

Original Research Article

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Impact of Biotic Stress on Edaphic Features under two Important Medicinal Plants (*Podophyllum hexandrum* and *Rumex acetosa* L.) of Kashmir Valley, J & K, India

Aijaz Ahmad Sheikh¹, S.A. Shameem^{2*} and Naseer Ahmad³

¹P.G. Department of Environmental Sciences, S.P.College Srinagar, 190001/ Presently, Department of Environmental Sciences, Govt. Degree College Tangmarg, Brarmulla, 193402

²P.G. Department of Environmental Sciences, S.P.College Srinagar, 190001/ Presently Division of Environmental Sciences, SKUAST-K, Shalimar Campus, 190025

³Department of Environmental Sciences, S.P.College Srinagar, 190001

*Corresponding author

ABSTRACT

The present study was conducted to assess the status of edaphic features under two medicinal plants viz., *Podophyllum hexandrum* and *Rumex acetosa* at three high altitude sites (site I, Boisaran Pahalgam; site II, Betab valley Pahalgam; and site III, the Lolab valley, Kupwara) in Kashmir valley, J &K. Results of soil characteristics revealed soil moisture content slightly high under *Podophyllum hexandrum* (45.30%, site II, summer to 14.97%, site I, summer) season and low under *Rumex acetosa* (16.5%, site I, winter to 36.7%, site II, summer). pH of soil samples depicted slightly alkaline (7.21, summer, site I) of *Podophyllum hexandrum* to acidic (5.27, autumn, site I) under *Rumex acetosa*. The seasonal trend showed pH high in summer season and low in autumn in *Rumex acetosa* while as it was high in summer and decline in winter season. Organic carbon of two plants soils recorded high carbon content under *Rumex acetosa* soil (6.61%, autumn, site I) and low under *Podophyllum hexandrum* (2.12%, summer, site II). Nitrogen content of soil recorded maximum percentage of *Rumex acetosa* (0.35%, autumn, site I) and minimum under *Podophyllum hexandrum* (0.10% site II, summer season). Assessment of loss on ignition was recoded high 8.02%, site I, autumn and, low 4.04% site III in the same season in *Rumex acetosa* soil samples. Among three sites, site I overall showed dominance in soil nutrients was recorded in the summer/autumn season depicted high value. The overall results obtained in the present study revealed that *Rumex acetosa* soil dominated in nutrients status and *Podophyllum hexandrum* soil was recorded under stress due to various factors include slope aspect, micro-climate, seasonal influences and biotic stress which changed the soil composition in two medicinal plants. The study thus recommends immediate scientific measures to protect and mitigate further deterioration of soil status from degradation under two medicinal.

Keywords

Soil, Medicinal,
Podophyllum,
Rumex, Seasons

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Introduction

It is well known that natural ecosystems are continuously being disturbed throughout the world. Several thousands of medicinal plants are being destroyed due to various causes like human neglect, industrialization, uncontrolled deforestation, and indiscriminate collection. There are also many other potential causes responsible for the rarity in medicinal plant species, such as habitat specificity, habitat alteration, narrow range of distribution, land use disturbance, the introduction of non-natives, climate change, heavy livestock grazing, an explosion of the human population, fragmentation and degradation of population and genetic drift (Kala, 2005 and Weekley, 2001). High altitude medicinal plants are of great concern throughout the Himalayan region, because they are important for traditional health care and in large scale collection for trade. Moreover, it is estimated that, about 3000 plants were recognized in India for their medicinal value, and of them, 200 species are in wide use for their curative properties. World wide 80% of all synthetic drugs are derived from medicinal plants (Bauer and Brönstrup, 2014). According to the World Health Organization, the global market for plant-based medicines will hit 5 trillion US dollar by 2030 (Anon., 2013).

Plant nutrition is the major factor which influences the growth and development of a plant. Inadequate supply of plant nutrients is detrimental to plant growth having a negative effect on the yield. Thus, the maximum yield can be obtained with optimum nutrient levels. Nutrient deficiencies in plants are often made most evident by plant physiological responses. Nutrient deficiency symptoms tend to occur in three major patterns: localized to the younger tissues, localized to the more mature tissues, or widely distributed across the plant (Boroomand and Grouh, 2011). Stress in plants refers to external conditions

that adversely affect growth, development, or productivity of plants (Verma, *et al.*, 2013). Stresses trigger a wide range of plant responses like altered gene expression, cellular metabolism, changes in growth rates, crop yields, etc. Plant stress usually reflects some sudden changes in environmental conditions. However in stress-tolerant plant species, exposure to particular stress leads to acclimation to that specific stress in a time time-dependent manner (Verma *et al.*, 2013). Plant stress can be divided into two primary categories namely abiotic stress and biotic stress. Abiotic stress imposed on plants by the environment may be either physical or chemical, while biotic stress exposed to the crop plants is a biological unit like diseases, insects, etc. Some stresses to the plants injured them as such that plants exhibit several metabolic dysfunctions The plants can be recovered from injuries if the stress is mild or of short term as the effect is temporary while as severe stresses leads to death of crop plants by preventing flowering, seed formation and induce senescence (Verma *et al.*, 2013).

