Journal of Biodiversity and Environmental Sciences (JBES)
ISSN: 2220-6663 (Print) 2222-3045 (Online)
Vol. 4, No. 3, p. 77-83, 2014
http://www.innspub.net

RESEARCH PAPER OPEN ACCESS

Comparison on allowable use of *Festuca ovina* in semi-steppe and mountainous rangelands of Alborz and Zagros

Farhang Ghasriani[1], **Ehsan Zandi Esfahan**[2*], **Ali Mohebbi**[3]

[1,2,3] *Rangeland Research Division, Research Institute of Forests and Rangelands, Tehran, Iran*

Article published on March 06, 2014

Key words: Forage production, allowable use, *Festuca ovina*, semi-steppe, rangeland.

Abstract

Current research was carried out in selected sites of semi-steppe region including Badamestan (Zanjan), Firoozkooh (Tehran), Gharebagh (West Aazarbaijane), Zaghe (Lorestan), Ghavan- ban- hersin (Kermanshah), Alamot (Qazvin), Ghorveh (Kurdistan), Ser and Til Abad (Gholestan). *Festuca ovina* is a key and palatable species, having a considerable portion in rangeland yield. For this purpose, 40 similar species of *Festuca ovina* were selected in each site. Selected species were exposed to different harvesting intensities of 25, 50 and 75 as well as 0% as control group. Data were analyzed by SPSS and MSTATC and Duncan's Multiple Range Test were used for mean comparisons. According to the results, a higher production was recorded for the bases on which a light harvesting intensity was implemented. Significant differences were found among the studied years in terms of forage production, indicating the effects of climatic factors including precipitation and temperature. In general, rainfall and temperature were identified as the first and second limiting factors for the growth of *Festuca ovina,* respectively. No significant differences were recorded for 25 and 50% harvesting intensities in terms of studied traits but a harvesting intensity of 75% negatively affected *Festuca ovina*. Consequently, a harvesting intensity of 25-50% is recommended as the best allowable use for *Festuca ovina* in this vegetative region and other similar areas.

***Corresponding Author:** Ehsan Zandi Esfahan ✉ zandiesfahan@gmail.com

Introduction

Rangelands are one of the most important and most valuable national resources of Iran, forming a large part of the country (over 52%). Other services of the rangelands including pharmaceutical, industrial, and food products, soil conservation, control and increased groundwater storage, fresh air, the raise of relative humidity, regulation of the water cycle in nature, providing forage for livestock, preservation of plant and animal genetic resources as well as wildlife are important nationally (Fazilati *et al.*, 1965). It is noteworthy to state that providing forage for grazing livestock is the main use of rangelands, while forage quantity and quality are inadequate to provide the forage needed for livestock due to overutilization (Gharedaghi and Fazel Najafaabadi, 2000).

Despite the major role of determining allowable use of important species in the projects of improvement and restoration, soil erosion, calculation of available forage to livestock and also calculation of grazing capacity of rangeland and sustainability of desirable species, which result in economic prosperity, unfortunately, no systematic and adequate research has been done in this regard.

