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Full Length Research Paper

Effect of sheep grazing on forage yield, yield components and grain yield of local black barley, under rainfall conditions in Iraqi Kurdistan

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In Iraqi Kurdistan, farmers usually graze young barley if it sown early in fall and then let the crops recover for grain production. Barley field that was established from the seeds of harvest lost from the previous season (2008 to 2009), due to poor adjustment of the combine harvester. The plant population density was 190/m² at 13-2-2010; this was close to the normal rate 200 /m². The field was exposed to different grazing intensity; including two and four ewes which were fixed by ropes and wedges in the centre of the circle plots of 2.82 m radius to form an area of 25 m²; for three and six hours grazing duration in addition to none grazing treatment. Results revealed that, grazing treatments reduced significantly all measured characters (excluding number of tillers with no spike). The effect of grazing duration was more obvious than that of grazing intensity by increasing the number of ewes per plot. Therefore, the lowest plant height value was recorded for the treatment of four ewes grazed six hours; this was true for spike length, number of grain per spike, grain yield/spike, number of spike/m², grain yield/m², biological yield and grain yield/donum. There were reverse results for harvest index; it was increased with increasing number of ewes and grazing hours or by stress on plants this was attributed to the fact that, reduction of straw was more drastic than that of grains. The amount of reduction of straw and grain from the treatment of four ewes and six hours grazing was 59.63 and 49.15%, respectively.

Key words: Grazing, sheep, barley, grazing intensity, plant height.

INTRODUCTION

Barley (*Hordeum* sp. L) is a dominant winter crop, as it is always gives higher yield than wheat and its straw is more preferable to sheep than wheat (*Triticum aestivum* L). In rainfed conditions, like all other countries of West Asia and North Africa, some farmers permit sheep (*Ovis aries*) to graze young barley crops and then let the crops recover to allow grain harvest at maturity (Yau, 2003).

Sheep owner usually suffer from forage deficit during winter, as pastures plants are of little growth due to low temperatures, grazing at this stage will deteriorate the pasture; at that time the price of concentrated rations almost go up steadily. Therefore, seeking for reasonable sources for animal's forage can be achieved by grazing early growth cereals as barley to fulfill the shortage of animal's requirement and also, to protect crops from lodging.

All cereals, regardless of species, are a good quality feed source. Good live weight gains are achievable when grazing cereals as they have good metabolisable energy levels and are high in digestibility and crude protein.

The practice of green stage grazing, help to gain a certain amount of nutritious forage, but may reduce straw and grain production, particularly when conducted in late growth stage. This practice is common in Morocco (Belaird and Morris, 1991); Syria (Mazid and Hallagian, 1983) and Tunissia (Amara et al., 1985).

In South Australia, barley growers are becoming increasingly interested in grazing crops as a form of canopy management and to provide early sheep feed. The effect of grazing on barley recovery and yield has

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Table 1. *Monthly rainfall for season, 2009 to 2010.

Months	Rainfall (mm)
October	0
November	26.8
December	50.7
January	151.2
February	166.9
March	24.2
April	107.6
May	4.7
June	0
Total rainfall	532.1

*Meteorological station at the Faculty of Agriculture and Forestry.

Table 2. Soil physical and chemical traits.

Soil traits	Value
N	1512 ppm
P	2.59 ppm
K	85.90 ppm
pH	7.9
Ec dS/m	0.55
Organic matter	1.18 g/kg
Soil texture	
Sand	2.76%
Silt	43.34%
Clay	53.94%

Rajab (2010).

been studied by Lovegrove and Wheeler (2008) to assess the effect of simulated grazing regimes on dry matter production, grain yield, etc. Their results revealed that, late grazing at Zadoks growth stage 30 (ZGS30) reduced barley yield while early growth stage (ZGS20) and continuous grazing (beginning at 2-leaf stage, grazing six times in four weeks) had no impact on grain yield.

The objective of the current study is to test whether in Duhok governorate of Iraqi Kurdistan, as a semiarid area, sheep grazing before stem elongation stage has any impact on straw and grain yield of local black barley cultivar when grown early in the season, getting at the same time the benefits from grazing green forage during winter. Carrying capacity of the field can also be determined.

MATERIALS AND METHODS

The experiment was carried out during the growing season 2009 to 2010 at Faculty of Agriculture and Forestry farm, Duhok University, Iraqi Kurdistan (situated between longitudes 43.01°E, latitude 36.84°N and altitude 583 m above sea level) under rain-fed conditions with an average annual rainfall 500 mm. Climatic information and soil physical and chemical characteristics are represented in Tables 1 and 2, respectively).

The experiment comprised an area of 700 m² of two rowed local black barley which was established from the seeds of harvest lost from the previous crop (June 2008 to 2009), due to poor adjustment of the combine harvester. Rainfall events during November and December secured abundant soil moisture (77.5 mm, Table 1), which encouraged early germination, seedling establishment and vegetative growth, particularly with application of 10 kg of urea (46% N) fertilizer/donum (1/4 hectare) during January. The plant population density was 190/m² when measured at 13-2-2010, that was close to the normal rate 200/m²; plants were at six tillers stages and at 32 cm in height, that was correspond to Zadoks (1974) growth stage 26 (the time that tillers continue to be formed and the plant has main shoot and six tillers).

