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CONCENTRATION OF MACRO NUTRIENTS IN DRY FOLIAGE OF RUSSIAN OLIVE (*ELAEAGNUS ANGUSTIFOLIA*)

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ABSTRACT

To be acquainted with the essential nutrients for plants for the sake of their growth is an important aspect of successful production of crops. These macro nutrients are Nitrogen (N), Phosphorus (P), Potassium (K), Calcium (C), and Magnesium (Mg). *Elaeagnus angustifolia* is a small tree and it is also called a large shrub. It has silvery leaves and thorny body. This species is tolerant to saline as well as alkaline soils and is hosted from Russia. This essential plant nutrient research will definitely help to solve such nutrient deficiency problems. This aim of present study was to explore the importance of essential nutrients for livestock and to assist farmers in the selection of fodder and forage. The results showed that concentrations of N, P, K, Ca and Mg in the dry foliage of Russian olive were 3.75, 0.558, 4.37, 2.459 and 0.769 % respectively. It may be concluded from the results that the range of N, P, K, Ca and Mg in the leaves of *E. angustifolia* was very close to sufficient range of plant N, P, K, Ca and Mg content.
Keywords: Essential nutrients, *Elaeagnus angustifolia*, Fodder and forage.

INTRODUCTION

Currently the animal protein deficiency is an alarming issue in most of the developing countries. This deficiency is typically due to dearth of forage. In such developing countries mostly the available grazing is not sufficient for the livestock due to their harsh environmental conditions; in such condition trees and shrubs play a vital role by providing fodder to the livestock. These trees and shrubs are mostly known as a provider of proteins to animals (Paterson et al., 1998; Azim et al., 2011). Russian olive is an alien tree that is progressively common in riparian environments and is highly resistant to extreme environmental condition like floods and droughts. It has also the ability to resist different soil textures and moisture levels. This is actually the reason behind its successful occurrence in all types of environments (Katz and Shafroth, 2003). *E. angustifolia* adds substantial nitrogen to ecosystems as it has a good actinorrhizal nature, deciduous routine and high leaf nitrogen content (Castro et al., 1993; Katz and Shafroth, 2003). Leaves of *E. angustifolia* grown in the laboratory enclosed 3.3% N, which was related with a high photosynthetic rate (Cote et al., 1988; Katz and Shafroth, 2003). Due to this possession of high nitrogen content *E. angustifolia* is used in silvicultural activities and it is also used as a biofertilizer (Dawson and Sambeek 1993, Domenach et al., 1994; Katz and Shafroth, 2003). According to the author, 60% of cultivated soils suffer from different types of minerals and nutrient deficiencies and many types of toxicities; which can cause growth-limiting problems. It is also estimated that around 50% of the world population undergoes micronutrient deficiencies (Cakmak, 2002).

According to USDA (2015), the physical and environmental condition like high winds, extreme temperatures (- 50 °F to 115 °F), saline or alkaline soil settings, flooding, drought and race from other trees and shrubs leave little or no impact on the growth of the species *E. angustifolia*. This species was introduced in United States as an ornamental tree. Soon after its invasion the species become dominant due to its properties like aggressive reproduction, adaptability, and rapid growth rate. The components of growth of *E. angustifolia* include stem and foliage density, canopy cover etc. *Elaeagnus angustifolia* can grow in groups as well as it can also grow individually. This species is part of mature riparian vegetation (Kelly et al., 1999;

