

The study of Forage Quality of *Smirnovia iranica* In Different phonological stages in sandy areas-case-study: Band-e-Rig-Kashan

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(Received 19 July 2005, Accepted 20 Feb. 2006)

Abstract

Smirnovia iranica, a native valuable woody species from *Fabaceae*, is an adaptable plant of central sandy areas of Iran. On other hand, this species could be markedly considered from different view points of forage production, soil conservation and medicinal applications.

The current research was carried out in Band-e-Rig of Kashan, Iran to evaluate *Smirnovia iranica* properties including crude protein (c.p), NDF, ADF, P, K, ME and DMD in different phonological stages in order to find its forage quality for livestock nutrition. The result of chemicals analysis indicates that there is a significant difference among different phonological stages of *S.iranica* in terms of its properties. As the plant age is increased, c.p, ME and DMD are decreased while NDF and ADF are increased. This leads to reduction of *S.iranica* forage quality, since there is not significant difference between flowering and growth stages in view point of their c.p, ME, DMD, NDF and ADF, also according to increase of P and K in flowering stage, it seems that this stage could be considered as favorable time for *S.iranica* utilization by livestock.

Key words: Forage quality, growth stages, *Smirnovia iranica*, Band-e-Rig, Kashan, Iran

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Introduction

Understanding the nutrient content of a plant body will be a useful way for determining rangeland capacity, the most proper time of utilization of range plants, prediction of malnutrition and evaluation of nutrition requirements of plants. In order to optimum utilization of rangelands, it is necessary to consider temporal variation of forage quality. For determining forage quality, different variables are evaluated. Korouri et al (1982) studied crude ash, organic matter, N, Na, K, Ca, P and Mg in some range plant species. Safaian and Shokri (1996) also studied crude protein, Ca and P in order to determine nutritious value of range plants. Mc Donald (1998) studied some grass species and concluded a reverse relation between protein and fiber of a given species. Zohdi (2001) compared the quality of plant organs in different growth periods in five range plant species and found a significant difference between the quality of plant organs and phenologic stages. Plants of arid and dry land regions are valuable species due to their resistance to humid deficiency, high temperature and salinity, lack of organic matter content, wind and water erosion. Therefore plant associations of such regions are special species. *Smirnovia iranica* is one of the valuable shrub species with high resistance to dry condition and only appears on sand dunes. The plant is important for forage

production, soil conservation and medicinal values (Sabeti, 1994).

Current research attempts to determine P, K, crude protein, NDF, ADF, metabolic energy, percentage of digestible dry matter of *Smirnovia iranica* in different phenologic stages to find the most appropriate time of utilization and nutrient variation.

Materials and methods

Studied area

The study area covers Band-e-Rig border and the surrounding sand dunes located in south of Namak lake, 70 km NE of Kashan extended to 55 km SE of the city. The region is in 33°45' to 34°38' N latitudes and 51°53' to 52°51' E longitudes. The annual average precipitation based on 30 years record is 133 mm which shows uneven distribution in the form of storms. The region lies between 1600-2800 iso-potential evaporation lines and according to umbrothermic diagram, the study area has 9 dry months annually. The region is mostly placed between 15-17.5° iso-temperature lines. Also, the climate of this region is extremely warm with dry summers.

Methodology of research

First, vegetative zones of *S.iranica* species were determined. Then, four areas with long distances from each other were selected for sampling purposes with five replications and at least 15 shrubs. The

sampling points were recorded to be tested in other seasons in three stages including:

- 1- Vegetative growth stage (before flowering)
- 2- Flowering stage
- 3- Seed ripening and fruiting stage

Furthermore, the seeds were separately sampled. Kjeldal method was used for measuring Nitrogen content of the plant. Phosphorous and Potassium were measured using spectrophotometer and flame photometry techniques, respectively. Measurements of cell walls except hemi cellulose (ADF) and cell wall (NDF) was done based on the guidelines of AOAC (1990) using Fibertec device. The formula proposed by Oddy et al (1983) was used for measuring digestible dry matter (DMD) while metabolic energy (ME) was measured using the equations proposed by the US Agricultural Standard Committee (1990). Factorial method was used to determine the variation of nutrients in different phenologic stages using Excel and SPSS. Duncan method was also used for comparison and grouping of nutrients.

