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Corn grains losses in the function of different speeds of the harvesting

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Abstract. The main objective of this work was to quantify and evaluate the occurrence of corn grain losses due to the different speeds of the harvesting machine in the second harvest, considering that, in the state of Mato Grosso, corn cultivation, mainly in the off-season, has been gaining space every year due to the increase in both the quality and the quantity of grains planted and harvested in the state. The frame was made in relation to the size of the platform with 0.37 m in length, the frame was superimposed on the straw to collect the grains lost by the harvester. The experiment was carried out at speeds of 3.5; 4,5; 5.0; 5.5 and 6 $km.h^{-1}$ with rotation of 540 per minute in the cylinder and concave in the opening position No. 05 corresponding to 50 mm of standardized opening for all speeds, where it was possible to observe that there were no significant losses of corn kernels with the speed of the harvester 3.5 $km.h^{-1}$. The variation between the losses is 30.2 kg per hectare of whole corn grains, between the speeds of harvest tested. It was concluded that the speed of the harvester of 3.5 $km.h^{-1}$ has lower losses of corn kernels when compared to the other speeds experienced, noting that this loss was lower, acceptable for maize.
Keywords: Mechanized harvest, Productivity, *Zea mays* L.

Introduction

In the state of Mato Grosso, maize production, especially in the second season (off-season) has greater relevance each year. This is due to the high demand for grain, due to the demands of the ethanol plants and also for the characteristics of the soil and favorable climate, advanced technologies, increased income to the producer and the option of crop rotation and straw production for Cerrado soils (Kappes, 2013). The estimated corn acreage for the 2018/19 harvest in Mato Grosso was 4.69 million hectares. Thus, the expected production was 28.78 million tons, with an average productivity of 6,120 kg. ha^{-1} (IMEA, 2019).

According to Cruz et al. (2010) with the advance of genetic improvement, it was possible to create new varieties of soybeans with shorter cycle, anticipating the harvest and facilitating the implementation of off-season corn production, since there is still good soil moisture. , reducing the risks of loss due to lack of rainfall. Thus, the best sowing period for off-season corn is in February, extending to the first week of March at most. Brazil is the world's third largest producer and second largest exporter of maize grains (Zea mays), reaching records in productivity due to the following factors: no-till system, genetic improvement, insect and glyphosate resistant materials, improved crop yield. specialized technical assistance, use of precision agriculture, industrial seed treatment, among others (Peixoto, 2014).

An important factor to note is the loss of corn grain at harvest. Investment in inputs and pest control are susceptible to climate (Maurina, 2012) and, at harvest time, problems such as lack of machine maintenance, lack of operator training, improper adjustments that are incompatible with actual harvesting conditions and of harvester, inadequate harvester speed, out-of-harvest crop and climate, which combined all these factors reduce the expected yield potential of corn crop (Benedetti, 2009).

Oliveira et al. (2014) reported that in addition to maintaining the harvester constant speed, the ear insertion level can influence the losses. At a constant speed and an uneven spike insertion resulted in a lot of variation, on the other hand, the results can be better if the whole harvester assembly is in perfect alignment and operation. Costa et al. (2012) corroborated this point, as this factor can result in large grain losses..

For proper mechanical harvesting, it is important to verify the physiological maturity point and to perform it at the appropriate time. Corn sowing should be properly spaced and in the best possible alignment so that the operator has no difficulty driving the machine along the field. The harvester must be well regulated, revised and with all parameters up to date. Another condition to be observed is the harvester adjustment, such as the concave adjustment in relation to the machine cylinder. It is considered one of the most important adjustments because it is related to the threshing of grains and, depending on the moisture and opening, there may be losses in quantity and quality, such as broken and cracked grains. The best setting in the concave opening is the average of the average ears, so that at the time of threshing, the beans come out whole and do not stick to the cob (Mantovani, 2010).

As the state of Mato Grosso has a large production of corn grains and in two harvests per year, further studies are recommended to increase the operational capacity of harvesting machines, thus reducing losses. Thus, the aim of this study was to quantify and evaluate the occurrence of second crop corn grain losses as a function of harvester speed.

Methods

The present study was carried out in Fazenda Aurora production area, in Nova Mutum, Mato Grosso state. The experimental area was 3024 m² (ha), located at the geographic coordinates 13º51'16.38''S and 55º45'10.82''O. The climate of the region, according to the KÖPPEN classification, is tropical moist (Aw), with high temperatures, rain in summer and drought in winter. The average annual temperature was 24.4 ° C per year and the average annual rainfall was 2,200 mm (Alvarez et Al., 2013).

