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**Research and Short Length Article:**

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## **Effects of Sowing Season and Cultivation Methods on Seedling Emergence, Survivor Rate and Growth of *Astragalus flexilipes* L. in Rangelands of Kermanshah Province, Iran**

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**Abstract.** One of the fundamental difficulties in Iranian rangelands is the existence of wide area of poor condition rangelands that their grazing capability is low due to continuous livestock grazing pressure. *Astragalus flexilipes* is one of the palatable plant species of rangelands in Iran, while its distribution is being decreased due to improper grazing. The aim of this study was to evaluation the sowing season and cultivation methods of *Astragalus flexilipes* in dryland farming using split plot design based on completely randomized block with three replications in Meleh-Kabud, Gahvareh, Kermanshah, Iran over two years of 2016-17. The first factor was sowing seasons (spring and autumn) and the second one was cultivation methods (row sowing and scatter sowing). Data were collected for seedling emergence, survivor rate and growth condition in the second year. Result showed significant effect of cultivation method on seedling emergence and survival rate and significant effect of sowing date on growth condition ( $P < 0.01$ ). The sowing date by cultivation method interaction was significant for seedling emergence and survival rate ( $p < 0.05$ ). The highest values of the latter traits were obtained in spring season coupled with row cultivation method. In autumn sowing the highest growth scores of 3.74 and 3.15 (out of 5) for row sowing and scatter sowing, respectively. It was concluded that the highest establishment was achieved in spring cultivation, but the vigorous plants was observed in the autumn cultivation. Thus, early spring cultivation of *Astragalus flexilipes* using row-sowing method was recommended for rehabilitation of the poor condition rangeland in similar climate area having relatively lower temperature.

**Key words:** *Astragalus*, Dryland Farming, Cultivation Method Establishment, Sowing Date

## Introduction

One of the fundamental difficulties in Iranian rangelands is the existence of wide area of poor condition rangelands that their grazing capability is low due to continuous grazing pressure. The genus *Astragalus* with 844 species is one of the huge genera in Iran, containing about 620 endemic species. The genus covering about 15-17 million ha of country and plays an important role in ecosystem equilibrium, soil conservation, carbon sequestration, and forage production (Masomi, 2016). *Astragalus flexilepes* is a palatable range species without thorns that its frequency has been decreasing due to livestock overgrazing.

The genus *Astragalus* faces with lots of problems and limitations for the establishment and regeneration in rangelands of Iran (Zarekia *et al.*, 2014). In the severe destructed rangelands which are converted to low yield drylands, a combination of legumes and grasses could preserve the biodiversity and high forage production (Barati *et al.*, 2014). Also, in arid and semi-arid areas the soils are eroded due to lack of vegetation and it lead to dust storms (Hou *et al.*, 2016; Erice *et al.*, 2010). In such circumstances, grazing management should be coupled with cultivating of range species with high quality and drought resistant (Gurvicha *et al.*, 2017). For the rangeland reclamation, the cultivation and establishment of native high yield and compatible forage species are required. Range plants such as legumes play a vital role in forage producing and fixing their nitrogen (Gurvicha *et al.*, 2017; Shannon *et al.*, 2014). Forage of many *Astragalus*, *spp.* species nominated as high quality due to their nutritional values. Shahbazi *et al.* (2016) found higher values of crude protein, dry matter digestibility and metabolism energy in *Astragalus cyclophllan* than that for alfalfa in the similar phenological growth stages.

Investigation on sowing seasons is more likely result in correct and quick establishment of species (Bacchetta *et al.*,

2011; Loeppky *et al.*, 1996). Various studies have been conducted on determining the cultivation time of *Astragalus* species (Zarekia and Mirhaji, 2017; Zarekia *et al.* 2013; Ghasriani *et al.* 2016). The higher survivor rate of 58.2% was obtained in *Astragalus cyclophyllon* cultivated in crescent-shaped holes method than that for typical method (Moshtaghyan *et al.*, 2009). Another factor which affects the efficiency of cultivation method is the cultivation date. In a study of cultivation date of some *Astragalus* species Zarekia *et al.* (2019), found the best result in the fall sowing season. Accordingly, two factors of cultivation method and cultivation date are effective in the establishment of *Astragalus* species (Abolghasemi *et al.*, 2019).

