Contents available at ISC and SID

Journal homepage: www.rangeland.ir

Research and Full Length Article:

Comparison of Plant Litter Composition in Three Range Species and its Effects on Soil Fertility (Case Study: North Eastern Islamabad Rangeland, Kermanshah Province, Iran)

Afshin Sadeghirad[A], Mohamad Nasrollahi[B], Hossein Azarnivand[C], Mohamad Ali Zare Chahoki[D]

[A]M.Sc. Range Management Faculty of Natural Resources University of Tehran, Iran
(Corresponding Author), Email: afshinsadeghirad69@gmail.com
[B]M.Sc. Combat desertification Faculty of Natural Resources University of Tehran, Iran
[C]Faculty of Natural Resources University of Tehran, Iran
[D]Assistant Professor, Faculty of Natural Resources University of Tehran, Iran

Abstract. Plant litter is an important factor for soil conservation and sustainability that could modify soil chemical properties and increase the plant biomass production. The aim of this research was to compare plant litter chemical composition and its effects on soil properties in three species including *Hordeum bulbosum*, *Poa bulbosa*, *Bromus tectorum*. First, soil samples were taken in the depth of 0-30 cm and litter samples were collected from soil surface based on a random-systemic method using three 200m transects. Then, samples of dried plants of current and previous years were taken from 1 m^2 plots. The soil samples under the plants and bare soil (as control) were also taken at the depth of 0-30 cm. Finally, the chemical composition of litter and physical and chemical properties of soils were analyzed. Results showed significant differences between species in terms of potassium (K), carbon (C), nitrogen (N) and carbon to nitrogen (C/N) ratio (P<0.01). There were also significant differences between litter and soil for chemical elements (P<0.01). The litter of species generally had higher values of all the chemical elements than soil elements except for the phosphorus (P). *Hordeum bulbosum* had higher values of P and C/N ratio in litter (3.23 ppm, 43.01, respectively) and higher values of P and K in the soil (10.8ppm, 400 ppm, respectively). *Bromus tectorum* had higher values of C and K in litter (44.88%, 1120 ppm, respectively) and higher values of C and N in the soil (1.53%, 0.50%, respectively) and *Poa bulbosa* had higher values of N in litter (1.53%) and lower

values of C/N ratio in the soil (8.7). It was concluded that *Poa bulbosa* due to lower values of C/N ratio had higher litter quality than two other species for soil fertility.

Key words: Litter, Chemical composition, Soil properties, *Hordeum bulbosum*, *Poa bulbosa*, *Bromus tectorum*

Introduction

The remainder of plants plays a major role in adding the organic matter (OM) to soil. Decomposition of OM has an important role in nutrient cycling, especially for nitrogen (Bormann *et al.,* 1977; Henderson *et al.,* 1978; Mahendrappa and Salonius, 1982). Releasing nutrients from plant litter decomposing is a major route through material flows in the rangeland ecosystems which may be available for the uptake by the plants or exit from the ecosystem controls and ultimately, it affects the ecological potential (Blair, 1988).

Decomposition of species litter leads to increase OM and soil chemical properties so that plant production is increased (Moghadam, 2007). OM of range soil was provided through plant litter, animal dung, animal feces or remaining carcasses and other components of ecosystems (Tahmasebi, 2009). Nutrient cycling (NC) is an important factor which directly affects the soil micro-organisms and indirectly the improvement of soil chemical and physical processes (Fisher and Binkley, 2000).

The release of nutrients from decomposing the litters plays an important role in NC of rangeland ecosystems. In fact, by litter decomposition, the elements are added to soil or re-absorbed by plants so that species with different properties concerning the amount of litter production, releasing nutrients and litter chemical composition play a major role in NC (Blair, 1988).

Optimal growth of plants depends heavily on the nutrients of soil. Nutrients

not only should be ingredients that easily accessible for plants, but the balance between them also is important (Tandon, 2004). Elements such as N, P, K and C are containing macro and essential nutrients. Soil organic carbon energy storage in the C-C bond may be used during the process of respiration by the plant roots and soil organisms and then, returned to the atmosphere as CO_2 while other elements directly affect the growth and quality of plants (Shahoyi, 2006). In litter decomposition, the main factor is litter quality that affects the microbial population and the decomposition rate after microclimate and soil (Jamaludheen and Kumar, 1999).