This research was aimed to determine the allowable use of *Festuca ovina* as a key range species in semi-steppe rangelands of Iran. The main question of the study was to what extent of harvesting could be tolerated by this species. Jaindl *et al.*, (1994) showed that, Idaho fescue (*Festuca idahoensis*) survival in heavily grazed areas might be the result of differences in growth form rather than overcompensation or variation in time or phenologic development. *Festuca arundinacea* and *Festuca rubra* showed a reduction in forage production under heavy grazing (Pontes *et al.*, 2007). Heavy grazing caused a reduction in forage production of *Bromus tomentellus* and after one year rest, the production loss was offset (Tavakoli *et al.*, 1993). Smith *et al.*, (2007) introduced range condition as one of the most important criteria in determining the level of range utilization, and stated that allowable use of the rangelands with poor condition would result in rangeland improvement. Also, allowable use should be considered higher in the rangelands with good condition while it should be lesser in poor rangelands. Arzani (2010) stated that the percentage of allowable use varied depending on plant species. If allowable use is calculated for desirable species, it can be used for all plant species. Reece *et al.*, (2001) developed a theory on allowable use, expressed as half harvesting and half remaining and according to it livestock are permitted to graze a distinct percentage of available forage that its rate is typically 50%. Ghasriani *et al.*, (2013) determined the allowable use of *Stipa hohenackerian* in semi-steppe rangelands of Iran and concluded that a harvesting intensity of 25-50% is recommended as the best allowable use for this species in this vegetative region and other similar areas. Amiri (2008) estimated an allowable use between 20 to 40 percent in rangelands of Semirom of Isfahan. Also, Zhao and lin (2007) in studies of some range species, stated that a number of range species could not tolerate the pressure of forage harvesting and therefore are unable to offset declining production resulted from cutting shoots. Sharifi and Akbarzadeh (2010) studied the changes***Error! Reference source not found.*** of vegetation under exclosure and grazing conditions in rangelands of Ardebil (Arshagh site), and reported that species of *Stipa hohenackeriana* showed a considerable growth during exclosure. Fulstone (2009), in his studies on grazing management of Missouri rangelands, reported the allowable use of key species of *Stipa californica* and *Stipa nevadensis*, to be 50 and 55%, respectively. In Iran, the allowable use is usually considered as 50% of annual growth which this value is reduced to 40% in the rangelands located in catchment areas to provide more canopy cover and protection of the watershed (Moghaddam, 1998). Increase of grazing intensity at Savijbolagh region caused a reduction of grasses and shrubs while herbaceous forbs, especially invasive and poisonous species, increased (Kohandel *et al.*, 2005). As was mentioned, the determination of allowable use is dependent on the studies in place and its percentage will vary depending on the species. Unfortunately, no

systematic research has been done on determination of the allowable use of rangeland species. For this purpose, the project of determining the allowable use of Festuca ovina was carried out in reference sites of the semi steppe rangelands of Iran for 5 years.

Material and methods

Sampling

Characteristics of the selected sites of semi-steppe region are summarized in Table 1. In each of the selected sites, *Festuca ovina* was evaluated as a key species. Therefore, 40 similar stands were selected at the beginning of the grazing season in each region and were marked by wooden labels. These lables remained stable and were protected from livestock grazing during four years. In this research, grazing simulation was performed in which different harvesting intensities of 25, 50, 75% and 0 (as control) were investigated as treatments with 10 replications for each treatment. Harvesting was done with clippers. Since forage harvesting was commenced from the begining to the end of livestock grazing, therefore, the number of days that species were normally grazed by livestock was calculated in each region and then it was divided by 30 to get the number of harvestsing. Residual forage and total forage of the control treatment were harvested when species were completely dry. Thereby, total yield was calculated in each year.

Statistical analysis

A split plot design in time with 10 replications was used, and data analysis was performed with SAS software. Mean comparisons were done by Duncan's Multiple Range Test. Interactions between treatments were tested by AMMI model, using IRRISTAT software. Other items, investigated in this study, included assessment of plant mortality, height, seed production and meteorological data.

Results

According to the results of analysis of variance during 2007-2010 (table 2), the effects of year, harvesting intensities and location and also their interaction effects on forage production of *Festuca ovina* were significant at 1% level of probability.

Table 1. Characteristics of the selected sites of semi-steppe region.

