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Osama Asanousi Lamma
Department of Soil & Water Faculty of Agricultural, Bani Waleed University, Libya

Abduladheim Masoud Mohammed
Department of Soil & Water Faculty of Agricultural, Bani Waleed University, Libya

Hatem Asteil Ahmed Aljazwei
Higher Institute of Science and Department of Building and Construction Technologies Technology, al Shatii, Libya

Corresponding Author:
Osama Asanousi Lamma
Department of Soil & Water Faculty of Agricultural, Bani Waleed University, Libya

Studying altitude influence on Uludağ fir soil macro nutrients in Kastamonu, Turkey

Osama Asanousi Lamma, Abduladheim Masoud Mohammed and Hatem Asteil Ahmed Aljazwei

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Abstract
Soil macronutrients (P, K, Ca^{+2} and Mg^{+2}) showed significant differences between the altitudes (p<0.05). Mean soil macronutrients; Mg, P and K concentrations were significantly higher at the higher altitude than those at the lower altitude, whereas mean soil Ca^{+2} concentration was lower at the higher altitude than those at the lower altitude. Soil micronutrients, Mn^{+2}, Na, Zn^{+2}, Cl, Al and Co concentrations were also significantly higher at the higher altitude than those at the lower altitude. In conclusion, our results indicate that topographical factors, the slope aspect in this present study, can significantly affect soil properties and soil organic carbon and total nitrogen content. Therefore, those factors should be considered in future studies.

Keywords: Soil properties, soil organic carbon, total nitrogen, altitude, Kastamonu

1. Introduction
Soil quality is influenced by multiple factors that enhance or decrease the sustainability of the crop and woodland production, and range. These factors can be described based on chemical, physical or biological interference. Also, these factors can be broken down into land usage and management, and influence of environment in which socio-economic influence the most. (Warkentin & fletcher 1977) [33].
Soil formation is a physical and chemical approach. This approach has been made throughout decades. During this formation layers are made which caused to process of the hydrological and fuel terrestrial cycles. Soil has the best capacity to store water and fuel which are stored by adhesive and cohesive forces (Bandel, V *et al.*, 2000) [3]. Water is added to the soil by precipitation and when the soil exceeds the water holding in its content then the exceeded amount is transferred to the groundwater cycle or to the surface in which the surface moisture is 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 illustrate the solute flux and soil development that forms biogeochemical cycling (Chadwick *et al.*, 2003) [6]. The soil quality is redundant because everyone knows 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].

1.1. Soil-derived macronutrients
The six soil-derived macronutrients are present in plants at relatively high concentrations-normally exceeding 0.1 percent of a plant's total dry weight. This translates into a minimum need of 20 pounds of each macronutrient per acre each year.

1.1.1. Nitrogen
Plants require large amounts of nitrogen for adequate growth. Plants take up N from the soil as NH_4^+ (ammonium) or NO_3 (nitrate) A typical plant contains 1.5 percent nitrogen on a dry weight basis, but this can range from 0.5 percent for a woody plant to up to 5.0 percent for a legume. Nitrogen is a component of amino acids, which link together to form proteins. Nitrogen is also a Component of protoplasts and enzymes (Lee S, 1999) [8]. Once in the plant, N is mobile-it can move from older plant tissue to new tissue.

Consequently, if N is deficient in plants, the older leaves often turn yellow-green or yellow first. As the deficiency progresses the entire plant yellows. The major natural source of N in soils is organic matter (Karlen D, *et al*. 1997) [29].

1.1.2. Phosphorus

A typical plant contains 0.2 percent P on a dry weight basis, however, depending on the plant species this value can range from 0.1 to 0.5 percent. Plants take up P as an anion (ion with a negative charge)-$H_2PO_4^-$, HPO_4 or PO_4. The actual form of the anion is dependent on soil pH. Phosphorus is mobile within plants and can travel from old plant tissue to new plant tissue on demand. P deficiency in plants is hard to diagnose by eye because deficiency symptoms are not commonly visible.

1.1.3. Potassium

Plants typically contain 1.0 percent K on a dry weight basis. This value can range from 0.5 to 5.0 percent depending on the plant species. Potassium is held by the clays in soils and is taken up by plants as K^+.