High quality litter increased the decomposition population of soil and activation of soil biology (Fog, 1988). The amount of plants falling and dynamics of litter decomposition are effective in OM formations and the amount of storage nutrients (Lugo *et al.,* 1990). Litter quality and speed of decomposition depend on such factors as hardness, morphology, C/N, P and leaf longevity or the content of water-soluble components (Augusto *et al.,* 2002).

Palm and Rowland (1997) reported that the nutrient elements involving C, P and N are the most important elements in the study of litter quality. Muys and Lust (1992) stated that C/N ratio is an important indicator to know how nutrients affect litter decomposition process. Parrotta (1999) also stated that quality of species litter is effective in the speed of decomposing. Bird *et al*. (2002) examined the effects of plants on soil stability and soil C content. They introduced C/N ratio as the best indicator of soil stability. Franck *et al*. (1997) reported that the C/N ratio of litter in

Lolium perenne was lower than that for *Avena sativa*. The litter of *Lolium perenne* had higher quality. Litter decomposition of plant species and adding their OM to the soil are the main processes of natural ecosystems. Therefore, in soil fertility management, suitable decisions should be taken. Accessing to this purpose requires careful assessment of species litter elements, their amount and the speed of litter decomposition of each species. Rangeland ecosystems are not expected this issue due to their unique complexities. Therefore, the aim of this study was to compare the chemical compositions of litter in three species in rangeland and their effects on soil properties.

Materials and Method
Study area
The study area is located in the northeast of Eslamabad in Kabootaran, Chanar, Nesar and Barike Mountain with an area about 6157 ha In Kermanshah province, Iran. Geographically, the study area extends from 34°13'49″ to 34°19'14″ E latitude and 46°26'34″ to 46°35'22″ N longitude (Fig. 1), and the elevation range is about 1530 to 2320 m above sea level. There is no important permanent river basin and just has a seasonal stream that discharges all runoff from the areas through southeastern part of the field. According to the climatic classification of Ambrgeher, the studied area is divided into two types of regions as follows: semi-humid climate of the cold up to 1900 m and higher than 1900 m was mountainous climate. The region based

on Domarten is classified into three climate types as follows: semi-humid climate to a height of 1585 m, humid climate from 1585 to 1880 m and very humid above 1880 m (Nemati Peykani *et al.,* 2009).

Fig. 1. Map of study area in the country, province and site

Sampling method and chemical analysis
After determining the dominant species by physiognomic-floristic method in the key area, samples were taken from the soil depth of 0-30 cm using three 200 m transects (beginning and end of each transect) and samples from plant litter were taken based on a random-systemic method (Jafari *et al.,* 2010). The first transect was established on the slope and others perpendicular to the slope gradient. Sampling from the dried plant of previous and current years were taken using 1 m^2 plots and soil samples under plants and without plant area (control samples) at the depth of 0-30 cm (due to the depth of rooting) were also taken.

Chemical analysis
Samples from the plot area were taken with the method of minimum area, and the number and size of the sampling plots were selected according to the environmental conditions and vegetation. Plant litter samples were collected and transferred to the laboratory, plant residues in soil clinging by immersing in water then washed and dried at 60°C (Jafari *et al.,* 2010). The N, C, K and P of litter were measured as N by Kjeldal method (James, 1995), C by combustion in an electric furnace with a temperature of 385°C, K by flame photometer method and P with ammonium molybdate, respectively (Ranjbari, 2013). The soil samples for each profile were sieved. The soil properties were analyzed as follows: soil texture by baykas hydrometer (Gee and Buader, 1986), C by Valky-Black method (Nelson and Somners, 1982), N
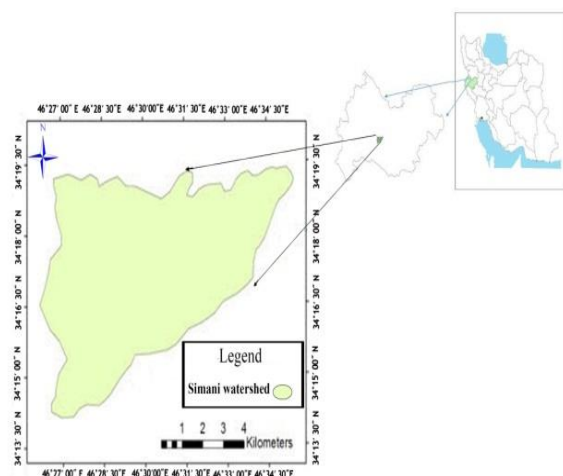
by Kjeldal method, soil pH by pH meter (McLean, 1982), EC by EC meter (McLean, 1982), K by flame photometer and P by spectrophotometer (Bremner and Mulvaney, 1982).

