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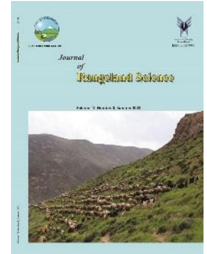

Research and Full Length Article:

Determination of Allowable Use and Grazing Tolerance of *Picris strigosa* (Case Study: Blooman rangelands, Lorestan Province, Iran)

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Abstract. *Picris strigosa* is a valuable forage species in mountainous rangelands of Lorestan province, Iran, which produces suitable forage for sheep grazing. The aim of this study was to determine the allowable use and grazing tolerance of this species. For this purpose, 50 individuals of *P. strigosa* were selected in its typical habitat and marked for monitoring after applying four levels of harvesting intensities including control (0%), 25, 50, and 75% of the annual production during 2007–2011. Treatments were investigated by clipping and weighing method every month from May to July in vegetation period. The results showed a significant difference in terms of forage production between treatments ($P \leq 0.01$). The highest and lowest forage production with average values of 42.45g and 15.23 g per plant were obtained in 0% harvesting rate (control) and 75% intensity rate, respectively. In other words, harvesting higher than 50% coupled with early grazing (April and May, in accordance with the local pattern and research method of this article) weakens the individuals. Continuation of this process also increases the mortality of the individuals (death of 30% of the stands at a harvest intensity rate of 75%). Due to the sensitivity of the species to early grazing, it was recommended that for such a dominant species, livestock should enter the pasture in early June. Maximum forage production in control and the fast reduction in forage production of 75% treatment emphasize that overgrazing of this species would completely eliminate it from the field. It was concluded that *P. strigosa* is sensitive to grazing and its sensitivity should be considered in rangeland management plans.

Key words: *Picris strigosa*, Harvest rate, Grazing intensity, Growth stage, Forage

Introduction

Plant vegetation plays an important role in the nutrient cycling of minerals (Tang *et al.* 2015), microbial content of soil (Hofmann *et al.* 2016), macro faunal community (Hu, *et al.* 2018), carbon cycling (Bachelet *et al.* 2017), biogeochemical cycling (de Graaff *et al.* 2014), ecosystems as the producer (Poore and Nemecek 2018) as well as controlling flood and sediment transportation (Vargas-Luna *et al.* 2015). Although several ecological aspects of *P. strigosa* were investigated, no information was found in literature regarding the reaction of this plant to livestock grazing and harvesting. Therefore, understanding the tolerance of *P. strigosa* to harvesting as a key species of drylands is very important for its sustainable exploitation.

P. strigosa is a vulnerable range plant species in steppe regions, which is important in several aspects amongst the others: soil conservation, facilitating water infiltration, conserving biodiversity and so on due to its high productivity, palatability, accumulating litter and canopy coverage. But due to its sensitivity to harvesting and overgrazing, it is declining in most rangelands of Lorestan province in Iran. Based on a rule of tomb, 50% of annual plant production is left intact for ecosystem and plant welfare and 50% is allowed to be harvested by livestock grazing (Ebrahimi *et al.*, 2010); however, this amount is not applicable for all plants with different grazing tolerance values. These function and services of vegetation are vital in arid and semi-arid biomes and are influenced by grazing intensities severely (Głowacz and Niżnikowski 2018). Therefore, conserving plant welfare in a such ecosystem is of great importance (Mureithi *et al.* 2016; Favretto *et al.* 2017). Determining which part of the phytomass is allowed to be foraged without endangering plant welfare, the so-called Harvest Coefficient (HC) is the cornerstone of proper management of rangelands. This coefficient should assign a part of the current herbage production, 1) to be consumed by wildlife rather than the introduced grazers, 2) to protect plant vigor, reproduction and regrowth; and 3) to maintain a certain stubble height for soil conservation purposes and proper functioning of the system (Ebrahimi *et al.*, 2010). From research on the grazing induced root-growth cessation of some grass species (Lamman, 1994), a general 50% HC was deduced. However, our understanding and knowledge on grazing tolerance of valuable species in terms of food producers, soil conversant and facilitator of mineral cycling of *Picris strigosa* are lack.