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Muldavin et al., 2000; Zouhar and Kris, 2005). The height of the Canopy of Russian olive is normally from 16 to 33 feet which is 5-10 m but the density of the canopy is quite high. Live foliage of the tree is often present in the upper portion of the tree; in the lower 2 meters of the Russian olive tree dense branches are present which are often dead (Zouhar and Kris, 2005). Leaves of the species are generally 2 to 3 inches long and are arranged in an alternative way. Small and plane margins are present on the leaves. Color of upper leave surface of the species is green-gray and the lower superficial as well as leaf stalks are silvery gray in color. Foliage of the species has generally silvery look with tiny scales that cover the leaves (Creech et al., 2008). As reported by Coconino, Kaibab and Prescott national forest Russian olive is consider as noxious weed. This species is included in B class weed. Smaller groups of the species could be easily controlled but larger groups are quite problematic to control effectively. They are commonly found at the riparian zones and residential areas due to wide plantation of these species (Shafroth et al., 1995; Knopf and Olson, 1984) According to the author's personal observation, domesticated animals used to feed on young russian-olive trees but adult russian-olives prevent most livestock with the help of their piercing thorns and protective compounds in the leaves. Mostly the barks of the tree are eaten by rabbits. Poultry for example chickens, ducks, turkeys, and pigeons) may also eat the leaves from freshly implanted trees (Borell, 1962; Zouhar and Kris, 2005).

The purpose of the experiment was to find out the macro nutrients in the leaves of *E. angustifolia* and to recommend the specie as a source of foliage and fodder in Gilgit Baltistan and to compare the nutrients with the palatable plants macro nutrient standards.

MATERIALS AND METHODS

The macro-nutrients tested in the leaves of the species *E. angustifolia* were N, P, K, Ca and Mg.

Leaf Nutrient Analysis

The leaves of plants are the major and crucial components for analysis of various nutrients because leaves are indicators of essential nutrients accumulation and show changes in nutrients concentration. The amount of macronutrients in the dry part of leaves and its comparison with standard values helps to understand nutrients status. The data obtained from nutrients analysis of the species was used to find out the difference between the results and optimal nutrient concentration (Motsara and Roy, 2008).

Table. 1: General sufficiency or optimal range of nutrients in plants

Nutrients (Macronutrients)	Sufficiency or optimal range (%)
N	2.0–5.0
P	0.2–0.5
K	1.0–5.0
Ca	0.1–1.0
Mg	0.1–0.4
S	0.1–1.3

Source: FAO (Motsara and Roy, 2008)

Methods

The methods involve in this research is totally based on laboratory work. Before the laboratory processes sampling of the species was done.

Sampling

From the surrounding of KIU campus the trees were selected through simple random sampling technique. Sampling was done during the 1st week of March where the already dried leaves were collected from the trees. After collection the leaves were placed in a grinder and crushed into fine powder.

Sampling size

4 trees were used as replicates in the sampling technique because in laboratory work minimum 3 to 4 replicates were used for accurate results (ITRC, 2012).

Laboratory processing

Laboratory work was done at Pakistan Agriculture Research Council Jaglote (Gilgit). The work properly started with the formation of solutions of the powder of the species and leaving it in the oven overnight. The process properly started next day to find out the readings of N, P, K, Ca, and Mg with the help of following procedures.

Kjeldahl Nitrogen and Phosphorous

Reagents and Apparatus

1. Concentrated Sulfuric Acid (H_2SO_4) reagent grade.
2. Digestion tablets (Kjeltab).
3. Glass boiling beads.
4. Aluminum digestion block with temperature controller.
5. Kimax glass tubes with 50-ml graduation mark.
6. TKN Standards.
7. Carries Solution

Procedure

The weight of 0.150 g ground plant material was put into 50 ml digestion tube. After that one digestion tablet (Kjeltab 1.72 g) and two glass boiling beads were added in each tube. Then in the underneath hood 3.5 ml concentrated sulfuric acid (H_2SO_4) was pour through 5 ml repipet device. For each run there was at least one blank and one check was included. Preheat aluminum digester until it reach at the temperature of 180 ^oC. The tubes were then put into the block digester which was preheated and continue to heat till 390 +/- 5 ^oC then keep it for digestion up to two hours. After that the tubes were taken out from heating then cooled it for around 20 minutes. Add 10-15 ml distilled water in the digestion tubes despite of they were warm. The samples were dilute with distilled water to the mark of 50 ml then mix completely after capping. After that the solution was filter by # 2 filter paper. Finally the analysis of ammonium for TKN on the flow injection analyzer based on the Lachat method No. 13-107-06-2-D was done.