Results and Discussion

Based on the comparison of nutrient mean content (table 1) the following results are suggested:

- Crude protein: the results showed that there is a significant difference in protein content among growth stages. The highest protein content was 18.41% in vegetative growth stage and the lowest value (14.49%) was in legume fruiting stage. The crude protein content of seeds was 12.65%. The figure 1 shows the measured protein content in three phenologic stages.
- NDF and ADF: The results indicated the significant difference in NDF and ADF in different stages of plant growth. The highest values of NDF and ADF in legume appearance period were 45.4 and 42.76%, respectively. While the lowest values in vegetative growth stage were 37.4 and 33.13%, respectively. Also, NDF value of fruits of the plant was 44.6%. Figure 2 shows NDF and ADF of the plant in different phenologic stages.

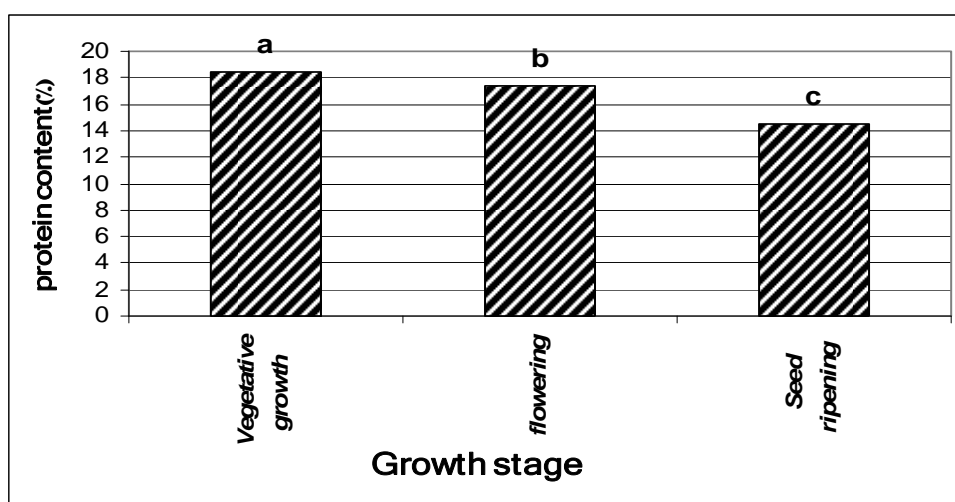
Table 1: Comparison of the studied mineral of *S. iranica* in different phenologic stages and regions

Properties	Treatment	DF	Mean of squares	F	Result
Nitrogen	Region	3	1.196	5.64	**
	Stage	3	3.532	16.66	**
	Region and stage	9	0.330	1.55	ns
	Error	64	0.212		
Crude protein	Region	3	46.340	5.54	**
	Stage	3	139.34	16.69	**
	Region and stage	9	13.207	1.58	ns
	Error	64	8.345		
NDF	Region	3	363.850	8.27	**
	Stage	3	253.251	5.75	**
	Region and stage	9	52.802	1.20	ns
	Error	64	43.990		
ADF	Region	3	155.200	3.46	**
	Stage	3	396.750	8.84	**
	Region and stage	9	85.790	1.91	ns
	Error	64	44.860		
Potassium	Region	3	0.164	11.69	**
	Stage	3	4.501	320.15	**
	Region and stage	9	0.240	17.03	**
	Error	64	1.406		
Phosphorus	Region	3	1.511	2.45	ns
	Stage	3	16.855	25.03	**
	Region and stage	9	1.051	1.56	ns
	Error	64	0.673		
DMD	Region	3	59.680	2.04	ns
	Stage	3	235.72	8.08	**
	Region and stage	9	43.012	1.47	ns
	Error	64	29.169		
Metabolic Energy (ME)	Region	3	1.725	2.04	ns
	Stage	3	6.812	8.08	**
	Region and stage	9	1.243	1.47	ns
	Error	64	0.834		