The area of the experiment was covered by native cerrado forest until 1998, the following year it was deforested, and rice was sown in the first agricultural year, subsequently producing soybean and off-season pearlmillet.

On January 15, 2017, after soybean harvesting reached an average yield of 59 bags.ha-1, corn was sown with a spacing of 45 cm between rows and a population of approximately 58,000 plants.ha-1. Soil was applied 300 kg.ha-1 of formulated 21-07-14, being performed in two applications, the first 8 days after sowing and the second to 15 days after sowing.

For plant disease control fungicide was applied and for weed control two herbicide applications were applied, which was applied 9 days after seedling emergence. In order to control weeds weed was applied 30 days after maize emergence. To maintain the health of corn plants, two insecticide applications for bed bug control were also made.

Harvesting took place on July 17, 2017 using the harvester (manufactured in 2007), coupled with a 12 row Bocuda corn platform with 0.45 m row spacing. It is noteworthy that the adjustment in all treatments was the same, being 540 rpm (rotation per minute) in the cylinder and the concave in opening position #5, corresponding to 50 mm opening.

Average field productivity was 120 bags.ha-1, with average humidity of 14% and 1% impurity rate.

During the harvesting process, corn grain losses were evaluated at five speeds: 3.5 - 4.5 - 5.0 - 5.5 and 6.0 km.h-1, with grain moisture close to 14%.

The experimental design was randomized (DBC), consisting of 5 treatments, using 5 harvest speeds (V1, V2, V3, V4 and V5) with 10 replications for each of the speeds, the blocks were 140 m long by 5.4 m, which corresponds to the width of the harvester platform.

Each plot consisted of 35 m in length. Experimental determinations using a 2 m² frame were made randomly within each plot.

The total size of each block was 756 m², and the total experimental area was 3024 m² (0.13 ha). Importantly, the first initial and final 5 m within each experimental plot were disregarded, considering an area of the 25 m plot.

Data were analyzed by variance using the Tukey test, with a significance level at 5%.

In order to measure harvester losses, the area of the experiment was previously delimited. After that, a frame with wooden slats and twine with an area of 2 m² was implanted and placed on the ground to collect the grains and quantify the losses (Mesquita, 2011). Before the harvester passed, the presence of grains on the ground, fallen ears, was evaluated, avoiding their quantification as losses. Also, to determine the measurement of the frame, an equation was made, which divides 2 m² by the width of the harvester platform, making it possible to determine the frame width (Maurina, 2012).

After the harvester was displaced, the frame was superimposed over the straw to collect the grains lost by the harvester.

After grain collection, they were taken for analysis in the laboratory. For this, the corn grains were selected the integers, then quantified. The "Rules for Seed Analysis" proposed by MAPA (2009) were used for lost grains, which were weighed and dried in a 24 hour air circulation oven at 105° C. First, the whole grains were weighed on a precision scale and the aluminum mugs placed. Then they were arranged in an aluminum tray in order to go for drying. Following, the beans were heated in air circulation at 105ºC for 24 hours. After 24 hours in the oven, the grains were quickly removed and placed in the desiccator for cooling for 30 minutes, then the whole grained and broken alumina mugs were weighed again.

After weighing the grains, calculations were performed (Equation 1) according to Weber (2005), the moisture was standardized to 14%, and later the grain losses were transformed into kg.ha-1.

$$Mf = Mi\ ((100 - Ua)/(100 - Up)) \quad \text{Equation (1)}$$

Where Mf is the final mass, Mi = the initial mass, Ua = the current humidity and Up = the standardized humidity.

Finally, the data were analyzed by variance using the F test, with a significance level of 5%. When the effect of corn harvesting speeds was significant, regression analysis was performed using the same level as the test.

Results and discussion

Table 1 shows the results of corn grain harvest loss assessments at different harvest speeds.

Table 1. Analysis of variance for corn grain losses according to harvester speed.