Calculations

For plant TKN %:
N % = reading (mg/l) x 50 / 0.150 / 10000

Total K, Na, Ca and Mg

Equipment

1. Adjustable pipette
2. 20-ml glass beaker
3. Atomic Absorption Spectrophotometer

Reagents

1. 1.2 N HCl solution Add 103.7 ml of hydrochloric acid (sp. Gr. 1.19, 37.5%) into 1 liter bottle. Dilute with distilled water and mix well.
2. 0.105 % Lanthanum diluent Place 1.2314 g lanthanum oxide (La_2O_3), low calcium grade, in a one liter volumetric flask. Add 4 ml of 6 N HCl to dissolve the La_2O_3 and then dilute to one liter with demineralized water.

Procedure

The filtrate was transfer from the dry ashing procedure into 20 ml beaker. Then 1.0 ml of filtrate was diluted by 9.0 ml of the 1.2 N HCl solution. The dilution was carried out 10 times. The dilute filtrate was dilute by 0.5 ml with 9.5 ml Lanthanum diluent. The reading of samples was taken at atomic absorption spectrophotometer using appropriate standards and instrument was set for Ca and Mg. For determination of K flame emission spectrometers may be used by using diluted filtrate and it is also used for determination of P.

Calibration and Standards

1. 1000 ppm K, Na, Ca and Mg stock solution
2. Working standards

Pipette the following volumes of 1000 ppm stock solution into 1000 ml volumetric flasks and dilute to volume with 1.2 N HCl solutions for Ca and Mg, and with 0.12 N HCl solutions for K and Na:

1000 ppm stock (ml)				Final working Standards			
K	Na	Ca	Mg	K	Na	Ca	Mg
0	0	0	0	0	0	0	0
20	15	50	5	20	15	50	5
40	30	100	10	40	30	100	10

Store in plastic bottles and keep in the refrigerator until ready to use.

Calculations

Ca and Mg % in plant = ppm in reading x 10 x 50 / 0.500 / 10000
K and Na % in plant = ppm in reading x 10 x 50 / 0.500 / 10000

RESULTS

Concentration of Nitrogen:

The leaves of *E. angustifolia* show the concentration of nitrogen as 3.75 % (Fig 1) in dry foliage collected from dry temperate mountainous range of Gilgit. The range of nitrogen in the leaves of *E. angustifolia* was very close to sufficient range of plant nitrogen.

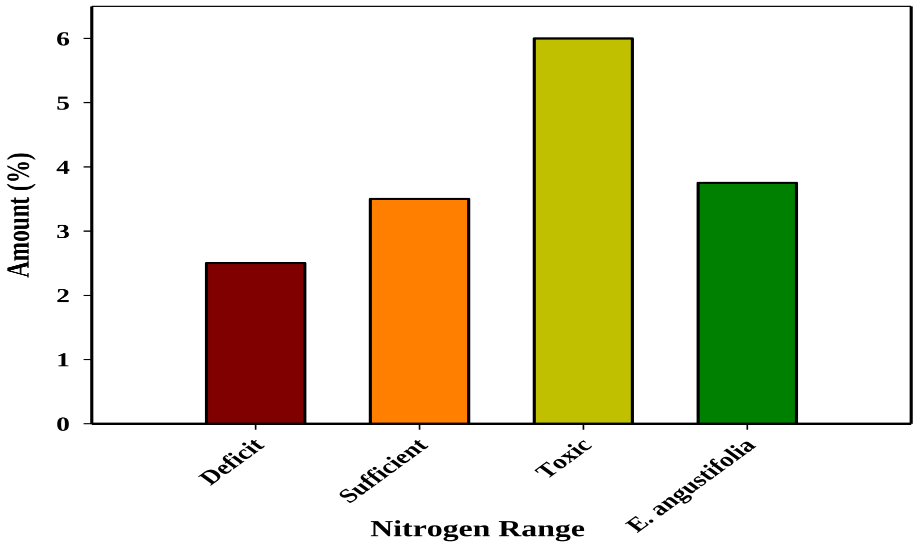

Figure 1: Percent value of Nitrogen in *Elaeagnus angustifolia* and its comparison with deficit, sufficient and toxic levels of Nitrogen in plants required for livestock.