Finally, the normality and homogeneity of data were tested using Kolmogorov-Smirnov tests. Then, data were analyzed using analysis of variance so that if there were significant differences among treatments, Duncan's method was used to means comparison of treatments.

Results

Analysis of variance of litter chemical composition of three species is presented in Table 1. The results showed a significant difference between three species for K, C, N, and C/N ratio (P<0.01). Mean comparisons of litter elements between species is presented in Table 2.

For P concentration, results showed that *H. bulbosum* and *B. tectorum* with the average values of 2.23 and 2.18 ppm had higher and lower P concentrations, respectively. For K values, results showed that *B. tectorum* and *P. bulbosa* with average values of 1120 and 550 ppm had higher and lower K concentrations, respectively. For N values, litter of *P. bulbosa* and *H. bulbosum* with the average values of 1.53 and 0.95% had higher and lower N%, respectively. For C, litter of *B. tectorum* and *P. bulbosa* with the average values of 44.88 and 36.57% had higher and lower C%, respectively. For C/N ratio, litter of *H. bulbosum* and *P.bulbosa* with the average values of 41.01 and 23.89 had higher and lower C/N ratio, respectively.

Table 1. Variance analysis litter chemical composition of three species

Source of variation	DF	MS				
		P (ppm)	K (ppm)	N (%)	C (%)	C/N ratio (%)
Between species	2	0. 57**	0.147**	0.01**	0.151**	0.357**
Error	15	0.042	0.021	0.0009	0.015	0.0132

**=Significant at 1% probability level

Table 2. Mean comparisons of three species litter for five elements

Elements	P (ppm)	K (ppm)	N (%)	C (%)	C/N Ratio (%)
H. bulbosum	3.23 [a] ± 0.006	900 [b] ± 0.007	0.95 [c] ± 0.007	41.15[b] ± 0.56	41.01 [a] ± 0.43
P. bulbosa	2.20 [a] ± 0.006	550 [c] ± 0.017	1.53 [a] ± 0.11	36.57[c] ± 0.41	23.89 [c] ± 0.32
B. tectorum	2.18 [a] ± 0.005	1120 [a] ± 0.014	1.16 [b] ± 0.007	44.88[a] ± 0.26	38.47 [b] ± 0.28

Means of column with the same letters are not significantly different (ρ<0.01)

Analysis of variance of soil physical-chemical properties in soil rhizosphere area of three species and control (bare area) is shown in Table 3. Results indicate significant differences (P<0.01) among three species and bare soil area for all the traits except P and silt%.

Means comparison of soil physical and chemical properties in three species and control area is presented in Table 4. Results for P concentration showed that *H. bulbosum* and control area with the average values of 10.8 and 6.40 ppm had higher and lower P concentrations, respectively. For K values, the *H.*

bulbosum soil rhizosphere and control area with the average values of 440 and 400 ppm had higher and lower K concentrations, respectively. For N%, the *B. tectorum* soil rhizosphere and control area with the average values of 0.5% and 0.1% had higher and lower N%, respectively. For C values, results showed that *B. tectorum* soil rhizosphere and control area with the average values of 1.53 and 0.84% had higher and lower C%, respectively. For C/N ratio, the *P. bulbosa* and *B. tectorum* soil rhizosphere area with the average values of 8.7 and 3.06 had higher and lower C/N ratio,

respectively. For pH, the *P. bulbosa* and *B. tectorum* with the average values of 8.00 and 7.59 had higher and lower pH values, respectively. For EC, results showed that *P. bulbosa* and *B. tectorum* with average values of 0.63 and 0.32 dsm^{-1} had higher and lower EC values, respectively. For soil sand, *B. tectorum* and *P. bulbosa* with average values of 19.4 and 11.4% had higher and lower sand%, respectively. For silt%, *P. bulbosa* soil rhizosphere and control area with the average values of 38.03 and 35.01% had higher and lower silt%, respectively. For clay%, the control area and *B. tectorum* rhizosphere area with average values of 51.30 and 44.6% had higher and lower clay%, respectively.