Potassium is mobile in plants. Potassium deficiencies can be diagnosed by looking at the older plant tissue. Deficiencies appear along the outer margins of older leaves as streaks or spots of yellow (mild deficiencies) or brown (severe deficiencies). Potassium plays several roles in plants. It is important for water and energy relationships and has been linked to improved cold hardiness. Soils in the Pacific Northwest generally contain adequate amounts of potassium. Deficiencies are isolated to soils where alfalfa and potatoes have been grown for several decades (Azlan A, *et al.* 2016) [2].

1.1.4. Sulfur

Plants take up S from the soil as SO_4, (sulfate). Because the plant-available form of S is negatively charged, it can be leached out of plant root zones with precipitation or irrigation. A typical plant contains 0.1 percent S on a dry weight basis, but this can range from 0.05 to 0.5 percent S. Sulfur, like N, is a component of some amino acids that link together to form proteins. Sulfur is also a component of plant protoplasts and enzymes. Once in the plant, sulfur has only fair mobility. New plant tissue will show a sulfur deficiency first, often turning yellow-green or yellow.

1.1.5. Calcium

A typical plant contains 0.5 percent Ca on a dry weight basis. However, woody plants may contain up to 5.0 percent Ca. Plants take up calcium as Ca_2^+. Calcium is required for cell division, cell elongation, and cell structure. Since Ca is not mobile in plants, calcium deficiency symptoms appear at their growing tips. Soils in the Pacific Northwest contain plenty of calcium. Consequently, calcium deficiencies plants grown under agronomic, horticultural, or lawn and garden situations have never been observed in the region.

1.1.6. Magnesium

Plants typically contain 0.2 percent Mg on a dry weight basis. This value can range from 0.1 to 1.0 percent depending on the plant species. Magnesium is held by the clays and organic matter in soils and is taken up by plants as Mg_2^+. Magnesium is mobile in plants. Magnesium deficiencies can be diagnosed by looking at the older plant tissue. Deficiencies appear as "interveinal chlorosis" in older leaves—the veins of the leaves stay dark green while the areas between the veins appear yellow-green, yellow, or white. Magnesium is a component of chlorophyll. Most soils in the Pacific Northwest contain adequate amounts of Mg for plant growth. Magnesium deficiencies are isolated to soils with pH values below 5.2 (Plaster E 2013, Lamma OA, & Swamy, AVVS 2018) [17, 9].

1.2. Soil-derived micronutrients

The eight soil-derived micronutrients are present in plants at relatively low concentrations-often just a few parts per million (ppm) of a plant's total dry weight. Even though plants require only small amounts of micronutrients, a deficiency will harm them as much as a lack of N or P. Plants need 0.5 to 2 pounds per acre of most micronutrients per year.

1.2.1. Boron

Plants require about 20 ppm of B. Boron is taken up by plants as an uncharged molecule(H_3BO_3) or as an anion ($H_2BO_3^-$, HBO_3) Since the plant-available form of B is not positively charged it can be leached out of soils and is often lost from the plant root zone by over irrigation or high precipitation (Parras-Alcántara L, 2015) [25]. Boron promotes the translocation of sugars and cell development and is believed to be important for growth regulators. Boron is not mobile in plants. Consequently, B deficiency symptoms most often appear on the growing tip of the plant In B-deficient plants, the growing tip is often deformed (Rezaei H., *et al*. 2015) [19].

1.2.2. Chlorine

You may not realize it but chlorine is classed as a plant micronutrient meaning that it is essential for the proper growth of plants. It is important to note though, that it is the ion (Cl^-) rather than the gas (Cl_2) that is used by plants (Johnson DW, & Curtis PS, 2001) [28]. In particular, chlorine is important for plant photosynthesis as it is involved in the opening and closing of stomata (pores in leaves that enable plants to take in and release carbon dioxide, oxygen and other gases as required. It also helps ensure leaves are firm (Lamma 2016) [16].

1.2.3. Copper

Copper is taken up by plants as Cu_2^+. Concentrations of Cu in plants average 6 ppm, but can range from 2 to 20 ppm. Copper is a component of plant cytochromes and is needed for enzyme activation. Copper is not mobile in plants deficiencies appear first in the youngest plant tissue

Most soils contain adequate levels of copper for plant growth. Copper deficiencies are most likely on soils that contain more than 8 percent organic matter—only about 1 percent of the soils in the Pacific Northwest. For additional information on Cu (Lamma *et al*. 2021) [11].

1.2.4. Iron

Plants take up iron as Fe_2^+. A typical plant contains 100 ppm of Fe, but Fe content range from 50 to 1,000 ppm depending on plant species. Iron is needed for chlorophyll synthesis, metabolic processes, and enzyme activation. Iron is not mobile in plants, so Fe deficiencies first appear on younger leaves. The characteristic deficiency symptom is interveinal chlorosis on the younger leaves. In general, there is plenty of plant-available Fe in acid and neutral pH soils.