Soil is an important natural resource, as a key component of the mountain ecosystem, and it underpins our very existence through providing a wide range of food, feed, fiber and timber production, as well as through earth system functions that support the delivery of other “ecosystem services” (Dominati *et al.*, 2010; Robinson, *et al.*, 2017). The suitability of the soil for those productions is based on the quality of the soil’s physical, chemical, and biological properties (Mobley, 2009; Khan, 2013). However, the spatial variability of soil properties in an ecosystem is significantly influenced by some environmental factors such as parent materials, topography, climate, vegetation, and disturbance due to human activities (Umali, 2012). Among these factors, it is well recognized that topographic

gradients (e.g., slope position, slope aspect, slope gradient) may play the most essential role due to their influence on the shape of the land surface, thereby dictating the distribution of local and regional microclimates by changing the pattern of precipitation, temperature and relative humidity (Tsui, 2004; Yimer, 2006). Topography-induced microclimate differences, in turn, can cause a significant change in plant growth and soil properties, which will drastically affect the structures and functions of ecosystems (Hook and Burke, 2000; Lozano-García *et al.*, 2016; Sun *et al.*, 2014; Zhang, 2018 and Begum *et al.*, 2010). As a major topographical parameter, the slope position, i.e., the relative height position along the hill's side slope could also significantly change the soil physico-chemical properties by controlling the movement of water and material in a hill slope and contributing to the spatial deference of soil properties (Begum *et al.*, 2010; Khormali *et al.*, 2007). The objective of this study was to investigate the impact of biotic interference on soil characteristics of two important medicinal plants of Pahalgam valley, south Kashmir, Anantnag district of Jammu & Kashmir Union Territory.

Materials and Methods

Composite soil samples were collected using a soil augur at three selected sites. Soil samples were collected on a monthly basis. The collected samples were homogenized by hand mixing and sieved through a 2 mm mesh to remove large fresh plant material (roots and shoots) and pebbles. Finally, the samples were air-dried for further analysis (Jackson, 1967). Briefly, soil (pH) pH was measured with digital pH meter (model Delux-101E) using a soil: water ratio of 1:2.5. Soil organic matter (%) was tested by using the dichromate oxidation method (Walkey and Black's rapid titration method: Walkey and Black, 1934). Moisture content (%) was analyzed by

(Michael, 1984). Soil total nitrogen (%) was determined by using the automatic Kjeldahl method (Piper, 1966).

Study area and sites

Pahalgam is located between 34⁰ 01' N latitude and 75⁰ 11' E longitudes at an elevation of 2,740 meters in Anantnag district of Union territory of Jammu and Kashmir, nearly 96 kilometers away from the summer capital, Srinagar. The valley is located between coordinates of 34° 01' N latitude and 75° 11' E longitudes at an elevation of 2,740 meters. The present study was conducted on a seasonal basis at three different study sites Kashmir valley. The site-wise description of the threes selected sites is given under:

Site I: Baisaran Pahalgam: The site is located at an altitudinal range of 2,900m masl in the Pahalgam valley.

Site II: Betab valley: The site is located about 6-7 kilometers away from Pahalgam town at an altitudinal range of 2,450m masl.

Site III: The Lolab valley: Lolab is situated in the north of Kashmir valley, district Kupwara. It is situated between geographical coordinates of 34⁰ 25' and 34⁰ 42' N latitudes and 74⁰ 15' and 74⁰ 32' E longitudes, at a distance of 90 km northwest of the Srinagar.

Description of selected plants

Rumex acetosa L.

Rumex acetosa L. (common sorrel) locally called as "Abej" in Kashmir is an herbaceous perennial plant belonging to order Carophyllales and buckwheat family Polygonaceae. This plant is native to the British Isles and can also be found in Britain, most of Europe, North America, Greenland, and temperate Asia. The leaves of the *Rumex*

acetosa are acidic in taste and contain high levels of oxalic acid. *Rumex acetosa* is reported to have medicinal properties: an astringent, for curing stomach problems, chest problems, cancer & tumors, and also acts as a diuretic. In Kashmir Himalaya, the young leaves are also used as vegetables.

Podophyllum hexandrum

Podophyllum hexandrum is a source of various biologically important metabolites and possess antioxidant, anti-inflammatory, antifungal, cytotoxic and radioprotection activity. It is an important medicinal plant known for valuable drug podophylotoxin which is effective against various diseases including warts and tumors growth of skin and possesses different properties such as purgative, laxative, cholagogue and emetic. In India *Podophyllum hexandrum* is mostly found in Alpine Himalayas (3000-4000 msl) of Jammu and Kashmir, Himachal Pradesh, Sikkim, Uttaranchal and Arunachal Pradesh. In Kashmir it has been used in traditional system of medicine from time immemorial and is locally known as Banwangun, since its red colour fruit (berry) is of the size of small brinjal. *Podophyllum hexandrum* grows from 12 to 18 inches high with deeply lobed leaves, fleshy stems, which rise straight up from the soil.

Results and Discussion

Soil, the source of infinite life is the most vital and precious natural resource, and not renewable in a short time. Soil fertility refers to the ability of soil to sustain agricultural plant growth, and result with consistent yields of high quality. Soil fertility is a dynamic natural property and it can change under the influence of natural and human induced factors. Parent material, climate, topographical conditions, and natural vegetation are the natural factors affecting the

soil fertility to a great extent. Among the anthropogenic factors, nutrient management practice is one of the most important factors affecting soil fertility. Soil physico-chemical properties, as an important indicator of soil quality, possess not only obvious differences but also interactions and close associations with each other, which jointly determine the quality of the soil (García-Ruiz *et al.*, 2009). The physico-chemical characteristics of soil under two important medicinal plants are depicted in Figure (1-12).