Row	Site	Altitude (a.s.l) (m)	Average annual precipitation (mm)
1	Gharebagh	1752	390
2	Firoozkooh	2880	274.5
3	Badamestan	2250	487
4	Ghavan- ban- hersin	2266	472
5	Zaghe	2315	348.5
6	Alamot	1960	578.4
7	Ghorve	2400	584.4
8	Ser	2300	328.3
9	Til Abad	2225	470

Mean comparisons of forage production of *Festuca ovina* in years, locations and different harvesting intensities are presented in Table 3. According to the results, there was significant difference in terms of the mean comparison of the effects of year, harvesting intensities and location on forage production of *Festuca ovina* so that the maximum and minimum forage production were obtained in 2007 and 2008, respectively.

Maximum forage production was obtained at 0% harvesting intensity (control group) and the minimum was obtained at 25 and 75% harvesting intensities, showing no significant difference with

50% . Also, a significant difference was found among the study sites so that the maximum and minimum forage production were recorded for Ghavan- ban- hersin (25.41 g) and Tilabad (1.27 g), respectively.

Mean comparisons of interaction effects of location and different harvesting intensities performed by Duncan test are presented in Table 4. Maximum production was obtained at 0% harvesting intensity at the sites of Ghavan- ban- hersin and Zagheh (33.9 g), and minimum production at 0 and 75% harvesting intensities at the sites of Til Abad(25.50 and 1.26 g, respectively), having no significant difference with each other.

Table 2. Analysis of variance of harvesting intensity, year and location on forage production of *Festuca ovina*.

Source of variations	Degrees of freedom	Mean squares
Location	9	5958.19**
Year	3	8451.44**
Location * Year	26	1832.82**
Error(1)	299	17.76
Harvesting Intensities	3	1000.8**
Location * Harvesting Intensities	27	330.8**
Year * Harveingst Intensities	9	70.77**
Harvesting Intensities * Site * Year	78	122.2**
Error(2)	876	12.8
cv		36.15

Table 3. mean comparisons of forage production of *Festuca ovina* in years, locations and different harvesting intensities.

Treatments	Forage Yield (g)
2007	16.57a
2008	7.3c
2009	8.25b
2010	8.22b
control	11.47a
25%	9.79b
50%	8.8c
75%	9.6b
Ghavan- ban- hersin	25.41a
Zaghe	18.89b
Gharebagh	11.81c
Ghorve	9.65d
Badamestan	8.43e
Alamot	8.3e
Firoozkooh	7.12f
Ser	4.38g
Til Abad	1.27h

Discussion

This study was carried out in selected sites of semi-steppe region including Badamestan (Zanjan), Firoozkooh (Tehran), Gharebagh (West Aazarbaijane), Zaghe (Lorestan), Ghavan- ban- hersin (Kermanshah), Alamot (Ghazvin), Ghorveh (Kordestan), Ser and Til Abad (Gholestan). The results of studies conducted at the sites showed significant differences in terms of production among different years so that the highest production was recorded in 2007 and the lowest in 2008 due to the drought. It means that reduced rainfall decreased the amount of forage production. In general, rainfall and temperature were identified as the first and second limiting factors for the growth of *Festuca ovina*, respectively. This result is consistent with results of

Moghadam (1998), Ghaemi (2001) and Tavakoli *et al.*, (1993). Kooc (2001) in studies on alpine rangelands of Turkey stated that spring and summer drought had no effect on production of legumes while the production of grasses declined under these conditions. Also, under 25 and 50% harvesting intensities the vigority and the height as well as the production and seed yield of the species increased. In contrast, under heavy harvesting intensities, the abovementioned traits decreased. This result is in agreement with the findings of Ghelichnia (1997), reporting that the potential production of rangelands decreased 30% under heavy grazing. On the other hand, heavy harvesting compared to other harvesting intensities would result in further height of reproductive stems of the species.

Table 4. Mean comparison of interaction effects of location, different harvesting intensities and year on forage production of *Festuca ovina*.

