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BARLEY GENOTYPES CLIPPING (FORAGE) AND GRAIN YIELD PRODUCTION UNDER RAINFED CONDITIONS OF HIGHLAND BALOCHISTAN, PAKISTAN

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Abstract

In the highlands of Balochistan farmers face acute shortages of feed for livestock during the winter season (November-February) and are forced to graze their wheat or barley crop to save livestock from mortality and maintain health for the breeding season. In Balochistan inter and intra-seasonal environmental variability is very high with low and erratic rainfall and drought periods during the life cycle of the crop, barley tends to escape the stress and adapt to environmental stresses.

An experimental trial was conducted in Randomized Complete Block Design (RCBD) in triplicate during the cropping season to evaluate different barley genotypes for their dual purpose use as forage and grain yield under rain-fed conditions of highland Balochistan.

The data showed the highest fresh biomass for genotype AZRC-B-9 with a production of 7369 kg ha-1. Un-clipped genotypes headed earlier compared to clipped genotypes with a non-significant difference of 2-4 days. AZRC-B-11 headed earlier after clipping with 140 days to head. The same genotype also reached earlier physiological maturity and took 160 days to mature (50%). Plant height reduction was observed after clipping in most of the genotypes except genotype AZRC-B-1 which sustained its height (49 cm) compared to the unclipped treatment (48 cm). Entry 1 also produced the highest number of tillers with 505 tillers per m2 in unclipped and 487 tillers in clipped treatment. Genotype AZRC-B-1 produced higher grain weight. The highest grain yield was also recorded for genotype 1 with a grain yield of 1846 kg ha-1 and total dry matter of 7866 kg ha-1. Barley local landrace (check genotype-12) produced more spikelets and also maximum spike length (7.3 cm) with 38 spikelets.

Five genotypes showed encouraging results (AZRC-B-1, 2, 3, 6 and check variety Balochistan Local-B) that produced more yield under clipped treatment compared to un-clipped treatment while the remaining genotypes reported a decrease in grain yield after clipping.

The results showed that genotype AZRC-B-1 can be a better substitute for the barley varieties grown in the rain more for income and help farmers in improving their livestock production. Fed/irrigated areas of Balochistan for producing results in better grain yield which can results in higher forage during winter and finally generate income.

Keywords: *Barley clipping, Barley production , Forage yield, Grazing*

INTRODUCTION

Barley (*Hordeum vulgare* L.) is an important cereal crop of the world, mainly used for animal feed and malt. Barley is fourth major cereal crop after wheat, rice and maize, in the world. It is grown in diverse agro climatic conditions of the arid and semi-arid regions. In 2007 barley placed fourth in ranking of cereal in the world (1). Barley is basic feed source in semi-arid areas of Asia, North Africa and South America (2). Barley is a crop which is grown in more than hundred countries due to their two main uses, as animal feed and malt. And its other feature is that it can survive in very poor environmental conditions such as low rainfall and cold temperature (3). Barley is traditionally grown for seed but in some countries it is used as dual purpose crop with forage in early season through grazing with not reducing grain yield or a minimal grain reduction. In Africa, West Asia and North Africa farmers allow sheep to graze or remove young barley or wheat crop (forage) and then let the crop recover to grain and harvest at maturity (4). Barley or wheat for the dual purpose is generally planted early to have abundant forage for livestock grazing during winter and early spring. Grain yield reduction can occur in an early planted, forage-plus-grain system compared with a later planted grain-only system (5). Reported yield reductions of 30% in clipped plots and 20 to 50% in grazed plots (6, 7). Depending on the genotype, rainfall distribution, termination date of forage grazing and other abiotic factors. If rainfall is adequate the effect of grazing in the arid areas did not reduce the grain (8). There is less forage production in Iraq, so the people grow barley as a feed for their livestock because its total biomass is very high and it grows even in very harsh environment (9). In Balochistan province inter and intra seasonal environmental variability is very high which makes it suitable for barley cultivation compared to wheat due to better adoptability of barley to variable environmental conditions and its mechanism to escape drought stress. Farmers in rain-fed regions of the province graze wheat or barley crop in early winters due to none availability of green forage in range lands. Live weight gains are feasible when grazing cereals as they have well metabolize able energy levels and high in digestibility of crude protein (10)

The study was initiated to check the comparative performance of different high yielding barley genotypes and check cultivars for their dual purpose (forage and grain) potential under rain-fed conditions of highland Balochistan.