* Significant in 0.01

** Significant in 0.05

*** Not Significant

**Figure 1: Comparison of protein content in three vegetative growth stages**

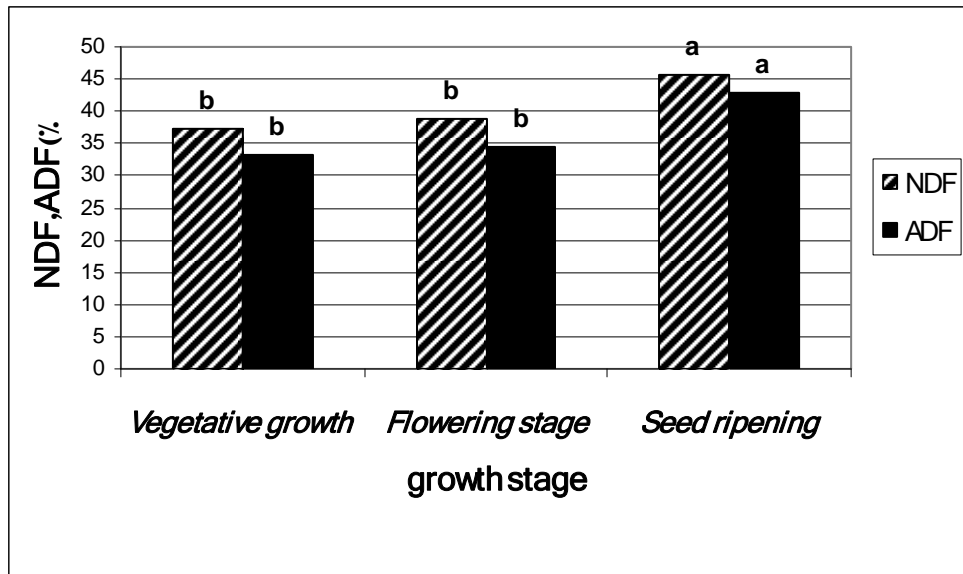


Figure 2: Comparison of ADF and NDF values in three vegetative growth stages

● Potassium: The content of K in different phonologic stages of *S.iranica* was significantly different. So the highest measured value was 1.06% in flowering

stages while the lowest value was 0.622% in vegetative growth stage. Also, the observed value K in legumes was 1.76% (Figure 3).

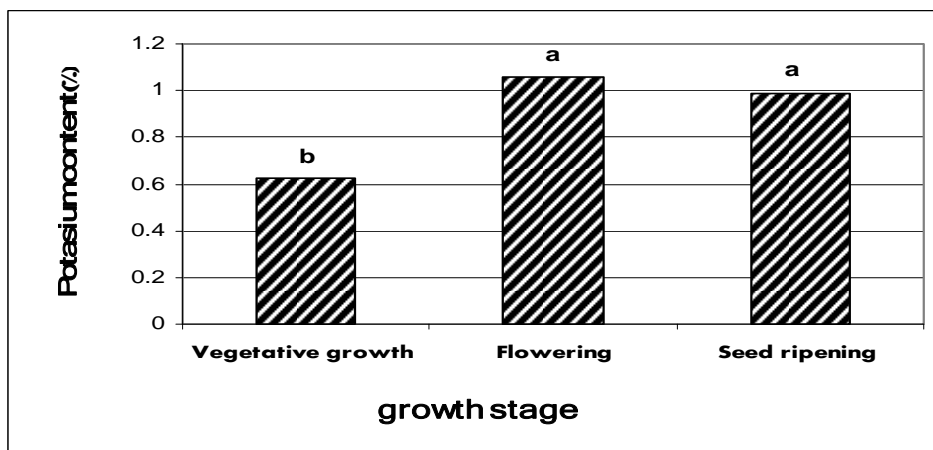


Figure 3: Comparison of Potassium content in different vegetative growth stages

● Phosphorus: Various vegetative stages of *S.iranica* showed the significant differences of P with the highest value of 4.33 ppm in flowering stage and the lowest value of 3.19 ppm in vegetative growth stage. There

is no significant difference in P content of flowering and fruit production stages. Furthermore, P content of legume was 5.42 ppm. Figure 4 shows the average content of P in different vegetative stages.

