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Double Utilization Reduced Total Biomass, Grain Yield And N Uptake In Oat, Barley, Wheat and Triticale

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Introduction. Growing **winter cereals** for **dual purpose (DP),** like early forage production during the vegetative phase+forage production at heading or grain production at maturity, can provide an opportunity to increase yield and crop N uptake compared to **single purpose (SP)**.
However, DP impact on the total dry biomass is variable depending on several factors and little information is available for the Mediterranean environment.
The goal of the research was studying the role of the biomass clipping at the end of the tillering stage (GS29, *Zadoks et al. scale*) on the biomass yield at the early dough (GS83) or full ripening (GS99) on the biomass partitions in sheaths, blades, spikes, and grain, yield components, bromatological composition of each fraction, and N uptake in four winter cereals sown at 2 seeding rates.

Results. The experiment showed reduced interaction among factors. In the GS29 cut, no difference between treatments were found for N uptake. Barley, Oat, Wheat and Triticale showed on average 1.39, 1.21, 1.04, and 1.02 t DM ha^{-1}, respectively. Increasing SR consisted +18.1% of the DM yield. When crops were harvested at GS 83, increasing SR improved only Wheat biomass. **Crops previously used at GS29 showed 28.1% less biomass yield (p<.0001) and 23.9% less N uptake (p <.0001) than the non previously cut** and such losses were more marked in the Triticale and Barley than to the Wheat and Oat (-32.8%, -32.5%, -16.7%, and -8.0% respectively, Figure 1).

Similar losses of total biomass, grain yield, and total N uptake were found at GS99, in the crops previously cut at tillering compared to the non previously cut (-24.1% to 28.9%) with no differences in the losses among the species or seeding rate, nor the strategy of double utilization (GS29+GS83 vs GS29+GS99, Figure 1). Grain yield strongly varied among PS: Oat showed 33% to 45% less grain yield and 10% to 12% lower harvest index (HI) than to the other species. Increasing SR increased the grain yield of all the species on average by the 17.8%, with no effects on the HI. DP crop showed increased straw protein content compared to the SP.

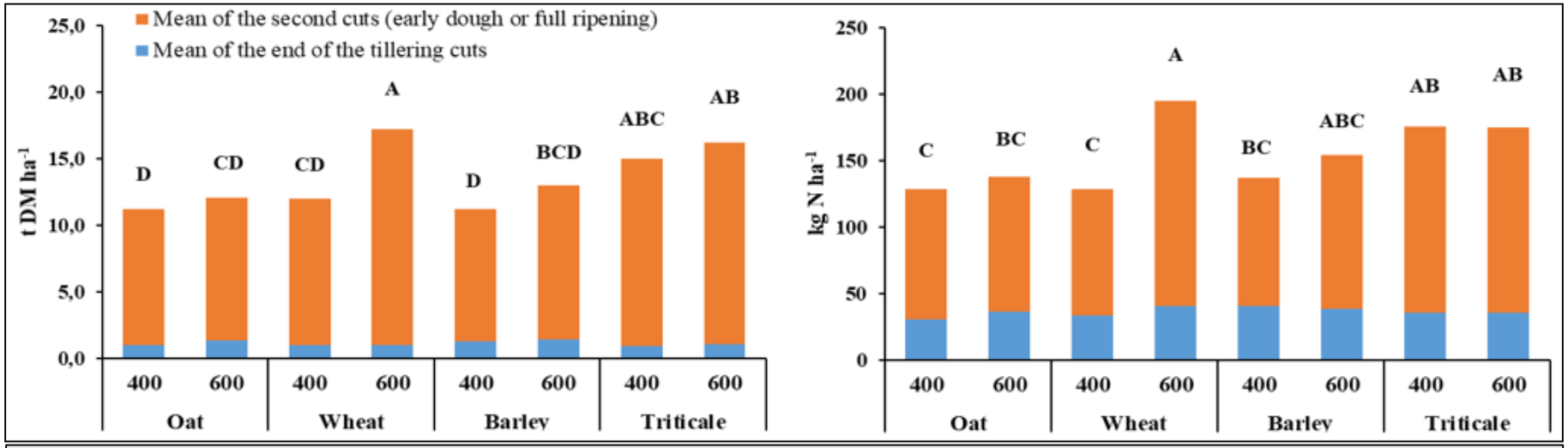

***Fig. 1**: Total biomass yield (left panel) and N uptake (right panel) in the 4 species sown at 400 or 600 seeds m² split in the first utilization (GS29, blue bars) or second utilization (GS83 or GS99). Since no differences were found between growth stages of the 2nd utilization, means are reported. Bars with a letter in common can't be considered different according to a LSMEANS Tukey-Kramer0.05 grouping.*

Materials and Methods. The trial was conducted under field condition using a split plot experimental design replicated 3 times with plant species (PS) as the main factor and sowing rate (SR) and crop management (CM) as subfactors. The PS were Oat (*Avena sativa* cv. Prevision), Wheat (*Triticum aestivum* cv. Solenio), Barley (*Hordeum vulgare* cv. Ketos), and Triticale (*×Triticosecale* cv. Trimour). SR were either 400 or 600 viable seeds m-². CM involved an early crop utilization (clipping at 5-cm height at the stage GS29 compared to a non-utilised control) and the subsequent crop harvest as a forage crop at early dough (GS83) or as grain crop at full ripening (GS99). Crops were sown on the 7th December. At each harvest, dry matter (DM) concentration and yield were determined. A subsample was separated in botanical fractions and dried. All subsamples were analysed for Kjeldahl-N. Number of spikes per unit area and thousand kernel weight were determined and seeds per spike computed. Total biomass yield, grain yield, yield components and total N up-take were reported. Data were analysed by means of a general linear mixed model (Glimmix procedure in SAS/STAT 9.2). Total biomass and total N uptake were computed per each CM and between GS29+GS83 vs GS29+GS99. Restricted maximum likelihood (REML) was used to produce unbiased estimates of variance and covariance parameters after degrees of freedom and standard errors corrections by the Kenward-Roger procedure. Replicate was treated as random factor. Differences among means were compared by a conservative Tukey-Kramer grouping at the 5% to the LSMEANS p-differences.

Conclusions. Independently from PS and SR the double utilization strongly depressed the biomass yield. These results likely depended on a relatively late sowing date and low cutting height and need to be take in account when aiming to establish DP crops. Further research is needed to establish adequate time for an early utilization and choice of the genotype for DP crop.