MATERIALS AND METHODS

The experiment was conducted at the Balochistan Agriculture Research and Development Centre (BARDC), Quetta, Balochistan located in the semi-arid Mediterranean type climate. The Randomized Complete Block Design (RCBD) was used within triplicates having 12 genotypes and each entry/genotype had four rows/plot. The row length was 5m with an inter row distance of 25cm. Sowing was carried out in Rabi on 26 Oct 2010 with seed rate of 100 kg ha^{-1}. During Feb. 2011 each plot was divided into 2 sub plots of 2.5 m^2 with each half was clipped and the remaining one was left unclipped to check the effect of clipping on barley genotypes. All triplications were treated same. Clipping was carried out manually. In Jan 2011 barley genotypes were clipped to collect the fresh biomass, the barley crop was harvested in May 2011 to determine the effect of forage clipping on grain yield and other parameters. Data were recorded from both clipped and unclipped treatments as fresh biomass of clipped plots, days to heading, plant height (cm), day to physiological maturity, number of tillers/m^2, number of spikelets/spike, spike length (cm), total dry matter kg ha^{-1}, grain yield kg ha-1, 1000 grain weight and Harvest Index. Analysis of data was carried out by using Mstate.C program through 2 factorial design and results were discussed by observing means.

RESULT AND DISCUSSION

Farmers in rain-fed areas of Balochistan face severe shortage of feed for livestock during winter season due to harsh dry winter with no rainfall during October to December. To overcome the feed shortage farmer, graze their livestock on wheat/barley fields and leave the crop to complete its cycle after rainfall. Farmers allow their sheep or goats to graze the crop either before the severe cold spell of winter or early spring, therefore facultative-type genotypes of barley with sufficient cold tolerance and also clipping/grazing tolerance is more desirable for the rain-fed areas of highland Balochistan (11). The local wheat and barley cultivars are more favorable for grazing in winter with better and fast growth but they suffer losses due to disease susceptibility and low yield potential. The present study was conducted under rain-fed conditions at AZRC, Quetta showed non-significant differences among barley genotypes for fresh dry weight of barley clipped genotypes.

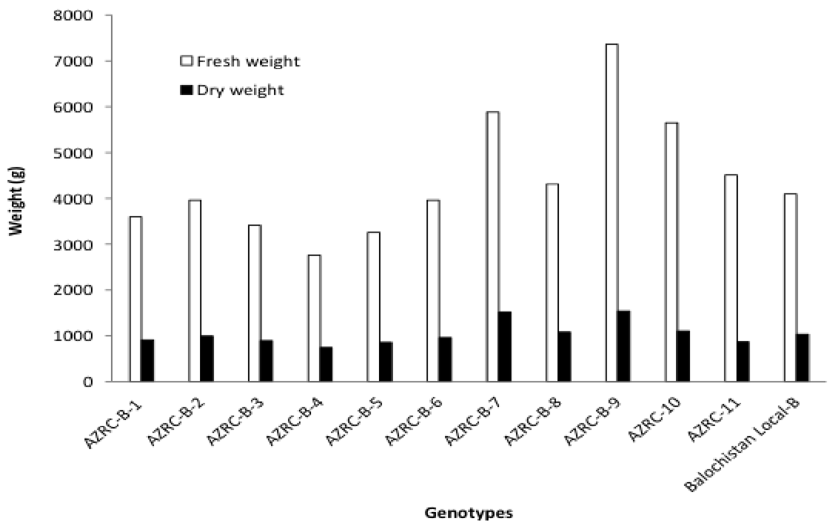
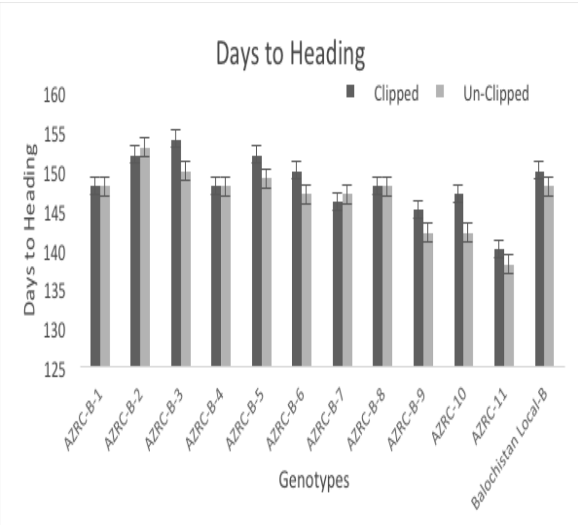