The Soil moisture content of two medicinal plants varied from 16.5%-36.7% (*Rumex acetosa*) and 14.97%-45.30% (*Podophyllum hexandrum*). Season and site-wise trend depicted soil moisture percent high at site II in summer season under *Rumex acetosa* and low at site I in the same season under *Podophyllum hexandrum*. Comparing mean values of soil moisture content, *Podophyllum hexandrum* showed high/low value (18.82%, site I and 38.07%, site II) and ranged between (19.23%-28.36%) in *Rumex acetosa*. The Summer season was at par with the other two seasons in soil moisture content in two medicinal plants (Figure 1-2).

The role of pH is to control the solubility of nutrients in the soil. Soil pH of *Rumex acetosa* at three sites ranged between (5.27 site I-site II, 6.70) and under *Podophyllum hexandrum* (5.59, site II-7.21, site I). Summer season showed high soil pH in two selected plants with a decline in autumn till the winter season. The soil pH overall showed acidic to alkaline character. Mean values however show pH in acidic range in *Rumex acetosa* (5.46-5.79) to nearly neutral in *Podophyllum hexandrum* (6.11-6.74) Figure 3-4. A similar trend in pH was recorded by Liu *et al.*, 2020. Acidity directly affects plant growth. Acidity (pH) has a significant effect on the distribution of plant species. The role of pH is to control the solubility of nutrients in the

soil. Our results are in agreement with those reported by Janisova (2005), Virtanen *et al.*, (2006) and Zolfaghari *et al.*, (2010) and Akbarlou and Nodehi (2016).

Organic carbon among two medicinal plants recorded high in *Rumex acetosa* soil with variation between (3.46%, site II-6.61%, site I). At *Podophyllum hexandrum*, it depicts high value (5.35%, site III) and low at site II (2.12%). Seasonal trend projected high carbon content in soil during autumn season followed by winter and then summer season. Mean values recorded high carbon content in *Rumex acetosa* (4.80%-5.62%) and low under *Podophyllum hexandrum* (3.44%-4.59%) Figure 5-6.

Loss on ignition of two plant soils showed both high/low values recorded by *Rumex acetosa* soil during the autumn season at site I and site II (8.02% and 4.04%). However, at *Podophyllum hexandrum*, it varied between (5.61%, site I, autumn-7.95%, site III, summer). Seasonal change in loss on ignition of *Rumex acetosa* depicted maximum in summer/autumn season and decline in winter. *Podophyllum hexandrum* showed maximum value in summer/winter and a decline in the autumn season. Mean values showed a difference of (4.66%-7.12%, *Rumex acetosa*) and (5.74%-7.66%, *Podophyllum hexandrum*) Figure 7-8. Nitrogen in *Rumex acetosa* soil was recorded high (0.17%, site II-0.35%, site I) comparatively to *Podophyllum hexandrum* (0.10%, site II-0.26%, site III) with average value ranges between 0.23%-0.29% (*Rumex acetosa*) and 0.17%-0.22% (*Podophyllum hexandrum*). Summer season showed high nitrogen content at both plants followed by winter and summer season in two plants (Figure 9-10).

Kooch *et al.*, (2007) in the study of ecological distribution of indicator species and effective soil factors in Mazandaran province showed

that the distribution of vegetation was correlated with soil properties such as soil texture, organic matter, nitrogen, and pH. Different types of soil have quite different physicochemical and biological properties, which have substantial effects on the growth, development, and active constituents of medicinal plants (Li and Xiao, 2012). Thus, different plants have different demands for the appropriate type(s) of soil. In the present study organic carbon and total nitrogen varied between (OC, 2.12%-6.61%) and (TN, 0.10%-0.35%). Liu *et al.*, (2007), reported that the type and texture of soil were closely related to the growth and development of medicinal plants and that loam soil was the relatively ideal type of soil for the cultivation of root/stem-types of medicinal plants. Among which, soil serves as an essential medium for supporting plant growth and development, and thus, it has important influences on the growth, development and the medicinal quality of herb plants (Liu *et al.*, 2007).

Plant nutrition is the major factor which influences the growth and development of plant. Inadequate supply of plant nutrients is detrimental to plant growth and harms the yield. Thus, the maximum yield can be obtained with optimum nutrient levels. Nitrogen in *Rumex acetosa* soil was recorded high (0.35%, site I) comparatively to *Podophyllum hexandrum* (0.26%, site III) with average value ranges between 0.23%-0.29% (*Rumex acetosa*) and 0.17%-0.22% (*Podophyllum hexandrum*). Since they are sessile organisms, plants have evolved numerous mechanisms for accommodating changes arising in their fluctuating growth conditions to enable functional flexibility under the influence of environmental factors without affecting cellular and developmental physiological processes (Yang *et al.*, 2018; Arnold *et al.*, 2019) by producing a repertoire of secondary metabolites (SMs) that play a

variety of roles in response to changing environment, growth, and development (Kroymann, 2011; Berini *et al.*, 2018). Taghipoor *et al.*, (2008) investigated the effects of environmental factors on the distribution of species. Their results showed that the most important factors affecting the distribution and establishment of dominant species were moisture, acidity, and altitude from sea level.

