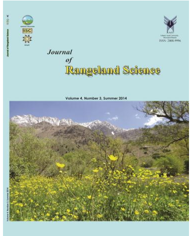
Contents available at ISC and SID

Journal homepage: www.rangeland.ir



Full Length Article:

Studying Varieties and Relationships of Yield and Quality Traits in Tall Wheatgrass (*Agropyron elongatum*) under Two Cutting Management Procedures

Ata Elmi[A], Ali Ashraf Jafari[B], Amin Farnia[C], Mohammad Bakhtiari[D]

[A]M.Sc. Graduated, Islamic Azad University, Boroujerd Branch, Boroujerd, Iran
[B]Professor, Research Institute of Forests and Rangelands, Tehran, Iran (Corresponding Author), Email: aajafari@rifr-ac.ir
[C]Assist Prof., Islamic Azad University, Boroujerd Branch, Boroujerd, Iran
[D]M.Sc. Research Institute of Forests and Rangelands, Tehran, Iran

Received on: 22/04/2014
Accepted on: 15/07/2014

Abstract. The objectives of this research were to study the varieties and relationships of yield and quality traits under two harvesting management procedures concerning forage dry matter (DM yield) and 5 quality traits such as Dry Matter Digestibility (DMD%), Water Soluble Carbohydrates (WSC%), Crude Protein (CP%), Acid Detergent Fibre (ADF%) and total ash in tall wheatgrass (*Agropyron elongatum*). In this study, 17 genotypes were examined in two separate experiments for conservation (1 cut per year) and frequent cutting management procedures (2 cuts per year) in a dry land farming system over three years (2006-2009) in Damavand rangelands, Iran. Results suggested that two cut management procedures resulted in lower yield with high quality. The means of annual DM yield were 1482 and 3053 kg ha^{-1} for two and one cutting management procedures. Considering the conservation management, the CP and DMD were decreased in the opposite direction to DM yield, WSC and ADF. The local population of 774M (Takestan) with the means of 1740 and 3837 Kg ha^{-1} for DM yield had a higher production for 2 and 1 cut management procedures, respectively. DM yield was positively correlated with total ash in frequent cutting. DMD was negatively correlated with ADF in both management procedures and positively correlated with CP in frequent cutting. Results of Principle Component Analysis (PCA) showed that the first three components were accounted for 78 and 82% of the total variety for the conservation and frequent cutting, respectively. In both management procedures, DMD and ADF in the PC1 were identified as the important traits. Using Ward cluster method, 17 genotypes were grouped into 3 clusters. For the conservation management, the genotypes in cluster 3 and for frequent cutting, genotypes in cluster 2 coupled with the quality traits had higher productivity.

Key words: Tall wheatgrass (*Agropyron elongatum*), Cutting management procedures, Yield, Quality traits

Introduction

Iran covers 165 million hectares of which about 90 million ha (54.5%) is rangelands (Anonymous, 1999). About 14 million ha is in the cooler high altitude regions in the country. They are grazed during spring and summer and their vegetation cover is generally a combination of soft herbs and grass species. These rangelands have fairly good conditions. About 60 and 16 million ha are shrub dominant, winter grazing and desert areas, respectively (Anonymous, 1999). Due to harsh climatic factors and over grazing, the rangelands with the shrub dominance and desert areas are not in good conditions. Also, in herb dominant areas during a long period, shifting cultivation within the rangelands leads to the increased soil erosion while decreasing the perennial component of the vegetation. This has occurred without obtaining viable crop yields while forcing the farmers to abandon such lower vegetative and eroded areas. Therefore, sowing the seeds of adaptable range species (grass and legumes) will be an integral part of the country ranges' rehabilitation.

Tall wheatgrass (*Agropyron elongatum* (Host) P. Beauv.) is an important cool-season grass that is used for range improvement in Iran. It is well adapted to steppe or semi steppe regions in Iran. It is used for pasture, hay and erosion control. It is native to the Eastern Mediterranean areas (Darbyshire, 1997). Tall wheatgrass can survive under dry land conditions and alkaline soils with a pH of 7.5-9 (Roundy, 1985; Undersander and Naylor, 1987). Tall wheatgrass could persist in soils with Electrical Conductivity (EC) of 26 mm hos/cm (Ogle *et al.,* 2008).

Because of its late maturing characteristics, tall wheatgrass provides a long grazing period (USDA, 2005). Tall wheatgrass is most palatable during the early spring months. As the grass matures, its nutrient value rapidly declines (Cohen *et al.,* 1991). If the grass is not well managed, old coarse growth may inhibit the grazing for the following year. So, it must be heavily grazed to maintain the plants in the vegetative state and prevent becoming stemmy in the late stage of maturity (Cohen *et al.,* 1991; Undersander and Naylor, 1987). However, this species does not tolerate continuous close grazing and a rest period is required between grazing events (USDA, 2005). In a study to determine the influences of clipping frequency on yield, Undersander and Naylor (1987) found the highest yields of tall wheatgrass when it was clipped at 4 week intervals (USDA, 2005).