Fig. 1. Mean fresh and dry weight of *H. vulgare* genotypes

Even the differences were huge but the environmental variability in rain- fed conditions produced non-significant results. The results depicted the highest fresh weight for genotype AZRC-B-9 followed by AZRC-B-10 with 7369 and 5652 kg ha-1 after clipping respectively (Fig. 1), while AZRC-B-4 produced lowest dry weight. Similarly, Yau (2003) reported that clipped crop improves water use efficiency and result in improved rain yield (4). The same results were stated by Bonachela *et al*., 1995, who reported that forage clipping of barley reduced water usage and decrease plant water deficiency (12). Early stage clipping of wheat results in high forage reported by Shuja *et al*., 2010 (13). Winter wheat clipping do not effect green forage and provide additional advantage during scarcity season, (14). Green stage clipping of barley provide forage in winter for farmer and grain yield may not be reduced by this practice. Significant differences at (p< 0.05) were recorded for days to heading and days to physiological maturity which revealed differences for treatment effect and also significant differences for genotypic effect. Data revealed 0-5 day's difference in unclipped and clipped genotypes with clipped genotypes headed late as compared to un-clipped genotypes (Fig. 2). AZRC-11 headed earlier in both clipped and unclipped treatment with 140 and 138 days to head while same genotype matured earlier with 168 days after clipping while AZRC-10 took 170 days to physiological maturity (Fig. 3).



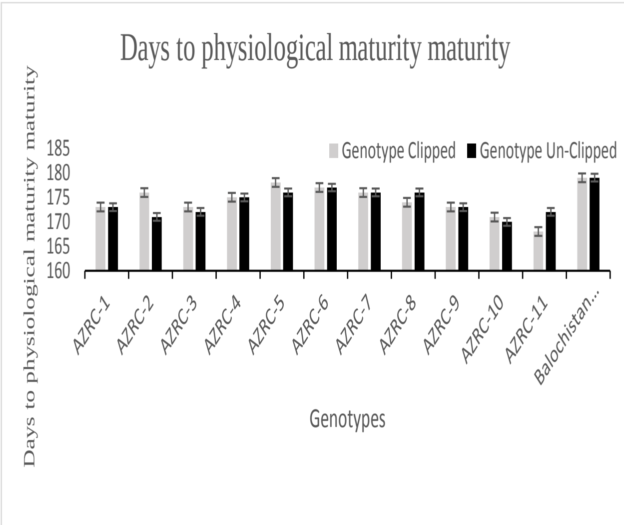


Fig. 2. Heading days for clipped and unclipped genotype

Fig.3. Days to Physiological Maturity

shows mix response to barley clipping due to genetic differences between genotypes (6 and 2 rowed types) which will be helpful in selection of better genotype for the climatic conditions of Balochistan (15). Vaezi *et al*., 2010 reported that days to heading increased as clipping as barley has to re-grow so clipping significantly affected days to heading, they also reported 10 days' difference in days to heading in earliest and late genotypes tested and sensitive genotypes responded with earlier heading, and therefore a shortened lifecycle to stress (16). Barley earliness is considered to be affective in escaping late drought conditions in rain-fed areas of Balochistan. Number of tillers is an important parameter which has positive effect on grain yield and total dry matter production in deferent crops (Fig. 4).