One of the most important physico-chemical properties of soil, soil pH directly affects plant growth and microbial activities, and most plants are suitable for growth in an environment where pH is neutral (Simek, and Cooper, 2002). Conversely, excessive pH will inhibit plant root growth, thereby reducing the accumulation of soil organic matter. Hence, a suitable pH is beneficial to the decomposition of soil organic matter by micro-organisms and affects the release of phosphorus (Yu *et al.*, 2017). Soil pH influences the availability of plant nutrients and it is a good indicator of forest fertility (Black, 1968). In the present study soil pH did not show much difference site wise and season wise (Figure 1-2). Soil pH of *Rumex acetosa* was acidic to nearly neutral with variation between (5.27-6.70) and acidic to nearly alkaline under *Podophyllum hexandrum* (5.59-7.21). The acidic to nearly neutral pH values has also been reported in forest sites by Kala, 2005; Shameem *et al.*, 2011. Mean values of soil pH reflect acidic soil nature with significant difference (5.66, site I; 6.46, site II) under *Rumex acetosa* and (6.11, site II to 6.74, site I) under *Podophyllum hexandrum* (Figure 1-2). In concurrent to the present study acidic soil pH (5 to 6) was already reported by Kharkwal and Rawat (2010). However, low pH at site I (5.27) *Rumex acetosa* and (5.59) under *Podophyllum hexandrum* at site II were due to higher organic matter and continuous decomposition of surface litter over the years. Similar results about these observations were

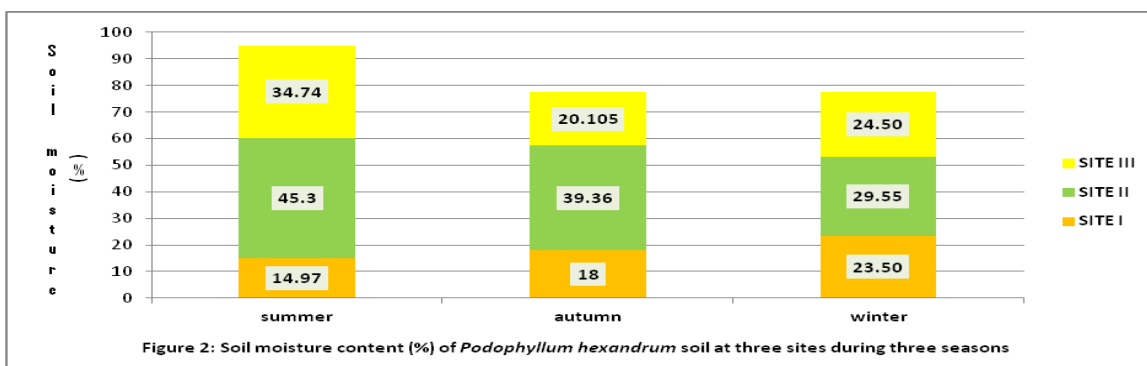
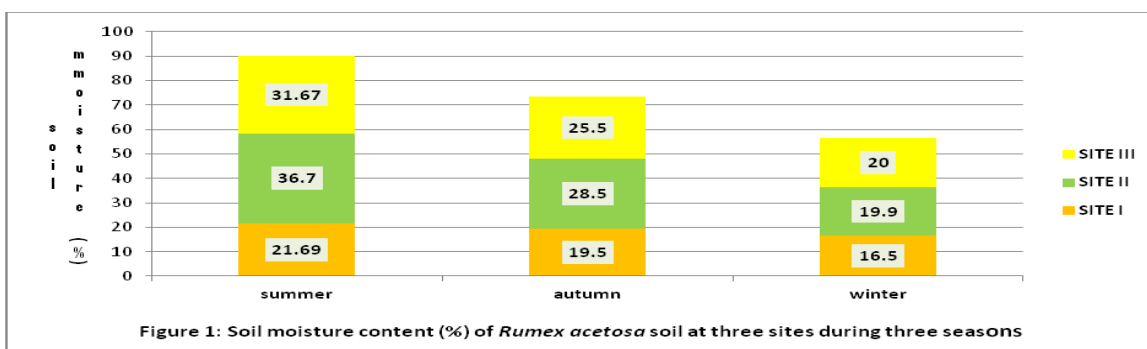
also reported by Raina (1988). Comparatively, the lowest pH value was observed during the dry season (autumn) compared to two seasons. Concurrent results were obtained by Buckman and Brady (1967) and Keogh and Maple (1972). In general soils under both medicinal plants showed acidic approach. Nitrogen content of plant-soil recorded high/low content under *Rumex acetosa* at site I & site III (0.35%, site I, autumn and 0.17%, site II, summer) with the average value of (0.23%-0.29%). In *Podophyllum hexandrum* soil nitrogen ranged between (0.10%-0.26%) with high in autumn at site III and low in summer season at site II with average mean values (0.17%-0.22%) Figure 9-10.

The High content of nitrogen at site I and site III was due to less biotic and abiotic pressure which affects the normal growth and development as well as internal and external qualities of plants (Li and Xiao, 2012). Increase stress to soil nitrogen indicates a lack of nitrogen-nutrient which leads to the accumulation of nitrogen-free secondary metabolites. Previous studies conducted on soil-plant interaction revealed nitrogen as the most important nutrient element required by plants reported by (Chen *et al.*, 2016), thus supports the results obtained in this study. Significantly, the comprehensive assessment revealed that stress, sites, and season have significantly affected the soil nitrogen content of *Podophyllum hexandrum* (0.10%-0.26%) in the shape of biotic interference such as grazing, human disturbance, and tourist visitors. Important factors affecting the soil properties of two medicinal plants were climate, altitude, slope aspect, and changing season. Pertinent results comparing this study were also reported by Shameem *et al.*, (2017). Furthermore, Nitrogen is reported to have a synergistic effect on the regulation of plant growth (Mengel and Kirkby, 1987; Marschner, 1995; Desai *et al.*, 2014). The

enhancement of growth characters might be ascribed to the influence of nitrogen, which is the chief constituent of protein and an important component of amino acids and co. enzymes, which are of considerable biological importance. Balky (1998), physiologically, nitrogen is mostly available to plants in the forms of ammonium; nitrate and preference for one of the two forms to be taken up by plants tend to be influenced by the plant species and soil conditions, including pH and soil temperatures. A High content of nitrogen was reported under *Rumex acetosa* (0.17%-0.35%) and low under *Podophyllum hexandrum* (0.10%-0.26%). Fertilization program in medicinal plants has two important objectives: high vegetative growth, high quantity and quality of secondary metabolites produced. Meeting these objectives could lead to high medicinal materials and increased medicinal value of a plant. Nitrogen content was recorded high at site I (0.35%, *Rumex acetosa*) and site III

(0.26%, *Podophyllum hexandrum*). Generally, nitrogen supply favor increased vegetative growth Argyropoulou *et al.*, 2015.