P. strigosa is a member of Asteraceae family, and many studies have described it as the herbaceous valuable and palatable forbs (Slovák *et al.* 2007; Ouarab *et al.* 2009; Habibian 2010; Jankju *et al.* 2011; Haidari *et al.* 2012) but it qualitatively was not studied. About 50 species of *Picris* genus have been reported so far around the world based on differences in taxonomic definitions. These species are widespread in Eurasia (Lack 1979) but 3 species of this genus are also reported in the East Africa while some indigenous species have been reported in Australia and New Zealand (Holzapfel 1994) too. *Picris* genus contains several groups of compounds originated from different morphological characteristics of each species (Slovák *et al.*, 2007), which may influence their resistance or tolerance to harvesting. *P. strigosa* as a forb species; however, it has been known as a relatively palatable but sensitive to grazing compared to other species. The emergence of leaves of *P. strigosa* begins in the early of spring, followed by stem elongation in the middle of spring; then, the flowering stage occurs in the late of spring to the beginning of summer (Siahmansour *et al.* 2013), ending the lifecycle of the plant with seeding in the middle of summer to beginning of autumn. The sensitivity to grazing of different species varies (Trlica, Buwai *et al.* 1977); also, results of vegetation data analysis showed that the lowest Vitality of canopy and forage production of *Salsola rigida* were recorded in the experimental plots under heavy grazing intensity (Baghestani *et al.* 2020) or Tasisa and Nemomissa (2019) found that the degraded rangelands can be restored by an increase of an enclosure and shadow of the trees from which pastoral community will benefit. However, utilization of grazing land is communal and rangeland around homestead and watering points were overgrazed and resulted in bare land and encroached by unpalatable and thorny species (Jarso, 2019).

This is more imperative in the recent decades due to climatic conditions due to accelerating plant extinction. Precipitation and grazing explain a significance although there is low proportion of compositional changes in the vegetation (Tabares *et al.* 2018). The effects of rainfall and overgrazing were investigated in the shrublands of Cairo from 1949 to 1971, indicating that inter-annual plant communities production was mainly influenced by rainfall while the effect of long-term grazing was an important driver of community composition (O'connor and Roux 1995).

Structure, function, and composition of plant communities in rangelands are in different grazing pressures ranging from low to heavy, by two different herbivores (sheep, cattle). In three different climatic zones, 7615 published articles were reviewed in Australia by Eldridge *et al.* (2016). The results indicated that grazing reduced structure (by 35%), function (24%), and composition (10%). Structure and function (but not composition) declined fastter when grazed by sheep and cattle together than sheep alone specifically in drier environments. *P. strigosa* has a preference index of 1.2, 1.3 and 0.9 in June, July and August, respectively, which is in the category of perfectly palatable plants. They also concluded that livestock grazing in Australia is unlikely to produce positive outcomes for ecosystem structure, function, and composition or even as a blanket conservation tool unless reduction in specific response variables is an explicit management objective (Eldridge *et al.* 2016).

P. strigosa is reported to be more sensitive plant species in a plant community dominated by perennial grasses. The palatability of this species has been reported to be lower than the shrubs in the arid lands that may be due to the lower water availability and woody state (Siahmansour *et al.* 2012). Therefore, due to the behavioral changes of the species, it is necessary to do more research on this plant so that it can be better managed in the habitat.

This research aimed to determine the effect of different intensities of grazing on forage production and to answer the question of allowable use factor and grazing period of *P. strigosa* for its sustainable production. Determination of allowable use factor of this species can guarantee its long-term welfare and reproduction and prevent its extinction that is dealt with in this study.

Materials and methods

This study was conducted in the Research Station of Zaghe, Lorestan, Iran located in 33°29′16″ N latitude and 48°40′25.7″ E longitude with an average elevation of 1,960 m above the sea level (Fig. 1), Long-term mean annual rainfall of the study area is 720 mm (1970-2010) that varies yearly, but during the study period (2006-2010), it received 570.6 mm in average annually. The rainy season is short, with 95% of the rainfall occurring between October and April in the study area. *P. strigosa* species has the density of 1,340 plants per hectare. The rangeland is mostly grazed by goats, sheep and cattle.