Breaking the seed dormancy in many of *Astragalus* species has important role in their establishment. Zarekia *et al.* (2013) reported that scratch treatment is the best treatment for improving seed germination of some *Astragalus* species.

Delkhosh and Bagheri (2012) studied the impact of mechanical crescent basin project on some forage species production, canopy crown and soil humidity in Gorik rangelands, Zahedan, Iran. Their results showed that implementing this project has increased the soil humidity and plant canopy crown percent through rainwater harvesting. Totally, utilization of contour furrow and pitting reduce runoff, soil erosion, and increase humidity in deep soil and finally, enhanced vegetation in desert rangelands (Jahantigh and Pessarkli, 2009; Yazdanshenas *et al.*, 2019). Similar results were achieved in the research conducted by Chamani *et al.* (2011) in terms of contour furrow and pitting in northern rangelands, Golestan province, Iran.

According to mentioned published literatures, three factors including cultivation method, sowing season and dormancy breaking are the most important factors affecting the establishment of *Astragalus flexilepes* species in the field. Therefore, the aim of current study was to

determine the best cultivation methods and sowing season on seedling emergence and survivor rate of *Astragalus flexilepes* in Dalaho, Kermanshah province over 2 years (2016-2017).

### Materials and Methods

This research was conducted in Maleh Kabod village at 10 km northeast of Gahvareh town and 54 km northwest of Kermanshah city, Iran. It is located at 46°29'53" E longitude and 34°24'42" N latitude and 1700m above sea level. Mean annual precipitation is 500 mm and its climate is humid and cold. Its soil is half deep and relatively loamy-clay. Winters are cold enough for temperature to drop to below zero during December, January, and February. Summers are, however, relatively cool and dry, indicating a semi-arid region. Furthermore, mean annual rainfall in the study site during 2016 and 2017 was 687 and 616 mm, respectively.

Seeds were collected from their natural habitats in Gahvareh habitats at 1450-1700 m above sea level in Kermanshah province. Prior to seed sowing seeds were tested for germination. The seeds germination percentages were 24 to 26%. Therefore, to overcome the seed dormancy, the seeds were scratched with sandpaper prior to cultivation (Zarekia *et al.*, 2013). The seeds germination percentages were increased up to 76 to 81%. In the study area, an appropriate farmland was selected for seeds cultivation. A split-plot design was established using two factors. Sowing seasons (autumn and spring) as the main factor and cultivation methods (row

sowing and scatter sowing) the sub factor. The size of each plot were 12.5 m<sup>2</sup> (5×2.5 m) with 50 cm distance between rows. Seeds were sown in soil depth 3 cm as 10 kg/h. The autumn and spring sowing dates were in October 2015 and April 2016, respectively. In the first and the second years, data were collected for seedling emergence percentage and survivor rates and growth condition (1 to 5 score) in June of 2016 and 2017.

The collected data were subjected to analysis of variance and mean comparisons were made using Duncan method. The SPSS software version 19 was used for data analysis. The mean comparisons were done by Duncan's multiple range tests.

### Results

The collected seeds were scratched using sandpaper prior to cultivation. Result showed seed scratching increased germination percentage up to three times from (24 to 26% in control) to (76 to 81% in treated seeds). Similar to our finding Zarekia *et al.* (2013) reported that scratch treatment is the best treatment for improving seed germination of some *Astragalus* species.

Result showed significant effect of cultivation method on seedling emergence and survival rate and significant effect of sowing date on growth condition ( $P < 0.01$ ). The sowing date by cultivation method interaction were significant for seedling emergence and survival rate ( $p < 0.05$ ), indicating that in each season, the cultivation method had different effects on the plant establishment (Table 1).

