ECOPERSIA

DOI:10.18869/modares.Ecopersia.4.1.1225 **2016, 4 (1): 1225-1237**

Assessment of Planting Season Effects on Vegetation Parameters of *Astragalus effusus* and *Astragalus brachyodontus* Accessions

Sedigheh Zarekia[*1], Ali Ashraf Jafari[2] and Taghi Mirhaji[2]

[1] *Forest and Rangeland Research Division, Yazd Agriculture and Natural Resources Research and Education Center, AREEO, Yazd, Iran*
[2] *Rangeland Research Division, Research Institute of Forests and Rangelands, AREEO, Tehran, Iran*

Received: 20 April 2015 / Accepted: 27 February 2016 / Published Online: 31 March 2016

ABSTRACT: This research aimed to evaluate the effect of planting seasons (autumn and spring) on 10 accessions of two species of *Astragalus effusus* and *Astragalus brachyodontus* in the field condition (Homand Absard station, Damavand). After preparing the seedbed, the plant species were planted on two lines in 2 m, where the spacing between the lines of each accession was 0.5 m, and the spacing between the lines of different accessions was 0.75 m. The selected design for this study was a complete randomized block with three replications. Evaluation parameters were: forage production, canopy cover, plant height, seed yield, and number of flowering stems. Data were analyzed using split plot in time as year for each plot, and mean comparisons were made using Duncan's method. The results showed that planting seasons had a significant effect on most of the measured parameters in different accessions. Autumn planting increased the forage production, height, canopy cover and number of flowering stems. The species *A. brachyodontus* (Zereshk), *A. brachyodontus* (Alamut) and *A. effusus* (Dareh Shohada) had high production and canopy cover in the autumn cultivation. Thus, the mentioned accessions are recommended for the improvement and development of rangelands and abandoned dry land farming with the same weather conditions of Homand Absard station.

Keywords: *Astragalus, Forage, Planting season, Rangeland, Semi-arid*

1 1INTRODUCTION

Herbage legumes are of the desirable species that play an important role in animal food. They are rich in forage quality and used for livestock in different areas. They can further increase soil fertility through fixing nitrogen (Carlsson and Huss-Danell, 2003). Zhan-Bin and Qing-Yi (2013) cultivated species of *Astragalus adsurgens* in the loss and gully lands in China and showed that the establishment of this plant species can improve the existing soil nutrients, especially nitrogen, and organic matters have an effective role in preventing soil degradation and erosion.

Astragalus is a large genus of about 804 species in Iran, belonging to the legume family Fabaceae and the subfamily Faboideae in which 527 species, equivalent to 65%, are endemic (exclusive) of Iran. Among the different species of this genus, there are more than 300 herbaceous species, many of them are permanent, and many others are used for livestock food

* *Corresponding author: Forest and Rangeland Research Division, Yazd Agriculture and Natural Resources Research and Education Center, Yazd, Iran, Tel:+98 3538249901, Email: szarekia@yahoo.com*

(Masoumi, 2006).

Two major management decisions, variety selection and planting date management, can have a profound effect on the development and final outcome of the crop (Norton and Silvertooth, 1999). Selection of a plant specific variety will have a large impact on the way the planting date should be managed. Similarly, the time frame in which crop can be planted due to weather and/or other circumstances should have a large impact on the selection of a suitable variety (Norton and Silvertooth, 1999). Planting time is an important factor to obtain the yield potential of the crop species. There is a perfect harmony between vegetative and reproductive growth, on the one hand, and climate on the other (Loeppky, 1996).

In the Mid-South, seeding date for cool-season legumes is typically early fall and mid-February through March. Seeding dates for warm-season legumes range from winter through early May, depending on species (Ashworth *et al.*, 2011).

Arshad and Ranamukhaarachchi (2012) stated that growth and yield parameters of intercropped sweet sorghum were comparatively lower in the wet season compared to the dry season. They attributed this to its sensitivity to high water table resulting from frequent and intense rainfall and reduced light intensity affecting photosynthesis, and hence, assimilation availability in the wet season.

The study of Turk and Tawaha (2002) in Jordan on dates 14 January, 28 January and 12 February for planting *Vicia faba*, revealed that the higher production would be produced in the earlier planting times. Ngwako *et al.* (2013), studying the effect of planting date on the growth and yield of Vigna subterranean (an indigenous grain legume), found that the number of leaves and leaf area were increased with planting dates. Early sawing reduced the number of leaves, mass of petioles, mass of stem and leaf area. Ajeigbe *et al*. (2008) stated that, for cowpea, planting is done when there is sufficient moisture in the soil to allow germination and when there is enough time for the varieties to mature after the end of the rainy period. Salehi (2002) in evaluating the effect of planting date on the yield of *Onobrychis vicifolia*, concluded that the best time for planting in Shahrekord is in late September that had the highest performance. On the other hand, Kuchaki and Kahrobadian (2006) expressed that *Onobrychis* sp. as well as alfalfa can be sown in both autumn and spring; however, in Mashhad, autumn planting was a better choice. Noorbakhshian (2010) also recommended that planting red clover (*Trifolium pratensis*) was cultivated at the beginning of September so there was a good forage production in the region.

Extensive studies have been made in the case of the cultivation of many of legume species but the literature available on these aspects on herbaceous *Astragalus* is scarce. This is the first report on evaluation of herbaceous species here in Iran. This research was conducted aiming to study the best time for planting the seeds of nine accessions of two species of *Astragalus* in the field condition.

2 MATERIALS AND METHODS

2.1 Geographical location and climatic conditions of the study area

Homand Absard Rangeland Research Station is located 70 km east of Tehran between 52° 15' 25" E and 35° 4' 9" N, with an altitude of 1960 m a.s.l. on the southern slopes of the Alborz Mountains with a mild slope. It has an average annual rainfall of 338.7 mm, mainly occurring in the form of snow during December, January, February, and March (Table 1). The average temperature is 12°C. Also absolute maximum and minimum temperatures are 36 and -22°C, respectively.