Organic matter is one of the important components of soil whose amount and type are affected by climate and vegetation. Organic matter creates a good soil structure, increases capacity, and makes some changes in the acidity of soil and biological activity (Jafari *et al.*, 2008). Sheikhsosseini and Noorbakhsh (2007) believe that the organic matter of soil plays a major role in supplying soil carbon and energy of heterotrophic micro-organisms. Soil organic matter is a complex mixture, which influences a series of soil properties and nutrient cycling, while soil enzymes are mainly adsorbed on the soil organic matter particles or combined with humus (Loveland, and Webb, 2003). Soil organic matter is one of the most important soil components, along with stabilizing soil structure and improving the infiltration rate.



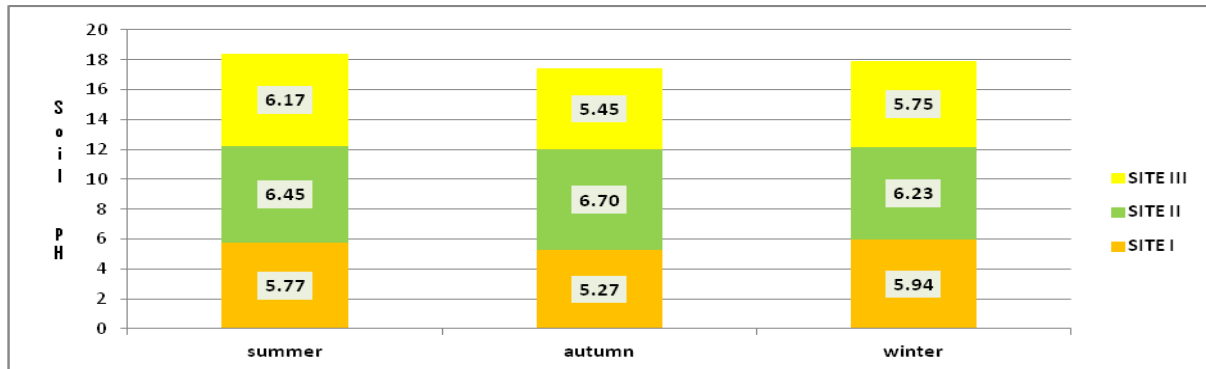


Figure 3: Soil pH of *Rumex acetosa* soil at three sites during three seasons

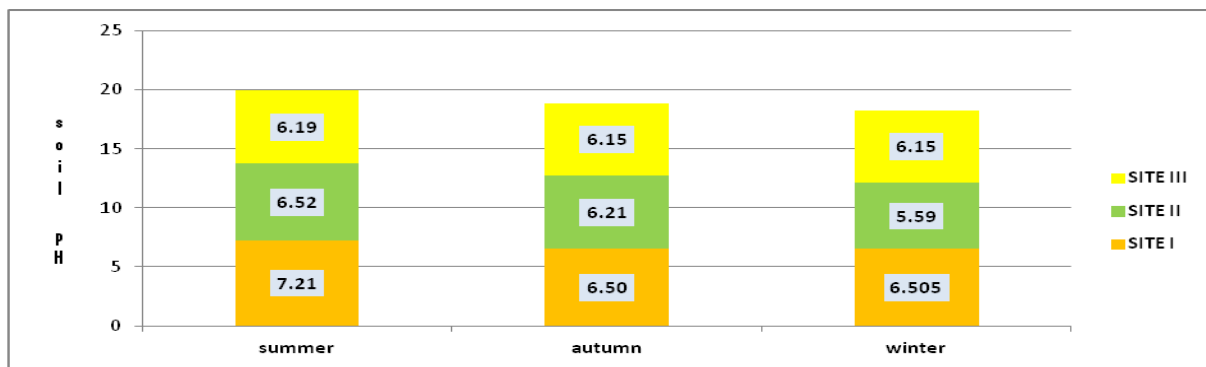


Figure 4: Soil pH of *Podophyllum hexandrum* soil at three sites during three seasons

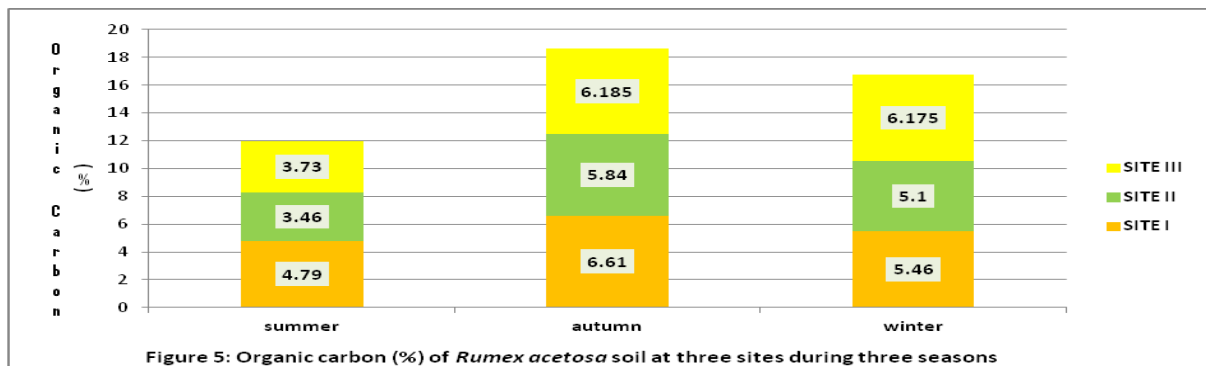


Figure 5: Organic carbon (%) of *Rumex acetosa* soil at three sites during three seasons

