OM) utilizing hydrogen peroxide (H_2O_2) and scattering the soil with sodium hexameta phosphate ($NaPO_3$)., 1962).

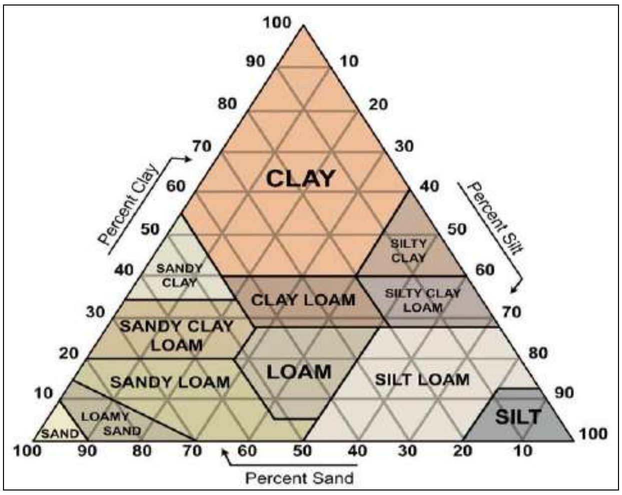

Fig 5: USDA textural triangle

3.6.3. Bulk Density And Pore Space

Two undisturbed soil core samples from each horizon were collected for the determination of dry bulk density. Cores of 4 cm height and 5.6 cm diameter were driven vertically into the soil by means of a wooden hammer. The cores were carefully dug out using a knife and excess soil at both ends removed before the cores were capped. After weighing the field moist soil samples in laboratory and determining the total volume of the soil samples using the formula ($V = \Pi r^2 h$). The oven-dry weight, they were placed in an oven at 105 ^{0}C for 24 hours. The dry bulk density of the soil was then calculated as follows:

Dry bulk density (g cm^{-3}) = mass of oven-dry soil (g) / total volume of soil (cm^3)

Percentage pore space was computed from the values of bulk density (BD) and particle density (PD) (Brady and Weil, 2002) as:

Total pore space (%) = (1-BD/PD) x 100

3.6.4. Determination Of Moisture Content And Loss On Ignition (LOI)

Silica crucibles used for the determination of dry weight and LOI were thoroughly washed, placed in an oven at 105 °C for 1 hour, cooled, and stored in a desiccator until required. Five grams of moist soil was weighed into a pre-weighed oven dried silica crucible and placed in an oven over night at 105 °C. Crucibles were then re-weighed after they had cooled in a desiccator.

"The crucibles containing the oven-dry soil were then transferred to a furnace at 850 °C for 30 minutes. The crucibles and its contents were then allowed to cool in a desiccator and re-weighed to determine the LOI. The LOI was then expressed as a percentage relative to the weight of oven dried soil. The % moisture content (MC) is expressed relative to moist soil and the LOI as a % of the dry weight. Both calculations are shown in equation.

$$\% \text{ MC} = \frac{\text{Mass of moist soil} - \text{Mass of soil after drying} \times 100}{\text{Mass of moist soil}}$$

$$\% \text{ LOI} = \frac{\text{Mass of oven dry soil} - \text{Mass of soil after ignition} \times 100}{\text{Mass of oven dry soil}}$$

The percentage of content organic carbon was estimated from the LOI. Ball (1964) estimated that for an organic soil ignited at 850 C for 30 minutes the % organic carbon content could be estimated from the following regression equation:

% Organic carbon = (0.476 x LOI) - 1.87

(Reeuwijk, LP van (2002)

3.6.5. Determination Of Soil Organic Carnon And Nitrogen

Soil organic carbon and nitrogen contents were analysed in Kastamonu University Center Laboratory using Eurovector EA3000-Single CNH-S element analyser.

3.6.6. Determination Of Soil Macro And Micro Nutrients

Soil macro (P, K, Ca, Mg, S) and micro nutrients (Fe, Mn, Na, Cu, Zn, Cl, Al and Co) were determined in Kastamonu University Center Laboratory using Spectro-Xepos II model XRF (X-Işını Floresans Spektormetresi)

3.6.7. Calculation Of Soil Mass And Soil Organic Carbon And Total Nitrogen Stock Capacity

Soil mass was calculated as follows:

Mi=BDi·Ti·104

"Where Mi is dry soil mass (Mg ha^{-1}), BDi is bulk density (Mg m^{-3}), Ti is the thickness of the i-th soil layer (m), and 10^4 is the unit conversion factor (m^2 ha^{-1}). The fixed depth (FD) determination of areal C or (N) stock is calculated as follows:

Ci−fixed or Ni−fixed=([Ci]or[Ni])·Mi

Where Ci-fixed is the C (or Ni-fixed is the N) mass to a fixed depth (kg C or N ha^{-1}) and [Ci] or [Ni] is the C or N concentration (kg C or N Mg^{-1})".

