

YIELD AND QUALITY OF DUAL-PURPOSE BARLEY AND TRITICALE IN A SEMI-ARID ENVIRONMENT IN TUNISIA

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Abstract

Semi-arid region of Tunisia is characterized by a low and erratic rainfall. This makes year-round maintenance of pasture and forage production under non-irrigated conditions both costly and difficult. In order to fill deficit period, some cereals can be used as dual purpose by cutting or by animal grazing during early stage of growth and then allowed to recover to produce grain. This study aimed at evaluating agronomic performances and grain quality of two dual-purposes cereal crops, Barley and Triticale, cut at the pseudo stem erect stage (C30). The trail was conducted during 2010-2011 season and results have showed that barley yielded more forage crop than triticale without being statistically different, also crude protein in the plant was higher in barley (18.6%) compared to triticale (17.7%). Defoliation has caused a significant grain yield reduction for both cereals and was about 23% for triticale and 33% for barley. Clipping at stem erect stage has a variable effect on different yield components. Thus, higher number of tillers and number of spikes in defoliated compared to undefoliated plants were noted. In the other hand, both number of grains per spike and total kernel weight was negatively affected by clipping.

Grain protein was significantly higher after clipping for barley (11,35% for dual purpose and 10.17% for grain production only) and was not affected for triticale (9.42 % versus 9,57 %).

Under Tunisian semi-arid environment, triticale and barley have comparable yields with a small superiority for barley in forage yield production and higher plant and grain protein contents in triticale.

Key words: Triticale, Barley, Forage, Dual purpose, semi-Aride, Tunisia

Introduction

In the north-west of Tunisia, farmers face serious problems of low quantity and quality of forage to feed their animals. This is caused by the poor weather and fertility conditions which characterize the region. One of the solutions, used mainly by local and small farmers, is the practice of cereals dual-purpose. Barley, oat or triticale are grazed or cut in a young stage (tillering) and then allowed to re-growth up to grain production. This will provide forage during winter season which is known as a forage deficit period. Researches about cereals dual-purpose for seeds and forage have given widely varying results according to the climate, to the specie and to the cut or grazing stage. In fact, the practice of first use by cutting or grazing helps 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 & Morris, 1991); Syria (Mazid & Hallagian, 1983) and Tunisia (Amara et al., 1985). In Mediterranean environments, Hadjichristodoulou (1991) reported that grazing only affected grain yield of dual-purpose barley in rainfed conditions, while the same effect was not detectable in irrigated conditions. Decreases in grain yield after clipping have been

attributed to a reduced number of spikes/m² at harvest in barley (Scott et al., 1988) and triticale (Royo et al., 1993) and also a reduced grain number (Bonachela et al., 1995) and kernel weight (Royo et al., 1994). Other studies have reported a grain yield increase after a cutting or grazing during green stage. This Increase has been associated to the decrease of lodging (Droushiotis, 1984). In the other hand; it appears that the management of cutting stage influences the forage and green yield. Royo et al. (1997) have reported that, when cut at the first detectable node stage (C. 31) triticale and barley forage yield was almost double the yield at the pseudo-stem erect stage (C. 30). Defoliation during early growth stages optimizes seed yield and forage quantity and quality (El-Shatnawi et al., 2004). The objective of this study was to investigate the effect of defoliation on production and quality of two dual-purpose species, triticale and barley under rainfall conditions in a semi-arid region of Tunisia.

Materials and methods

The present study was performed in el Kef region, in the experimental field of the higher Institute of Agriculture Kef (36° 11' 9'' N, Longitude 8° 42' 59'' E ; Altitude 652 m). trial was carried out in a a clay-sandy-loamy soil with organic matter content arround 1,8%. The climate is mediterranean, with rainfall concentrated in in the autumn and winter. The average annual rainfall is 425 mm on the basis of 50 years.