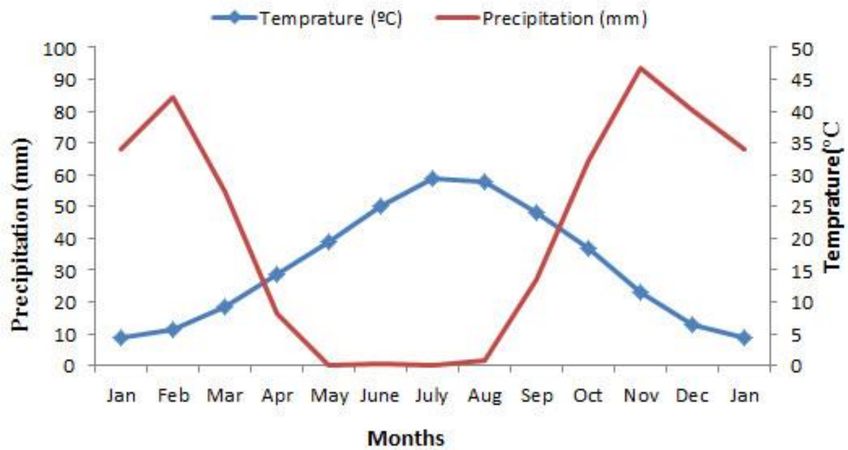

Fig. 1. Ambrothermic diagram of the studied station (1994- 2019)

Sampling method

At first, a representative site of the species' habitat was selected within the study area. In this site, 50 healthy individual plants of *P. strigosa* (Fig. 2) were selected with more or less in the same age, diameter, height, and canopy area. Plant individuals were marked using an Iron-flag named with the species code fixed during the study period of 5 years (2007–2011). After that, *P. strigosa* plant individuals were treated by four grazing intensities of 0 (control), 25, 50, and 75%. Each group was numbered accordingly 1 to 10 (control plants without any grazing), 11-20 (25% harvesting rate), 21-30 (50% harvesting rate), 31 to 40 (75% harvesting rate) and finally, 40-50 control plants. The total annual production of control plants was measured at the end of grazing period when the plant reached to its end of life cycle annually (Siahmansour *et al.*, 2012 and 2013). This process was reassessed over 4 years. Plants were cut based on the research method in harvesting rate of 0, 25, 50 and 75%, using a pair of hand scissors and then weighed. These treatments were considered to simulate livestock grazing during the growing season and active growth stage of the plant for four times a year including May, June, and July. Therefore, plant individuals harvesting treatments were repeated yearly during the sampling period. Samples were weighed after coding, transferred to the laboratory, and dried in an oven of 70°C for 48 hours. In addition, all of above-ground-phytomass productions were separated from clipped crown at the end of growth stage. The control plant individuals were clipped in a completely dried state at the senescence stage from 5 cm above ground and were weighed as the control samples.

Data were prepared into an Excel worksheet, analyzed based on a completely randomized design (One way ANOVA) where the harvesting rates were regarded as the treatments and forage yield of each individual plant was measured as replication and finally, means comparison was performed using a Duncan's test.

Fig. 2. *Picris strigosa* in flowering stage, flowers and seeds

Results

The results of ANOVA showed significant differences between treatments (harvesting intensities of 25, 50 and 75% and control) for plant production for each year and average over four years of 2007-2010 (P<0.01) (Table 1).

Means of forage production in different harvesting rates for the sampling periods of 2007-2010 were compared by Duncan method (Table 2). The harvesting intensities of 25, 50 and 75% were significantly different from control (no grazing) in all years except 2008. The high forage production was observed in 25% treatment in all years. The results indicate that the harvesting rate (75%) significantly decreases forage production of *P. strigosa* than other treatments in all years, and this treatment caused decreasing of plant production from 2007 to 2010. (Table 2)

Statistical analysis showed that there was no significant difference between three harvesting intensities of 25, 50 and 75% in the first year (2007) but all three treatments had significantly lower production than that for control. The cumulative production of the studied years indicated that harvesting rate of 25% during the growing season may less harm to plant welfare than harvesting rates of 50 and 75%.

Table 1. Analysis of variance (ANOVA) of *Picris strigosa* plant material with different grazing intensities (P<0.01) during different sampling years

Source of variation	DF	MS				
		2007	2008	2009	2010	2007-2010#
Between Groups	3	1367.66**	370.18**	2638.81**	3305.75**	5689.39**
Within Group	36	148.86	164.31	53.397	54.49	163.88
Total	39					

**= Significant at 1 % probability level
#=DF of between group and within group are 4 and 165, respectively

Result showed that during the period of 2007 to 2010, the maximum forage production of control with average value of 50.02 g/stand was obtained in 2007, whereas, the average production of control over four years was 42.45g. The average production of control in 2010 was 45.69 g. Although harvesting rates of 25.50 and 75% lead to significant diminishing of the average annual production of plants, in the first year, average production of 75% was slightly higher in harvesting than 25% and 50% harvesting (Table 2).

