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Delayed Cutting Stage in Dual Purpose Wheat: A Better Strategy to Control Weeds and Enhance Forage Production

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Abstract

Green fodder accessibility is a serious issue for livestock, especially in crop land areas where fodder crops cannot be sown due to competition with staple food crops like wheat. The aim of the study was to estimate reduction in weeds density in dual purpose wheat crop utilized for forage and grain production under different cutting stages. Wheat variety Atta-Habib was sown at Palatoo Research Farm (PRF), The University of Agriculture Peshawar, during 2014-15, for fodder and grain production. The five treatments were consisting of no-cut and one cut i.e. at Zadok growth stage 12 or 14 or 16 or 18. The experiment was laid out in randomized complete block (RCB) design with four replications and plot size 3x3m^2. Results showed that fodder production was increased while weeds fresh and dry weight were reduced with delaying cutting stage from ZGS-12 to ZGS-18, whereas biological and grain yield were also decreased from 13354 to 9949kg ha^{-1} and from 4552 to 3086 respectively with delayed cutting. No cut results highest weeds density (241m^{-2}) as compared to cut at ZGS 18 i.e. (131m^{-2}). From all findings it was concluded that no cut is optimum to obtain higher grain yield (4542kg ha^{-1}) and highest biological yield (13354kg ha^{-1}) but cut at ZGS-18 is optimum for forage production (1865kg ha^{-1}) as well as for reduction in yield losses due to weeds. About 48% weeds control and highest green fodder may be obtained with a reduction of 1466kg ha^{-1} in grain yield and 3405kg ha^{-1} in biological yield.

Keywords: Dual purpose wheat; Zadok growth stages; Fodder production; Weeds Density; Yield

Introduction

Among all the cereals wheat (*Triticum aestivum*) is most important on the basis of production. In Pakistan it occupies about 66% of the annual food cropped area [1]. It is a rich source of quality forage, protein, energy, nutrients and low in fiber. Wheat has the potential to meet the food and feed requirements of the rapidly growing human and livestock population from the same piece of land under optimum management practices [2]. Wheat can be grown non-traditionally to attain maximum benefit for both grains and feed Shuja et al. [3] to diminish fodder shortage during winter. Wheat has the great potential to re-grow and set seed for their dual-purpose cultivation [4]. Forage availability is reduced during the winter period; therefore cereals as dual purpose crop can be used to provide good quality forage and also increases the area for grain production [5]. The fodder scarcity in winter is one of the main warning factors for livestock production. About six million acres wheat in Mexico is cultivated for dual- purpose to nourish three million stocker cattle in fall [6]. However, many reports suggested that dual purpose wheat crop produce lower grain production. For example Borman et al. [7] reported that yield reduction depends on a combination of timing, intensity and extent of grazing.

Therefore, keeping in view the current demand of both grain and fodder production and yield losses due to weeds, this experiment was conducted to determine optimum cutting stage suitable for dual purpose wheat and weed population control. The objectives of the study were to quantify the impact of cutting a wheat crop for fodder purpose and letting it to re-grow for seed production and to evaluate the response of important characteristics of wheat to different cutting stage. These characteristics were weeds m^{-2}, weeds fresh weight, weeds dry weight, green fodder yield, grain yield and biological yield.

Materials and Methods

The experiment was conducted during winter season 2014-15 at Palatoo Research Farm (PRF), Amir Muhammad Khan

Campus Mardan, The University of Agriculture Peshawar. The five treatments were consisting of no-cut and one cut i.e. at Zadok growth stage (ZGS) 12, 14, 16 or 18. The experiment was laid out in Randomized Complete Block Design (RCBD) having four replications. The plot size was 3×3m^2. The soil was ploughed up to 30cm depth twice by using common cultivator followed by planking to break the clods. The wheat variety Atta-Habib was sown at the rate of 120kg ha^{-1} manually in each plot. Nitrogen and phosphorus were applied at the rate of 120 and 60kg ha^{-1} using urea and DAP respectively. All phosphorus was applied at the time of sowing. Half nitrogen was applied at tillering stage, while the remaining half of the nitrogen was applied before boot stage. The cutting of fodder carried out with the help of sickle along with the ground level at each specific stage. The data was recorded on different parameters as: Weeds were collected by hand weeding, counted and converted to weeds m^{-2}. Weeds collected from 1m^2 were weighted by digital balance to find weeds fresh weight m^{-2}. For weeds dry weight m^{-2}, weeds were dried in oven for 24 hours and weighted by digital balance. The biological yield, each plot was harvested, dried in sun for seven days and then weighted by digital balance. The yield was then converted to kg ha^{-1}. The wheat grain yield after threshing were collected and weighted to record grain yield in kg m^{-2}. Then it was converted to kg ha^{-1}. The green fodder yield was determined by weighting fresh fodder when it was harvested. Then fodder yield in kg m^{-2} was converted to kg ha^{-1}. Data collected were analyzed statistically according to procedure relevant to RCB design. Upon significant F-Test, least significance difference (LSD) test was used for mean comparisons as clarified via [8].