In Iran, the semi-arid rangelands cover the majority of the terrestrial areas. Badripour *et al.* (2006) estimated that 55% of the Iranian land may be occupied by the rangelands. Sheep and goats are the vital sources of income for the rural population through the production of meat, milk, and wool. The main sources of forage for sheep and goats are the natural pastures provided by the extensive rangelands, cereal straw and stubble grazing. Forage grass species are the major components of rangelands. The most importance traits of tall wheatgrass are drought tolerance and higher forage production (Jafari *et al.,* 2014). However, little is known about the yields of herbage and quality of the promising accessions under on-farm conditions. Such data are needed to select the accessions for the animal feeding studies and subsequent integration into the dry land farming systems. The objective of this work was to study the pattern of variety of yield and quality traits in 17 locally collected populations of tall wheatgrass under two cutting systems (1 and 2 cuts/year).

Materials and Methods

Case study

The present research study was carried out in Homand Absard rangeland station that is located in southern slope of

Damavand mount in Alborz Mountains (35°40′ N 52°05′ E) 1960 m above sea level (70 Km in the east of Tehran in Iran). The rainiest month is March with the rainfall of 51.4 mm. The mean annual rainfall is 338 mm and the mean annual temperature is 10.1 °C. The maximum temperature is 22.8 °C in August and minimum temperature is -3.2 °C in January. The climate of this region using Emberger method is cold sub-steppe. The results of soil analyses showed plenty of limy layers in the depth of 80-100 cm. The soil texture was generally clay loamy to silt clay loamy with the alkaline pH= 7.7. The available nutrients of the soil except potash were generally low and the soil had no salinity problem (Shakoi *et al.,* 2005).

Experimental design and management

The genotypes utilized in this study were derived from Iranian natural resource gene bank. They were collected from the slopes of Alborz in the north and Zagros in the west of country. The 17 genotypes, four from Qazvin province (774m, $774p_4$, $774p_7$, $774p_{15}$), four from west Azerbaijan (1360m, $1360P_8$, 1755m, $1755p_4$), four from east Azerbaijan (240m, $240p_{15}$, 685m, $685p_{11}$) and 5 genotypes from Tehran province (301m, $301p_1$, $301p_8$, $301p_{13}$, $301p_{14}$) were sown under dense sward conditions.

Two separate experiments were done in October 2005. Seeds were sown in four drilled lines as long as 2 meters with 50 cm distance in sward conditions using a completely randomized block design with three replications. During the establishment year, the plots were cut one time, but no measurements were taken. No irrigation was made during these experiments. Fertilizer was applied as 100 Kg ha^{-1} phosphorus (P_2O_5) and 50 Kg ha^{-1} nitrogen (N) in the establishment year. 50 Kg ha^{-1} nitrogen was also applied for three successive years in Mid-March.

Sampling for yield and quality traits

Cutting management procedures were based on the growth seasons. The growth season started from mid-March and continued to Mid-June. So for frequent cutting, only 2 cuts were harvested: cut 1 in booting stage (early May) and a regrowth cut by 45 day intervals in Mid-July. For the conservation management, only one cut was harvested at the pollination stage. Since there was a drought period during summer and autumn for both experiments, there was no regrowth cut in both trials.

Forage yield (fresh weight) was determined by cutting each plot at the height of 5 cm immediately after cutting and the fresh yield of each plot was sub-sampled. These samples were air dried and then placed in an oven at the temperature of 100 °C overnight and DM % was estimated from the fresh yield. Measurement of quality parameters was done in the first cut of both management procedures. To estimate the quality traits, a second sub-sample was taken from each plot following the above cut. These samples were dried at 70 °C for 24 hr and ground to pass through a 1-mm screen mill. The samples were evaluated for DMD, WSC, CP, ADF, and total ash using near infrared spectroscopy (NIR). Details of the methodology and calibrations of NIR were given by Jafari *et al.* (2003b).

Statistical analysis

Data for each cutting management procedures were separately analyzed using the GLM uni-variable method (SAS, 2004). Duncan test was used to determine the superior lines. Phenotypic correlations among the characteristics were estimated for all pair-wise combinations. All of the variables were used in Principal Component Analysis (PCA) and cluster analysis. The variables were standardized for the cluster analysis

(Ward method). The Minitab 16 (2012) was used for multivariate analysis.