**Table 1:** Analysis of variance of sowing season and cultivation method for on seedling emergence, survival rate and growth score of *Astragalus flexilepes*

Source of variation	DF	MS		
		Seedling emergence	Survival rate	Growth condition
Replication	2	1.58	9.25	1.052
Sowing date (S)	1	48.00	96.33	3.808*
Error <sub>1</sub>	2	23.25	9.08	0.686
Sowing Method (M)	1	533.3**	385.3**	1.658
S×M	1	161.3*	120.3*	0.065
Error <sub>2</sub>	2	17.58	15.33	0.556

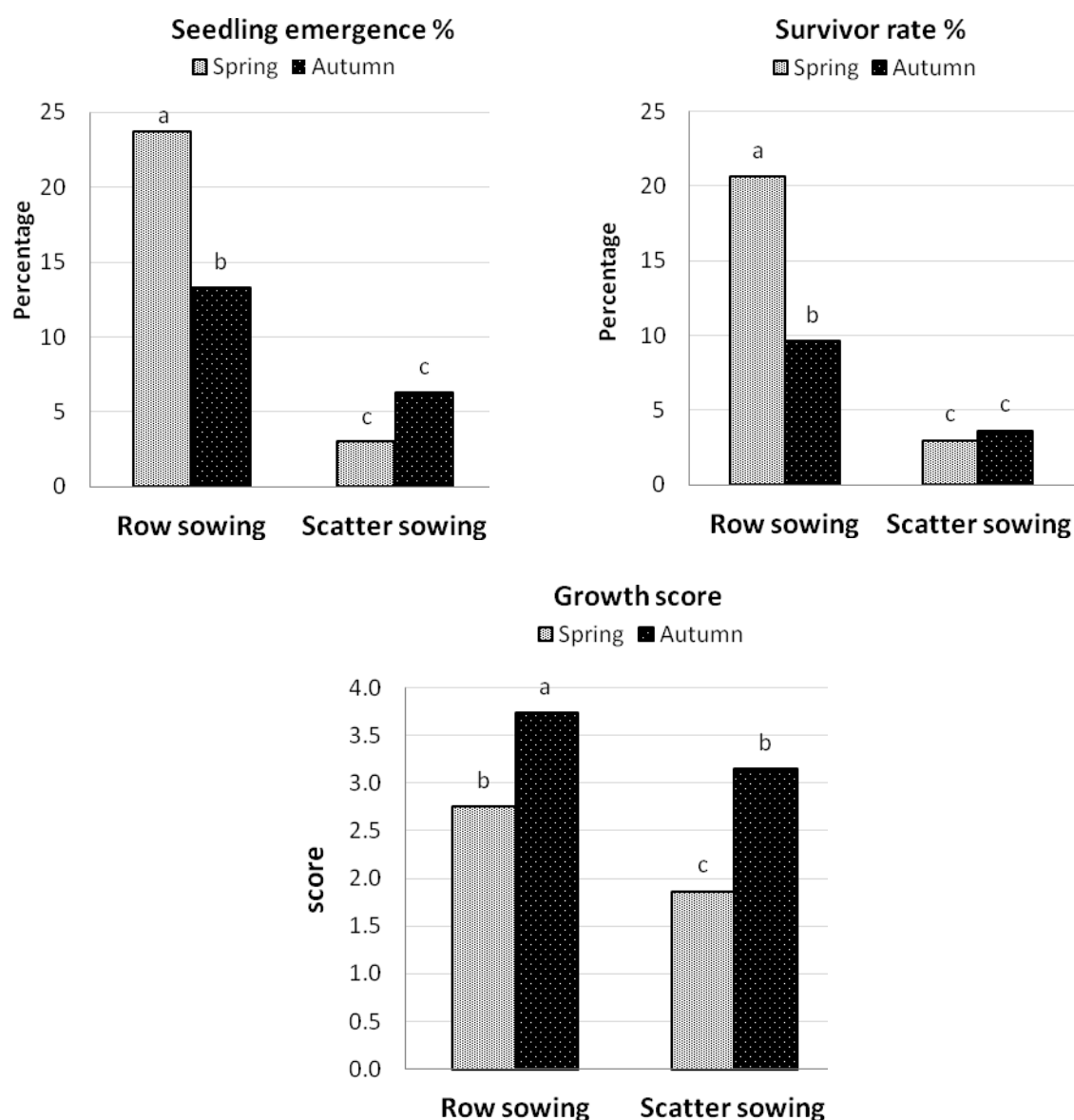
\*, \*\*= Means of square are significant at 5 and 1% probability levels and non-significant