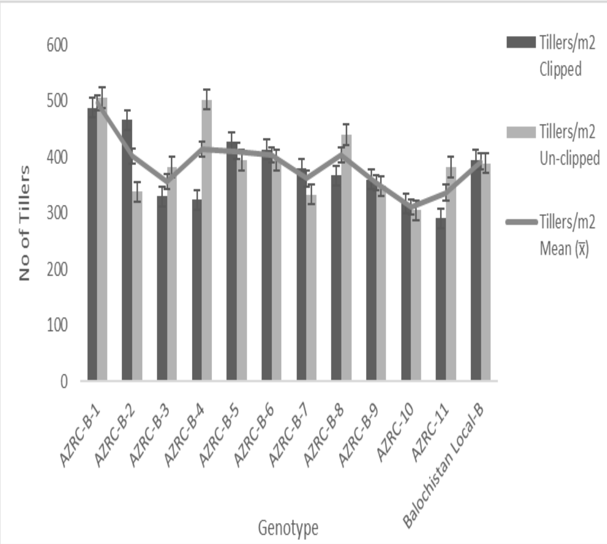


Fig. 4. Tillers for clipped and Un-Clipped treatments

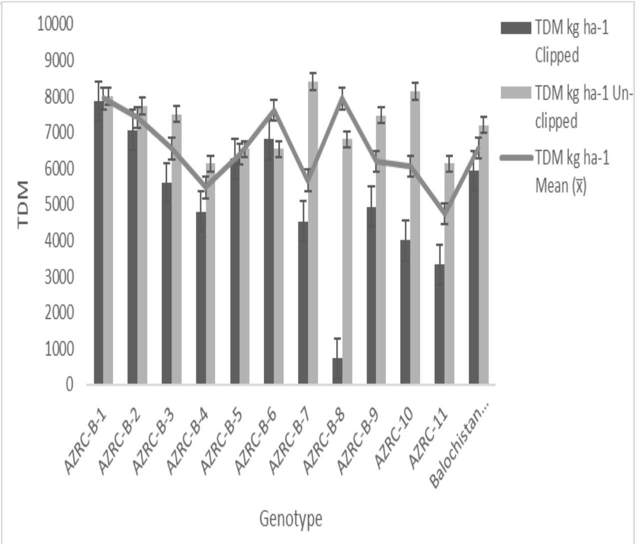


Fig. 5. Total Dry Matter kg ha-1 for Clipped and Un-Clipped treatments

Significant difference was observed in tillers m² among barley genotypes but the interaction between genotype and treatment was found non-significant. Abbas *et al.*, 2011 revealed that no reduction was recorded after clipping in barley (10). Similarly, Shuja *et al.*, 2010 evaluated that clipping treatment had not decreased the no of tiller/plant and showed no differences for clipped and unclipped genotypes (13). *El-*Shathnawi and Haddad 2004 reported that in dual-purpose barley the plant height was reduced but not affected tillering and tiller density increased by clipping in the barley plants. So more tillers mean a better chance to produced grain in grazed than un-grazed wheat (17). The results for grain yield and total dry matter were non- significant and only significant effect was recorded for treatment effect for total dry matter (Fig. 6). Genotype AZRC-B-1 produced highest grain yield with 1846 kg ha^{-1} in clipped treatment while it also produced maximum grain yield (Fig. 7) in unclipped treatment with 1440 kg ha^{-1}. AZRC-B-1 also produced maximum total dry matter with an average of 7866 kg ha^{-1} (Fig. 5). Different genotypes showed reduction in total dry matter after clipping due to different factors like reduce plant height and spike length. In dry seasons, most of the barley is continuously grazed resulting in no grain harvest.

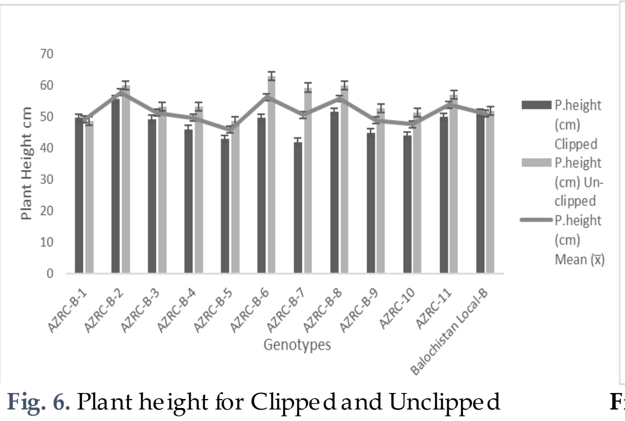


Fig. 6. Plant height for Clipped and Unclipped treatments

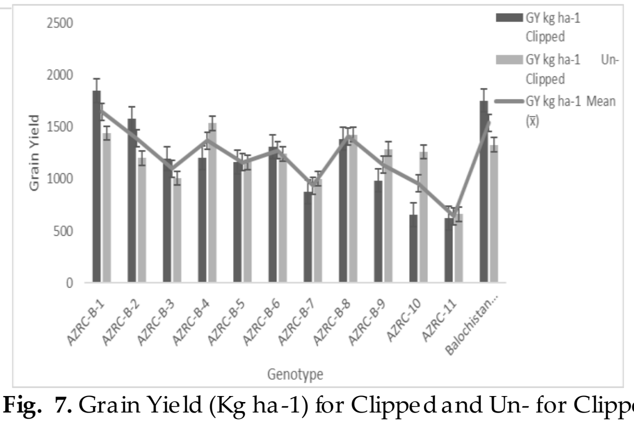


Fig. 7. Grain Yield (Kg ha-1) for Clipped and Un- for Clipped and Un-Clipped treatments