Results

Means comparisons of genotypes

Results of analysis of variance showed the significant effects of populations for WSC, CP and ADF ($P \leq 0.05$) in frequent cutting and DMD, WSC and ADF ($P \leq 0.01$) for DM yield in the conservation management, respectively. There was a range of DM yield as 1181 to 1740 Kg ha^{-1} for frequent cutting and 2086 to 3837 Kg ha^{-1} for conservation management, respectively (Table 1). The genotype means were compared using DMRT method. The results for frequent cutting management procedures showed that genotypes 240 m, 1360 p_8 and 774 m with the average values of 1662 to 1740 Kg ha^{-1} and for conservation management, the genotypes 774 m, 774 p_7, 301 p_8, 301 p_{14} and 240 p_{15} with the average values of 3591 to 3837 Kg ha^{-1} had higher forage DM productions (Table 1). The genotypes 774 m, 774 p7, 301 p_8, 301 p_{14}, 240 p_{15} and 685 m with the average values of 2400 to 2788 Kg ha^{-1} had higher DM yields in both management procedures (Table 1). The local genotype 774 m (Takestan) with the average values of 1740 and 3837 Kg ha^{-1} DM yield had higher productions for frequent cutting and conservation management procedures, respectively. 240 M (Tabriz), 301 P_{14} (Alborz) and 774 m (Takestan) had higher values for both yield and quality traits for frequent cutting, conservation and means of both management procedures, respectively (Table 1).

The average values for yield and five quality components for each management procedure are quoted in the last rows of (Table 1). For frequent cutting and conservation management procedures, the obtained average values were as follows: for the annual DM yield (1482 and 3053 Kg ha^{-1}), DMD (42.88 and 38.79%), WSC (10.37 and 13.81%), CP (7.96 and 4.86%), ADF (43.17 and 45.23) and total ash (7.02 and 4.67), respectively. Results suggested that frequent cutting management procedures resulted in a lower yield with high quality.

Relationships between yield and quality traits

DM yield was positively correlated with the total ash in frequent cutting. DMD was negatively correlated with ADF in both management procedures and positively correlated with CP in frequent cutting. WSC was negatively correlated with the total ash in conservation management procedure. CP was positively correlated with ADF in conservation management procedure (Table 2).

Table 1. Means of DM yield and quality traits in 17 genotypes of tall wreath grass for two cutting management procedures over three years

Entry	DM yield				DMD%				WSC%				CP%				ADF%				ASH%			
	Frequent		Conservation		Frequent		Conservation		Frequent		Conservation		Frequent		Conservation		Frequent		Conservation		Frequent		Conservation	
1360m	1504	abc	2975	cd	42.24	cde	38.29	b-e	10.35	bcd	13.48	cd	8.38	ab	5.10	abc	44.42	a	46.12	ab	7.00	ab	4.71	ab
1360p$_8$	1674	ab	2921	cd	43.44	abc	38.76	a-e	10.09	cde	14.11	abc	8.53	a	4.56	de	42.60	cde	45.13	bcd	7.08	abc	4.63	ab
1755m	1364	c-f	2365	ef	43.16	a-d	39.33	abc	10.47	bc	13.75	bcd	7.34	f	5.03	abc	43.00	bcd	44.98	cde	6.88	bc	4.85	a
1755p$_4$	1181	f	3274	bc	43.03	a-e	39.70	a	10.55	bc	13.99	abc	8.07	a-d	4.48	e	42.61	cde	44.05	e	6.75	c	4.71	ab
240m	1662	ab	2086	f	42.29	cde	38.04	de	9.57	e	13.68	bcd	7.96	b-e	4.83	b-e	44.19	ab	46.13	ab	7.31	a	4.65	ab
240p$_{15}$	1243	def	3636	ab	43.26	abc	38.19	cde	11.15	a	13.76	bcd	7.98	a-e	4.71	cde	42.76	cde	45.89	abc	6.96	abc	4.77	ab
301m	1523	abc	2412	ef	43.41	abc	39.01	a-d	10.38	bcd	13.07	d	8.33	ab	4.56	de	42.77	cde	44.60	de	7.13	abc	4.76	ab
301p$_1$	1473	bcd	2748	de	44.13	a	39.52	ab	10.19	cd	13.75	bcd	8.20	abc	4.99	abc	42.10	de	44.73	de	7.12	abc	4.76	ab
301p$_{13}$	1579	abc	2380	ef	41.79	e	39.42	abc	10.87	ab	14.04	abc	7.48	ef	4.87	a-e	44.05	ab	45.07	cde	6.96	abc	4.33	c
301p$_{14}$	1223	ef	3817	a	43.24	abc	38.96	a-d	10.57	abc	13.68	bcd	8.02	a-e	5.09	abc	42.96	bcd	44.73	de	6.87	bc	4.74	ab
301p$_8$	1434	b-e	3614	ab	41.82	de	37.95	de	9.82	de	14.33	ab	7.56	df	4.58	de	43.55	abc	45.30	a-d	6.99	abc	4.47	bc
685m	1556	abc	3291	bc	43.12	a-e	38.27	b-e	10.86	ab	13.82	bc	7.96	b-d	5.18	ab	42.91	b-e	45.76	abc	6.97	abc	4.63	ab
685p$_{11}$	1561	abc	2859	cd	42.64	b-e	39.11	a-d	10.20	cd	14.59	a	8.04	a-e	5.00	abc	43.51	abc	45.10	cd	6.78	c	4.46	bc
774m	1740	a	3837	a	43.89	ab	39.42	abc	10.25	cd	13.57	cd	7.96	b-e	4.98	abc	41.67	e	44.65	de	7.17	ab	4.53	bc
774p$_{15}$	1353	c-f	3044	cd	42.82	a-e	38.08	de	10.04	cde	13.66	bcd	7.91	b-e	4.90	a-d	43.34	a-d	46.31	a	6.97	abc	4.93	a
774p$_4$	1578	abc	3054	cd	41.85	de	37.69	e	10.41	bcd	13.44	cd	7.72	c-f	5.28	a	44.13	ab	45.94	abc	7.10	abc	4.65	ab
774p$_7$	1548	abc	3591	ab	42.85	a-e	39.73	a	10.58	abc	13.98	abc	7.87	b-f	4.54	d	43.31	a-d	44.48	de	7.32	a	4.74	ab
Mean	1482		3053		42.88		38.79		10.37		13.81		7.96		4.86		43.17		45.23		7.02		4.67	