Table 3. Variance analysis of soil physical-chemical properties in the species soil and bare soil (area control)

S.O.V.	DF	MS									
		P (ppm)	K (ppm)	N%	C %	C/N	pH	EC(ds/m-1)	Sand %	Silt %	Caly %
Species	3	0.184^{ns}	521.2**	1.58**	0.62**	0.35**	1.60**	0.101**	658.65**	129.77^{ns}	435.5**
Error	20	0. 070	105.3	0.07	0.117	0.02	0.07	0.01	57.37	1740.33	69.69

**, ns= Significant at 1% probability level and non-significant, respectively

Table 4. Mean comparison of soil physical and chemical properties in three species and control area (bare soil)

Properties	P (ppm)	K (ppm)	N (%)	C (%)	C/N Ratio	pH (-)	EC (dsm^{-1})	Sand (%)	Silt (%)	Clay (%)
Control area	6.9^a ± 0.08	440^a± 1.63	0.10^a± 0.01	0.84^c± 0.05	8.4^a± 0.56	7.6^c± 0.01	0.52^c± 0.07	13.7^c± 0.08	35.01^a± 8.6	51.3^a± 0.08
H. bulbosum	8.2^a± 0.01	400^a± 1.08	0.13^a± 0.01	1.12^b± 0.01	8.6^a± 0.01	7.8^b± 0.01	0.34^b± 0.01	15.4^b± 0.08	36.01^a± 0.8	48.6^b± 0.08
P. bulbosa	8.1^a± 0.08	300^a± 1.70	0.13^a± 0.01	1.13^b± 0.01	8.7^a± 0.01	8.0^a± 0.01	0.63^a± 0.01	11.4^d± 0.01	37.03^a± 0.7	50.6^a± 0.01
B. tectorum	7.0^a± 1.42	280^b± 1.56	0.50^b± 0.01	1.53^a± 0.01	3.1^b± 0.01	7.6^c± 0.01	0.32^b± 0.01	19.4^a± 0.01	36.01^a± 0.8	44.6^b± 0.01

Means of each row (species) with the same letters are not significantly different ($\rho < 0.01$)

Results of means comparisons between *H. bulbosum, P. bulbosa* and *B. tectorum* showed significant differences between litter and soil rhizosphere for P, K, C, N, and C/N ratio (P<0.01) (Table 5).

Results showed that P concentrations of soil rhizosphere and litter were 10.8 and 3.23 ppm for *H. bulbosum*, they were 8.10 and 2.20 ppm in *P. bulbosa* and they were 7.00 and 2.18 ppm in *B. tectorum,* respectively (Table 5). Results showed that K concentrations in soil rhizosphere and litter were 400 and 900 ppm for *H. bulbosum*, they were 300 and 550 ppm in *P. bulbosa* and they were 280 and 1120 ppm for *B. tectorum*, respectively (Table 5). Results of means comparisons of N% between litter and soil rhizosphere in three species were significant (P<0.01). The N% in soil rhizosphere and litter were 0.11% and 0.95% for *H. bulbosum*, they were 0.11% and 1.53% in *P.*

bulbosa, and they were 0.5% and 1.16% for *B. tectorum*, respectively (Table 5). Results of C% between litter and soil rhizosphere for all of species were significant (P<0.01). The C% in soil rhizosphere and litter were 1.12% and 41.15% for *H. bulbosum*, they were 1.13% and 36.57% for *P. bulbosa* and they were 1.53% and 44.88% for *B. tectorum* (Table 5). Results of C/N ratios between litter and soil rhizosphere for individual species were significant (P<0.01). Results showed that C/N ratios in soil rhizosphere and litter were 8.6% and 43.01% for *H. bulbosum*, they were 8.70% and 23.89% for *P. bulbosa* and they were 3.06% and 38.47% for *B. tectorum* (Table 5).