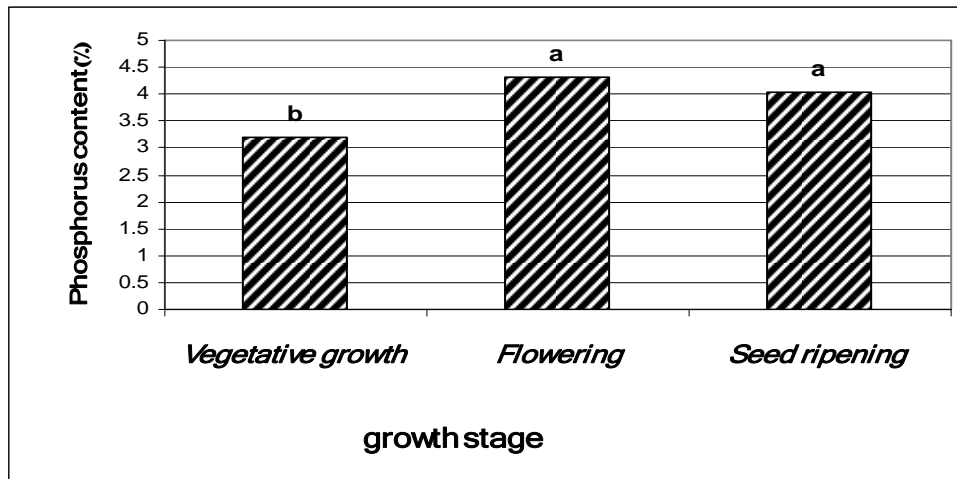


Figure 4: Comparison of Phosphorus content in different vegetative growth stages

* Percentage of Digestible Dry Matter (DMD): The results of statistical analysis showed that DMD content of plant tissues in different vegetative stages have significant differences. So, the highest value of DMD in vegetative growth stages

was 64.19% and the lowest value in fruit appearance stage was 57.11%. DMD content of fruits was also 61.07%. No significant difference was observed in DMD content of vegetative growth and flowering stages (Figure 5).

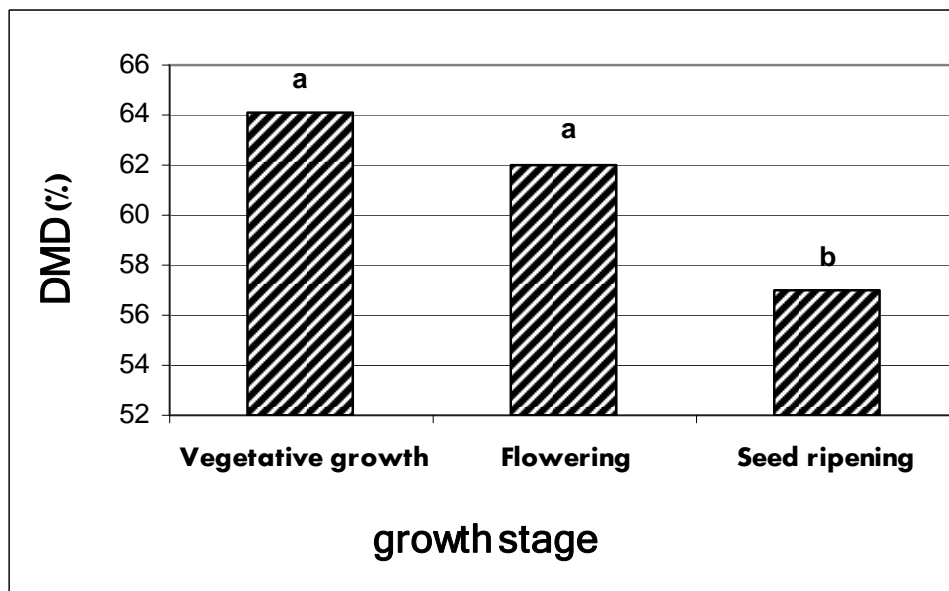


Figure 5: Comparison of DMD content in three vegetative growth stages

* Metabolic Energy (ME): The ME content in different vegetative stages shows

significant differences. The highest value of ME in vegetative stage was 8.93% while

the lowest value in fruit appearance period was 7.61%. Furthermore, the ME of fruit was measured 7.95%. Figure 6 illustrates

the average value of ME in tissues of the plant in various phenologic stages.