Homand Absard has a cold semi-steppe climate. The length of freezing periods lasts up to 120 days, and the length of dry period is about four months (Zarekia, 2013).

[DOR: 20.1001.1.23222700.2016.4.1.4.5]

Table 1: Monthly and annual precipitation (mm) in Homand Absard station

Year	Oct	Nov	Des	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Average
2008	3	49	34	19	37	39	47	52	1	0	3	2.5	285
2009	8.5	46	1	43.5	42	62.5	14.5	56	0	6.5	0	61	341
2010	1	120.5	19	22.5	65	27.5	50	29.5	7	23	0	5	370
Long term	14.53	37.8	39.8	30.5	46.5	48.3	48.2	38	11.2	8	8.2	7.7	338.7

Figure 1: *Astragalus brachyodontus*

Figure 2: *Astragalus effuses*

2.2 Methods

The two *Astragalus* species (see Figures 1 and 2) were perennial, and their seeds were collected from different rangelands of Iran, including Ardabil, Isfahan, Semnan, Khorasan, Chahar Mahal Bakhtiari and Qazvin Provinces.

After preparing the seedbed, in the autumn 2008 and in the spring 2009, the plant species were planted on two lines in 2 m, where the spacing between the lines of each accession was 0.5 m, and the spacing between the lines of different accessions was 0.75 m. Design for this study was a complete randomized block with three replications.

The studied accessions were: *A. brachyodontus* (Alamut, Zereshk, Khalkhal, Muteh and Arshagh), and *A. effusus* (Semnan, Darehshohada, Qarabaq, Karsang, and Isfahan). During the establishment year, no data were collected. In the following year (2012), forage production, canopy cover, height, seed yield, and number of flowering stems were evaluated as follows:

1. Plant height: Five spaced plants of each plot were selected, and their heights were measured based on cm and then their averages were taken.
2. Flowering stem number: The average stems number of a 50 cm row planting of each plot was noted down based on counting.
3. Canopy cover area: Five plants of each plot were selected, and their canopy short and long diameters were measured and expressed as cm^2; then their averages were taken.
4. Forage production: Due to the species' density and no harvest for each plant,

[DOR: 20.1001.1.23222700.2016.4.1.4.5]

production was harvested on each plot separately, the plant material was air-dried, and the dry weight was expressed in kg ha^{-1}.

5. Seed yield: At the time of maturity, the average seed yield was calculated on each plant based on g/plant.

Data were analyzed using ANOVA, and mean comparisons were made using Duncan's Multiple Range Test (DMRT). Statistical analysis was performed using SAS.

3 RESULTS

The ANOVA results showed that the effects of the planting season, species, and accession on the quantitative properties including canopy cover, forage production, plant height, number of flowering stems, and seeding rates were significant. According to Table 2, all the characteristics of a plant other than the seed yield in the autumn and spring planting seasons had a significant difference at the level of 1%; so all of the properties had the highest and lowest amount in the autumn and spring, respectively.

3.1 Investigation of plant parameters related to the autumn planting in different species of Astragalus

The results clearly showed that the investigated plant species for all the parameters in the autumn and spring plantings had a significant difference ($p<0.01$). Accordingly, means of the species' vegetation parameters were compared and classified using the Duncan's method; the results for the autumn and spring planting dates are given in Tables 3 and 4, respectively.

Table 3 shows that in the autumn planting, the plant species were different in vegetation parameters, and the highest production was related to *A. brachyodontus*. However, other parameters were low in *A. effusus*. In the spring planting, different species had different outcome in terms of vegetation parameters, and the highest forage production and plant height were related to *A. brachyodontus*. However, in terms of other parameters, *A. effusus* was in the first level (Table 4).

Table 2: Means of vegetation parameters in two planting seasons

Planting date	Forage production (kg ha^{-1})	Plant height (cm)	Canopy cover (cm^2)	Flowering stems No.	Seed yield (g $Plant^{-1}$)
Autumn	1028± 33[a]	42±3 [a]	3574± 425[a]	18.59±2.8 [a]	54.59± 8.8[a]
Spring	498±27 [b]	29±2.25 [b]	1840±312 [b]	8.44±1.2 [b]	47.77 ±12.5[a]

Values within a column followed with same letters were not significantly different ($P<0.05$).

Table 3: Means of vegetation parameters in two plants (autumn planting)

Treatment	Forage production (Kg ha^{-1})	Plant height (cm)	Canopy cover (cm^2)	Flowering stems No.	Seed yield (g $Plant^{-1}$)
A. brachyodontus	1376±43.3 [a]	42±2.1 [a]	2844±192 [b]	15.66±1.2 [b]	48.83± 8.3[a]
A. effusus	751±42.8 [b]	43±2.7 [a]	4158± 322[a]	20.93±2.2 [a]	59.2± 11[a]

Values within a column followed with same letters were not significantly different ($P<0.05$).

[DOR: 20.1001.1.23222700.2016.4.1.4.5]

Table 4: Means of vegetation parameters (spring planting)

Treatment	Forage production (kg ha^{-1})	Plant height (cm)	Canopy cover (cm^2)	Flowering stems No.	Seed yield (g Plant^{-1})
A. brachyodontus	590± 19^{a}	31.25±2 ^{a}	1448±126 ^{b}	6.58±0.7 ^{b}	19.92±4.4 ^{b}
A. effusus	358±24.5 ^{b}	27.55±5.3 ^{a}	2363± 511^{a}	12.1±0.6 ^{a}	103.5±10 ^{a}

Values within a column followed with same letters were not significantly different (P<0.05).