Table 5. Comparison of measured elements in soil and litter of each species using t-test

Elements	Factor	*H. bulbosum*	T-test	*P. bulbosa*	T-test	*B. tectorum*	T-test
P (ppm)	Soil	$10.8^a \pm 0.008$	3.27^{**}	$8.10^a \pm 0.085$	4.22^{**}	$7.00^a \pm 1.420$	8.1^{**}
	Litter	$3.23^b \pm 0.006$		$2.20^b \pm 0.006$		$2.18^b \pm 0.005$	
K (ppm)	Soil	$400^a \pm 1.008$	3.32^{**}	$300^a \pm 1.700$	3.75^{**}	$280^a \pm 1.560$	7.0^{**}
	Litter	$900^b \pm 0.007$		$550^b \pm 0.017$		$1120^b \pm 0.014$	
N (%)	Soil	$0.11^a \pm 0.007$	13.42^{**}	$0.11^a \pm 0.007$	9.9^{**}	$0.50^a \pm 0.008$	7.3^{**}
	Litter	$0.95^b \pm 0.007$		$1.53^b \pm 0.010$		$1.16^b \pm 0.007$	
C (%)	Soil	$1.12^a \pm 0.008$	3.32^{**}	$1.13^a \pm 0.003$	10.5^{**}	$1.53^a \pm 0.008$	12.9^{**}
	Litter	$41.15^b \pm 0.56$		$36.57^b \pm 0.40$		$44.88^b \pm 0.260$	
C/N ratio	Soil	$8.60^a \pm 0.007$	31.58^{**}	$8.70^a \pm 0.008$	28.4^{**}	$3.06^a \pm 0.006$	18.6^{**}
	Litter	$43.01^b \pm 0.530$		$23.89^b \pm 0.320$		$38.47^b \pm 0.380$	

$**$= Significant at 1% probability level

Means of factors with the same letters are not significantly different ($\rho < 0.01$).

Discussion and Conclusions

Results showed that the concentration of chemical elements varied in different species litters. So, significant differences were observed between species for K, C, N, and C/N ratio (P<0.01). The reason of this difference could be related to species patterns in terms of nutrient release. Furthermore, different species recovered much of their nutrient before litter fall. The litter of plant debris is more likely to be the main source of nutrients for soil organisms. So, the organisms decomposed the plant residues and provided the needed nutrient for plants. In fact, this cycle is a protective mechanism that is different in various soils. So, we can say that nutrients of P, K, C and N are the most important elements for assessing. Similar results were obtained in the field (Hosseini, 2004).

The results showed that the amounts of N, P, C and C/N ratio in the litter of all the species were higher than those for the soils. The reason for this can be justified as the leaching process in soil. On the other hand, N and K are the elements which are not resistant to leaching and easily removed from the soil (Jafari *et al.,* 2010). The first stage of materials separation from plants and joining to soil was done by leaching of ions and water-soluble OM. Large amounts of nutrients in the plant tissues also contain many substances that are easily washable with water and can be added to the soil. In fact, there was a small amount of available forms of N for the plants in the soil solution. On the other hand, if there was no balance in C/N ratio, decomposing microorganisms can supply the lack of N from soil solution. So, it causes N to get immobile. Tandon (2004) found similar results in the field. For all the species, the amount of P in the soil was higher than litter among the desired elements. Phosphorus compounds are insoluble and are not washed easily from the soil profile contrary to N. P is resistant to leaching and it can be less got out of the soil unlike N and K. In addition, the lower mobility and reduced absorption by the plant caused that the amount of this element in soil was more than litter. Jafari *et al.* (2010) investigated the relationship between the litter and soil quality of under the plant species and expressed that the amounts of K, N, P and C/N values were always higher in the litter. Indeed, results showed that the C/N ratio in the litter of *Hordeum bulbosum*, *Poa bulbosa* and *Bromus tectorum* was estimated as 4.22, 2.32 and 12.57% that

were higher than soils rhizosphere area. Since the C/N ratio of *Poa bulbosa* was higher in its litter, its decomposition rate had a mineralization cycle period in a shorter time than two other species. Because the C/N ratio was less and whatever this ratio was lower, it indicates that resistance of plant debris is lower.