1.2.5. Manganese

Manganese is taken up as Mn_2^+ by plants. Concentrations of Mn in plants average 50 ppm, but can range from 20 to 200 ppm. Manganese is required in the Hill reaction of photosystem II and is important for enzyme activation. Manganese is not mobile in plants, so deficiencies appear first in the youngest plant tissue

(Lamma *et al*. 2018) [9].

1.2.6. Molybdenum
Plants take up molybdenum as MoO_4 A typical plant contains only 0.1 ppm of Mo. However, this small amount of Mo allows plants to utilize N. In addition, legumes require Mo for nitrogen fixation. Molybdenum is not mobile in plants, so deficiency symptoms appear in younger plant tissue first. Molybdenum-deficient plants turn yellow-green to yellow. Most Mo deficiencies occur when legumes are grown in soils with pH values less than 5.4.

1.2.7. Nickel
Soils with high Ni contents occur in several parts of the world, especially in areas with ultramafic rocks which cause serious environmental impacts. This book aims to extend the knowledge on the risks and problems caused by elevated Ni contents and to cover the existing gaps on issues related to various aspects and consequences of high Ni contents in soils and plants (Lamma *et al.*, 2018) [9].

1.2.8. Zinc
Zinc is an essential plant micronutrient. It is important for production of plant growth hormones and proteins and is involved in sugar consumption. Good root development as well as carbohydrate and chlorophyll formation are also dependent on zinc. Maintaining adequate zinc levels is important for enabling plants to withstand low air temperatures. Zinc is also involved in the synthesis of auxin, a plant hormone that helps plants determine whether to focus on growing tall or becoming bushy. Deficiencies do occur in soils where the topsoil or organic matter has been removed. (Bhaskar, B *et al.* 2004) [4].

2. Aim of study
The 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.

3- Material 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 (ranging from 40 to 60%) and high elevations (up to 3000 m). The location of the study area is shown in Figure 2. In the area, both north- and south-facing 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 along 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

3.2. 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 basically a stone/quartz blend.

3.3.Soil sampling ın the field
Two slope positions were selected at the top (1189 m) 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 At the bottom slopes on the north- and south-facing sites were covered by Black pine trees.

3.4. 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.

3.5. Soil macro and micro nutrients

Soil macro and micro nutrient concentrations of Black pine stands collected from the north aspect at two altitudes are given in Table 1 and Table 2 respectively.

Soil macronutrients (P, K, Ca and Mg) only showed significant differences between the altitudes ($p<0.05$). Only, macronutrient, S did not show any significant variation between the altitudes and also between the soil depths. Soil micronutrients (Na, Cl, Al and Co) only varied significantly between the altitudes, while soil micronutrients (Mn and Zn) differed significantly between the altitudes and between the soil depths. Fe and Cu concentrations did not vary between the altitudes and between the soil depths.

Mean soil macronutrients; Mg, P and K concentrations were significantly higher at the higher altitude than those at the lower altitude, whereas mean soil Ca concentration was lower at the higher altitude than those at the lower altitude (Table 1). Soil micro nutrients, Mn, Na, Zn, Cl, Al and Co concentrations were also significantly higher at the higher altitude than those at the lower altitude (Table 1).

Table 1: Soil macronutrients of Black pine stands collected from North aspect at two altitudes

Altitude (m)	Soil depth (cm)	Ca (ppm)	Mg (ppm)	P (ppm)	K (ppm)	S (ppm)
871 Mean	0-5	1049	131,2	72,1	1049	90,8
	5-10	1011	129,0	66,8	1011	82,8
	10-15	1237	121,4	84,7	1237	176,2
	15-20	1099	124,6	70,1	1099	109,6
	20-25	1264	124,4	64,4	1264	60,3
	25-30	936	113,6	57,6	936	78,7
	0-30	1099	124,0	69,3	574	100,0
1189 Mean	0-5	446	165,7	95,6	1917	77,0
	5-10	660	147,8	100,0	1813	95,9
	10-15	976	171,1	130,8	1865	139,5
	15-20	698	174,2	109,4	2017	113,6
	20-25	409	187,0	102,2	2091	77,8
	25-30	1273	171,1	165,4	1875	272,2
	0-30	744	169,5	117,2	1929	129,3