Site	Harvesting Intensities	Forage Yield (g)	Duncan Grouping
Zaghe	control	33.9	a
Ghavan- ban- hersin	control	33.04	a
Ghavan- ban- hersin	25%	26.13	b
Zaghe	75%	22.82	bc
Ghavan- ban- hersin	50%	21.33	c
Ghavan- ban- hersin	75%	21.16	c
Zaghe	50%	13.92	d
Gharebagh	control	13.62	de
Gharebagh	25%	12.8	def
Gharebagh	25%	12.7	def
Zaghe	25%	12.44	defg
Gharebagh	50%	11.54	hegdfi
Ghorve	control	10.69	hegdfi
Alamot	control	10.4	hegdfi
Gharebagh	75%	9.27	hegkdjfi
Badamestan	75%	9.01	helgkdjfi
Badamestan	50%	8.98	helgkdjfi
Alamot	25%	8.82	helgkdjfi
Badamestan	25%	8.31	helgkjfi
Ghorve	75%	7.95	hlgkjfi
Firoozkooh	50%	7.77	hlgkjfi
Badamestan	control	7.41	hlgkjfi
Firoozkooh	75%	7.22	hlgkji
Ghorve	50%	7.19	hlgkji
Alamot	50%	7.11	hlgkji
Firoozkooh	control	6.89	hlkji
Alamot	75%	6.89	hlkji
Firoozkooh	25%	6.58	lkji
Ser	control	4.81	lkmj
Ser	25%	4.64	lkmj
Ser	50%	4.26	lkmj
Ser	75%	3.82	lm
Til Abad	75%	1.29	m
Til Abad	50%	1.26	m
Til Abad	control	1.26	m
Til Abad	25%	1.26	m

The number of reproductive stems was affected by rainfall more than any other feature. In fact, the harvesting of grasses in drought years may have significant effect on shoot production while this effect may be not significant in wet years (Zhang and Romo, 1995). There were also statistical significant differences among the study sites so that the maximum production was recorded at Ghavan- ban-hersin site, and minimum production was recorded at Til Abad site. In general, it can be concluded that a

harvesting intensity of 75% for *Festuca ovina* in this vegetative region and similar conditions would result in increased production of *Festuca ovina*.

This result is consistent with the findings of Bedell (2002). According to his results, a harvesting intensity of 65 and 45% was obtained for *Agropyron cristatum*, and shrubs and forbs, respectively. However, this result was contradicted by the findings of Tavakoli *et al.,* (1993), and Kohandel *et al*., (2005) at Savojbelagh region.

No significant differences were recorded for 25 and 50% harvesting intensities in terms of studied traits but a harvesting intensity of 75% negatively affected *Festuca ovina*. Consequently, a harvesting intensity of 25-50% is recommended as the best allowable use for *Festuca ovina* in this vegetative region and other similar areas.

This result is in agreement with the findings of Akbarinia *et al.,* (2003), Sanadghol and Moghaddam (2001) and Holechek *et al*., (2003). In contrast, the results of Gasriiani and Najibzade (2012) showed that the maximum amount of production of *Bromus tomentellus* was obtained at 75% harvesting intensity. Also, the increasing of grazing intensity has resulted in reduction of grasses and shrub species (Kohandel *et al*., 2005).

Acknowledgements

We would like to give special thanks to Baiat, Ahmadi, Rashvand, Zahedi, Abarsaji, Hoseini, Siah mansor, Shoshtari, Mirhaji, for their help.

References

Akbarinia A. 2003. Determining the allowable use of *Bromus tomentellus* in semi-steppe region of Ghazvin province. Iranian Journal of Range and Desert Research **7**, 333-345.

Jaindl RG, Doescher P, Miller RF, Eddleman LE. 1994. Persistence of Idaho fescue on degraded rangelands: Adaptation to defoliation or tolerance. Journal of Range Management **47(1),** 54-59.

Kohandel A, Chaichi M, Arzani H, Mohsenie Saravi M , Zahedi GH. 2005. Effect of different grazing intensities on plant cover composition, and on moisture content, mechanical resistance and infiltration rate of the soils, Savojbolagh rangelands. Journal of the Iranian Natural Resources **59(4),** 1001-1011.