Table 2. Means±SE of *Picris strigosas'* forage production in different harvesting levels in the four sampling years and averaged over 4 years (2007-2010)

Grazing Intensity	Years				
	2007	2008	2009	2010	2007-2010#
	Forage production (g/ stand)				
25%	26.49 ± 4.46 [b]	21.03 ± 5.36 [ab]	11.48 ± 2.45 [b]	4.76 ± 1.08 [c]	15.94 ± 2.24 [b]
50%	25.33 ± 2.18 [b]	18.15 ± 3.98 [b]	9.44 ± 2.43 [b]	3.67 ± 1.91 [c]	14.15 ± 1.87 [b]
75%	28.53 ± 5.86 [b]	20.89 ± 4.45 [ab]	8.45 ± 1.96 [b]	2.98 ± 1.20 [c]	15.21 ± 2.45 [b]
Control	50.02 ± 0.70 [a]	31.90 ± 1.14 [a]	42.18 ± 2.37 [a]	45.69 ± 1.64 [a]	42.45 ± 1.32 [a]

Means of column with the same letter are not significantly different based on Duncan method

Result showed that during the period of 2007 to 2010, the maximum forage production of control with average value of 50.02 g/stand was obtained in 2007 whereas the average production of control over four years was 42.45g. The average production of the control differs significantly ($P \leq 0.01$) with harvesting treatments (25, 50 and 75%) for each year and averaged over four years (Table 2).

The average production of different harvesting intensities is presented in Fig. 3. The slope of linear regression was slow in the first year indicating that no linear trend was observed between treatments. But the slope of linear regression in the last year was stronger indicating that 75% harvesting rate significantly decreased plant production in 2010 and also caused death of 30% of the plant stands.

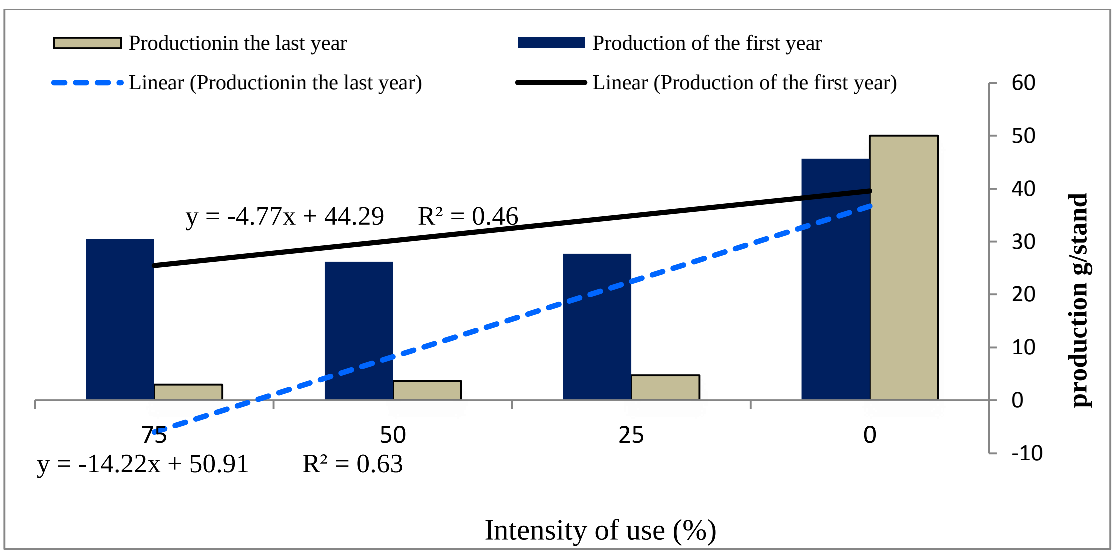

Fig. 3. Compromise the amount of cumulative production with production quantities during the first and last years of implementation of treatments and their regression

As shown in Fig. 4, the phenological stage of *Picris strigosa* overlaid on an amberothermic graph of the study area and indicated that plants emerge at the end of April and beginning of May, the vegetative period evolved in June, the flowers is appeared in the beginning of August, seedling in September, maturity occurs in October and finally, senescence reaches at December (Fig. 4). This species is not sensitive to harvesting after flowering stage whereas it was highly sensitive at the beginning of vegetative stage (Table 3); therefore, significant delay in grazing of vegetative stage is recommended. As a forb species, its resistance to grazing is very low at the vegetative stage; therefore, in high stocking rate, this species is amongst the first vulnerable species to extinction even by low harvesting rate of 25%. Our filed observation discloses that the population of this species is very low in the other rangelands where high stocking rate is a commonplace phenomenon, so we suggest that the phenological stage of this plant should be taken into account for initiation of grazing in vegetation types; this species composes a large portion of plant communities due to high sensitivity of the species to harvesting (Fig. 4 and Table 3).