3.2 Investigation of plant parameters related to the autumn planting in different accessions of Astragalus

The results showed that in the autumn planting, the best accession in terms of forage production was *A. brachyodontus* (Zereshk, 2000 Kg ha^{-1}), and two accessions of *A. brachyodontus* (Alamut and Khalkhal) were at the next level. The minimum forage production was obtained for *A. effusus* (Karsang, 257 Kg ha^{-1}) (Tab. 5). Accession of *A. effusus* (Qarabaq, 5389 cm^2) and *A. brachyodontus* (Alamut, 2494 cm^2) had the highest and lowest canopy cover, respectively. In addition, *A. effusus* (Qarabaq) and *A. effusus* (Semnan) with a height of 52 cm and 29 cm had the highest and lowest height, respectively**.** In terms of the number of flowering stems, accession of *A. effusus* (Qarabaq) with 29 stems on each plant had the highest number of flowering stems. However, with respect to the number of flowering stems, this accession was highly rated in terms of seed production, and *A. effusus* (Dareshohada) has the highest seeding rate (191 gr plant^{-1}).

3.3 Investigation of plant parameters related to the spring planting in different accessions of Astragalus

The results showed that, in general, the spring planting in comparison with the autumn planting has not been a suitable situation for all the investigated parameters (Table 6). In the spring planting, *A. brachyodontus* (Alamut, 832 Kg ha^{-1}) was in the first place, and *A. brachyodontus* (Zereshk) was ranked at the next level. The lowest production was related to *A. effusus* (Semnan, 41 Kg ha^{-1}). Likewise, *A. effusus* (Dareshohada, 4039 cm^2) and *A. effusus* (Semnan, 286 cm^2) had the highest and lowest canopy cover, respectively. Generally, *A. effusus* (Dareshohada), *A. effusus* (Qarebaq), *A. brachyodontus* (Zereshk) and *A. brachyodontus* (Alamut) are the best accessions in terms of the all measured parameters of the species compared with other identified accessions.

[DOR: 20.1001.1.23222700.2016.4.1.4.5]

Table 5: Means of vegetation parameters in the plant species of *Astragalus* spp. with regard to the origin of species by Duncan's method (Autumn planting)

Species	Origin	Forage production (kg ha^{-1})	Canopy cover (cm^2)	Plant height (cm)	Flowering stems No.	Seed yield (g Plant^{-1})
A. brachyodontus	Khalkhal	1208±34 ^{bc}	3063±180 $^{b-d}$	38.33±0.9 ^{de}	19.3±0.9 $^{a-c}$	63.6±15.9 ^{b}
	Arshagh	561±16.8 ^{d}	2497±345 ^{d}	33.33±2.2 ^{ef}	12.66±2.9 ^{c}	11.39±3.4 ^{c}
	Alamut	1702±25 ^{b}	2494±513 ^{d}	48±2 $^{a-c}$	15.33±2.3 ^{bc}	58±16.2 ^{b}
	Zereshk	2023±54 ^{a}	2322±403 $^{b-d}$	49.3±2.4 $^{a-c}$	15.33± 2.3^{bc}	62.32±6.5 ^{b}
A. effusus	Dareshohada	1640±27^{ab}	4184±308 $^{a-c}$	50±1.5 ^{ab}	25.33± 5^{ab}	191.3±9.4 ^{a}
	Qarebaq	1030±77 ^{c}	5389±312 ^{a}	52.33±3.2 ^{a}	28.68±3.6 ^{a}	59.4±16.9 ^{b}
	Semnan	465±29.4 ^{d}	2891±711 ^{cd}	29±3.6 ^{f}	17±4.1 ^{bc}	6.33±1.9 ^{c}
	Isfahan	465±28 ^{d}	4474±394 ^{ab}	43.66±2 $^{c-d}$	14±3.1 ^{c}	32.39±13 ^{c}
	Karsang	257± 11^{d}	3851±657 $^{b-d}$	41.66±2.7 ^{cd}	19.66±3 $^{a-c}$	6.67± 1.4^{c}

Values within a column followed with the same letters were not significantly different (P<0.05).

Table 6: Means of vegetation parameters in the plant species of *Astragalus* regarding the origin of species by Duncan's method (spring planting)

Species	Origin	Forage production (kg ha^{-1})	Canopy cover (cm^2)	Plant height (cm)	Flowering stems No.	Seed yield (g Plant^{-1})
A. brachyodontus	Khalkhal	418±30.7^{a-c}	1366±392 ^{c}	23.33± 3.7^{c}	9.33±1.3^{ab}	12.32±4.13 ^{c}
	Muteh	457±7.5 $^{a-c}$	1286± 157^{cd}	34.3±0.9^{a-c}	4.33±0.9^{c}	17.33±4.9 ^{bc}
	Alamut	832±33.6^{a}	1733±156^{bc}	33.3±1.3 ^{ab}	6.6±0.9^{bc}	22.67 ±3.8^{bc}
	Zereshk	653±51.1^{ab}	1404± 316^{c}	31±3.5^{bc}	6±1.17 ^{bc}	27.3±12.6 ^{bc}
A. effusus	Dareshohada	800±41.6^{ab}	4039±297 ^{a}	44.33± 4.8^{a}	11.3± 1.2^{a}	111.3±25.7 ^{a}
	Qarebaq	381±18 ^{bc}	2762±415 ^{b}	33±4.6^{bc}	13±1.55 ^{a}	95.38 ±19.1^{a}
	Semnan	41± 7^{c}	286 ±149^{d}	5.33± 1.8^{d}	-	-

Values within a column followed with same letters were not significantly different (P<0.05).