Means followed by the same letters in each column are not significantly different ($P<0.05$)

Table 2. Correlation analysis of DM yield and quality components in 17 genotypes of tall wheatgrass under conservation and frequent cutting management procedures

Traits	Managements	DM Yield	DMD%	WSC%	CP%	ADF%
DMD%	Conservation	-0.01				
	Frequent Cutting	-0.09				
WSC%	Conservation	0.15	0.17			
	Frequent Cutting	-0.37	0.13			
CP%	Conservation	-0.05	-0.29	-0.23		
	Frequent Cutting	0.13	0.46*	-0.14		
ADF%	Conservation	-0.18	-0.87**	-0.16	0.45*	
	Frequent Cutting	0.10	-0.91*	-0.16	-0.26	
ASH%	Conservation	0.01	-0.07	-0.52*	-0.01	0.12
	Frequent Cutting	0.63**	0.06	-0.34	0.14	0.04

*significant at the 0.05 probability level, ** significant at the 0.01 probability level

Classification of genotypes

Results of Principal Component Analysis (PCA) showed that the first three components were accounted for 78 and 82% of the total variety for conservation and frequent cutting procedures, respectively. In both management procedures, DMD and ADF in the PC1 were identified as the important traits. In conservation management procedure, WSC and ash in the opposite direction in PC2 and DM yield in the PC3 were important traits. In frequent cutting management procedure, DM yield, WSC and ash in PC2 and WSC and CP in the opposite direction in the PC3 had higher coefficients (Table 3).

Using Ward cluster method, the 17 genotypes of tall wheatgrass were grouped into 3 clusters for the conservation (Fig. 1) and frequent cutting management procedures (Fig. 2). For conservation management procedure, the genotypes in cluster1 had a moderate yield with lower values for both DMD and WSC (Fig. 1). The genotypes in cluster 3 with quality traits had a higher productivity (Table 4 and Fig. 1). In frequent cutting management procedure, the genotypes in cluster1 had a high productivity with lower quality. In contrast, the genotypes in cluster 3 with higher quality traits had a lower productivity. The genotypes in cluster 2 with quality traits had a higher productivity (Table 4 and Fig. 2).

Distribution of accessions based on the first two principal component scores was in agreement with the cluster analysis for both cutting management procedures (Figs. 3 and 4).