Results and Discussion

Weeds density & biomass

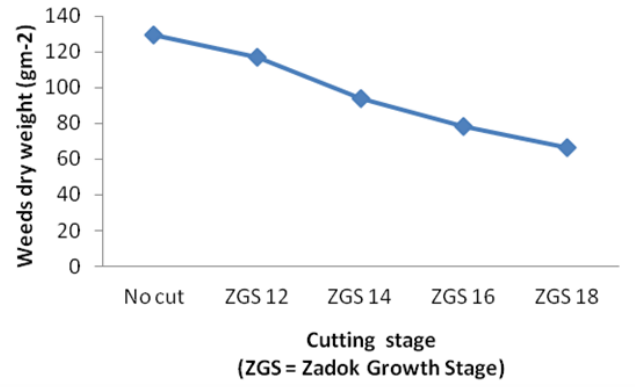

Figure 1: Effect of cutting stage on weeds density m^{-2} in dual purpose wheat.

The data about weeds density, weeds fresh weight and dry weight is represented in Figure 1-3 respectively. Weeds density as well as fresh and dry weights was extensively affected by cutting stages. The highest weeds density (241) was observed in no -cut plots, whereas lowest weeds density (131) was observed with delaying the cutting stage (to ZGS- 18). Similarly weeds fresh and dry weight was also reduced (from 413 to 220g m^{-2}) and (from 130 to 66g m^{-2}) respectively with delaying cutting stage. These results are in line with those of Ali et al. [9] and Kirkegaard et al. [10] but do not agree with agree with results of Saleem et al. 2015. Dual-purpose crop can also generate similar benefits while providing a break crop for weeds and disease to clean up Paddocks for subsequent cereals.. In our study, cutting of the crop 70 days after sowing also suppressed weed density and thus their fresh and dry biomass. It may be due to cutting of weeds with the crop and quicker recovery of the crop after cutting [10] (Figure 4 & 5).

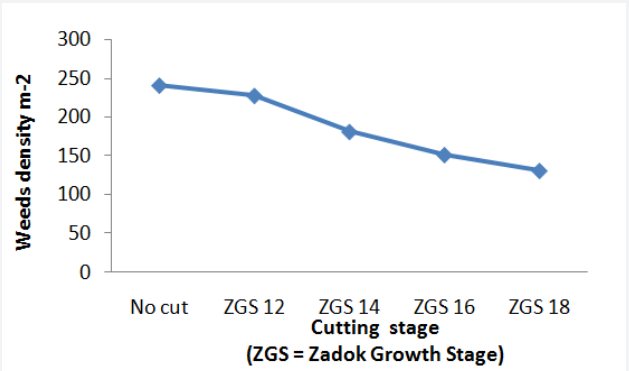

Figure 2: Effect of cutting stage on weeds fresh weight (g) in dual purpose wheat.

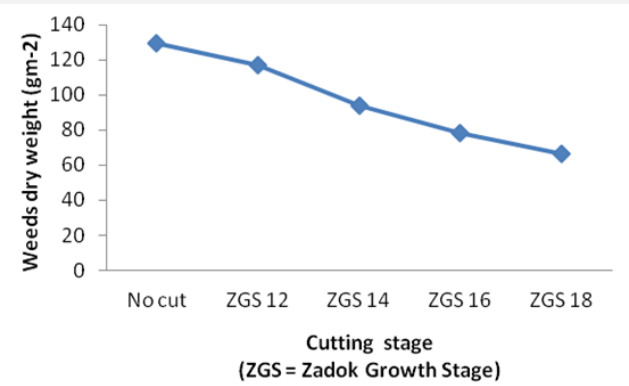

Figure 3: Effect of cutting stage on weeds dry weight (g) in dual purpose wheat.