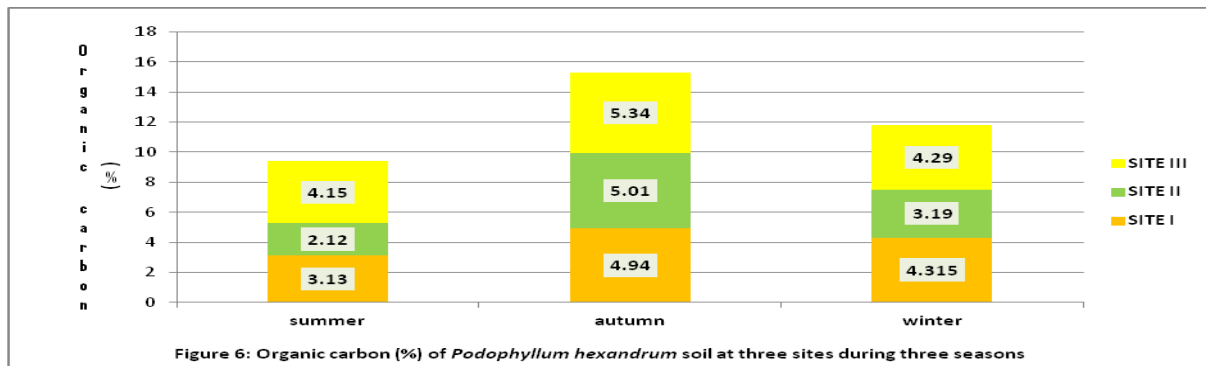
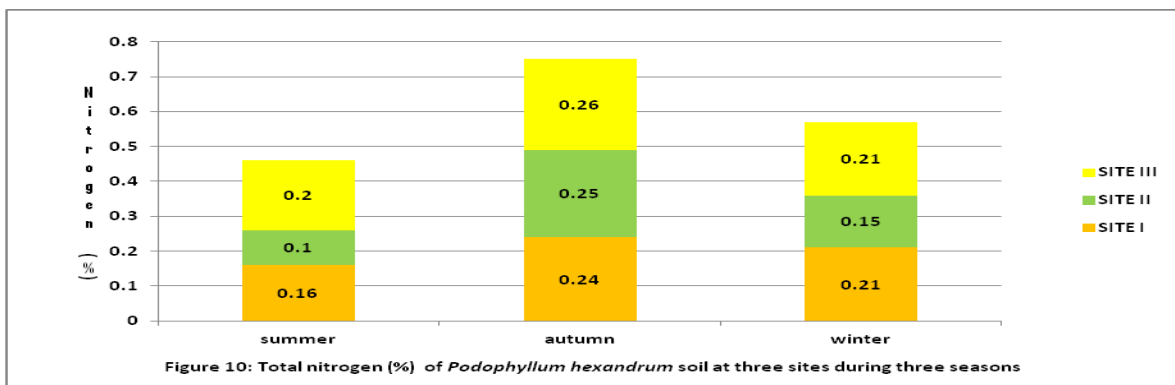
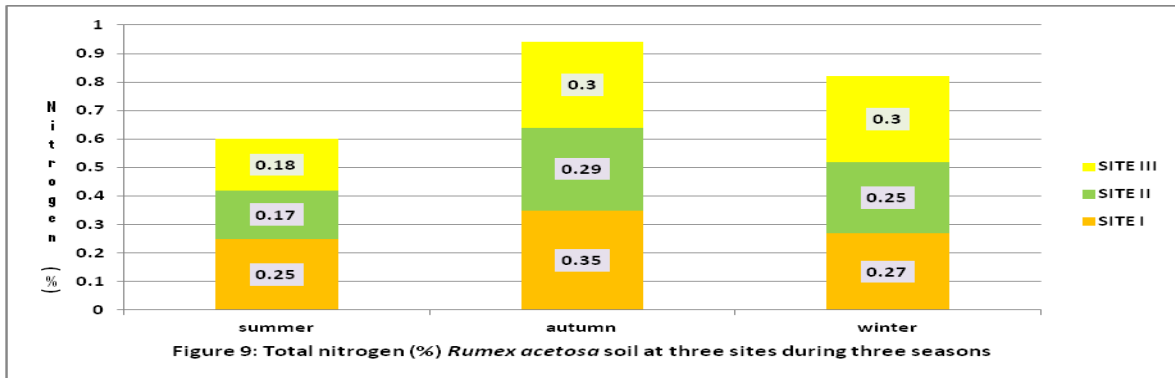
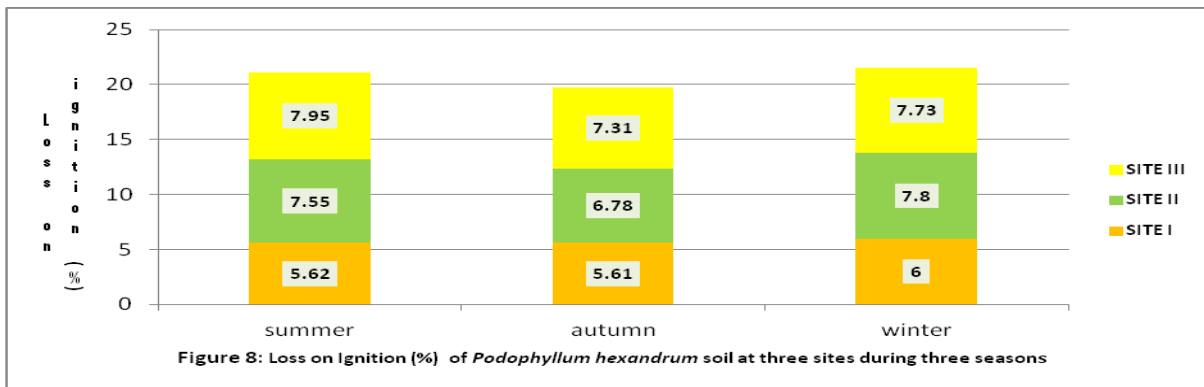