Table 3. Matrices of coefficients for Eigen vectors and variance proportion from the first three principal component axes in 17 genotypes of tall wheatgrass under conservation and frequent cutting management procedures

Variable	Conservation			Frequent Cutting		
	PC1	PC2	PC3	PC1	PC2	PC3
DM yield	0.13	-0.10	**<u>0.95</u>**	-0.18	**<u>0.58</u>**	-0.30
DMD%	**0.56**	0.28	-0.19	**<u>0.65</u>**	0.15	-0.10
WSC%	0.33	**<u>-0.61</u>**	0.03	0.21	**<u>-0.44</u>**	**<u>-0.51</u>**
CP%	**<u>-0.40</u>**	-0.13	-0.05	0.33	0.32	**<u>0.66</u>**
ADF%	**<u>-0.60</u>**	-0.26	0.00	**<u>-0.62</u>**	-0.08	0.24
ASH%	-0.22	**<u>0.67</u>**	0.23	-0.10	**<u>0.59</u>**	-0.39
Eigen value	2.27	1.40	1.01	2.17	1.96	0.80
Proportion	0.38	0.23	0.17	0.36	0.33	0.13
Cumulative	0.38	0.61	0.78	0.36	0.69	0.82

The bold and underline coefficients have significant correlation with the relevant axes

Table 4. Mean comparisons of 3 clusters for the traits used in classification for conservation and frequent cutting management procedures

Managements	Clusters	DM	DMD%	WSC%	CP%	ADF%	ASH%
Conservation	1	3014 a	38.09 b	13.64 b	5.00 a	46.03 a	4.72 a
	2	2944 a	38.81 a	14.27 a	4.75 a	45.15 b	4.47 b
	3	3149 a	39.38 a	13.68 b	4.81 a	44.60 c	4.73 a
Frequent Cutting	1	1509 a	42.38 b	10.26 b	7.81 b	43.72 a	7.03 a
	2	1603 a	43.72 a	10.23 b	8.26 a	42.29 b	7.13 a
	3	1301 b	43.16 a	10.78 a	8.01 ab	42.8 b1	6.89 a

The means of the column within two management procedures with the same letters were not significantly different (P<0.05)

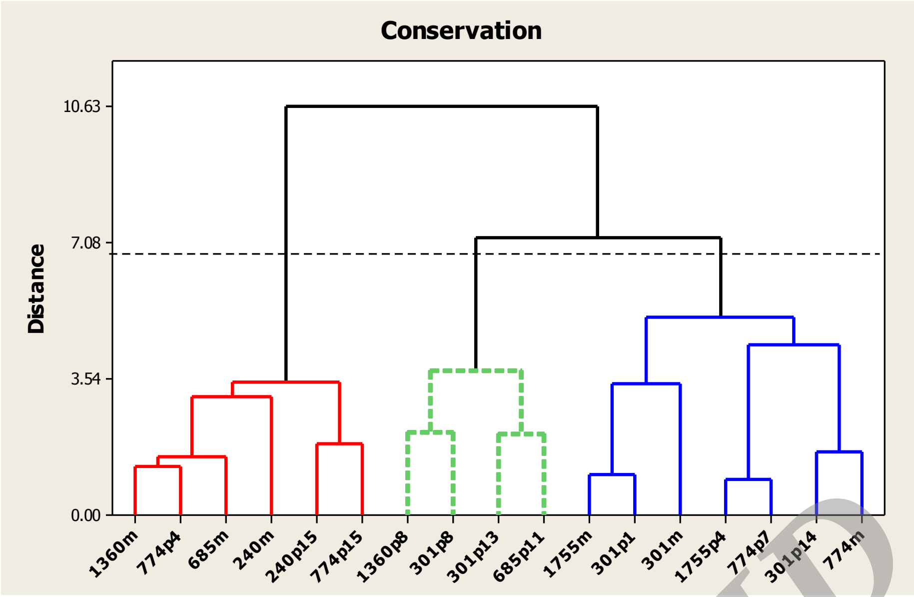


Fig. 1. Dendrogram with ward linkage and Euclidean distance in conservation management procedures

