How does a novel pull-type forage harvester with kernel processor harvest a vitreous corn hybrid?

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Introduction

The whole-plant corn silage (WPCS) can provide a greater production of low-cost starch per hectare with a high concentration of metabolizable energy in areas where the land is suitable for its cultivation (Wilkinson and Rinne, 2018). Furthermore, the rapid harvest and ease of ensiling (Nigon et al., 2016) has made the crop a popular choice for dairy farmers. Despite the increase in custom contractors offering self-propelled forage harvester (SPFH) services (Daniel et al., 2019), the adoption of pull-type forage harvesters (PTFH) by Brazilian dairy farmers is still very common (Bernardes and Rego, 2014). Until two years ago there was no PTFH with kernel processor on the market. This is a current concern as most cultivated hybrids have a higher proportion of vitreous endosperm in the kernel (Correa et al., 2002) which may be more difficult to fracture during the harvesting process (Ferraretto et al. 2018). In this scenario, reducing the theoretical length of cut (TLOC) may be a possible way to optimize the kernel breakage by cutting knives. The objective of this study was to evaluate the impact of two different kinds of forage harvesters (with or without kernel processor) and two TLOC settings on the phycical characteristics of WPCS.

Materials and Methods

A vitreous corn silage hybrid (BM 709, Sementes Biomatrix) was cultivated. The average of whole-corn plant DM was 34.8%. The whole-plant was harvested with a conventional PTFH (**PT**) at 6 and 10 mm of TLOC or by a PTFH with kernel processor (**PTK**) at same TLOC settings. WPCS samples were stored for 35 d. Vitreousness, measured by dissection in unfermented kernels, averaged 62.4%. As-fed whole-plant sample was used for determination of particle size distribution using Penn State Particle Size Separator (PSPS). The PSPS procedure was conducted manually using 3 sieves (19, 8 and 4-mm) and a pan (Heinrichs, 2013). A subsample, kernel and stover fractions were separated by a hydrodynamic separation procedure. After separation, the kernel-fraction was transferred to aluminum plates, re-dried at 60°C for 48 h in a forced-air oven and dry-sieved using a Tyler Ro-Tap Shaker (model RX-29, Tyler, Mentor, OH) with a set of 9 sieves with nominal square apertures of 9.50, 6.70, 4.75, 3.35, 2.36, 1.70, 1.18, 0.59-mm and pan. The percentage of grains smaller than 4.75 mm was calculated as described by Dias Junior et al. (2016). Data were analyzed as completely randomized design in a factorial arrangement: 2 harvesters × 2 TLOC using the procedure MIXED.

Results and Discussion

The follow differences occurred only in TLOC of 10 mm. The PTK reduced particles above the 19-mm sieve from 4.7 to 1.8%. This TLOC displayed the highest value of material retained in the 8-mm and the lowest values in the 4-mm sieve for unprocessed WPCS. Kernel processing and short TLOC led to a rise in particles retained in a 4-mm sieve. The PTK increased the percentage of grains smaller than 4.75-mm from 56.4 to 80.0%.

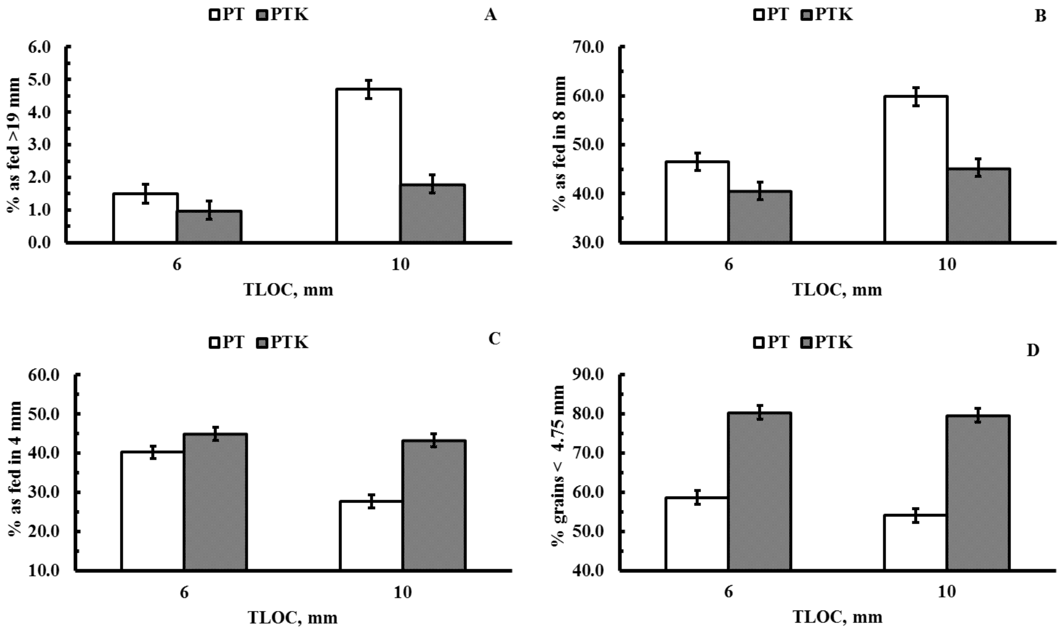

Figure 1. Interaction between theoretical length of cut and forage harvester type for percentage of particles above the 19-mm sieve (panel A, P < 0.01; SEM = 0.28), retained in the 8-mm sieve (panel B, P = 0.04; SEM = 1.79), retained in the 4-mm sieve (panel C, P < 0.01; SEM = 1.66), of the Penn State Particle Size Separator and the effect of kernel processor at percentage of grains smaller than 4.75 mm (panel D, P < 0.01; SEM = 1.80, without interactions).

Conclusion

The new PTK promoted a greater kernel breakage. The impact of kernel processor in WPCS particle size distribution was pronounced in the TLOC of 10 mm which led to drop in particles > 19 mm. The reduction of TLOC for both forage harvesters did not impact kernel processing for WPCS at 34.8% of DM.

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