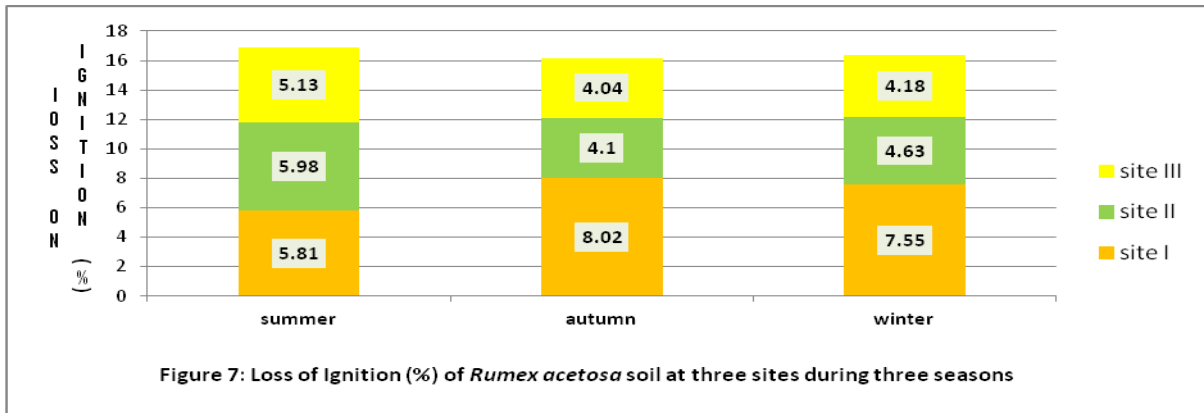
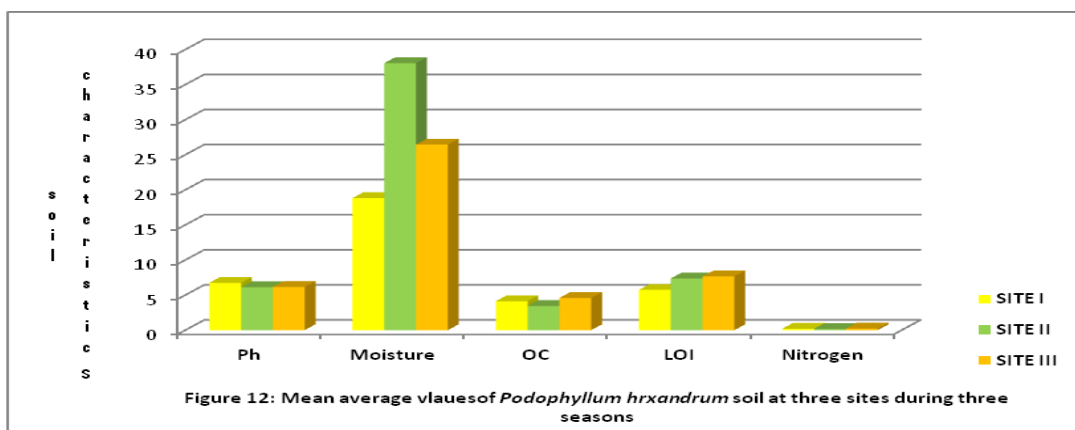
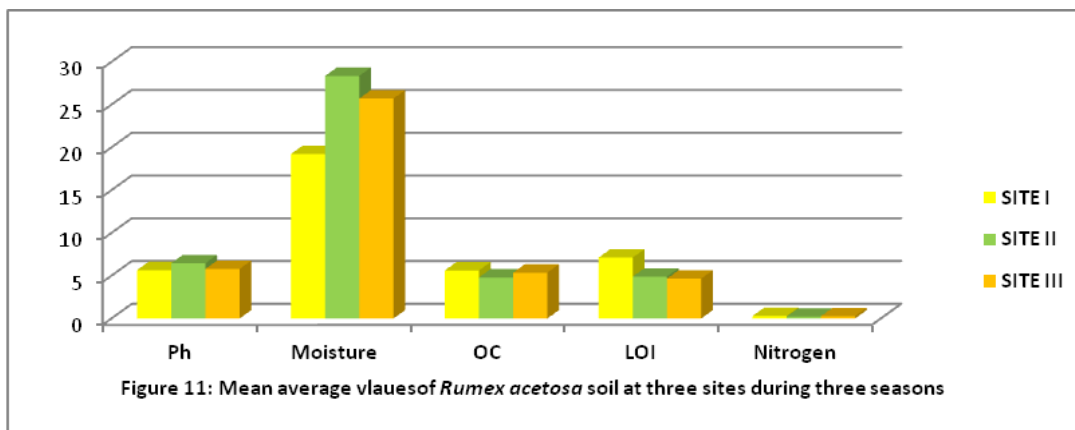