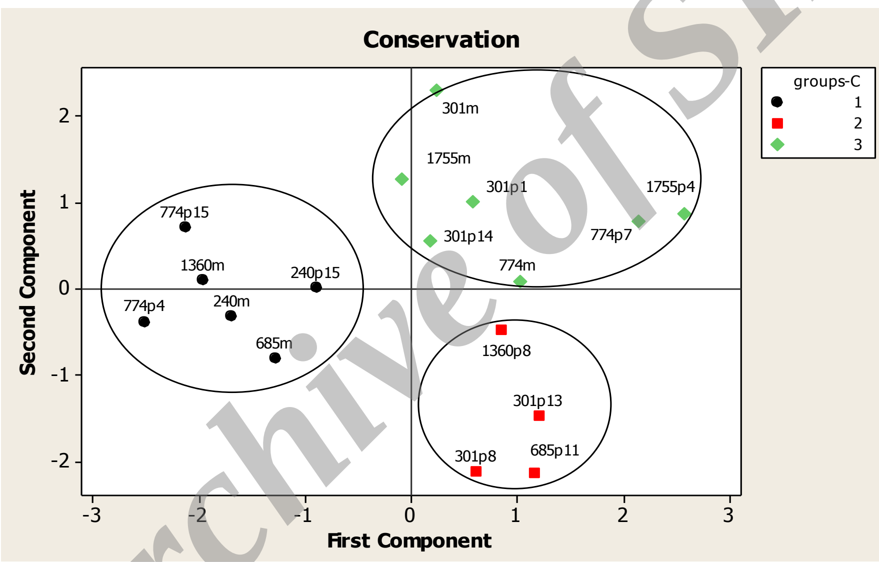


Fig. 2. Scatter plot of 17 genotypes and 3 clusters for the first two principal components in conservation management procedures

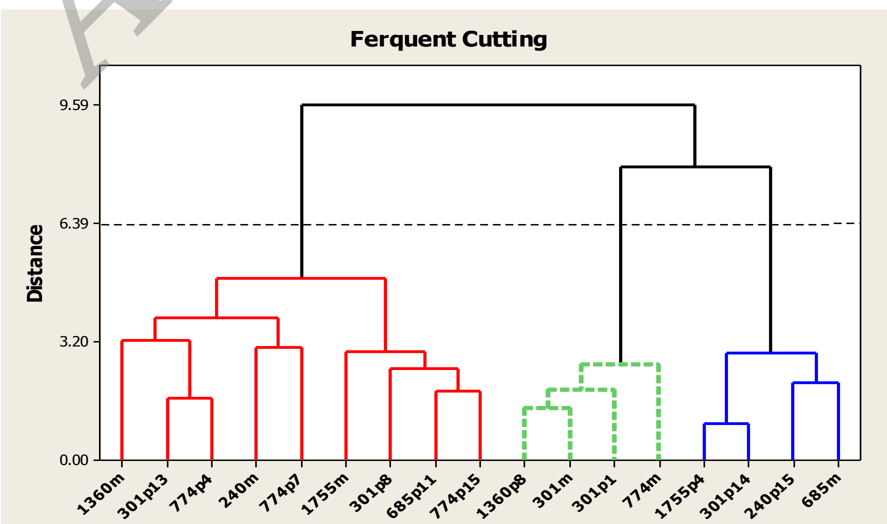


Fig. 3. Dendrogram with ward linkage and Euclidean distance in frequent cutting management procedures

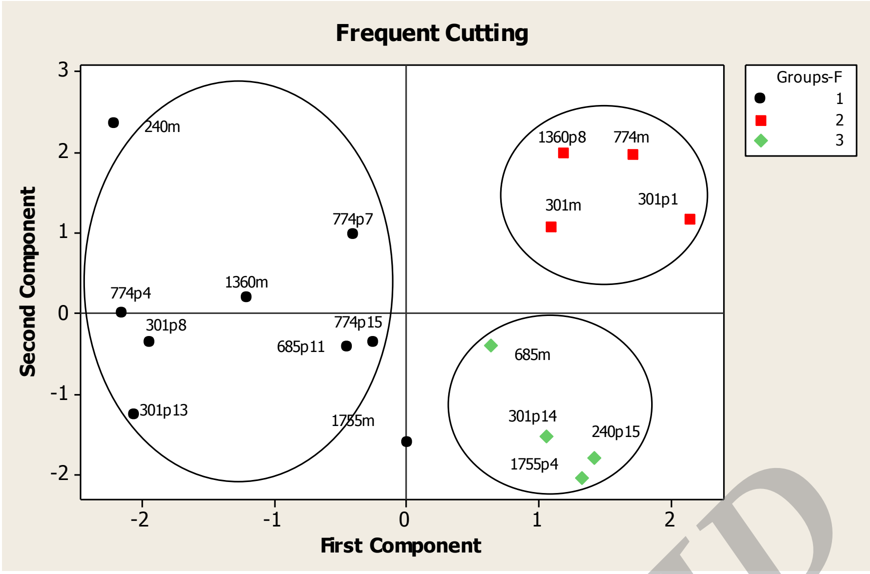


Fig. 4. Scatter plot of 17 genotypes and 3 clusters for the first two principal components in frequent cutting management procedures

Discussion and Conclusion

There was a range of DM yield as 1181 to 1740 Kg ha^{-1} for frequent cutting and 2086 to 3837 Kg ha^{-1} for conservation management procedures, respectively (Table 1). There are various published data showing that the maturity stage can affect both yield and quality traits (Buxton *et al.*, 1996; Belanger and McQueen, 1997; Jafari *et al.*, 2003a). Results suggested that frequent cutting management procedures resulted in a lower yield with high quality. In similar results, Mut *et al.* (2006) in the evaluation of forage of triticale in two phonological stages found 43% higher DM yield in milky-dough stage than the early heading one. Overall means of DMD, CP and total ash over years were lower for conservation as compared to frequent cutting management procedure. This result was in agreement with the finding of Chestnutt *et al.* (1977), Wilkins (1997) and Jafari *et al.* (2003a). In contrast, the mean of WSC was higher for conservation management procedure. This can be explained by higher stem/leaf ratio in conservation management procedures. McGrath (1988) reported that WSC content was at least 50% higher in stem than leaf.