Concentration of phosphorus

The leaves of *E. angustifolia* show the concentration of phosphorus as 0.558 % (Fig 4.2) in dry foliage collected from dry temperate mountainous range of Gilgit. The range of phosphorus in the leaves of *E. angustifolia* was also very close to sufficient range of plant phosphorus

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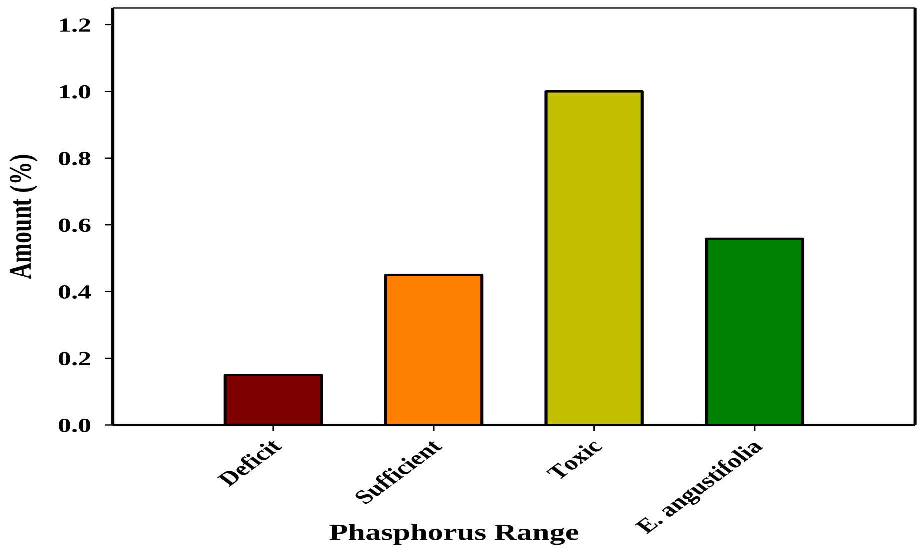

Figure 2: Percent value of Phosphorus in *Elaeagnus angustifolia* and its comparison with deficit, sufficient and toxic levels of Phosphorus in plants required for livestock.

Concentration of Potassium:
The concentration of potassium in the leaves of *E. angustifolia* was 4.37 % (Fig 4.3) in dry foliage collected from dry temperate mountainous range of Gilgit which is quite more than the sufficient range of plant potassium.

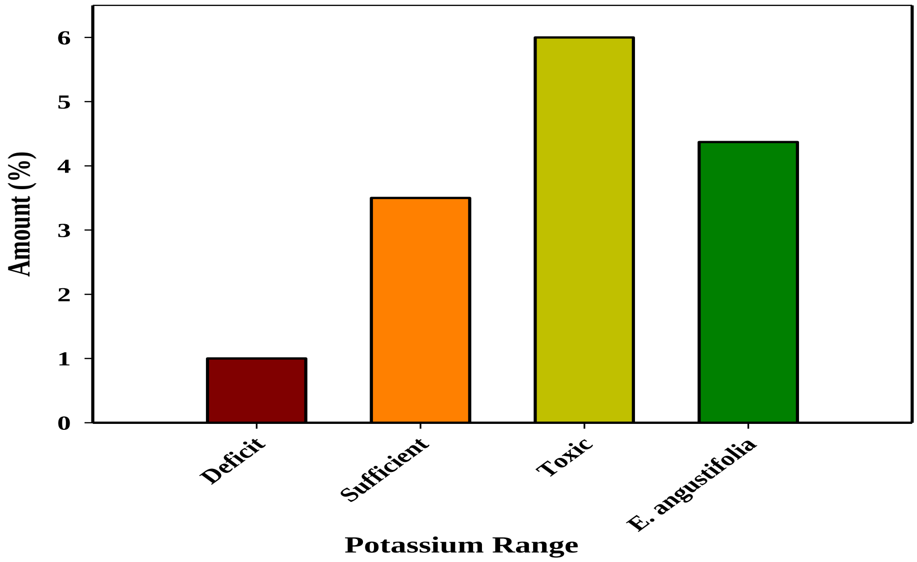

Figure 3: Percent value of Potassium in *Elaeagnus angustifolia* and its comparison with deficit, sufficient and toxic levels of Potassium in plants required for livestock.