3.4 Interaction of the planting season and plant species

According to the obtained results, the highest production and canopy cover in the autumn planting belonged to *A. brachyodontus* and *A. effusus*. The autumn planting had more success (Figure 3); however, in the spring cultivation, *A. effusus* was successful except for the forage production parameter. All parameters of *A. effusus* were in the highest amount in the autumn planting. Also all the plant species had the highest seed yield in thespring planting.

[DOR: 20.1001.1.23222700.2016.4.1.4.5]

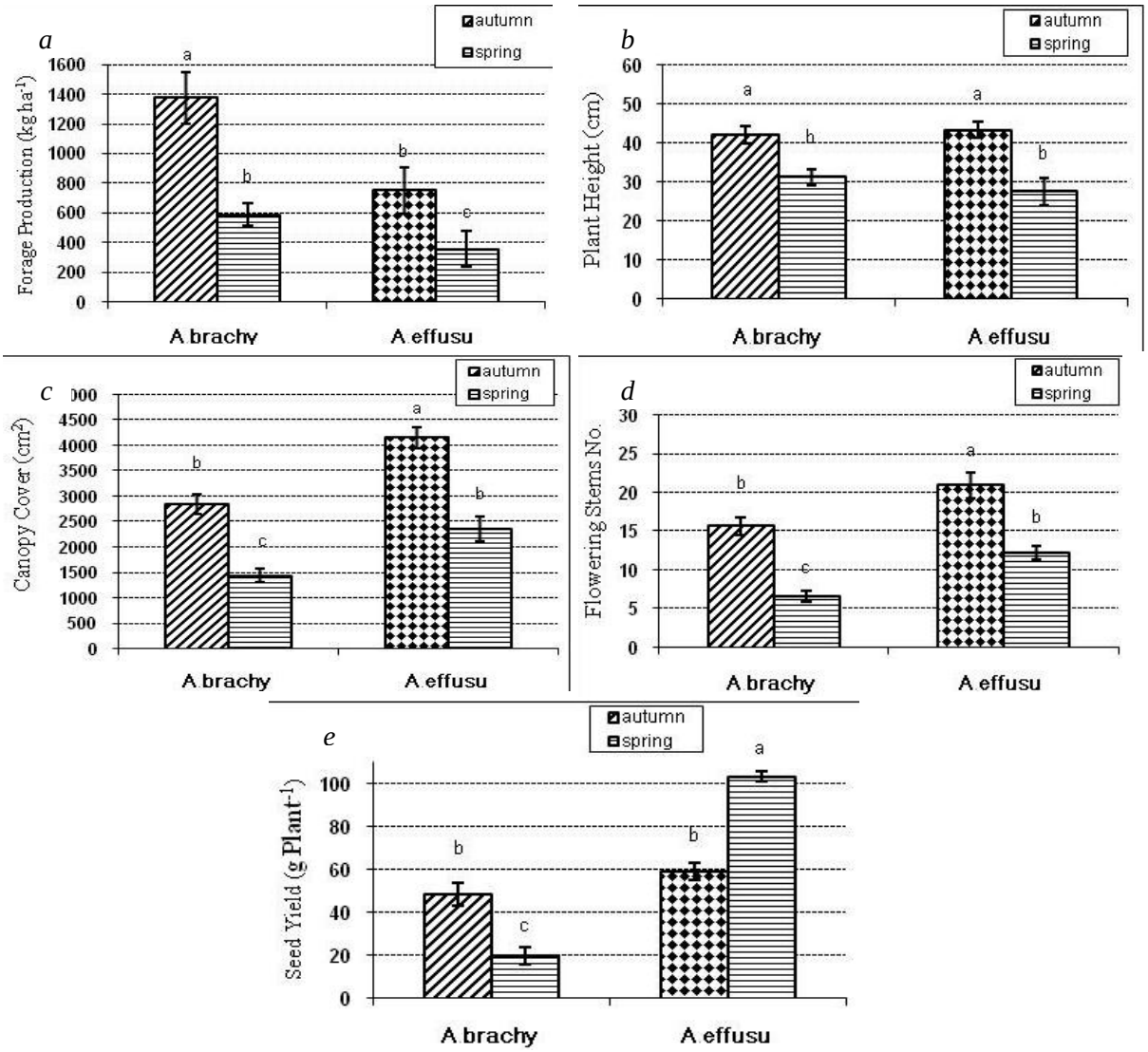

Figure 3: Mean (±SE) of forage production (a), plant height (b), canopy cover (c), flowering stem (d) and seed yield (e) of the studied species in two seasons

3.5 Interaction of the planting season and accessions

Based on Figures 4 to 8, the autumn planting was more successful than the spring planting in all cases. Accordingly, the best accession for forage production belonged to the autumn cultivated *A. brachyodontus* (Zereshk, 2000 Kg ha^{-1}) followed by the autumn plantings of *A. brachyodontus* (Alamut) and *A. effusus* (Dareshohada). However, in the case of forage production for *A. brachyodontus* (Alamut), the spring planting time is more appropriate. In terms of canopy cover, *A. effusus* (Qarebaq, 5000 cm^2) had the highest value in theautumn planting. The Isfahan accession of this species in the autumn planting was located on the second level (Figure 5). *A. effusus* (Qarebaq) in the autumn planting with more than 27 stems on each plant had the highest number of flowering stems. The maximum amount of seed yield in *A. effusus* (Dareshohada) was obtained in the autumn

[DOR: 20.1001.1.23222700.2016.4.1.4.5]

planting; whereas in the spring planting, this accession was ranked second in terms of seed yield.