Source of Variation	GL	SQ	QM	F	Pr>Fc
Speed	4	1963,33	490,38	5,07	0,0086
Residue	15	1449,92	96,66		
Total	19	3413,26			

The treatment at a speed of 3.5 km.h-1 presented lower losses of corn grain than at a speed of 4.5; 5; 5.5 and 6 km.h-1 with rotation of 540 per minute in the cylinder and concave in opening position nº 05 corresponding to 50 mm standard opening for all speeds. Considering that the variation between losses is 30.2 kg.h-1 of corn grains, among the harvest speeds tested. It is noteworthy that this loss was low for the corn harvest.

Still, the treatment with speed of 3.5 km.h-1 presented lower loss of corn grains when compared to speeds of 5.0 and 5.5 km.h-1, being represented by a reduction of 24 kg.ha -1 for both treatments. It was also noted that the speed of 3.5 km.h-1 was similar to the speeds of 4.5 and 6 km.h-1 (Figure 1).

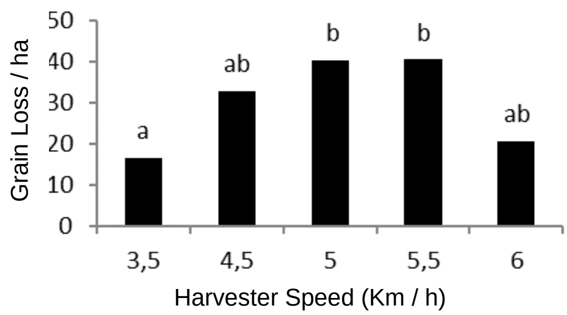

Figure 1. Average corn grain losses according to harvest speed

Similar results were found by Venegas et al. (2012), in a research conducted in Alto Garças - MT. These authors analyzed the corn grain losses at different rotations of the harvester cylinder, with speeds of 4 to 6 km.h-1, and the losses ranged from 14.7 kg.ha-1 to 109 kg.ha-1. , with an average of 45 kg.ha-1.

Corn grain moisture remained constant for all treatments, it was found that there was no difference between the groups (Table 2)..

Table 2. Analysis of variance for corn grain moisture according to harvester speed.

Source of Variation	GL	SQ	QM	F	Pr>Fc
Speed	4	21,91	5,47	2,55	0,0822
Residue	15	32,18	2,19		
Total	19	54,09			

Humidity did not differ as shown in Table 2, the data presented in Figure 2 clearly complement this result, presenting constant with average values around 14%.

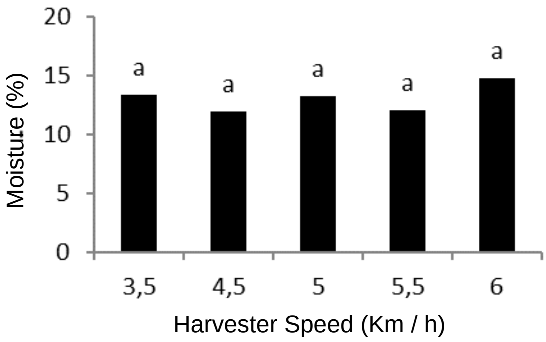

Figure 2. Average corn grain moisture according to harvester speed

Corn moisture during mechanized harvesting significantly interferes with yield. If it is high it can increase grain losses, causing great losses to the producer. According to Mantovani et al., (2009) it is difficult to have no losses in grain quality. These authors reported that grain moisture above 18% resulted in lower impurity rates, but losses are higher due to lower harvester threshing. Losses are lower at < 13% humidity, but impurity content increases

Total losses of whole or brittle grains were lower than the minimum recorded by Oliveira et al., (2014). The results of these authors evaluating six properties with speeds ranging from 7 to 8 km.h-1, showed losses between 15.1 to 159.4 kg.ha-1, with higher percentage of whole grains, mainly due to standard property regulation..

Corn grain losses were similar for speeds ranging from 3.5 to 6.0 km.h-1. Probably the straw resulted in improper feeding conditions in the harvester, being the mass flow in the harvester's trailing system. Similar results were found by Bertonha et al. (2012) in the evaluation of losses and the friction to corn grains at speeds of 4.1; 4.4; 4.7; 4.9 and 6.8 Km.h-1.

Mello (2006) related operating speed to harvest losses at speeds 5.4; 6.8 and 9.8 km.h-1, being harvested by an SLC 1165 harvester, with a speed of 500 RPM. The author observed that the losses were similar between the analyzed speeds, and further recommended that the cylinder and concave rotation should be in the standard setting.