Herbage yield and quality of tall wheatgrass varied under on-farm conditions in the dry land farming system with semi-steppe environment in Iran and they could be used to select tall wheatgrass accessions for herbage production. The overall means of all of genotypes with the values of annual DM yield (1482 and 3053 Kg ha^{-1}), DMD (42.88 and 38.79%), WSC (10.37 and 13.81%) and CP (7.96 and 4.86%) were obtained for frequent cutting and conservation procedures, respectively. The local genotype 774 m (Takestan) with the average values of 1740 and 3837 Kg ha^{-1} DM yield had higher production for frequent cutting and conservation management procedures, respectively. Selection in drought conditions should focus on the increased DM yield and quality traits.

On the basis of presented results, it is suggested that for wheatgrass pasture grazing, delay in spring grazing preferably in booting stage would improve herbage DM yield and quality in semi-steppe regions of Iran. If the aim is to have silage or winter hay, it is suggested to cut the pasture in the early stage of ear emergence to keep herbage quantity and quality at maximum level.

Literature Cited

Anonymous, 1999. The rangelands of Iran, proceeding of IRAN-UNEP-FAO initiative. Low Forest Cover Country (LFCC) meeting 4-8 Oct. Tehran, Iran

Badripour, H., Eskandari, N. and Rezaei, S. A., 2006. "Rangelands of Iran, an overview". Published by ministry of Jihad-e-Agriculture, forest range and watershed management organization, technical office of rangeland, Tehran, Iran, Pooneh, (http://www.fao.org/ag/AGP/AGPC/doc/Counprof/Iran/Iran.htm).

Belanger, G. and McQueen, R. E., 1997. Leaf and stem nutritive value of timothy cultivars differing in maturity. *Can. Jour. Plant Sci.,* 77: 237-245.

Buxton, D. R., Mertens, D. R. and Fisher, D. S., 1996. Forage quality and ruminant utilisation. In: "Cool-season forage grasses" (eds. Moser *et al*.,) ASA, CSSA, and SSSA, Madison, USA pages 229-266.

Chestnutt, J. C., Murdoch, J. C., Harrington, F. J. and Binnie, R. C., 1977. The effect of cutting frequency and applied nitrogen on production and digestibility of perennial ryegrass. *Jour. British Grass. Soci.,* 32: 177-183.

Cohen, R. D. H., Kernan, J. A., Cruise, K. A., Coxworth, E. C. and Knipfel, G. E., 1991. The effect of ammoniation of the nutritive value of tall wheatgrass. *Can. Jour. Plant Sci.*, 71: 867-870.

Darbyshire, S. J., 1997. Tall wheatgrass, *Elymus elongatus* subsp. *ponticus*, in Nova Scotia. *Rodera*, 99:161-165.

Jafari, A., Connolly, V. and Walsh, E. J., 2003a. Genetic analysis of yield and quality in full sib families of perennial ryegrass (*Lolium perenne* L.) under two cutting managements. *Irish Jour. Agric. Food Res.,* 42: 275–292. (In Persian).

Jafari, A., Connolly V., Frolich, A. and Walsh, E. J., 2003b. A note on estimation of quality parameters in perennial ryegrass by near infrared reflectance spectroscopy. Irish J. Agric. *Food Res.,* 42: 293–299. (In Persian).

Jafari, A., Elmi, A. and Bakhtiari, M., 2014. Evaluation of yield and quality traits in 17 populations of tall wheatgrass (*Agropyron elongatum*) grown in rain fed area of Iran, under two cutting management, Romania Romanian Agricultural Research, 31: 1-10. (In Persian).

McGrath, D., 1988. Seasonal variation in the water-soluble carbohydrates of perennial and Italian ryegrass under cutting conditions. *Irish Jour. Agric. Food Res.,* 27: 131-139.

Minitab 16, 2012. Minitab Inc. Quality Plaza, 1829 Pine Hall Rd. State College PA 16801-3210, USA.

Mut, Z., Ayan l. and Mut, H., 2006. Evaluation of forage yield and quality at two phonological stages of triticale genotypes and other cereals grown under rain fed conditions. *Bangladesh Jour. Bot.*, 35: 45-53.