Results of means comparison showed that the highest values of both seedling

emergences and survival rate were obtained in spring season coupled with row

cultivation method. The survival rate values were dramatically dropped from row cultivation to scatter sowing in the same season. In the other word, in the spring, the highest germination and survival rate with values of 23.67 and 20.67% were obtained in row cultivation method and they dropped to 3.0 and 3.0% for scatter sowing, respectively. The similar trend was observed in autumn. The highest values of germination and survival rate with values of 13.33 and 9.67% were

obtained in row cultivation method and they dropped to 6.33 and 3.66% for scatter sowing, respectively (Fig. 1.). The contradiction result was obtained for growth condition in two cultivation dates. In autumn, the highest growth scores of 3.74 and 3.15 were obtained for row sowing and scatter sowing method, respectively. Similarly, in spring season the values were 2.76 and 1.87, respectively.



**Fig. 1.** Means of sowing date by cultivation method interaction effects on seedling emergence, survival rate and growth score of *Astragalus flexilepes* using Duncan method at 5% level

## Discussion and Conclusion

Considering the retrogressive trend and limitations of habitats, the establishment of this valuable species is fundamentally necessary. This research shows that the row cultivation method in spring date was more successful than the autumn due to lack of coldness and presence of soil humidity in early spring. Climate changes affected the plants growth and reduce their production. Therefore, cultivation of desired species in the row sowing method in spring could be successful. It seems that such traits as growth condition had no significant difference between spring and fall but for other traits, the higher values were obtained in spring. Thus, the rows cultivation was recommended. This finding was in agreement with those reported by Zarekia *et al.* (2016) and Moshtaghyan *et al.* (2009). Some criteria including cultivation time, germination percent, and survivor rate and growth condition were the most important ones to specify the success of species establishment. *Astragalus flexilepez* L. is to be going extinct and the selection of appropriate cultivation time and method will improve its germination power in its habitat condition. Germination percentage in spring coupled with row cultivation method had a significantly increased the plant establishment. Considering high potential and nutritional value of the desired species, further researches should be done to expand the useful species in the rangelands and dryland farming while preserving the soil erosion and enhancing the fertility. It was concluded that the highest establishment was achieved in spring cultivation, but the vigorous plants was obtained in autumn cultivation. Thus, early spring cultivation of *Astragalus flexilipes* using row sowing method was recommended for rehabilitation of the poor condition rangeland in similar climate area having relatively lower temperature.

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## بررسی اثر فصل و روش کاشت بر استقرار گون *Astragalus flexilepes* L. در مراتع استان کرمانشاه

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**چکیده.** گیاه *Astragalus flexilepes* نوعی گون بدون خار و خوشخواراک مرتعی است که به دلیل تغییرات اقلیمی و چرای نامناسب دام، جزو گیاهان در معرض خطر محسوب میشود. هدف از انجام این پژوهش بررسی مناسب‌ترین روش و زمان کشت گونه مذکور یادشده مراتع روستای مله‌کبود واقع در شمال شرق شهرگهواره در استان کرمانشاه بود. کشت بذر در اواسط آبان (کشت پاییزه) و اسفند ماه (کشت بهاره) انجام یافت. پژوهش در قالب طرح آماری اسپلیت پلات با دو فاکتور اصلی تاریخ کشت (بهاره و پاییزه) و فاکتور فرعی روش کاشت (ردیفی و دستپاش) در قالب طرح بلوک‌های کامل تصادفی با سه تکرار در سال‌های ۹۶-۱۳۹۳ انجام شد. جهت افزایش درصد جوانه‌زنی، بذور در آزمایشگاه خراش داده شدند. نتایج این تحقیق نشان داد که بیشترین درصد سبز شدن به روش بذرکاری ردیفی در کشت بهاره بدست آمد ( $p < 0.05$ ). در مقابل، کمترین میزان جوانه‌زنی به روش بذرپاشی در هر دو فصل کشت به‌دست آمد. بنابراین روش بذرکاری در فصل بهار در داخل جویچه‌ها بصورت ردیفی به دلیل عدم برودت هوا و فراهم بودن رطوبت بیشتر در خاک، بر بذرپاشی معمولی در هر دو فصل برتری داشت. برای این منطقه و مناطق مشابه روش کاشت ردیفی در فصل بهار که در آن استقرار گیاهان بیشتر است توصیه می‌شود.

**کلمات کلیدی:** تاریخ کاست، روش کاشت، استقرار، گون، دیمکاری