Figure 6: Organic carbon (%) of *Podophyllum hexandrum* soil at three sites during three seasons





Organic carbon ranged from (3.73%, site III, summer) to (6.61%, site I, autumn) under *Rumex acetosa* and (2.12%, summer, site II) to (5.34% autumn, site III). Mean values depicted high range under *Rumex acetosa* soil (4.80%-5.62%) and low (3.44% to 4.59%) under *Podophyllum hexandrum* Figure 5-6. In the comparison of two plants and three sites, organic carbon was found significantly high in *Rumex acetosa* soil at site I (4.79%-6.61%) Figure (5 and 6). Most of the N, P, and S remain bound to the soil organic matter, which is not degraded sufficiently under low temperature. Previously, nitrogen mineralization rate, soil organic matter degradation rate, and soil P content were found to decrease with temperature (Gao *et al.*, 2014; Walz *et al.*, 2017). Overall low percentage of organic carbon was observed at site II (*Rumex acetosa* 3.46; *Podophyllum*

hexandrum 2.12,) under two plants soils. Therefore, low nutrient status of high altitude soil is the result of low temperature-induced decrease in mineralization and decomposition. Generally soil with SOM contents <0.5% is considered poor and >2.0% is desirable for agriculture (Hardy *et al.*, 2013). Soil organic matter (soil organic matter) is an important factor determining the microbial community structure in the soil. The high organic carbon content in *Rumex acetosa* soil is due to a high amount of litter addition to these soils at three selected sites. Similar observations in accordance with the present study were also reported by (Kharkwal and Rawat, 2010; Kharkwal *et al.*, 2009; Kumar *et al.*, 2002; Shameem *et al.*, 2017). The closed canopy in natural forests also minimizes erosion resulting in the accumulation of organic matter in the natural forest compared to

pastures. Besides, the difference in vegetation type, species composition, and natural protection can be attributed to a high amount of organic carbon of *Rumex acetosa* soil (3.46%-6.61%). The reason meant for a lower percentage of organic carbon under *Podophyllum hexandrum* could be due to biotic stress mainly grazing and human disturbance which reduces soil organic matter/compacts the soil surface layer and ultimately increases surface runoff (Faizul *et al.*, 1995). Moreover, topography has an indirect effect on plant community distribution and soil properties. Total nitrogen content of *Rumex acetosa* soil revealed higher values (0.17%, summer to 0.35%, winter) compared to *Podophyllum hexandrum* (0.10%, summer to 0.26%, autumn). The changes may be induced by environmental components that include local geo-climatic and seasonal changes, external conditions of temperature, light, humidity and developmental processes, among others and impact biomass production and biosynthesis of plant secondary metabolites (PSMs) (Berini *et al.*, 2018; Morison and Lawlor, 1999; Ramakrishna and Ravishankar, 2011; Chetri *et al.*, 2013; Zykin *et al.*, 2018). Increased soil temperature is reported as a primary environmental factor that decreases the nitrogen mineralization processes thus influencing the bioavailability of soil nitrogen (Bu *et al.*, 2015). Soil nitrogen was the most important factor limiting plant growth. One of the factors affecting the value of nitrogen is soil texture. According to Salardini (1979), clay soils have more N as compared with sandy soils due to the increased nitrogen retention by clay. Fahimipoor *et al.*, (2010) reached similar results in their study. Though, the soil OC, LOI, and N content were found high in *Rumex acetosa* soil, their bioavailability to the living system is a major factor. Nitrogen associated with soil organic matter is not readily mineralized, thus comparatively high total N content of the soil

at high altitude could be the result of high soil organic matter. Total nitrogen in agriculture soil is generally reported to vary from 0.10% to 0.15%, thus the soil under two selected plants was comparatively rich in total nitrogen. However, during the summer season total nitrogen content was recorded lowest at two plant soils depicted a higher trend in autumn and winter Figure (9 and 10). The possible reason for higher organic matter and nitrogen content under *Rumex acetosa* soil may well be due to high moisture content and low decomposition rate (Bortharkur, 1992). The higher amount of humus and total nitrogen percent in such a landscape could be explained by a higher amount of available organic material present site I (Shourkaie *et al.*, 2007). Similar seasonal variations in concurrence to the present study were also reported by several workers like Jenny (1930) and Jackman (1964). Sebastia (2004) showed that soil fertility is the main environmental factor in vegetation establishment particularly medicinal plants.

In conclusion, this study comprehended that the soil characteristics viz., soil pH, organic carbon, nitrogen, moisture content, and loss on ignition overall showed high content at the site I and site II. Seasonal changes in soil nutrient properties depicted soil status good in summer/autumn season followed by winter season at two selected plants. Moreover, *Rumex acetosa* soil dominated in nutrients status and *Podophyllum hexandrum* reported slight in stress due to various factors including slope aspect, micro-climate, seasonal influences, and biotic stress. Furthermore, the impact on soil properties at selected study sites are increasing due to fuel fodder collection, illegal harvesting of medicinal herbs, deforestation, and frequent tourist visitors particularly in the summer season, therefore immediate protective measures required to maintain the soil health status of two selected medicinal plants. The

study concluded that improvement in soil characteristics of two selected medicinal plants at three sites can be achieved through sustainable and regular monitoring of biotic interference of livestock grazing and human disturbance at different seasonal.

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