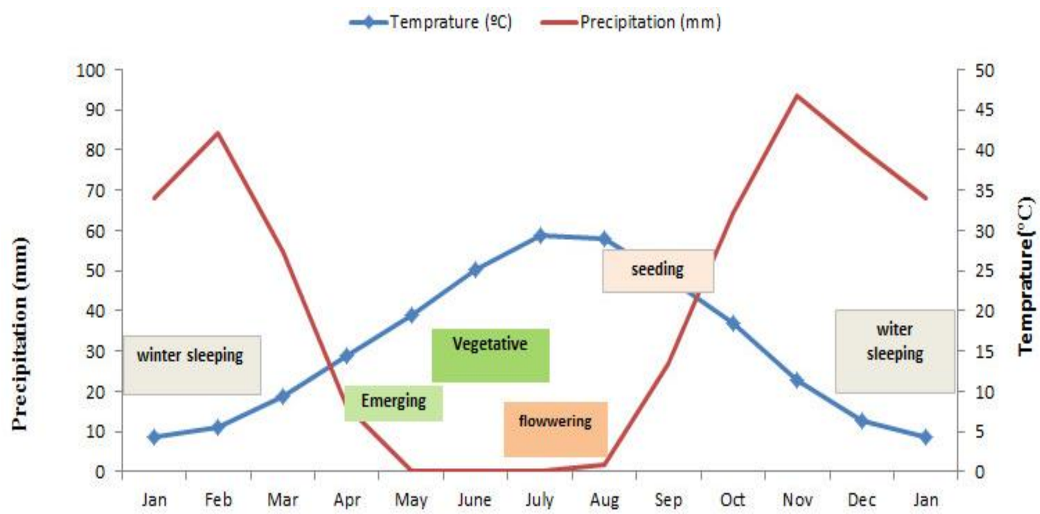

Fig. 4. Depicting the phenological stage of *Picris strigosa* on an amberothermic graph of the study area, emergence starts at the end of April and beginning of May, the vegetative period evolved in June, the flowers are presented in the beginning of August, seedling in September, maturity occurs in October and finally senescence reach at December

Harvesting rate of 75 and 50% endangers plant welfare, but 25% of harvesting rate caused only 10% plant distinction when compared to the control plants. Despite increasing plant production by 75% harvesting rate compared to 50% harvesting in the first year, the vigor and vitality of the plants and consequently, the rate of mortality were increased by harvesting rate of 75 and 50% compared with 25% in the long-term period. P. strigosa was not sensitive to harvesting after flowering stage; whereas it was highly sensitive at the beginning of vegetative stage even with low harvesting rate of 25% (Table 3).

In this situation, even 30% of the plants individual were declined, which was similar to the 75% harvesting rate. Although harvesting rate of 25, 50, and 75% leads to significant diminishing of the average annual production of plants, the average production per stands was slightly higher in harvesting rate of 75% in 2007 than 25 and 50% harvesting (Table 3).

Table 3. Average of forage harvested per month and year in different grazing intensities (g/ stand)

Year	Month	Grazing intensity			
		25%	50%	75%	Control (0%)
		Forage production (g/ stand)			
2007	May	1.02	0.96	2.96	
	June	2.66	4.18	4.92	50.2
	July	8.69	10.02	10.3	
	Plant residuals after harvesting	14.1	10.16	10.35	
2008	May	0.93	1.27	2.10	
	June	2.76	3.16	4.33	31.90
	July	4.51	4.12	5.66	
	Plant residuals after harvesting	12.83	9.6	8.81	
2009	May	0.75	0.74	0.73	
	June	1.85	1.59	1.61	42.8
	July	1.78	3.77	2.00	
	Plant residuals after harvesting	7.10	3.41	4.11	
2010	May	0.57	0.5	0.50	
	June	1.35	0.73	0.68	45.69
	July	0.63	0.57	0.46	
	Plant residuals after harvesting	2.21	1.87	1.42	