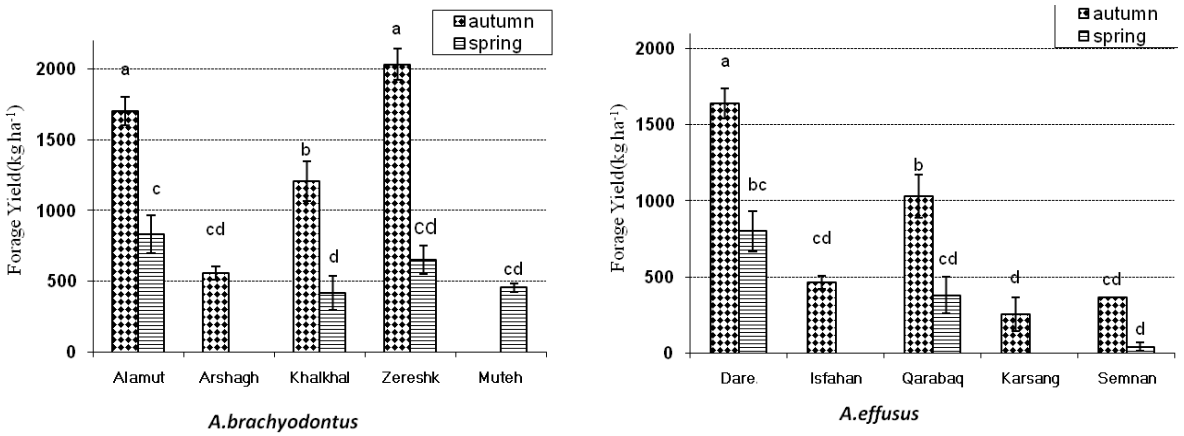

Figure 4: Mean (±SE) of forage production of different accessions in two seasons

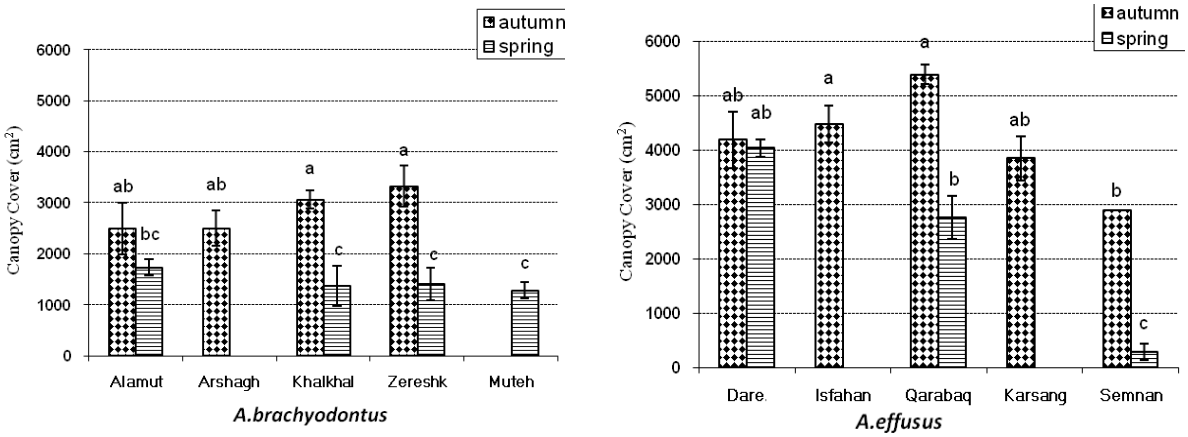

Figure 5: Mean (±SE) of canopy cover of different accessions in two seasons

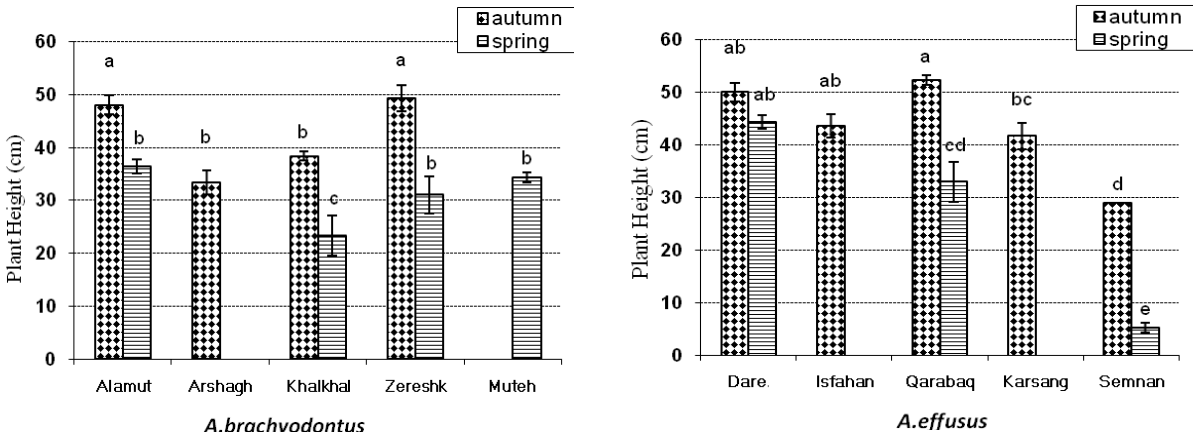

Figure 6: Mean (±SE) of plant height of different accessions in two seasons

[DOR: 20.1001.1.23222700.2016.4.1.4.5]