Concentration of calcium:
The results given by the analysis of calcium content in the leaves of *E. angustifolia* was 2.459 % (Fig 4.4) in dry foliage collected from dry temperate mountainous range of Gilgit. This range of calcium in the leaves of *E. angustifolia* was very close to sufficient range of plant calcium content
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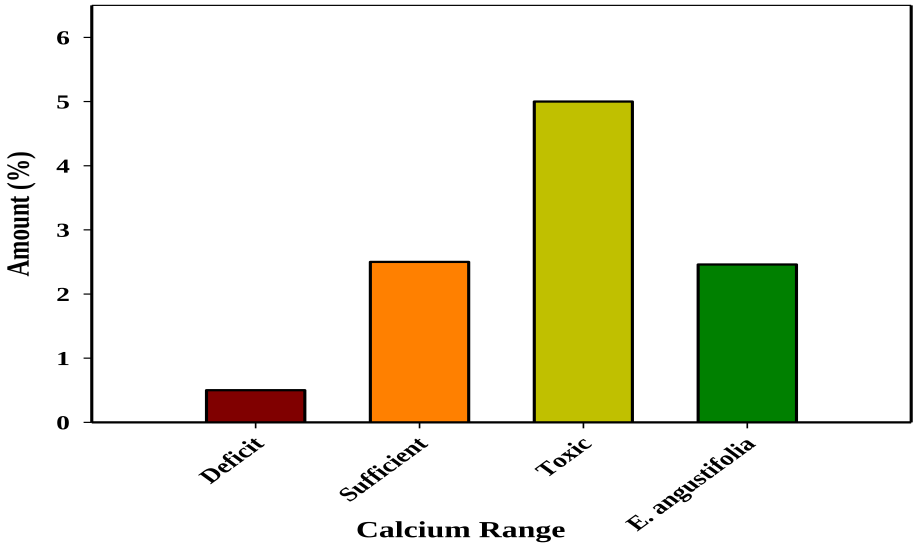

Figure 4: Percent value of Calcium in *Elaeagnus angustifolia* and its comparison with deficit, sufficient and toxic levels of Calcium in plants required for livestock.

Concentration of magnesium:
The concentration of magnesium in the leaves of *E. angustifolia*is 0.769 % in dry foliage of collected from dry temperate mountainous range of Gilgit (Fig 4.5). The range of magnesium in the leaves of *E. angustifolia* was also very close to sufficient range of plant magnesium content.

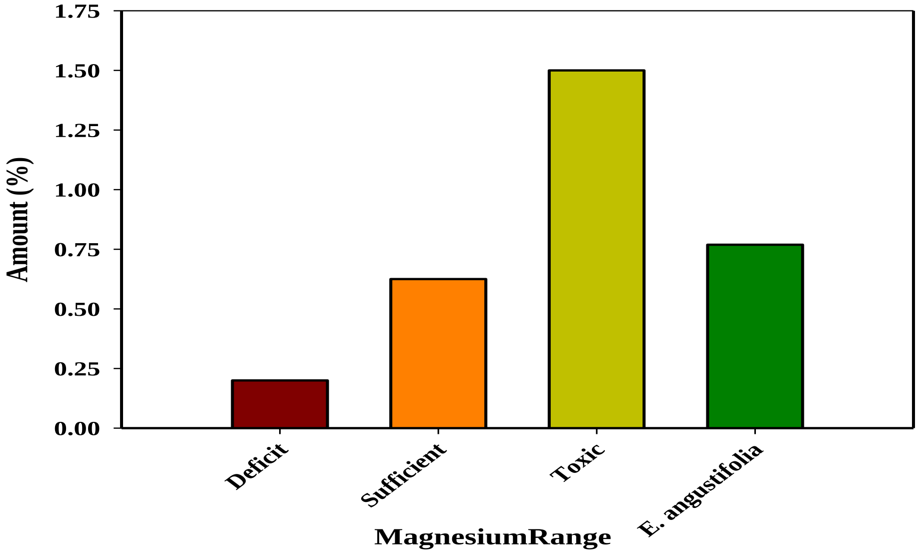

Figure 5: Percent value of Magnesium in *Elaeagnus angustifolia* and its comparison with deficit, sufficient and toxic levels of Magnesium in plants required for livestock.