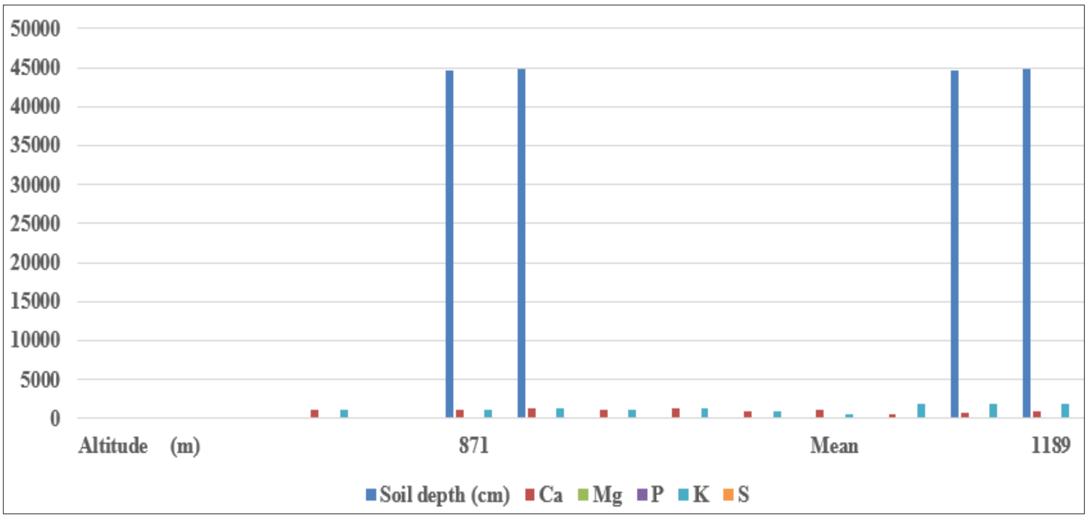

Fig 2: Soil macronutrients of Black pine stands collected from North aspect at two altitudes

Table 2: Soil micronutrients of Black pine stands collected from North aspect at two altitudes

Altitude (m)	Soil depth (cm)	Fe	Mn	Na	Cu	Zn	Cl	Al	Co
871 Mean	0-5	23609	387,4	27,1	55,0	95,9	36,4	3414	2,62
	5-10	23710	372,6	25,9	54,5	91,4	31,1	3373	2,11
	10-15	20898	399,9	25,4	52,7	91,3	53,7	3145	2,64
	15-20	21968	384,6	25,9	52,4	89,7	42,0	3289	2,61
	20-25	23759	291,5	26,1	53,7	86,9	28,2	3173	2,43
	25-30	22125	316,0	22,4	52,2	86,9	42,7	3038	2,57
	0-30	22678	359	25,5	53,0	90,0	39,0	3239	2,49
1189 Mean	0-5	25158	1095,6	37,0	52,5	181,6	67,7	5973	2,78
	5-10	23578	1614,3	33,2	53,3	191,1	48,0	5274	2,71
	10-15	21048	2034,0	33,4	56,6	196,6	64,8	6064	2,59
	15-20	23702	1379,1	35,0	58,6	191,6	62,0	6376	3,09
	20-25	24700	963,3	36,8	58,0	181,1	44,3	6922	3,05
	25-30	22953	2473,0	35,2	53,0	221,5	110,2	5736	3,07
	0-30	23523	1593	35,1	55,0	194,0	66,2	6057	2,88

4. Discussion

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.

Soil macro nutrients (P, K, Ca and Mg) only showed significant differences between the altitudes ($p<0.05$). Only, macronutrient, S and soil micro nutrients (Na, Cl, Al and Co) varied significantly between the altitudes, while soil micro nutrients (Mn and Zn) differed significantly.

5. Conclusion

Our research found that the study altitude had an impact on various soil parameters of Black pine in the Daday Area of Kastamonu.

In order to understand the change in soil characteristics in the Daday region, this study focused on the changes in soil properties, soil carbon and nitrogen levels between two elevations.

The major findings of this study revealed that several soil qualities are spatially variable and are considerably impacted by elevation. The carbon content of the soil varied significantly depending on height.

Our research found that soil micronutrients (Na, Cl, Al, and Co) varied considerably between elevations, with Ca being lower at higher altitudes than at lower altitudes.

More research on the creation of supplements in the over-the-ground materials of the majority of forest types is expected to fully appreciate the intuitive atmosphere and topography.

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