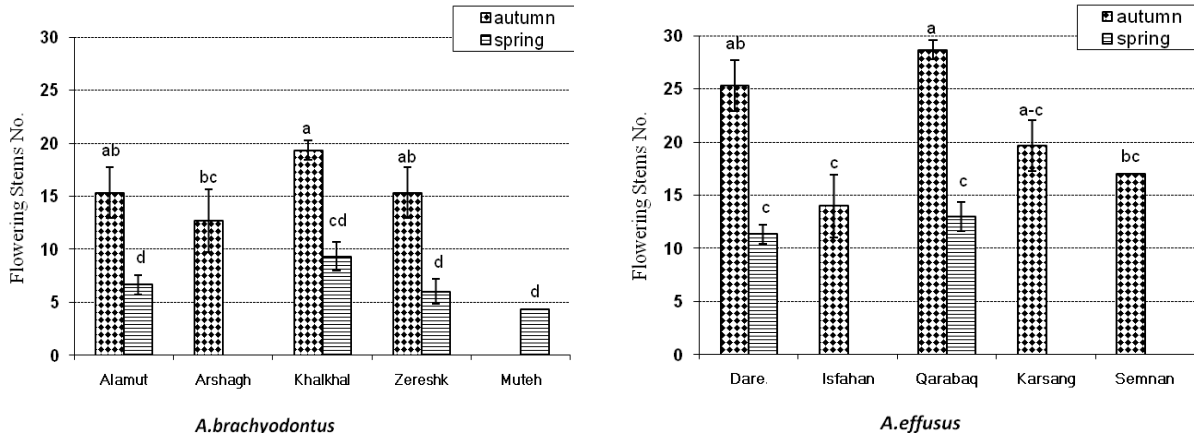

Figure7: Mean (±SE) of flowering number of different accessions in two seasons

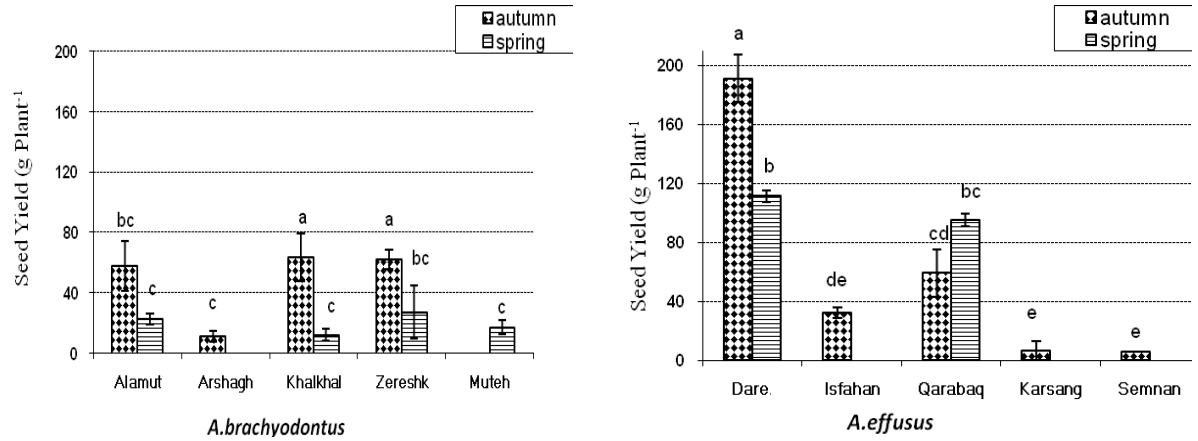

Figure 8: Mean (±SE) of seed yield of different accessions in two seasons

4 DISSCUTION

Forage plant species are debatable and examined with respect to the forage yield and soil conservation. In the present work, the production in area unit and the effective factors in production such as plant height and canopy cover for soil conservation were examined as a criterion for classification of plant species and accessions. It was revealed that for the majority of the measured parameters, autumn is the best time for the planting seeds of herbage *Astragalus* in semi-steppe areas.

The optimum time for rangeland seeding and/or re-seeding is from November to February during the cold and wet weather. It is important to start seeding only after the cold weather had settled in, as ants and rodents are in hibernation and will not collect, store or eat the seeds (Gintzburger, 2003).

According to the literature, in the cool highlands of Iran, species of the legume family (like *Astragalus*) will be commonly cultivated in the spring, but in the right time for planting in dry conditions, the plants will use the spring rains and meet a significant amount of needed water. However, with a decrease in precipitation and particularly dealing with the heat and drought of last season, the spring crop

[DOR: 20.1001.1.23222700.2016.4.1.4.5]

yield decreases sharply (Nakhforoush *et al*., 1998).

The choice of spring or autumn planting depends on the reliability and quantity of anticipated rainfall (Fribourg *et al.*, 2009). Legume family should normally be sown in the spring but, in some areas, planting in the autumn to take advantage of a subsequent moist, mild winter and to encourage well-established root system before the onset of dry summer conditions is necessary. This way the root system will be given the chance to develop more and reach deeper and more humid soil layer (Agiotantis, 2001). On the other hand, Singh *et al.* (1989) stated that the autumn planting of dry land pea (legume family) in some parts of the world such as the areas covered by ICARDA (International Center for Agricultural Research in the Dry Areas) was relatively successful, and has played a crucial role in the yield of pea.

Some researchers also reported that in most parts of Iran, especially in the highlands, lens cultivation (from legumes) can be cultivated in the spring, because high rain in the autumn may cause farmers to lose the opportunities of cultivation, and timely planting and growing would be postponed until late April and May. So, the majority of the spring rainfall is out of reach for the plant, and due to unfavorable environmental conditions such as water shortages, increased air temperatures and warm winds, its yield would be substantially reduced. By replacing the autumn planting instead of the spring planting and more use of precipitation, the qualitative and quantitative yield would be desirably increased. According to our results, the autumn planting of *A. brachyodontus* had the highest value in terms of forage production but *A. effusus* was suitable in terms of plant cover and soil conservation. *A. effusus* as a palatable species with high nutritional value and grazing tolerance is the most appropriate species for soil conservation (Yousefzadeh *et al.*, 2010); however, in the spring planting, *A. brachyodontus* had the most forage production, and in terms of other parameters, *A. effusus* was in the first place. This is while Sharifi (2006) reported that *A. brachyodontus* seeds planted with their pods in autumn were successful. According to the results, the best accessions in the autumn planting in terms of forage production were *A. brachyodontus* (Zereshk and Alamut) and *A. effusus* (Dareshohada). So if the purpose of cultivation is producing the livestock forage, the introduced accessions would be the best.