Shuja *et al.*, 2010 also supported the above results with increased grain yield after clipping in wheat trials conducted at Peshawar (13). Hossain *et al.*, 2004 reported increase in grain yield after clipping in oats (18). Khalil *et al.*, 2011 were in disagreement and reported reduction in grain yield after clipping (15). Francia *et al.*, 2006 reported non-significant results for biological yield in winter wheat trial conducted under dual purpose crop management system (19). The results are also in agreement with Shuja *et al.*, 2010 who reported decrease in biological yield after clipping in wheat genotypes in unclipped treatment (13). While

Balochistan Local-B produced highest 1000 grain in unclipped treatment with 33.33g (Fig. 8) and in clipped treatment it produced 32.6 g (15). Shuja *et al.*, 2010 reported the decrease in 1000 grain weight after clipping in wheat genotypes tested (13).

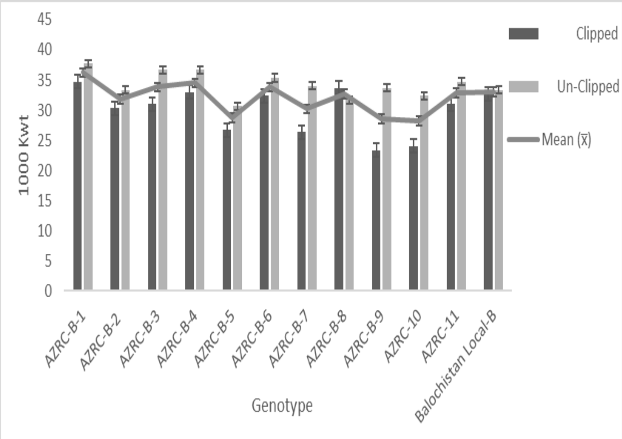


Fig. 8. 1000 Kernel/Grain weight Clipped and Un-Clipped treatment

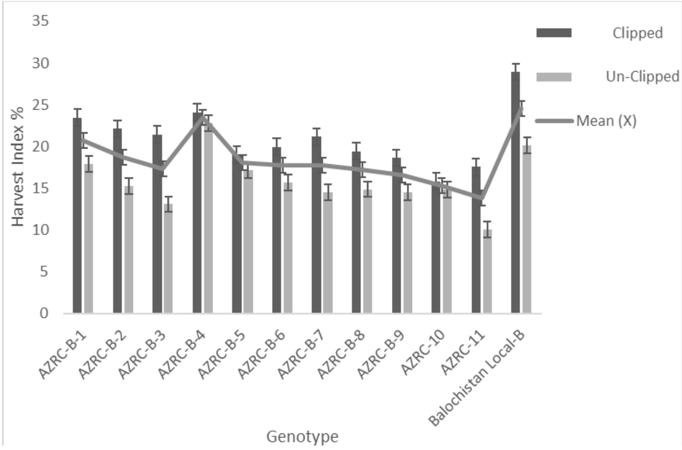


Fig. 9. Harvest Index for Clipped and Un-Clipped treatment

In contrast Lovegrove and Wheeler, (2008) reported that early and nil grazing treatment produced significantly higher 1000 grain weight. Harvest Index is used to calculate source to sink relation which helps in measuring percentage of vegetative and reproductive production of crop (20). In clipped treatment Balochistan Local-B produced highest harvest index HI% with 29.54 followed by AZRC-B-7 with 26.19 HI%. In unclipped treatment AZRC-B-4 produced maximum value of 22.79 harvest index HI% value. The data revealed that harvest index increased after clipping in all genotypes except genotype AZRC-B-4 (Fig. 9) (13). Lovegrove and Wheeler, (2008) reported increased HI% in winter wheat after clipping but showed more reduction if clipping is carried out in later stages (20). The HI is also dependent on the moisture availability after grazing as good moisture conditions can recover crop after grazing/clipping.

CONCLUSION

In Mediterranean regions, forage production for animals is difficult and expensive because of uneven distribution of rainfall. As an alternative, barley, winter wheat, triticale and oat can be utilized as dual-purpose crops, thus barley is used for winter grazing and as grain for feed. Clipping before elongation of stem on appropriate early planted barley not lead any reduction of grain yield. Indeed, in many countries of the Mediterranean problems, such as heavy grazing and grazing out of season in limited grassland, and climatic conditions results insufficient quantity and low quality of forage. The cultivation of barley helped to overcome such problems because barley can be grown in harsh winter season and clipping help in availability of green forage during winter. Barley can escape the terminal drought stress and also provide better ground cover during early season of the crop.

Conflict of Interest:

Authors have no conflict of interest.

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