Two species were used for the experiment : Triticale (*Triticosecale*) variety Tcl 83 and barley (*Hordeum vulgare* L) variety Martin. The experimental design was a Split plot one with 4 replications and each plot mesured 6m² in which the main factor was the species and the secondary one the treatment. The two management systems (treatments) experimented were : (i) control plots which were only clipped at seeds maturity in order to estimate the grain yield and (ii) dual_purposes plots which were clipped first time and harvested as forage at the stem erect stage (C30) and then let regrowth up to seeds maturity. Sowing was carried out early october at a density of 300 viable seeds/m². The soil was chisel plowed in september and right before sowing. Pre-sowing fertilization rates for all plots were 46kg P/ha and 18kg N/ha. During growth cycle 2 fertilizations were provided : 40 Kg N/ha in 3 leafs stage and 50 Kg N/ha after clipping for dual-purpose treatments and in elongation stage for control treatments. Forage harvest was done on 13 February 2011 for barley and 28 February 2011 for triticale. Plants were cut about 12 cm above ground level. Grain harvest was made at seeds maturity on 28 june for both species.

Fresh biomass production from each dual-purpose plot was determined at harvest and it's reported in tones of dry matter (DM) per hectar ; a 500 g sample was also taken for chemical analysis. Forage and grain crude protein content were evaluated by means of the standards micro-kjeldahl procedure. Grain yield, number of spikes/m², number of grains per spike, kernel weight were determined for each plot at seed maturity. Analyses of variance (ANOVA) were performed using SAS (1985) and Means were separated using Duncan Test.

Results and discussion

Total rainfall during 2010-2011 was 685,9 mm (fig 1) which is about 50% more than the annual average (450 mm). A maximum monthly rainfall was registred during december (143mm) and April was a dry month with 40 mm. But because of a wet may (100 mm), dual-purpose triticale and barley grew normally.

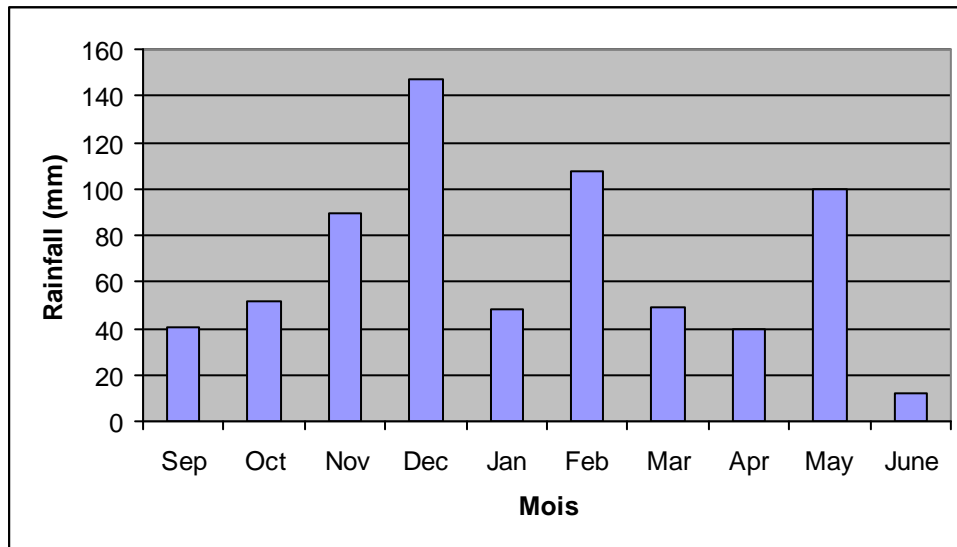


Figure 1. Rainfall distribution for 2010-2011 growing season

1. Influence of defoliation at C30 stage and species on grain Yield, components Yield and forage production

Results of forage quantity harvested in C30 are shown in Table 1. Forage yield did not depend on the specie. Barley and triticale has given close quantities of Forage respectively 2,6 t/ha and 2, 4 t/ha. This could be attributed to the fact that the cutting stage is too early that different species could express differences. Specific traits for each specie will be more observable after cutting with regrowth. Royo et al. (1997) have reported, under Mediterranean conditions, similar forage yields in first detectable node stage for triticale (2,03 t/ha) and barley (2,11 t/ha).