Regarding canopy cover, flowering stem and height, *A. effusus* (Qarebaq) has the most value, and due to the maximum amount of canopy cover, this accession might be used to prevent soil erosion. According to the number of flowering stems, this accession in terms of the seed amount is not placed in a high grade; showing that the number of flowering stems alone does not ensure a high number of seeds, and environmental factors may play a role in reducing the amount of seeds in the seeding time as well. Overall, it can be concluded that species such as *A. brachyodontus* (Zereshk) and *A. effusus* (Dareshohada) are appropriate species for the improvement and development of rangelands (with the autumn planting). In the spring planting, *A. brachyodontus* (Alamut) is the best accession in terms of forage production. The *A. effusus* (Dareshohada) has the greatest canopy cover. Development of *A. effusus* (Dareshohada) canopy can probably be related to the more and stronger surface roots of the plant, and therefore, more absorption of surface moisture in comparison with other plants. The species of *A. effusus* (Qarebaq) and *A. effusus* (Dareshohada) have the highest number of flowering stems; therefore, these two accessions have a high amount of seeds.

[DOR: 20.1001.1.23222700.2016.4.1.4.5]

Ahmadi *et al.* (2013) suggested that presence of desirable rangeland species such as *Astragalus effusus* with the desirable species of the grass family such as *Festuca ovina* and *Bromus tomentellus* at habitat has created a suitable compound for a range of high-quality forage production. This combination provides a suitable pattern for intercropping species in degraded habitats. In general, it is better to plant herbaceous species in the autumn.

According to the results, species and accessions like *A. brachyodontus* (Zereshk and Alamut) and *A. effusus* (Dareshohada) are proposed for the reform and development of rangeland and abandoned dry land farming with similar climatic conditions to Homand Absard station.

5 CONCLUSION

It can be concluded that in regards of the majority of the measured parameters, autumn is the best time for planting the seeds of *Astragalus*. In addition, *A. brachyodontus* (Zereshk and Alamout) and *A. effusus* (Dareshohada) are proposed for the reform and development of rangeland and abandoned dry land farming with similar climatic conditions to Homand Absard station (rainfall of 300 mm and e average temperature of 11°C). The proposed accessions can be introduced as an important forage source for livestock.

6 ACKNOWLEDGEMENT

The authors thank the following colleagues from the Agricultural and Natural Resources Research Center of West Azerbaijan (A. Ahmadi), Isfahan (Saeedfar and Feizi), Semnan (Mirakhorly), Chahar Mahal (Shirmardi), Ardabil (Sharifi and Mohammadi) and Qazvin (Rashvand) Provinces for their cooperation in collecting the seeds, and also special thanks to Gholamreza Nadi, Farhang Jafari and Shamohammadi for their assistance in the cultivation and cooperation in the project.

7 REFRENCES

Agiotantis, Z. Book of proceedings. International workshop new frontiers in reclamation. 19-21 September, Greece. 2001; 245 P.

Ahmadi, A., Shahmoradi, A.A., Zarekia, S., Ahmadi, E. and Nateghi, S. Autecological study of *Astragalus effusus* in rangelands of West Azerbaijan Province, Iran. J. Range and Desert Res., 2013; 20(1): 172-181. (In Persian)

Ajeigbe, H.A., Abdoulaye, T. and Chikoye, D. Legume and cereal seed production for improved crop yields in Nigeria. Proceedings of the Training Workshop on Production of Legume and Cereal Seeds. 2008; 24 January–10 February

Amanda Ashworth, A., Keyser, P., Allen, F., Bates, G. and Harper, G. Intercropping Legumes with Native Warm-season Grasses for Livestock Forage Production in the Mid-South. 2011. http://nativegrasses.utk.edu/publications/SP731-G.pdf

Arshad, M. and Ranamukhaarachchi, S.L. Effects of legume type, planting pattern and time of establishment on growth and yield of sweet sorghum-legume intercropping. Australian J. Crop Sci., 2012; 6(8): 1265-1274.

Carlsson, G. and Huss-Danell, K. Nitrogen fixation in perennial forage legumes in the field. Plant Soil, 2003; 253: 353-372.

Fribourg, H.A., Hannaway, D.B. and West, C.P. Tall Fescue for the Twenty-first Century- Science. 2009; 539 P.

[DOR: 20.1001.1.23222700.2016.4.1.4.5]

Gintzburger, G. Rangelands of the Arid and Semi-arid Zones in Uzbekistan. 2003; 426 P.

Kuchaki, A. and Kahrobadian, A. Nutritional characteristics and nutritive value of *Onobrychis* in relation to planting date and climatic conditions Mashhad. J. Agric., 2006; 17: 23-33.

Loeppky, H.A., Bittman, S., Hiltz, M.R. and Frick, B. Seasonal changes in yield and nutritional quality of cicer milkvetch and alfalfa in northeastern Saskatchewan. Can. J. Plant Sci., 1996; 76: 441-446.

Masoumi, A.A. Astragalus in Iran, Research Institute of Forests and Rangelands publication, Tehran, 2006; 786 P. (In Persian)

Nakhforoush, A., Koochaki, A. and Bagheri, A. Study the morphological and physiological indices effects on seed yield and yield components of lentil accessions. Iranian J. Crop Sci., 1998; 1: 37-20.

Norton, E.R. and Silvertooth, J.C. Evaluation of Planting Date Effects on Crop Growth and Yield for Upland Cotton, Arizona Cotton Report, The University of Arizona College of Agriculture, 1999; index at http://ag.arizona.edu/pubs /crops/az1123/

Ngwako, S., Balole, T.V. and Malambane, G. The effect of irrigation and planting date on the growth and yield of Bambara groundnut landraces. Int. J. Agr. Crop Sci., 2013; 6(3): 116-120.