Forage dry weight per 25 m² plot was 2.5 kg; each ewe required 2% of live body weight of dry matter daily (Holechek et al., 2004). Therefore, as the average weight of Karadi ewe was 52 kg, then each ewe need 1.04 kg dry forage/day. Accordingly, we designated two and four ewes to graze the plot of 25 m². The fields was exposed to different grazing levels, thirty six Karadi ewes of a uniform age (four years) and with an average live body weight of 52 kg, were involved in the trial. The experiment was designed as completely randomized blocks, comprising five treatments combination (none grazing, two ewes grazed three hours, two ewes grazed six hours, four ewes grazed three hours and four ewes grazed six hours); with three replicates. Figure 1 shows the experiment layout.

The experiment comprised of (15) circle plots, each circle of 2.82 m radius to form an area of 25 m² (2.82×2.82×3.14), circles were 0.5 m apart from each other, circles circumference were marked by gypsum. Ewes were fixed by ropes and wedges in the center of the circle (Figure 2), for the specified grazing duration which was three and six hours. Average of ten plants height after grazing was 8 cm. All treatments were left to maturity, at 12/5/2010 when the plants were at ZGS90 (this stage denotes physiological maturity, followed by kernel ripening and grain drying) plants were harvested and the average of ten plants for vegetative characters were recorded; plant height from soil surface to top of the spike (excluding the awn), straw yield, yield components and grain yield were measured for 1 m² and transformed per donum. The recorded data was subjected to statistical analysis using SAS program version, release 6.12 (1999). Means were tested according to Duncan's multiple range test (1955), at 0.05% level of significant.

RESULTS AND DISCUSSION

Results in general emphasized that grazing treatments reduced significantly all measured traits (excluding number of tillers with no spike), although, there was a compatible trend in the reduction values of the traits with increasing the number of ewes and prolonging the grazing duration, but the effect of grazing duration was more pronounced than grazing intensity, thus increasing grazing duration from three to six hours reduced all measured traits much more obvious that that of increasing grazing intensity by increasing the number of ewes from two to four for grazing 25 m² (Table 3).

Therefore, the lowest plant height value was for the treatment of four ewes grazing for six hours that was true for spike length, number of grain/spike, grain yield/spike

Figure 1. Experiment layout.

Figure 2. Tied ewes graze freely within marked circle.

Table 3. Effect of ewe's number and grazing hours on vegetative growth, yield components and grain yield of local black barley. Within each trait values sharing alphabetical letters are not significantly different at 0.05 level of significant (Duncan's MRT, 1955).

Treatments	Plant height (cm)	Spike length (cm)	No. of grains/ spike	Grain yield (g)/ spike	No. of spike/ m²	No. of tillers with no spike /m²	Straw yield (g)/m²	Grain yield (g)/m²	Biological yield (g)/m²	Harvest index	Straw yield kg/ donum	Grain yield kg/ donum
None-grazed	9.33a	6.39a	9.13a	71a	a		466.76a	332.53a	779.30a	41.55c	1166.22a	831.33a
2 ewes 3 h	60.98b	88b	16.63b	8b	53.33b		282.43b	259.57b	42.00b	47.88b	706.08b	648.92b
2 ewes 6 h	6.02bc	24d	5.96b	54bc	84.33c		191.50c	220.00c	11.50c	53.39a	478.75c	550.00c
4 ewes 3 h	6.55bc	43c	03b	2cd	06.77bc		185.00c	195.73cd	80.93cd	51.37a	463.00c	489.33cd
4 ewes 6 h	2.55c	4.91e	4.53c	48d	321.00d		188.40c	169.07d	57.47d	47.29b	471.00c	422.67d

and the number of spike/m², grain yield/m², biological yield and grain yield/donum.

There was reversed result for harvest index, it was increased with increasing number of ewes and grazing duration hours or by stress on plants, this was attributed to the fact that, the declination of straw was more drastic than that of grains, which was resulted in higher harvest index with grazing practice. These results are in harmony to that of Lovegrove and Wheeler (2008) who demonstrated that, un-grazed treatment gave harvest index for barley 42.03, while for late grazed it was raised up to 44.08. The amount of reduction due to four ewes and six hours grazing for straw and grain were 59.63 and 49.15%, respectively.

These reduction in traits values were coincide with that of Lovegrove and Wheeler (2008) who stated that, a single late graze (Zadoks GS30- ear at 1 cm - pseudostem erect - stem elongation begins at this stage and the leaf sheaths are strongly erect at this stage) removed more dry matter than continuous grazing over a four -week period. Late grazing reduced barley grain yield, while early (Zadoks GS20- this stage denotes main shoot only) and continuous grazing treatments (beginning at two leaf stage, grazing six times in four weeks) had no impact on grain yield.

In this experiment, the field was grazed late (Zadoks GS26); concerning the planting date, it was actually established from previous harvest lost, most tillers that contribute to grain yield have formed by this stage, thus, grazing at this stage have deleterious impact on final grain yield.

Relative to ungrazed plot, late grazing at ZGS26, reduced both straw and grain yield, but some dry matter have been utilized by sheep through grazing, this option depends to farmers situation may be a useful management to reduce or avoid barley lodging, as shown from harvest index which was increased by grazing. While these results contradict those of Yau (2003) who reported that, grazing or clipping barley before stem elongation by sheep planted early in the season may not lead to grain and straw yield reduction. Thus, if barley growers in semiarid areas allow such a practice, they may gain a certain amount of forage. The results of Yau (2003) consistent with those of Redmon et al. (1995) where grazing by cattle of winter wheat in southern USA usually has a minimal effect on subsequent grain yield if soil moisture at planting and subsequent precipitation during the growing season is adequate. These researchers confirmed that, if external conditions are favorable after grazing, the crops will recover and produce grains. Current research suggests not to grazing barley crop late as it significantly lower most of growth characters and ultimately grain yield.

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