The vigor and production of control stands of *P. strigosa* were in the proper condition in 2007; nevertheless, rainfall influenced these properties significantly in the following years of 2008 to 2010. In 2009, the forage production in harvesting rates of 25, 50, and 75% was 11.48, 9.44, and 8.54 g/stands, respectively. In addition, harvesting rates of 25, 50, and 75% caused extinction of 10, 20, and 30% of plant stands respectively as well as reducing vigor and vitality of *P*. strigosa (Table 4). Considering phenological stage of this plant (Fig. 4), a two-month delay in grazing of this species with implementing low intensity harvesting rate of 25% seems to be the best choice in grazing planning where this species is a predominant rangelands species. The average forage production per stand of P. strigosa species reduced from 2007 to 2008 during the investigation months of the growing season for 25, 50, and 75% treatments of harvesting by 27.7, 26.2, and 28.53 g, respectively while comparing to 2010; it was reduced only 4.76, 3.67, and 2.56 g respectively (see Table 4).

Table 4. Harvesting rate of *Picris strigosa* and its effects on vitality and plant production per stands during the inventory periods of 2007-2010

Year of study	Harvesting Rate (%)	Mortality (%)	Vitality (%)	Harvested forage (g)	Forage residual after harvesting (g)	Total production (g/stand)
2007	25	0	10	12.4	14.1	26.49
	50	0	9	15.1	10.2	26.2
	75	0	9	18.1	10.4	28.53
	Control	0	10	0.0	0.0	50.02
2008	25	0	9	8.2	12.8	21.0
	50	0	8	8.6	9.6	18.2
	75	0	8	12.1	8.81	20.91
	Control	0	10	0.0	0.0	31.9
2009	25	0	7	4.4	7.1	11.5
	50	0	6	6.1	3.4	9.5
	75	0	6	4.4	4.1	8.5
	Control	0	10	0.0	0.0	42.2
2010	25	10	8	2.6	2.21	4.76
	50	20	6	1.8	1.87	3.67
	75	30	5	1.6	1.42	2.98
	Control	0	10	0.0	0.0	45.69
Control (4 Years)	0	30	6			16.73

The results showed that serious damage to individuals was happened in 75% harvesting rate and caused dead 30% individuals at the end of experiment. In other word, in the last year of the experiment, 10%, 20% and 30% of individual plants were died by harvest rates of 25%, 50% and 75%, respectively.

The results revealed that the harvesting intensities coupled with annual precipitation may affect plant production. This pattern was observed in 2008 too and 50% harvesting rate still caused a slight lower production.

Discussion

Picris strigosa is an important species in arid to semi-arid rangelands from ecological and economical point of view. In this research, we investigated its tolerance to harvesting. In the first step, its production under 0, 25, 50 and 75% harvesting rate was evaluated. The results of ANOVA indicate that there was a significant difference between productions of this species under implemented harvesting rates ($P \leq 0.01$) in different years. The highest decreasing of production was observed from the first to the last year of study when 75% harvesting rate was implemented (from 28.53 to 2.98 g/stand). The lowest decreasing of forage production was also observed when 25% harvesting rate was performed (from 26.49 to 4.76 g/stand) where in the control samples, this decreasing was neglectable (from 50.02 to 45.69 g/stand). In other words, annual production of control was reduced in the control samples by 4.33 g/stand, which may be due to the interference and preventing the growth of the new shoots by remaining semi-woody stems of the previous years. Therefore, different levels of harvesting should not be considered simultaneously. High level of harvesting (75%) significantly decreases forage production of *P. strigosa*, which may endanger this plant productivity in long-term period. Looking at Table 2 reveals that not only harvesting rate, but also climatic condition and more specifically precipitation of the current and previous years also influence production significantly.