Noorbakhshian, Effect of planting date and seeding rate on yield of red clover in Shahrekord: Final report of project; Research Center of Agriculture and Natural Resources, Esfahan, 2010; 25 P. (In Persian)

Sharifi, J. Surveying of ecological characteristics of *Astragalus podocarpus* in Range Ecosystem of Ardabil Province. Final report of the project; Research Center of Agriculture and Natural Resources, Ardebil, 2006; 71 P. (In Persian)

Salehi, F. Effect of planting date and seedling rate on quantitative and qualitative: Characteristics in sainfoin (*Onobrychis viciifolia*). Final report of the project; Research Center of Agriculture and Natural Resources, Chahar Mahal v Bakhtiari, 2002; 90 P. (In Persian)

Singh, K.B., Malhotra, R.S. and Saxena, M.C. Chickpea evaluation for cold tolerance under field conditions. Crop Sci., 1989; 29: 282-285.

Turk, M.A. and Tawaha, A.R.M. Impact of seeding rate, seeding date, rate and method of phosphorus application in faba bean (Vicia faba L. minor) in the absence of moisture stress Biotechnol. Agron. Soc. Environ., 2002; 6(3): 171-178.

Yousefzadeh, K, Houshmand, S., and Zamani, G. Karyotype. Analysis of Astragalus effusus Bunge (Fabaceae) Caryologia., 2010; 63(3): 257-261.

Zarekia, S. Cultivation of Eight species of perennial herbaceous and evaluation of their establishment. Final report of research. Res. Inst. Forest and Rangelands. 2013; 77 P. (In Persian)

Zhu, L. Q. Study on soil erosion and its effects on agriculture sustainable development in west Henan province loess hilly and mountainous areas. J. Soil Water Conserv., 2001; 49: 41-45.

[DOR: 20.1001.1.23222700.2016.4.1.4.5]

Zhan-bin, W. and Qing-yi, W. Cultivating Erect Milkvetch (Astragalus adsurgens Pall.) (Leguminosae) Improved Soil Properties in Loess Hilly and Gullies in China. J. Integr. Agr., 2013; 12(9): 1652-1658.

ارزیابی اثر فصل کاشت بر شاخص‌های گیاهی ژنوتیپ‌های *Astragalus effusus* و *Astragalus brachyodontus*

صدیقه زارع کیا[۱]، علی اشرف جعفری[۲] و سید تقی میرحاجی[۳]

۱- استادیار پژوهش، بخش تحقیقات جنگل و مرتع، مرکز تحقیقات و آموزش کشاورزی و منابع طبیعی استان یزد، سازمان تحقیقات، آموزش و ترویج کشاورزی، یزد، ایران

۲- استاد پژوهش، بخش تحقیقات مرتع، موسسه تحقیقات جنگلها و مراتع کشور، سازمان تحقیقات، آموزش و ترویج کشاورزی، تهران، ایران

۳-کارشناس ارشد، بخش تحقیقات مرتع، موسسه تحقیقات جنگلها و مراتع کشور، سازمان تحقیقات، آموزش و ترویج کشاورزی، تهران، ایران

تاریخ دریافت: ۳۱ فروردین ۱۳۹۴ / تاریخ پذیرش: ۸ اسفند ۱۳۹۴ / تاریخ چاپ: ۱۲ فروردین ۱۳۹۵

چکیده به‌منظور بررسی اثر فصل کاشت (پاییز و بهار) تعداد ۹ ژنوتیپ از دو گونه *Astragalus effusus* و *Astragalus brachyodontus* در ایستگاه همند آبسرد مورد ارزیابی قرار گرفت. پس از آماده‌سازی بستر کاشت، ژنوتیپ‌ها روی خطوط ۲ متری در ۲ خط طوری کشت شدند که فاصله خطوط بین هر ژنوتیپ ۰/۵ متر و فاصله خطوط بین ژنوتیپ‌های مختلف۰/۷۵ متر از یکدیگر بود. این بررسی در قالب طرح بلوک کامل تصادفی در سه تکرار انجام گردید. معیارهای ارزیابی عبارت بودند از: تولید علوفه، پوشش تاجی، قطر تاج پوشش، ارتفاع گیاه، عملکرد بذر، تعداد ساقه‌های گلدار داده‌های به‌دست آمده مورد تجزیه و تحلیل آماری قرار گرفت. از آنالیز واریانس جهت مقایسات کلی استفاده شد و مقایسه میانگین تیمارها به‌وسیله آزمون چند دامنه‌ای دانکن انجام گردید. نتایج نشان داد که بین فصول کاشت و اکثر صفات اندازه‌گیری شده و ژنوتیپ‌ها اختلاف معنی‌دار وجود دارد. اثر کاشت در فصل پاییز باعث افزایش میزان تولید، ارتفاع، درصد پوشش تاجی و تعداد ساقه‌های گل‌دهنده شده است. هم‌چنین ژنوتیپ‌های زرشک و الموت از گونه *A. brachyodontus* و ژنوتیپ دره شهدا از گونه *A. effusus* در کشت پاییز دارای تولید و پوشش تاجی مناسب می‌باشند. بنا براین ژنوتیپ‌های بالا برای اصلاح و توسعه مراتع و دیم‌زارهای رها شده با شرایط مشابه آب و هوایی ایستگاه همند آبسرد پیشنهاد می‌گردد.

کلمات کلیدی: *Astragalus*، زمان کاشت، علوفه، مرتع، نیمه استپی

[DOR: 20.1001.1.23222700.2016.4.1.4.5]