As Cortez et al. (2008) analyzed the impurity and loss levels of a 1997 year-old SLC harvester, with three cylinder rotations (500, 600 and 700 RPM) with an average harvest speed of 3.5 km.h-1. . According to these authors, higher cylinder rotation resulted in less loss, however, with an increase in impurities, being similar to the guidelines of Mantovani (2010), who reported that the concave position and cylinder rotation may vary according to the humidity, not having a specific regulation rule, keeping only the level of losses below 1.5 $bags.ha^{-1}$. Thus, in addition to monitoring humidity, it is also necessary to monitor the level of impurities, machine travel speed and grain losses periodically during harvesting..

Regardless of the crop to be harvested, by any harvester model, whether in conventional or axial form, you should seek an equilibrium point in the setting so as to thrive as efficiently as possible, with minimum losses and with a level of impurities <1. % (Mantovani, 2008). Thus, the productive potential can be high, maintaining a grain quality standard (Torres, 2011).

Conclusion

Based on the results obtained and the conditions under which the experiment was performed, it can be concluded that:

- At a speed of 3.5 km.h-1, there were lower losses of corn grain when compared to a speed of 5.5 km.h-1 at a rotation of 540 per minute in the cylinder and concave in the open position number 05 standardized to all speeds;
- The variation between losses was 30.2 kg.ha-1 of corn grains, at the tested speeds considered to be lower than acceptable in the corn crop.

References

ALVARES, C. A.; STAPE, J. L.; SENTELHAS, P. C.; GONÇALVES, J. L. M.; SPAROVEK, G. Köppen's climate classification map for Brazil. Meteorologische Zeitschrift, v. 22, n. 6, p. 711 – 728, 2013.

BENEDETTI. B. C. Fórum permanente de agronegócios. Qual tamanho do desperdício. 2009. Disponível em: <http://www.unicamp.br/nepa/downloads/QualoTamanhodoDesperdicio.pdf>. Acesso em: 01 jul. 2019.

BERTONHA, R. S. et al. Perdas e desempenho de sementes de milho em dois sistemas de preparo do solo e velocidades de deslocamento da colhedora. Revista Brasileira de Milho e Sorgo, v.11, n.3, p.243-253, 2012. Disponível em: <http://www.unicentroagronomia.com/imagens/noticias/artigo_fitotecnia.pdf>. Acesso em: 22 jun. 2019.

BRASIL. Ministério da Agricultura, Pecuária e Abastecimento. Regras para análise de sementes. Brasília, 2009. 395 p.

CARREIRA, A. S; EPIRO, G. A; TANAKA, E. M. Perdas na colheita mecanizada de milho (*Zea mays* L.) na região de Cândido Mota e Pedrinhas Paulista. Vale do Paranapanema. 2013. Disponível em: <http://www.portalmaquinasagricolas.com.br/files/2015/02/Tecnologia- Colheita- Maior-aproveitamento-no-campo.pdf>. Acesso em: 12 jun. 2019.

CORTEZ, J. W. Perdas na colheita de milho em função da rotação do cilindro trilhador e umidade de grãos. Scientia Agrária, Curitiba, v. 9, n. 4, p. 505-510, 2008. Disponível em: <dialnet.unirioja.es/descarga/articulo/2906137.pdf>. Acesso em: 24 out. 2019.

COSTA, M. M. et al. Perdas quantitativas na colheita mecanizada do milho cultivado em espaçamentos reduzido e convencional. Seminário: Ciências Agrárias, Londrina, v. 33, n. 2, p. 565-574, abr. 2012. Disponível em: http://www.uel.br/revistas/wrevojs246/index.php/semagrarias/article/viewFile/6464/10473>. Acesso em: 11 jun. 2019.

CRUZ, C. J. et al. Cultivo do milho. Embrapa Milho e Sorgo. 6. ed. 2010. Disponível em: <http://www.cnpms.embrapa.br/publicacoes/milho_6_ed/manejomilho.htm >. Acesso em: 08 jun. 2019.

IMEA- INSTITUTO MATO-GROSSENSE DE ECONOMIA AGROPECUÁRIA. 3ª Estimativa da Safra de milho – 2018/19. 2019. Disponível em: <http://www.imea.com.br/upload/publicacoes/arquivos/R403__3a_Estimativa_de_safra_de_milho_2018-19___23-04-2019.pdf>. Acesso em: 22 mai. 2019.