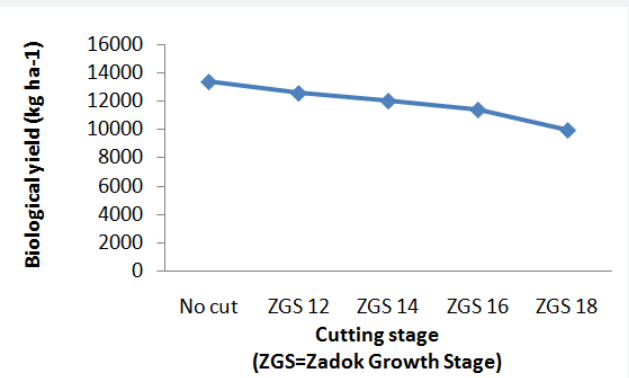

Figure 4: Effect of cutting stage on biological yield (kg ha^{-1}) in dual purpose wheat.

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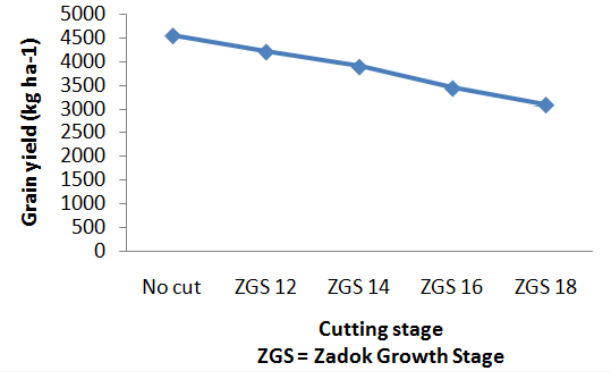

Figure 5: Effect of cutting stage on grain yield (kg ha^{-1}) in dual purpose wheat.

Biological yield (kg ha^{-1})

The data about biological yield is represented in Figure 6. Biological yield was significantly affected by cutting stages. The highest biological yield (11500kg ha^{-1}) was observed in no-cut plots, whereas lowest biological yield (9050kg ha-1) was observed with delaying the cutting stage (to ZGS- 18). This reduction is due to removal of whole biomass during cut at ZGS-12, 14, 16 or 18, due to which secondary growth could not face the deficiency, due to shortage of time and nutrients. Afridi et al. [11] also reported reduced vegetative and reproductive biomass production with removal of flag leaf from wheat. The present results confirmed the earlier findings of Iqbal et al. [12], Naveed et al. [13] and Khalil et al. [2].

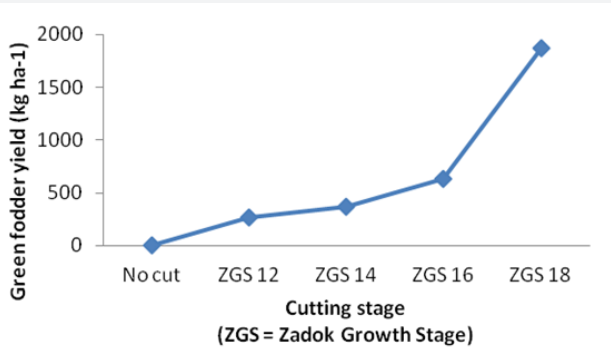

Figure 6: Effect of cutting stage on Green fodder yield (kg ha^{-1}) in dual purpose wheat.

Grain yield (kg ha^{-1})

The data about grain yield is represented in Figure 6. Grain yield was considerably affected by cutting stages. The highest grain yield (4400kg ha^{-1}) was observed in no-cut plots, whereas the lowest grain yield (2750kg ha^{-1}) was observed with delaying the cutting stage (to ZGS-18). Removal of leaves considerably reduced grain yield of wheat [14]. Similar results were also reported by Shuja et al. [3], Hastenpflug et al. [15] and Larson et al. [16].

Green fodder yield (kg ha^{-1})

The data about green fodder yield is represented in Figure 6. Green fodder yield was significantly affected by cutting stages. The lowest green fodder yield (210kg ha^{-1}) was observed in cut at ZGS-12, whereas the highest green fodder yield (3500 kg ha^{-1}) was observed with delaying the cutting stage (to ZGS-18). Early cut resulted in lower forage dry matter as compared to late cut. It is due to increase in biomass in growing days in between ZGS-12 and ZGS-18. Iqbal et al. [12] and Khaleel et al. [2] also reported the same results [17-19].

Conclusion

From all results it was concluded that cutting stage effect is highly significant. Highest green fodder productivity and lowest weeds density & biomass were observed in plots having cut at ZGS-18. Whereas highest biological yield and grain yield were observed in no cut plots. Therefore keeping in view the above conclusion the recommendations can be given that no cut is recommended on the basis grain yield and biological yield, while on the basis of weeds control strategy and green fodder yield, cut at ZGS-18 is recommended.

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