There was no significant difference between production of harvesting rates (25, 50 and 75%) in the first year (2007) but a significant difference was found with control (50.02 g/stand). This may be due to the presence of sufficient food reservoir in the organs and roots of the plants from the past years, which ensures the life and regrowth of the plant individuals. However, the slope of production curve in comparison to control plants showed that the increase in harvesting intensity in the following years decreases productivity dramatically. The cumulative production of the studied years suggests that harvesting rate of 25% during the growing season is the best harvesting rate to assure plant welfare and guarantee the regrowth of the plants. Significant reduction of production in the harvesting intensity of 50% seems to remove the apical meristem of plants which limits the regrowth of plant and producing the secondary shoots and branches (compared with 25% harvesting rate). The *P. strigosa* faced with a serious damage in 75% harvesting rate during the four years of study period. At the first glance, they were stimulated to regrowth; therefore, the production of plant individual increases in the short term periods (2007) but finally, their production decreases severely in the long term periods (2010) and 30% of these plants were unable to regrowth and extinct after four years of harvesting. Looking at plant vigor and health as well as their production indicates that plant death rate increases by continuation of harvesting in the consequent years. Therefore, the harvesting intensity of 25% is preferred for plant welfare due to lower death rate of plant individuals as well as increasing the relative production. Nevertheless, severe harvesting rate of 75% is not recommended during the vegetative period of the plant, but harvesting of senescence plant materials seems to be possible after plant maturity and finalizing its life cycle. Harvesting or grazing of the newly-emerged leaves will reduce photosynthetic capacity; consequently growth rate, and eventually, it will result in plant death. Results indicate that in the last year of applying treatments, 10% of plant individuals that have been harvested by 25% treatment, as well as 20% of plant which were harvested by 50% treatment, and 30% of plant individual harvested by 75% treatment died and their roots were unable to regrowth in the following years where they lost their germination and declined. It was revealed that *P. strigosa* is a very sensitive species to harvesting whilst 75 and even the 50 % harvesting are for rare, endangered plants, 25% of harvesting rate seems to assure plant welfare in long-term when compared to the control plants. When no harvesting (grazing) is implemented (controls), some plant production is wasted and unused whilst 75 and 50% harvesting rates caused significant extinction of the plants (30 and 20% respectively). The Highest production may be expected from the 25% harvesting rate rather than 75 and 50%. Despite of increasing plant production by 75% harvesting rate compared to 50% harvesting in the first year of sampling, the vigor and vitality of the plants and consequently plant death rates confirm that the reduction of production and high rate of plant mortality by harvesting rate of 75 and 50% will endanger plant welfare and survival in the long-term periods compared with 25%. In a review study by Eldridge *et al.* (2016), they have also concluded that grazing reduced plant biomass (40%), animal richness (15%), and plant and animal abundance, and plant and litter cover (25%), but had no effect on plant richness nor soil function. Grazing effects on plant and animal richness and composition were constant, or even declined, with increasing aridity. Due to significant reduction of production of this plant by even 25% harvesting rate that may also endanger plant welfare in a longer period of harvesting, specifically, in the severe drought years, which is a commonplace phenomenon of the arid lands, we recommend harvesting of this plant material at the end of the vegetative period (senescence) in which harvesting (grazing) will not damage the plant significantly.

Climate condition, specifically amount of rainfall influenced vigor and production of the species significantly (Table 4). During the period of 2007 to 2010, the maximum mean of production occurred in 2007 (50.02 g/stand compared with the mean production of the studied years with 42.45 g) which significantly differs with other years ($P \leq 0.01$). This led to the conclusion that the root reservoir of soluble carbohydrates in this plant is low; therefore, it was significantly influenced by high harvesting intensities and the amount of annual rainfall.

In the absence of harvesting (control stands), it seems that the branches of the previous years (woody branches) inhibited the growth of the New Year shoots and reduced its production. In other words, low intensity harvesting may stimulate regrowth of the species. After cutting and weighting of senescence residuals in every year, we found that the average production of the control treatment differs significantly with harvesting treatments of 25, 50 and 75% ($P \leq 0.01$) (Table 4). This leads to the decreasing of average production per stands from 42.45 to 16.73g after 4 years of unharvesting. The amount of 744mm rainfall in 2007 seems to be the reason of this outcome as Conner (1995) reported a significant relationship between plant production and rainfall. However, unexpected lower production of 50% harvesting compared to 75% may be caused by the plants physiological disruption in the first year and struggling for survival in the later as in the last year of sampling, the amount of plant production increased in 50% harvesting rate than in 75% (9.5 and 8.5 g/stand for 2009 and 4.76 and 3.67 g/stand for 2010). This means that 50% harvesting intensity did not forced the plant regrowth whereas 75% harvesting rate caused plant regrowth and consequently, reduced reservoir carbohydrates that limits both reproduction and regrowth of the species in the consequent years (2009 and 2010). This pattern was observed in 2008 too whereas 50% harvesting rate still caused lower production. By the way, it was compensated in the following years due to more soluble carbohydrate reservoir. But decreasing of plant production per stands by 75% harvesting intensity from 28.53 g in 2007 to 20.89 g in 2008 may have been caused by the stress of harvesting in the previous year, and dropping rainfall from 744 mm in 2007 to 354mm in 2008 that intensified the stress of harvesting and declined the plant production. Johnson (2007) evaluated and reported the effects of livestock grazing in different intensities and compared it with ungrazed plants and concluded that low intensity grazing provides plant welfare which is consistent with the findings of the present research. *Picris strigosa* is not highly sensitive to the harvesting at flowering stages and maturity and senescence; but it is very sensitive at vegetative stage. Therefore, if the meristems and petioles are completely removed, the plant will not be able to survive. This fact is very important when considering the productivity of this species. Therefore, considering its high sensitivity to harvesting at the vegetative stage and its phenological stage which is later than most of the arid land ephemeral forbs species as well as are productivity, early stage grazing of this species is not recommended (see Siahmansour *et al.*, 2012). Enclosure and light grazing seems to provide a chance for the plants to tolerate environmental stress such as grazing more effectively (Johnson 2007). In this research, 0, 25, 50, and 75% harvesting rates of this species were examined and based on production (Table 2), vigor, vitality and mortality rates (Table 4), we concluded that 25% harvesting rate of this species assures plant welfare in the long-term period in comparison to 50% and 75% harvesting rate that endangers it significantly. This issue should be considered in grazing planning specifically initiation of grazing. Notably, deterred grazing system until the flowering stage should be implemented for assurance of this species survival. We came to this conclusion from these results that *P. strigosa* as a forb species is highly sensitive to climatic condition of the year; therefore, taking into account yearly climatic condition in planning grazing intensity and grazing duration is critical for the vitality and production of this plant.