Sanadgol A, Moghaddam MR. 2001. The effects of grazing systems and grazing intensities on standing crop and forage intake in *Bromus tomentellus* pasture. Pajouhesh & Sazandegi **64,** 30-35.

Moghaddam MR. 1998. Range and Range Management, University of Tehran 470 p.

Amiri F. 2007. Multipurpose model for rangeland by using GIS (case study: Ghara aghagh Semirom catchment). Ph.D. thesis, Islamic Azad University, Science and Research Branch, Tehran, Iran.

Arzani H. 2009. Range Analysis (M.Sc. Booklet), Faculty of Natural Resources, University of Tehran.

Beetle AA, Johnson WM, Lang RL, May M, Smith DR. 2002. Effect of grazing intensity on cattle weights and vegetation at the Bighorn Experimental Pastures. University of Wyoming, Agricultural Experiment Station Bulletin 373. Laramie, Wyoming.

Cook CW. 1977. Effects of season and intensity of use on desert vegetation. Utah Agricultural Experiment Station, Utah State University, Logan, Utah. Bulletin 483 -Reprinted March 1977.

Ghaemi MT. 2001. Autecology of *Atriplex verrucifera* in West Azarbaijane Province. Final repor of project. Research Institute of Forests and Rangelands, Iran.

Fazilati A, Hosseini Araghi H. 1965. Country rangelands and management, adjustment and reclamation methods of it, Range engineering office press.

Fulstone F. 2009. Annual operating instruction in Missouri flat allotment for the 2009 grazing season. United States Department of Aagriculture, Forest Services, Humboldt-Toiyabe national forest, file code: 2210.

Ganskopp D. 1988. Defoliation of Thurber needlegrass: herbage and root responses, Journal of Rangemanagement **41(6)**.

Gasriiani F, Najibzadeh M. 2012. Study on the allowable use of important range species in Sahand-East Azarbaijane Province, Research Institute of Forests and Rangelands, Iran.

Gasriiani F, Mohebby A, Zandi Esfahan E. 2013. Determination of allowable use for *Stipa hohenackerian* in semi-steppe rangelands of Iran. Journal of Biodiversity and Environmental Sciences **3 (6),** 1-7.

Gharedaghi H, Fazel Najafaabadi M. 2000. Seasonal changes in carbohydrate reserves in the key plants of Polour area. The second national range and rangelands management conference,Tehran,16-18.

Holechek JL, Cole R, Fisher J, Valdez R. 2003. Natural resources, ecology, economic and policy. Rangelands **26,** 118-223.

Pontes LS, Carrère P, Andueza D, Louault F, Soussana JF. 2007.Seasonal productivity and nutritive value of temperate grasses found in semi-natural pastures in Europe: responses to cutting frequency and N supply, Grass and Forage Science **13,** 485–496

Reece PE, Alexander JD, Johnson JR. 2001. Drought management on range and pastureland, a handbook for Nebraska and South Dakota, Director of Cooperative Extension, University of Nebraska, Institute of Agriculture and Natural Resources.

Smith MV. 2007. Effect of stocking rate and grazing management on the persistence and production on dry land on deep sands. Proc. Int. Grassland Cong. **9**, 624-628.

Smith L, Ruyle G, Maynard J, Barker S. 2007. Principles of obtaining and interpreting utilization data on rangelands, The University of Arizona Cooperative Extension.

Tavakoli H, Hodgson J, Kemp PD. 1993. Responses to defoliation of tall fescue. Proceedings of the XVII International Grassland Congress.

Zhao w, Chen SP, Lin GH. 2007. Compensatory growth responses to clipping defoliation in *Leymus chinensis* (Poaceae) under nutrient addition and water deficiency conditions. Plant Ecology http://dx.doi.org/10.1007/s11258-007-9336-3.