The effect of forage removal in barley and triticale on grain yield and its components is shown in table 1. Cutting in green stage (C30) has caused reduction of grain yield for dual-purpose use comparing to grain use only management system. This reduction was more pronounced for barley (-33%) than for triticale (-23%). For both species this reduction was statistically significant ($p < 0,01$). In the other hand, when they were not cut in C30 stage, barley and triticale have given close grain yields which were not statistically different (4,48 t/ha for barley and 4,79 T/ha). For dual-purpose management system, triticale seems to be more adapted and has given a grain yield of 3,69 T/ha which is significantly higher ($p < 0,05$) than barley grain yield (3,01 t/ha). The interaction treatment x specie was significant ($p < 0,05$) for grain yield. Clipping dual-purpose barley and triticale has enhanced spike number production this is explained by the removal of the apical domination during final stage of tillering period. In fact, with defoliation the predominant apex is eliminated and then tillers production restarts again and drive to a higher number of productive tillers by plant. The spike number per m^2 increased from 357 spikes/ m^2 to 451 spikes / m^2 for barley and from 398 spikes / m^2 to 488 spikes/ m^2 for triticale. This range of variation was statistically significant ($p < 0,05$). In the other hand, spike fertility was significantly affected only by treatment ($p < 0,05$). In general number of grain/spike has decreased after clipping. The third yield component, 1000 kernel weight, was a very stable variable, being similar for both treatments. It was not affected by forage use neither by the species.

Straw quantity is also important for grain producers in general and for animal keepers in particular as it constitutes an alternative nutrition resource mainly during deficit period. With

this trial, It appear that triticale gives more straw quantity in both managements systems ($p < 0,01$). Clipping was affected significantly straw production ($p < 0,05$) and was reduced by 22% for barley and 26% for triticale.

Table1. Forage yield, grain yield and related components in different managements systems of dual purpose barley and triticale.

	Forage DM (T)	Straw yield (T)	spikes/m ²	Grain/spike	1000 kernel weight (g)	Grain yield (T/ha)
Barley one use (grain only)	-	8,23 b	387 b	29 a	39,07 a	4,48 a
Barley dual-Purpose	2,6 a	6,37 c	451 a	26 ab	40,18 a	3,01c
Triticale one use (grain only)	-	10,65 a	398b	28 a	41,54 a	4,79a
Triticale dual-Purpose	2,4 a	7,87 cb	488 a	24 b	41,8 a	3,69b
CV (%)	5,76	8,43	7,45	5, 32	4,67	5,76
Species	NS	**	NS	NS	NS	*
Treatment	-	*	*	*	NS	**
Treatment x specie	NS	NS	*	NS	NS	*

2. Influence of defoliation at C30 stage and species grain and forage protein content

Table2. Effect of defoliation on grain and forage protein content

	Grain Crude protein (g/kg DM)	Forage Crude protein (g/kg DM)
Barley one use (grain only)	101,76 b	-
Barley dual-Purpose	113,56 a	186,6 a
Triticale one use (grain only)	94,2 c	-
Triticale dual-Purpose	95,7 c	177 b
CV (%)	4,79	6,2
Species	*	**
Treatment	*	-
Treatment x specie	NS	NS

Results of this study indicated that forage barley has a higher protein content (186,6 g/kgDM) than forage triticale (177g/kg DM) when it's cut at C30 stage. Analysis of variance has shown that this difference is significant ($p<0,05$) (Table2). This is in accordance with Royo et al. (1997) results who have measured around 172g/kg DM for triticale cut in C30 and C31 stages.and around 189 g/kgDM for barley cut at same stages.

This experiment has also shown that dual-purpose cultivation affected positively the grain protein content of the two tested species. Clipped plant in C30 stage has given grain more rich in protein: 113,56 g/kg DM Vs 101,76g/kg DM for barley and 95,7 g/kgMS Vs 94,2 g/kgMS for triticale. This increase of grain protein content between treatments was significant only for barley ($p<0,05$). This significant increase of grain protein after defoliation in C30 stage could be attributed to the dilution effect, since the grain yield was decreasing after clipping and the number of spikes per plant was higher. This conclusion joins results of Francia et al. (2006) who has reported also an increase of grain protein content after clipping during green stage for barley and oat.

Conclusion

Of the two crops studied triticale demonstrates clear superiority in the grain yield and straw production over barley in the dual-purpose system in the semi-arid region of Tunisia. Triticale has specific morpho-physiological traits that make it more suitable to dual purpose cultivation than barley. Triticale has shown good regrowth after clipping in green stage and reduction of grain yield did not exceed 23%. In the other hand barley has given grain more rich in protein than triticale and this for both management systems.

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