Conclusion

In brief, the following general conclusion can be made from the results of this study:
Unharvesting of *P. strigosa* significantly reduced its production in one hand and on the other hand, intensive harvesting rate of 75 and 50% almost increased the mortality rate of the species by 30 and 20% respectively after four years of the study period. 25% harvesting rate seems to be an appropriate harvesting rate due to both stimulating regrowth and guaranteeing plant welfare and vitality.

P. strigosa as a forb species is not only sensitive to intensive harvesting rate but also to the harsh climatic condition; therefore, implementing deterred grazing system (Protective grazing system) specifically in drought condition is vital for this plant survival.

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تعیین حد مجاز بهره‌برداری و مقاومت به چرای گونه *Picris strigosa* (نمونه موردی مراتع ییلاقی ارتفاعات بلومان استان لرستان)

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چکیده. یکی از گونه‌های گیاهی با ارزش استان لرستان *Picris strigosa* می‌باشد که با وجود تولید علوفه مناسب تاکنون از جنبه بهره‌برداری مورد مطالعه قرار نگرفته است. هدف از این مطالعه تعیین حد بهره‌برداری مجاز این گونه می‌باشد. برای این منظور تعداد ۵۰ پایه متوسط از این گونه در منطقه معرف انتخاب شد. پس از اعمال چهار سطح شدت برداشت شاهد ۰، ۲۵، ۵۰ و ۷۵ درصد از تولید سالانه طی سال‌های ۲۰۱۱–۲۰۰۷ حد مجاز بهره‌برداری آن‌ها تعیین گردید. مقادیر برداشت هر شدت چرایی به نسبت هرماه با روش قطع و توزین انجام شد. نتایج حاکی از معنی‌داری اختلاف تولیدعلوفه بین شاهد و تیمارها می‌باشد **(P≤0.01)**. بیشترین و کمترین تولید علوفه با ۴۲/۴۵ و ۱۵/۲۳ گرم در پایه به ترتیب در شاهد و شدت چرای ۷۵٪ بدست آمد. به عبارت دیگر برداشت بیش از ۵۰٪ و چرای زودرس (فروردین و اردیبهشت، منطبق با الگوی محلی و روش‌تحقیق) باعث تضعیف پایه‌ها گردید. ادامه این روند حذف پایه‌ها را افزایش داد (مرگ ۳۰٪ از پایه‌ها در شدت ۷۵٪). با توجه به حساسیت گونه به چرای اول فصل، توصیه می‌شود تا رویشگاه‌های با غالبیت گونه، دام اوایل خرداد به مرتع وارد شود. تولید حداکثری علوفه در شاهد و شیب تند روند کاهش تولید در تیمار ۷۵٪ تاکید می‌کند که در چرای مفرط این گونه کاملا از عرصه حذف خواهد شد. در این مطالعه مشخص شد *P. strigosa* حساس به چرا است و باید در برنامه‌های مدیریت مرتع حساسیت آن مدنظر قرار گیرد.

کلمات کلیدی: *Picris strigosa*، ضریب برداشت، شدت چرایی، مرحله رویشی، علوفه