In other words, the rate of decomposition depends on the C/N ratio. But higher C/N ratio of two other species causes more N in the soil absorbed by microorganisms and got immobile. Therefore, *Poa bulbosa* had an important role in soil fertility more than the two other species. Jafari *et al.* (2010), Mahmoudi and Hakimian (1995) and Luo *et al.* (2006) came to the similar results. Thrope *et al.* (2004) reported that N mineralization rate is increased when C/N ratio are reduced. Also, Rahmani and Mohammadnejad Kiasari (2003) showed that the inappropriate of the litter composition can reduce the decomposer activity and leads to more OM accumulation in the soil. Therefore, it reduced soil fertility through reducing the decomposition speed of litter. Aber and Melillo (1982) indicated that every difference in litter chemical elements can affect the speed of decomposition in various stages of decomposition. Means comparisons of soil physical-chemical properties in soil rhizosphere area of species and control area showed significant differences (P<0.01) for all of traits except P and silt%. So, the amounts of C, sand and EC between soil rhizosphere and control area were significant (P<0.01). While no significant difference was observed for silt%. The results showed that soil of control area and soil of *Hordeum bulbosum* and *Bromus tectorum* in terms of K and P had no significant differences while there was a significant difference for the other species (P<0.01). Control area in terms of N% and C/N had no significant differences with *Poa bulbosa* and *Hordeum bulbosum* whereas there was a significant difference in terms of K

with *Bromus tectorum* species (P<0.01). Results showed that N% is increased in the soils of species more than control area; the reason is air N fixation by plants, but there is no N fixation in the bare soil (control area) so that it remains as an organic substance in soil. Soil under species had more fertility than control area due to N%. Increase in the fertility of species soils may be induced by the loss of plant shoots, thus augmenting the biological activity of living organisms. Decrease in P amount under soil of *Bromus tectorum* as compared to two other species was probably related to root system of this species. Whatever root surface is greater, it leads to more P sorption. C/N ratio in *Poa bulbosa* and *Hordeum bulbosum* soils was more than the control area. The C% was significantly increased as compared to N and caused the increased C/N ratio in the soil of these two species whereas in *Bromus tectorum*, soil had lower C/N ratio. Differences in the response of plant nutrients can result in the differences in the amount of root, absorption efficiency (The amount of nutrients consumed in a unit of root) and use efficiency (the amount of produced biomass from a unit of received dietary element). This result is consistent with the results reported by Brown (1999). In general, it can be concluded that the influence of studied species and their litter on soil can be attributed to the soil properties. In addition to litter, other factors may affect these properties. On the other hand, the difference in the C/N ratio of the studied species, litter quality and Litter degradation may lead to the changes in the dynamics of soil organic matter and nutrients, especially nitrogen.

It was concluded that *Poa bulbosa* due to lower C/N ratio had higher litter quality than that for two other species regarding soil fertility.

Literature Cited

Aber, J. D. and Melillo, J. M., 1982. Nitrogen immobilization in decaying hardwood leaf litter as a function of initial nitrogen and lignin content. *Can. Jour. Bot.* 60: 2263-2269.

Augusto, L., Ranger, J., Binkley, D., and Rothe, A., 2002. Impact of several common tree species of temperate forest on soil fertility. *Annals Forest Science*, 59(2): 233–254.

Bird, S. B., Herrick, J. E., Wander, M. M. and Wright, S.F., 2002. Spatial heterogeneity of aggregate stability and soil carbon in semi-arid rangelands. *Environ. Pol.* 116: 445-455.

Blair, J. M., 1988. Nutrient release from decomposing foliar litter of three trees species, with special reference to Calcium, Magnesium and Potassium dynamics. *Plant and Soil*, 110(12): 49-55.

Bormann, F.H., Likens, G.E., and Melillo, J.M., 1977. Nitrogen budget for an aggrading northern hardwood forest ecosystem. *Science,* 196: 981-983

Bremner, J.M., and Mulvaney, C.S., 1982. Nitrogen total. Pp: 595-624. In: Page AL. (ed.) Methods of Soil Analysis. Part 2, Chemical Analysis. ASA and SSSA, Madison, WI, USA

Brown, K.R., 1999. Mineral nutrition and fertilization of deciduous broadleaved tree species in British Columbia. Res. Br., B. C. Min. For., Victoria, B.C. Work. 60 p.

Fisher, R. F., and Binkley, D., 2000. Ecology and management of forest soils. John Wiley and sons, Inc., Third editions. 489p.

Fog, K., 1988. The effect of added nitrogen on the rate decomposition of organic matter. *Biology Fertility Soils,* 63(3): 433-642.