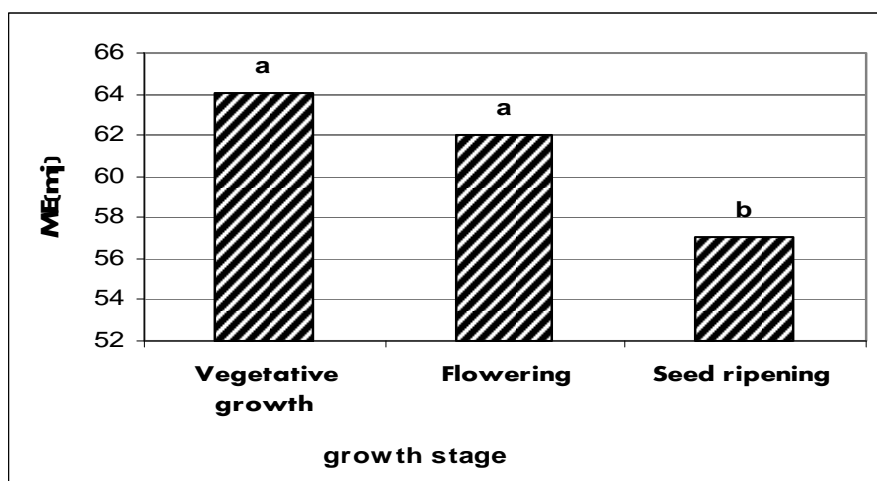


Figure 6: Comparison of ME content in three vegetative growth stages

Conclusion

Arid and semi-arid regions of Iran have diverse and rich collection of plants. Vegetation cover of such regions has high resistance to difficult environmental condition. Also, the forage, nutritional, industrial, medicinal and conservative values of these plants are of high importance. *Smirnovia iranica* is one of the rare and compatible plants of sand dunes of central Iran.

The chemical analysis of *Smirnovia iranica* showed that organic and mineral contents of the plant in phenologic periods have significant differences at 1% level.

The comparison of crude protein content of the plant indicates the decreasing trend of protein to 21.3% during the plant development stages. The average content of

measured crude protein showed 16.8% in three vegetative growth stages which confirms the results of research conducted by Azarnivand (1998). This fact indicates the high value of protein in *Smirnovia iranica* and shows the forage values of the plant for livestock feeding. The results of measured ADF and NDF showed significant differences in phenologic stages. Also, NDF and ADF showed an increasing trend (18.5 and 21.5%, respectively) during the development stages which is in accordance with the results of Baghestani (2003).

DMD and ME in phenologic stages of *S.iranica* showed significant differences with the highest value during vegetative growth and the lowest value in seed and fruit appearance period. It stresses on

decreasing of ME and DMD during growth stages. At the end of vegetative growth, the values of DMD and ME were measured as 11 and 14.5%, respectively.

The results suggest that palatability, digestibility and nutritional values are decreased during the growth period due to accumulation of fiber in plant tissues. Arzani et al (1999) have proposed that metabolic energy is decreased during vegetative growth period. The results of current research are also in accordance with the results reported by Baghestani (2003) that shows the decrease of metabolic energy during vegetative period.

Current research showed that legumes of *S.iranica* are rich in DMD and ME and are considered as a suitable source for livestock nutrition. Also, the minimum values of K and P were seen in the first stage of vegetation stage while the maximum value was seen in the flowering stages. This describes that during flowering stage, the plant stores high contents of K and P in its tissues.

This increase of K and P in *S.iranica* were 34 and 26.5%, respectively. Also, content of K and P in fruits were considerable.

Generally, comparison of mineral and organic nutrient of the plant shows that crude protein, metabolic energy, percentage of digestible dry matter all are decreased during vegetative growth stage while NDF and ADF are increased.

During the plant development, digestibility and nutritional content are decreased and the content of non-digestible nutrient is also decreased due to fiber increase of plant tissues. Consequently, forage quality will be decreased.

This result stresses the findings of other researchers indicating the phenologic effects on forage quality and variation of properties during the plant growth period (Kaboli 2001, Ahmadi 2004 and Holechek et al 2001). The results reported by other researchers about the effect of phenologic stage on forage quality emphasize that quality reduction is due to age, increase of stem to leaf ratio, increase of lignin and chlorenchyma cells (Fahey 1994, Zohdi 2001, Kaboli 2001, Ahmadi 2004, Holechek 2001). Torkan (1999) showed that forage quality is decreased during plant growth due to increase of NDF and ADF and decrease of crude protein.

The results of current research indicates that since there are no significant differences among protein content, metabolic energy, digestible dry matter, NDF and ADF values in flowering and vegetative growth stages and K and P increases during flowering stage, the most appropriate period for utilization of the species is flowering period. This will avoid land degradation, erosion and loss of plant production. Due to high content of crude protein in tissues of *S.iranica*, this plant is a valuable source of forage for livestock

especially in arid regions. Also, ingredient such as Spherophysinum and Smirnovinium of the plant have medicinal and industrial values.

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