A pie chart of the analyzed values
A pie chart showing the analyzed values of macronutrient in the dry foliage of Russian olive.

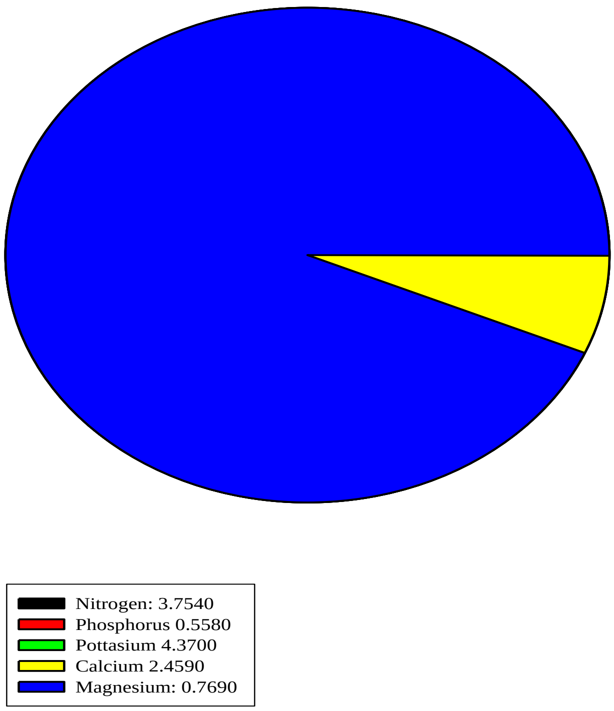

Figure 6: Concentration of Nitrogen, Phosphorus, Potassium, Calcium and Magnesium in dry foliage of *Elaeagnus angustifolia.*

Table 2: Comparison between the macronutrients present in the dry foliage of Russian olive along with their deficient, sufficient, toxic and analyzed ranges.

	Nitrogen	Phosphorus	Potassium	Calcium	Magnesium
Deficient	2.5000	0.1500	1.0000	0.5000	0.2000
Sufficient	3.5000	0.4500	3.5000	2.5000	0.6250
Toxic	6.0000	1.0000	6.0000	5.0000	1.5000
E. Angustifolia	3.7540	0.5580	4.3700	2.4590	0.7690