Franck, M., Bruce, A., Stuart, F., and Chistopher, B., 1997. Decomposition of litter produced under elevated co_2 dependence on plant species and nutrient supply. *Jour. Biogeochemistry.* 36: 223-237-

Gee, G.W and Bauder, J.W., 1986. Particle-size analysis. Pp: 383-411. In: Klute A (ed.). Methods of Soil Analysis. Physical and mineralogical methods. Part 1(2nd ed), ASA and SSSA, Madison WI, USA

Henderson, G.S., Swank, W.T., Waide, J.B., and Grier, C.C., 1978. Nutrient budgets of Appalachian and Cascade region watersheds: a comparison. *Forest Science*, 24: 385-397.

Hossini, V., 2004. Determination of litter and humus decomposition process compared to germination and growth rates as beech, hornbeam, alder and platform with native stone, Ph.D thesis, Tarbiat Modarres University, Tehran, 129p. (In Persian).

Jafari, M., Azarnivand, H., Haji Baglo, A., and Alizadeh, E., 2010. Litter and air organs quality and its impact on the habitat of four species in Hamand Absard, *Jour. Range Watershed Management,* 3: 307-318. (In Persian).

Jamaludheen, V., and Kumar, B.M., 1999. Litter of multipurpose trees in Kerala, India: variation in the amount, quality, decay rates and release of nutrients. J. *Forest Ecology Management*, 115(1): 1-11.

James, C. S., 1995. Analytical chemistry of foods. Blackie academic and Professional press, 90-92.

Lugo, A. E., Cuevas, E., and Sanchez, M. J., 1990. Nutrient and mass in litter and top soil of 10 tropical tree plantations. *Plant and Soil*, 125(2): 263-280

Luo, P., Huang, J., Han, X., Sun, J. O., and Zhou, Z.H., 2006. Differential responses of litter decomposition to increased soil nutrients and water between two contrasting grassland plant species of Inner Mongolia, China. *Appl. Soil Ecology*. 34(2-3): 266-275.

Mahendrappa, M.K., and Salonius, P.O., 1982. Nutrient dynamics and growth response in a fertilized black spruce stand. *Soil Science*. *Soc. Am. Jour.* 46: 127-133.

Mahmoudi, M., and Hakimian, S., 1995. Fundamentals of Soil Science, Tehran University Press, 666 p. (In Persian).

McLean, E. O., 1982. Soil pH and lime requirement: 199-224. In: Page, A. L. (ed.). Methods of soil analysis, Part 2. Chemical and microbiological properties. American Society of Agronomy, SSSA, Madison, WI, 1159 p.

Moghadam, M., 2007. Rangeland and management rangeland. Tehran University Press. Fourth Edition 470p. (in Persian).

Muys, B., and Lust, N., 1992. Inventory of the earthworm communities and the state of litter decomposition in the forest of Flanders, Belgium and its implications for forest management. *Soil Biology and Biochemistry*, 24(12): 1677-1681.

Nelson, D.W., and Somners, LE., 1982. Total carbon, organic carbon, and organic matter. Pp: 539-579 .In: Page AL (ed). Methods of Soil Analysis. Part 2, Chemical and microbiological properties .2nd ed. ASA and SSSA, Madison, WI, USA.

Nemati Peykani, M., Jamzad, Z., Noori, F., and Jalilian, N., 2009. Collection and identification

of Kermanshah province flora in order to herbarium establishment. *Agriculture and Natural Resources Researches Center of Kermanshah*, (in Persian).

Palm, C.A., and Rowland, A.P., 1997. A minimum dataset for characterization of plant native species in plantations on a degraded tropical site. *Jour. Vegetation Science*, 6(5): 627-636.

Rahmani, R., and Mohammadnejad Kiasari, Sh., 2003. Relation between millipede's abundance and litter nutritional elements composition in afforested and disturbed sites (Case study Darabkola-Mazandaran). *Iranian Jour. natural resources*, 56:201-212. (In Persian).

Ranjbari, Z.H., 2013. Comparison of carbon sequestration in brush land and meadows rangelands, M.Sc. of Thesis range management, Tehran University, Iran. (In Persian).

Shahoyi, S., 2006. The nature and properties of soils Kurdistan University, 880 p. (In Persian).

Tahmasebi, P. 2009. Rangeland ecosystem analysis, Pelk Press, Tehran, Iran. 276 p. (In Persian).

Tandon, H.L.S., 2004. Fertilizers in Indian agriculture from 20th – 21st Century. Fertilizer Development and Consultation Organization, New Delhi, 239 p.