3.6.8 Statistical Analyses

Differences in soil properties and soil carbon stock rates between slope positions were tested for significance using ANOVA. Tukey's honest significance difference (HSD) test was used when statistically significant differences ($p<0.05$) were observed.

4.1. Soil Properties

Some soil properties of Black pine stands collected from north aspect at two altitudes are given in Table 1. The single effects and interactions of slope positions and soil depths of soil pH, bulk density, porosity, sand, clay, silt and moisture are listed in Table 2, Table 3, Table 4, Table 5, Table 6, Table 7 and Table 8 respectively. Among soil properties, only sand and clay content showed significant diffreneces between altitudes ($P<0.001$). Soil pH, bulk density, porosity, silt and moisture did not vary between the atlitudes or between the soil depths. Mean sand content (72%) at the lower altitude (871 m) was higher than that (60%) at the higher altitude (1189 m), whereas clay content at the lower altitude was lower (18%) than that at the higher altitude (29%). Only clay content had a significant altitude x soil depth interaction, indicating that the clay content show different trends according to soil depths on different altitudes (Table 1).

Table 2: Some soil properties of Black pine stands collected from North aspect at two altitudes

Altitude (m)	Soil depth (cm)	Bulk density (g/cm^3	pH	Porosity (%)	Hygroscopic Moisture (%)	Sand (%)	Clay (%)	Silt (%)
871 Mean	0-5	1,28	7,09	52	7,02	72	17	11
	5-10	1,16	7,01	56	6,86	74	16	10
	10-15	0,93	6,97	65	6,87	70	20	10
	15-20	1,13	6,77	57	6,99	71	18	10
	20-25	1,20	7,00	55	7,11	69	20	10
	25-30	1,08	7,14	59	6,84	75	16	9
	0-30	1,13	7,00	57	6,95	72	18	10
1189 Mean	0-5	1,57	6,23	41	7,02	57	26	18
	5-10	1,55	6,30	42	6,97	49	39	12
	10-15	0,49	6,19	81	8,06	71	21	8
	15-20	1,05	6,01	61	8,59	67	27	6
	20-25	1,19	5,99	55	9,53	58	29	13
	25-30	1,18	5,93	33	9,08	57	33	10
	0-30	1,27	6,11	52	8,53	60	29	11

Table 3: ANOVA results for soil pH

Tests of Between-Subjects Effects						
Dependent Variable: pH						
Source	**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**	**Partial Eta Squared**
Corrected Model	3,421[a]	11	,311	,473	,866	,465
Intercept	686,816	1	686,816	1045,298	,000	,994
Soildepth	,143	5	,029	,044	,998	,035
Altitude	3,146	1	3,146	4,789	,071	,444
Soildepth * altitude	,116	5	,023	,035	,999	,029
Error	3,942	6	,657			
Total	815,290	18				
Corrected Total	7,364	17				
a. R Squared =,465 (Adjusted R Squared = -,517)						

Table 4: ANOVA results for soil bulk density

Tests of Between-Subjects Effects						
Dependent Variable: bulk density						
Source	**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**	**Partial Eta Squared**
Corrected Model	1,314[a]	11	,119	1,013	,522	,650
Intercept	23,074	1	23,074	195,648	,000	,970
Soildepth	1,009	5	,202	1,711	,265	,588
Altitude	,079	1	,079	,667	,445	,100
Soildepth * altitude	,541	5	,108	,918	,527	,433
Error	,708	6	,118			
Total	26,980	18				
Corrected Total	2,022	17				
a. R Squared =,650 (Adjusted R Squared =,008)						

Table 5: ANOVA results for soil porosity

Tests of Between-Subjects Effects						
Dependent Variable: porosity						
Source	**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**	**Partial Eta Squared**
Corrected Model	1826,435[a]	11	166,040	,988	,535	,644
Intercept	47957,350	1	47957,350	285,312	,000	,979
Soildepth	1403,515	5	280,703	1,670	,274	,582
Altitude	106,606	1	106,606	,634	,456	,096
Soildepth * altitude	751,593	5	150,319	,894	,539	,427
Error	1008,524	6	168,087			
Total	58496,120	18				
Corrected Total	2834,959	17				
a. R Squared =,644 (Adjusted R Squared = -,008)						

Table 6: ANOVA results for soil sand content

Tests of Between-Subjects Effects						
Dependent Variable: Sand						
Source	**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**	**Partial Eta Squared**
Corrected Model	939,944[a]	11	85,449	3,145	,086	,852
Intercept	69520,111	1	69520,111	2559,022	,000	,998
soildepth	166,222	5	33,244	1,224	,400	,505
Altitude	592,111	1	592,111	21,796	,003	,784
soildepth * altitude	274,222	5	54,844	2,019	,209	,627
Error	163,000	6	27,167			
Total	84199,000	18				
Corrected Total	1102,944	17				
a. R Squared =,852 (Adjusted R Squared =,581)						