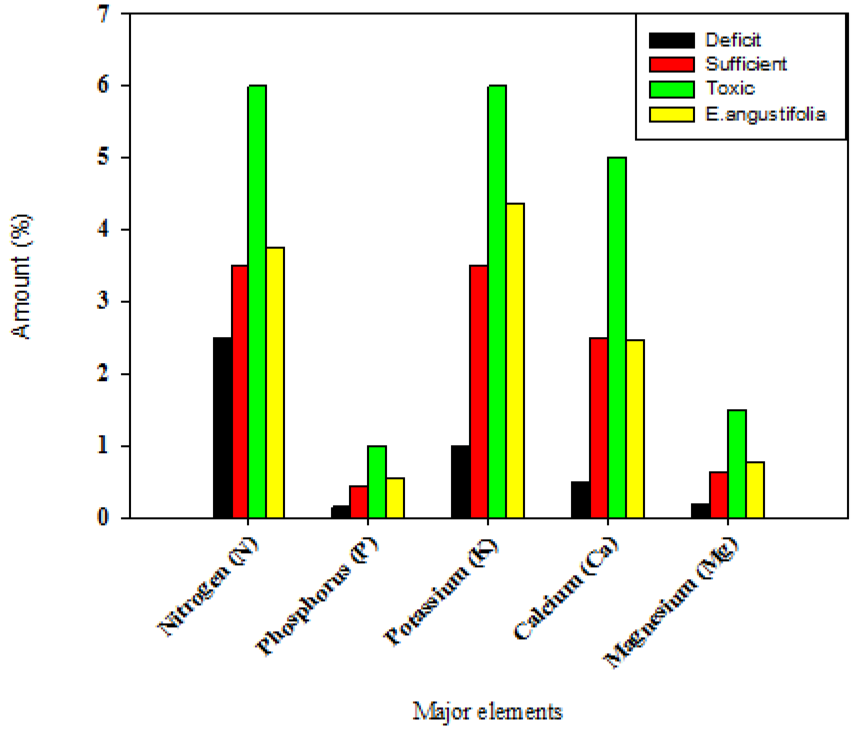

Figure 7: Comparison of Percent value of Nitrogen, Phosphorus, Potassium, Calcium and Magnesium in the dry foliage of *Elaeagnus angustifolia* with their deficit, sufficient and toxic levels in general plants required for livestock.

DISCUSSION

Nitrogen content is an important element as it is building block for amino acids, proteins and protoplasm in plants. Nitrogen behaves as a catalyst for other nutrients in plant. It is very essential for flowering differentiation. It is also important for the growth of shoots in trees (Abid et al., 2005). Deficiency of nitrogen can cause growth abnormalities in plants and yellowing of foliage (Saliva and Uchida, 2000). The current level of nitrogen in Russian olive is very close to general plant nitrogen level. This shows that the plant have sufficient level of nitrogen in the mountain region of Gilgit. The leaves of plant indicate an average N level of 3.23% in *E. angustifolia* analyzed by Llinares, el al. (1992) in San Pablo. In the Leaves of the species there is 3.1–3.3% N in Spain (Llinares et al., 1992; Katz1 et al., 2003), 2.9% N on the Rio Grande in New Mexico (Johnson 1995), and 1.6% N in southern Idaho (Katz et al., 2003). Some of these values are quite similar to my analyzed value of nitrogen concentration in Russian olive.

Similarly in case of Phosphorus; it assists in respiration processes as well as in photosynthesis (Ayub et al., 2002). Besides this if there is any deficiency of phosphorus in the plants, abnormalities related to growth, death of tissues decreased fruits quantity and leaves quality may occur (Assuero et al., 2004). Phosphorus concentration in the analyzed results is much close to the general plant phosphorus standard value. Deficiency of calcium can result in the weakening of stem structure of the plants. It also affects the structure and quality of the leaves of plants

(Silva and Uchida, 2000). According to Azim et al., 2011. The concentration of calcium and phosphorus in Russian olive in district Chakwal, Pakistan are 2.09% and 0.15 % respectively which is quite closer to my analyzed values.

Potassium content is supposed to be an enzyme activator and it promotes metabolism (Silva and Uchida, 2000). Generally it is said that sandy soils in high rainfall areas are susceptible to potassium deficiency (soil quality.org.au). It may be one of the reasons for the greater analyzed value of potassium in this study as Gilgit is a dry temperate area with lower rainfall and loamy soil have very good concentration of potassium in the dry foliage of Russian olive. According to Ersoy, (2013) the concentration of potassium in dry foliage of Russian olive in Turkey is 1.03 % which is very low as compare to the analyzed values. Among all the macro elements potassium content is varying due to location.

Deficiency of magnesium in plants may cause the reduction of green color in the leaves of the plant because magnesium supports the formation of chlorophyll (Sawyer, 2004). According to the analyzed value the concentration of magnesium is 0.769 % this value of magnesium is palatable as the standard value of plant magnesium concentration is 0.625%. According to the study of Ersoy, 2013 the concentration of magnesium in the dry foliage of Russian olive in Turkey is 0.0762 this value is quite similar with the analyzed value of magnesium.

CONCLUSION

It is concluded from the results that the range of N, P, K, Ca and Mg in the leaves of *E. angustifolia* was very close to sufficient range of plant N, P, K, Ca and Mg content. Therefore it may be recommended to use *E. angustifolia* as a fodder for livestock feeding.

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