Thrope, L., Holland, A., and Parton, J. 2004. Effect of nitrogen deposition and insect herbivore on pattern of ecosystem-level carbon and nitrogen dynamics, results from the century model. *Global Change Biology*, 10: 1092-1105.

quality for decomposition. In Cadish, G. and Giller, K.E. (eds) .Driven by Nature: Plant litter Quality for Decomposition. Pp. 379-392.

Parrotta, J.A., 1999. Influence of over story composition on under story colonization by

مقایسه ترکیبات شیمیایی لاشبرگ در سه گونه مرتعی و تاثیر آن بر حاصلخیزی خاک (مطالعه موردی: اکوسیستم‌های مرتعی شمال شرق اسلام آباد، کرمانشاه)

افشین صادقی راد^{الف}، محمد نصرالهی^ب، حسین آذرنیوند^ج و محمد علی زارع چاهوکی^د

^{الف}دانشجو کارشناسی ارشد مرتعداری دانشکده منابع طبیعی دانشگاه تهران، ایران (نگارنده مسئول)،
پست الکترونیک: afshinsadeghirad69@gmail.com
^بدانشجو کارشناسی ارشد بیابان‌زدایی دانشکده منابع طبیعی دانشگاه تهران، ایران
^جاستاد دانشکده منابع طبیعی دانشگاه تهران، ایران
^ددانشیار دانشکده منابع طبیعی دانشگاه تهران، ایران

چکیده. لاشبرگ حاصل از گیاهان بهترین عامل در امر حفاظت و پایداری خاک است که می‌تواند ضمن اصلاح خاصیت شیمیایی خاک، تولید گیاهی را افزایش دهد. این پژوهش به منظور مقایسه ترکیبات شیمیایی لاشبرگ در سه گونه غالب در منطقه شامل *Hordeum bulbosum*، *Bromus tectorum* و *Poa bulbosa* و تاثیر آن بر خصوصیات خاک انجام شد. ابتدا در منطقه مرجع هر تیپ با استفاده از سه ترانسکت ۲۰۰ متری نمونه‌برداری از خاک در عمق ۳۰-۰ سانتی‌متر و لاشبرگ گیاهی به روش تصادفی‌ـ سیستماتیک به عمل آمد. نمونه‌برداری از بقایای گیاهی خشک شده سال قبل و مواد گیاهی ریخته شده سال جاری (لاشبرگ گیاهی) با استفاده از پلات یک متر مربعی صورت گرفت. سپس به منظور تعیین تاثیر یا عدم تاثیر لاشبرگ گونه‌ها بر عناصر خاک، از فضاهای خالی بین پایه‌ها به عنوان منطقه شاهد نمونه‌برداری از خاک در عمق ۳۰-۰ سانتی‌متر صورت گرفت. در نهایت نیز ترکیبات شیمیایی لاشبرگ و خصوصیات فیزیکی و شیمیایی خاک گونه‌ها اندازه‌گیری شدند. نتایج نشان داد که لاشبرگ گونه‌های مورد مطالعه از نظر پتاسیم، کربن، نیتروژن و نسبت C/N با همدیگر در سطح یک درصد اختلاف معنی‌داری دارند. همچنین نتایج از وجود اختلاف معنی‌دار در سطح یک درصد بین عناصر شیمیایی لاشبرگ و خاک حکایت داشت. در واقع لاشبرگ گونه‌ها، به جز فسفر دارای بیشترین مقدار عناصر شیمیایی نسبت به عناصر خاک بودند. به طوری که *Hordeum bulbosum* دارای بیشترین میزان فسفر و نسبت C/N در لاشبرگ (۳/۲۳ppm و ۴۳/۰۱)، و بیشترین فسفر و پتاسیم در خاک (۱۰/۸ ppm و ۴۰۰ppm) داشت. گونه *Bromus tectorum* دارای بیشترین میزان کربن و پتاسیم در لاشبرگ (۴۴/۸۸ درصد و ۱۱۲۰ppm)، و کربن و نیتروژن در خاک (۱/۵۳ و ۰/۵۰ درصد)، و *Poa bulbosa* دارای بیشترین میزان نیتروژن در لاشبرگ (۱/۵۳ درصد) و کمترین نسبت C/N در خاک (۸/۷) بود. در نهایت نتیجه گیری شد که گونه *Poa bulbosa* به