Table 7: ANOVA results for soilclay content

Tests of Between-Subjects Effects						
Dependent Variable: Clay						
Source	**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**	**Partial Eta Squared**
Corrected Model	702,500[a]	11	63,864	13,685	,002	,962
Intercept	8961,778	1	8961,778	1920,381	,000	,997
soildepth	88,222	5	17,644	3,781	,068	,759
Altitude	484,000	1	484,000	103,714	,000	,945
soildepth * altitude	186,000	5	37,200	7,971	,013	,869
Error	28,000	6	4,667			
Total	9311,000	18				
Corrected Total	730,500	17				
a. R Squared =,962 (Adjusted R Squared =,891)						

Table 8: ANOVA results for soil silt content

Tests of Between-Subjects Effects						
Dependent Variable: Silt						
Source	**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**	**Partial Eta Squared**
Corrected Model	93,778[a]	11	8,525	,591	,787	,520
Intercept	1778,028	1	1778,028	123,331	,000	,954
soildepth	66,139	5	13,228	,918	,528	,433
Altitude	3,361	1	3,361	,233	,646	,037
soildepth * altitude	51,472	5	10,294	,714	,636	,373
Error	86,500	6	14,417			
Total	2123,000	18				
Corrected Total	180,278	17				
a. R Squared =,520 (Adjusted R Squared = -,359)						

Table 9: ANOVA results for soil moisture

Tests of Between-Subjects Effects						
Dependent Variable: Moisture						
Source	**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**	**Partial Eta Squared**
Corrected Model	14,198[a]	11	1,291	,097	,999	,150
Intercept	957,964	1	957,964	71,704	,000	,923
soildepth	2,810	5	,562	,042	,998	,034
Altitude	9,958	1	9,958	,745	,421	,111
soildepth * altitude	2,763	5	,553	,041	,998	,033
Error	80,160	6	13,360			
Total	1100,059	18				
Corrected Total	94,358	17				
a. R Squared =,150 (Adjusted R Squared = -1,407)						

4.2. Soil C And N Content And Stock Capacity

Soil C and N content of Black pine stands collected from north aspect at two altitudes are given in Table 9. The interactions impacts on the point of slope and soil depths of C and N content are given in Table 10 and Table 11 respectively. Soil carbon content only showed significant differences between the altitudes. However, soil total nitrogen content had a significant difference either between the altitudes or between the soil depths. Total soil nitrogen content also had a significant altitude x soil depth interaction, indicating that the total soil nitrogen content shows different trends according to soil depths on different altitudes (Table 9).

As for the SOC and TN stock capacities, mean soil organic carbon stock capasity was higher (137.1 Mg C ha-1) at the higher altitude than that at lower altitude (87.7 Mg C ha-1).Give info that the total of stock nitrogen capacity was also higher at the higher altitude (7.72 Mg N ha-1) than that at the lower altitude (4.51 Mg N ha-1). Both SOC and TN stock capacities did not show clear differences between the soil depths (Table 9).

Table 10: ANOVA results for organic carbon stock capacity

Altitude (m)	Soil depth (cm)	Soil organic Carbon (SOC)	Soil Total Nitrogen (STN)	SOC stock capacity (Mg C ha-1)	STN stock capacity (Mg N ha-1)	C/N ratio
871 Mean	0-5	2,66	0,115	17,1	0,74	23:1
	5-10	2,90	0,154	16,8	0,89	19:1
	10-15	2,88	0,186	13,4	0,87	15:1
	15-20	2,44	0,080	13,8	0,45	30:1
	20-25	2,38	0,139	14,3	0,84	17:1
	25-30	2,29	0,133	12,3	0,72	17:1
	0-30	2,59	0,135	87,7	4,51	19:1
1189 Mean	0-5	1,18	0,094	9,24	0,73	13:1
	5-10	3,46	0,227	26,8	1,76	15:1
	10-15	7,57	0,355	18,6	0,87	21:1
	15-20	2,84	0,203	14,8	1,06	14:1
	20-25	2,77	0,198	16,4	1,17	14:1
	25-30	8,67	0,360	51,1	2,12	16:1
	0-30	4,42	0,239	137,1	7,72	18:1

