Centralized Directional System for Reducing Ground Losses in Mechanized Coffee Harvesters

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Introduction

Mechanized coffee harvesting is based on the principle of vibration, according to which the harvester rods intersperse the coffee tree canopy, stripping the fruit. Of all the fruits that are stripped, about 15 to 25% do not reach bulk carriers, consisting of the so-called ground losses [1]. The largest volume of such losses occurs in the harvester blades, and they increase even more due to the decentralized guidance of the harvester w.r.t. the planting line (7 to 15% of the fruits that are stripped are lost in this way). This work summarizes the development and validation of a centralized directional system for self-propelled coffee harvesters [2], which aims at visually informing the operator about the misalignment condition of the machine w.r.t. the planting line, and consequently, decrease coffee ground losses.

Materials/Methods

To identify the off-center condition of the harvester, the proposed system, which is composed of a pair of ultrasonic sensors with embedded electronics for Wi-Fi connection with the developed application (Fig. 1), was installed directly under the harvester blades (Fig. 2). Harvesting experiments were carried out on coffee crops, which comprised of, at least 4 replications per treatment, each with 6 evaluated plants minimum. The following parameters were randomized for the purpose of the experiments: (a) coffee variety; (b) age of crops; (c) harvester model; and (d) operational speed. The effectiveness of the system was evaluated in terms of: (a) harvested volume (in liters); (b) ground losses (in percentage); (c) defoliation (in grams per plant); and (d) branch breaking (in units per plant). We also assessed the performance on the system for different update rates of the application screen, as this has direct impact on the speed of response of the operator. The main results are summarized in Table 1.

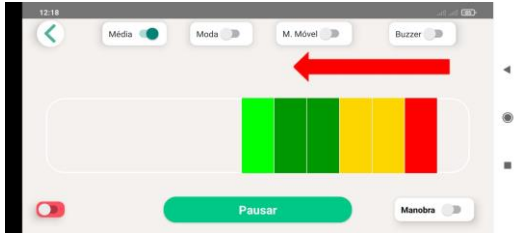

Figure 1: App Interface

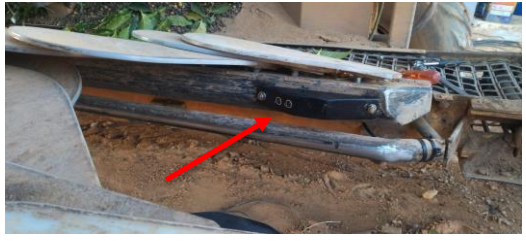

Figure 2: Centralized Directional System

Results/Discussion

Experiment	#1			#2				#3				#4		#5			
Coffee Variety	Catuaí			Catuaí				Topázio				Icatu/Catuaí		Icatu			
Age	Old			New				Mid-age				Old (pruned)		Old			
Location	Ijaci, MG			Ijaci, MG				Ijaci, MG				Candeias, MG		Candeias, MG			
Harvester	Case 200			Case 200				Case 200				Vetor		Vetor			
Speed (m/h)	600			600				850				1300		1600			
App Mode	w/o	1.0 s	1.5 s	w/o	1.0 s	1.3 s	1.5 s	w/o	1.0 s	1.3 s	1.5 s	w/o	1.0 s	w/o	1.0 s	1.3 s	1.5 s
Harvested Volume (L)	7.3	8.8	8.0	3.2	3.8	3.9	2.3	4.5	7.3	7.4	7.3	4.7	5.4	2.1	3.5	3.6	2.9
Ground Loss (%)	11.9	3.2	6.3	10.7	4.1	7.6	7.1	12.3	5.4	6.4	6.1	17.4	7.0	13.5	6.5	3.2	10.3
Defoliation (g/plant)	1115	613	756	194	154	184	165	932	436	679	615	449	205	884	386	124	532
Branch Breaking (unit/plant)	---	---	---	1.9	1.9	1.0	1.1	2.2	1.5	2.2	2.2	---	---	9.3	2.2	3.7	3.8

Table 1: Experimental Results – Average Values

Conclusion/Perspectives

Considering the best case scenarios (best update rates of the application screen), the proposed centralized directional system for mechanized coffee harvesters was able to increase, in average, the harvesting volume by **39%**, and to reduce ground losses, defoliation and branch breaking by **65%**, **52%**, and **48%**, respectively.

References:

[1] SOUZA, J. C. S. 2009. ***Determination of fruit losses in the blades and conveyors of mechanized coffee harvesters****. 62 p. Dissertation (Master in Agricultural Engineering) - UFLA.*

[2] SILVA, F. M. et al. 2019 Evaluation of a centralizing system for a self-propelled coffee harvester. ***Technical report****, 13 p.*