KAPPES, C. Sistemas de cultivo de milho safrinha no mato Grosso. In: XIII SEMINARIO NACIONAL DO MILHO SAFRINHA. Estabilidade e produtividade. DOURADOS.Anais.. 2013. Disponível em: <http://www.cpao.embrapa.br/cds/milhosafrinha2013/palestras/5CLAUDINEIKAPPES.pdf>. Acesso em: 24 jun. 2019.

KÖPPEN. Classificação climática. Disponível em:<http://meteo12.nforum.biz/t17-classificacao-climatica-de-koppen>. Acesso em 15 jan. 2019.

MANTOVANI, E. C. Cultivo do Sorgo. Colheita e pós colheita. 4 ed. 2008. Disponível em: <http://www.cnpms.embrapa.br/publicacoes/sorgo_4_ed/colheita_regulagem.htm>. Acesso em: 28 mai. 2019.

MANTOVANI, E. C. Cultivo do Milho. Colheita e pós colheita.6 ed. 2010. Disponível em: <http://www.cnpms.embrapa.br/publicacoes/milho_6_ed/colregula.htm>. Acesso em: 28 mai. 2019.

MANTOVANI, E. C; SANTOS, J. P; FONSECA, M. J. O. Cultivo do milho. Colheita e pós-Colheita. 5 ed. 2009. Disponível em: <http://www.cnpms.embrapa.br/publicacoes/milho_5_ed/colheita2.htm>. Acesso em: 24 jun. 2019.

MAPA - Ministério da Agricultura, Pecuária e Abastecimento. Regras para análise de sementes (RAS). Brasília, 2009. 395 p.

MAURINA, A. C. Perdas na colheita mecanizada da soja - Safra 2011/2012. Levantamento de prevenção de perdas na colheita da soja no estado do Paraná - safra 11/12. Curitiba. 2012. Disponível em: <http://www.emater.pr.gov.br/arquivos/File/Biblioteca_Virtual/Relatos_Resultados_e_Planejamentos/Perdas_na_Colheita/Rel_perdas_colheita_2011_2012.pdf >. Acesso em: 12 mai. 2019.

MELLO, A. J. R. 2006. Produtividade e perdas na colheita de dois cultivares híbridos de milho em função da velocidade de semeadura. Jaboticabal. 56 f. Dissertação. Disponível em: <http://www.fcav.unesp.br/download/pgtrabs/cs/m/2544.pdf>. Acesso em: 05 mai.2019.

MESQUITA, C. M. et al. Monitoramento das perdas de grãos na colheita de soja. Londrina: Embrapa Soja, 2011, p 14. Disponível em: <http://www.infoteca.cnptia.embrapa.br/infoteca/bitstream/doc/907539/1/manualcompleto3.pdf>. Acesso em: 12 mai. 2019.

OLIVEIRA, T. C. et al. Perdas quantitativas na colheita mecanizada de milho safrinha na região norte de Mato Grosso. AGRARIAN ACADEMY, v.1, n.02; p. Sinop. 2014. Disponível em: <http://www.conhecer.org.br/Agrarian%20Academy/2014b/perdas%20quantitativas.pdf>. Acesso em: 28 mai. 2019.

PEIXOTO, C. M. O milho no Brasil, sua importância e evolução. 2014. Disponível em: <http://www.pioneersementes.com.br/media-center/artigos/165/o-milho-no-brasil-sua-importancia-e-evolucao>. Acesso em: 22 jun. 2019.

TORRES, M. Novo padrão de classificação do milho é aprovado. Ano 05. ed 30. Jornal eletrônico da Embrapa milho e sorgo. Sete Lagoas. 2011. Disponível em: <http://www.cnpms.embrapa.br/grao/30_edicao/grao_em_grao_materia_02.htm>. Acesso em: 27 out. 2019.

VENEGAS, F.; GASPARELLO, A.V.; ALMEIDA, M.P. Determinação de perdas na colheita mecanizada do milho (*Zea mays* L.) utilizando diferentes regulagens de rotação do cilindro trilhador da colheitadeira. Ensaios e Ciência: Ciências Biológicas, Agrárias e da Saúde, Campo Grande, v.16, n.5, p. 43-55, 2012. Disponível em: <http://www.redalyc.org/articulo.oa?id=26030710004>. Acesso em: 22 mai. 2019.

WEBER, E.A. Excelência em beneficiamento e armazenamento de grãos. Canoas, RS: Editora Salles, 2005. 585p.