Ogle, D., Majerus, M. and John. L. St., 2008. Plants for saline to sodic soil conditions. Plant Materials Tech Note No. 9. USDA NRCS, Boise, Idaho.

Roundy, B. A., 1985. Root penetration and shoot elongation of tall wheatgrass and basin wild rye in relation to salinity. *Can. Jour. Plant Sci.*, 65: 335-343.

SAS, 2004. SAS 9.1.3 software, Cary, NC: SAS Institute Inc., USA.

Shakoi, M., Abasi, H. R., Aliha, M., 2005. Soil formation and development in Homand range research station, Iranian *Jour. Range and Desert Research*, 12(4); 377-394. (In Persian).

Undersander, D. J. and Naylor, C. H., 1987. Influence of clipping frequency on herbage yield and nutrient content of tall wheatgrass. *Jour. Range Manage*, 40:31-35.

USDA ARS, 2005. Intermountain planting guide. Publication No. AG 510. Forage and Range Research Lab, Logan, Utah, and Utah State University Extension. 107 pp.

Wilkins, P. W., 1997. Useful variation in *In vitro* digestibility within perennial ryegrass. *Euphytica*, 93: 249-255.

بررسی تنوع و روابط بین عملکرد و کیفیت علوفه در علف گندمی بلند (*Agropyron elongatum*) در دو مدیریت برداشت علوفه

عطا علمی[الف]، علی اشرف جعفری[ب]، امین فرنیا[ج] ، محمد بختیاری[د]

[الف]دانش آموخته کارشناسی ارشد زراعت، دانشگاه آزاد اسلامی بروجرد
[ب] استاد موسسه تحقیقات جنگل ها و مراتع کشور (نگارنده مسئول)، پست الکترونیک: aajafari@rifr-ac.ir
[ج] استادیار دانشگاه آزاد اسلامی، واحد بروجرد
[د] کارشناس ارشد موسسه تحقیقات جنگل ها و مراتع کشور

چکیده. هدف از این تحقیق بررسی تنوع و روابط بین عملکرد و صفات کیفی علوفه در دو شرایط بهره‌برداری یک چین حفاظت شده و دو چین (مشابه چرای دام) بوده است. در این آزمایش ۱۷ ژنوتیپ علف گندمی بلند ***Agropyron elongatum*** در برداشت یک چین و دو چین درسال در ایستگاه همند آبسرد (دماوند) به مدت سه سال (۱۳۸۵ لغایت ۱۳۸۷) در شرایط دیم مورد ارزیابی قرار گرفتند. در برداشت یک چین در مرحله گرده افشانی گیاه و در برداشت دو چین علوفه در مرحله شروع ساقه‌دهی علوفه برداشت گردید. نتایج نشان داد که در برداشت دو چین عملکرد علوفه کمتر ولی کیفیت آن بهتر بود میانگین عملکرد علوفه خشک در مدیریت یک چین و دو چین به ترتیب ۳۱۹۰ و ۲۱۴۳ کیلوگرم در هکتار بود. به منظور افزایش عملکرد و جلوگیری از کاهش کیفیت علوفه پیشنهاد گردید تا گیاه در مرحله ظهور خوشه برداشت گردد. ژنوتیپ ۷۷۴ متر (تاکستان) با عملکرد ۱۷۴۰ و ۳۸۳۷ کیلوگرم در هکتار بیشترین تولید علوفه به ترتیب در برداشت دو چین و یک چین داشت. همبستگی بین عملکرد علوفه با درصد خاکستر مثبت و معنی دار و همبستگی بین قابلیت هضم و درصد پروتئین مثبت و بین قابلیت هضم با درصد ADF منفی و معنی‌دار بود. نتایج تجزیه به مولفه‌های اصلی نشان داد که سه مولفه اصلی اول به ترتیب ۷۸ و ۸۲ درصد تغییرات کل را به ترتیب در مدیریت برداشت یک چین و دو چین توجیه نمودند. در هر دو روش قابلیت هضم و درصد ADF در مولف اصلی اول از صفات مهم بودند. با استفاده از تجزیه خوشه‌ای به روش وارد ۱۷ ژنوتیپ در سه گروه قرار گرفتند. در مدیریت برداشت یک چین ژنوتیپ‌های کلاستر ۳ و در مدیریت برداشت دو چین ژنوتیپ های کلاستر۲ علاوه بر کیفیت بهتر علوفه از عملکرد بالایی نیز برخوردار بودند.

کلمات کلیدی: علف گندمی بلند ***Agropyron elongatum***، مدیریت برداشت، عملکرد، کیفیت علوفه