Table 11: ANOVA results for total nitrogen stock capacity

Tests of Between-Subjects Effects						
Dependent Variable: Soil total nitrogen content						
Source	**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**	**Partial Eta Squared**
Corrected Model	117,971[a]	11	10,725	3797,010	,000	1,000
Intercept	82,804	1	82,804	29316,316	,000	1,000
soildepth	30,170	5	6,034	2136,338	,000	,999
Altitude	73,268	1	73,268	25940,129	,000	1,000
soildepth * altitude	29,425	5	5,885	2083,587	,000	,999
Error	,017	6	,003			
Total	161,883	18				
Corrected Total	117,988	17				
a. R Squared = 1,000 (Adjusted R Squared = 1,000)						

5. Dıscussıon

Our results showed that elevation significantly influenced some soil properties and soil organic carbon and total nitrogen stock capacities of Black pine in Daday region. If altitude was changed some soil characteristics would be also changed such as soil nutrients, soil texture and also soil micro climate of the area. These changes can also affect soil organic carbon and total nitrogen content and stock capacities.

Textures orbit from clay, sand, and silt at the extremes, to a soil which has every one of the three estimated parts display. The fundamental impact of texture is on accessibility which for mostly reductions with partial size. There were considerable changes in soil properties in Daday region, including dramatic differences in soil texture. Soil pH, bulk density, porosity, silt and moisture didn’t vary between the altitudes or between the soil depth (Table 2-8). However, we found differences for soil texture (sand, clay, silt). Sand content was (72%) altitude 871 and was percentage high 60% at altitude 1189. C clay was low (18%) at altitude 871 higher (29%) at 1189 altitude. Clay content had a significant variation with altitude.

Additionally, at times, soil pH increment at the base inclint point could be ascribed to the accretion of bases that were persumed to had been possibily disintegrated from the top and base slope points as was apparent from the Garcia *et al* work. (1990). The part natural matter in soil with the ascent in it in soil, microbial action in soil may have expanded which might be expanded the decay procedure and release of P, K, Ca, Mg and micronutrients (Bullock, 1992).

Table 10 and Table 11 showed that the nitrogen content of the altitude decreased quite substantially as altitude increased. The nitrogen content difference whether with soil depth and elevation as for the SOC and TN stock capacities, mean soil organic carbon stock capacity the proportion TN was higher 13.7 at altitude 1187 and low 87.70 at altitude 871. The significant differences between the altitudes and the amount of organic C were probably due to the differences of organic and natural decomposition rate (Lee, 1999) [8].

Soil macro and micro nutrient concentrations of Black pine stands collected from north aspect at two altitudes are given in Table. The single effects and interactions of slope positions and soil depths macro nutrients and micro nutrients were shown to be significant as found by Khormali, Ayoubi, Kananro Foomani, & Fatemi, 2012). By increasing the slope, the higher runoff, downward leaching of the carbonate reduced the nutrient contents. Additionally, Fe and Cu there were not difference between soil depth and altitude. In contrast, Mg, P and K concentrations were significantly higher at the higher altitude than those at the lower altitude. A similar result was observed by (Nizeyimana & Bicki, 1992; Tsui *et al*., 2004) [31].

The results for bulk density showed that there was no significant difference between altitude at 871 and at 1187 ($p>0.05$) where mean of 1.13 and 1.27. Those results were not in agreement with the finding of Farmanullah Khan (2013) who found significant ($p<0.05$) impact of the points of incline on soil density bulk and soil pH. Mulugeta Aytenew (2015) also showed that soil pH varied significantly with slope position ($P<0.01$). The results of the porosity showed that there was no significant difference between altitude at 871 and at 1187 ($P>0.05$) with mean of 57 and 52. Mulugeta Aytenew (2015) found significant ($p<0.05$) difference in soil porosity with slope position. Mean sand content (72%) at the lower altitude (871 m) was higher than that (60%) at the higher altitude (1189 m), whereas clay content at the lower altitude was lower (18%) than that at the higher altitude (29%). Only clay content had a significant altitude x soil depth interaction, indicating that the clay content show different trends according to soil depths on different altitudes agree with Farmanullah Khan (2013) ($p<0.05$) and Mulugeta Aytenew (2015) who found significant ($p<0.05$) sand content (46%) was recorded on the gently sloping area, while the highest sand content (55%) was observed on the moderately steep area. Similarly, the lowest silt fraction (14%) was recorded in soils of gently sloping area, while the highest silt content (22.67%) was in strongly sloping area. On the other hand, the lowest clay content (22.67%) was recorded in soils of moderately steep area, whereas the highest clay content (40%) was recorded in gently sloping area The results of mean organic matter showed that there was no significant between altitude at 871 and at 1187 ($p>0.05$) with mean of 2.59 and 4.42. Shazia Saeed (2014) found that many relationships which are negative combined between natural matter content and its increase, and the rate of correlation coefficient between the height and the organic matter content was -0.989. It was important with a P-value 0.222. [20.8] also reported that the effects of high gradient in the proportion of organic matter in the soil, and decreased with the increase of height in the above of sea level.

6. References

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