

Quantification of maize losses in road transport

ABSTRACT

The present work had the objective of quantifying corn grain losses in road transportation along a section of highway BR 163 in the state of Mato Grosso. The survey was done in July and August of 2016 in the section between the Imigrantes Highway, within the city of Cuiabá - MT, and the municipality of Nova Mutum – MT. This stretch is considered to be the one with the highest flow of grain loads in the state of Mato Grosso. Twenty one collect points were established along the stretch, with a distance of 10 km from one point to the other, at each collect point 3 areas of 1m² were delimited with the aid of a fixed frame of wood with the same area, in a distance of 1.3 m from the highway margin, in the north-south direction, which is the direction of the grain flow. The samples were placed in identified plastic bags and taken to the laboratory for separation and weighing. The points of the biggest grain losses were points 06 and 12 of the section, where it was verified pavement in poor quality with much road surfacing, and the points of lower losses were collected in the top quality asphalt range.

Keywords: grain flow; logistics, production

1. INTRODUCTION

The expansion of agricultural areas accompanied by new technologies and forms of planting make Brazil stand out in the cultivation of grains and occupy an important place in the production and supply world, projecting it in an optimistic scenario of productivity (United Nations Organization for Food and Agriculture (FAO) and United States Department of Agriculture [1].

Despite the climatic and technological advantages presented in Brazil in the areas of grain production, much of this is mitigated when related to this context grain losses occurring in the transport logistics by the main existing means that are the highways, railroads, waterways and ports [2], highlighting the Brazilian highways that did not follow the agricultural expansion. According to the authors cited in the reference [3] corroborate with this information, where it states that national grain production could be greater were it not for the problems faced with the outflow logistics where billions are lost due to the limited investment in infrastructure, with projects aimed at only capping the existing holes, without enlarging and giving better quality to the existing mesh, and still without proposals that aim to reduce the displacement that is still in long distances.

The flow of the agricultural harvest in Brazil is a visible bottleneck when it comes to grain logistics, the country begins to lose competitiveness from the movement of the harvest in the farm to the shipment in ports, raising the cost of products with logistics in transportation [4]. According to the authors cited in the reference [5], the transport of volumes over long distances, provide a low value added to the product, thus reducing its competitiveness in the market, the same author cites that the paving of BR 163 to the port of Santarém in Pará, would already bring a reduction of \$ 30 per tonne in freight, thus adding value to the grain transported. Thus, all efforts generated in recent years to raise agricultural products to the

level they are in are dissolving due to quality problems in the road transportation system and by more efficient means such as waterways and railroads, are not very representative in the outflow [6].

In the movement of the farm to the warehouses, the grain losses are scattered along the highways, coming from the modal choice for the freight price; the lack of conservation of highways; the lack of connection between road, rail and waterways; the low supply of another type of modal for the transportation of cargo; the lack of investment in cereal car bodies; losses during storage; long distances to storage sites; lack of maintenance in warehouses and the lack and inadequate use of cargo protection tarpaulins [7].

In view of this scenario, where the state of Mato Grosso is located, being the largest maize producer in the country, and facing serious problems in order to transfer this grain to its final destination, the objective of this work is to quantify the loss of corn grains in the margins of the BR 163 highway in the state of Mato Grosso.

2. MATERIAL AND METHODS

The evaluation work was carried out at the Nucleus of Storage Technology (NTA) of the Faculty of Agronomy and Animal Science (FAAZ), at the Federal University of Mato Grosso, Cuiabá - MT campus.

The survey was carried out in July and August of 2016 in the stretch between km 499 of BR070, which is an overlapping point between BR070 and BR163, on the Imigrantes highway, within the city of Cuiabá - MT, and km 536 of BR163, in the municipality of Nova Mutum - MT. The section where it comprised the evaluation points had approximately 210 km, being considered the section of greater flow of loads of grains of the state of Mato Grosso.

A total of 21 collection points were established along the stretch, with a distance of 10 km from one point to the other, in order to randomize collection points. For the distance between the points a margin of difference of 500 meters was accepted for more or less, in order to avoid points of collection in very dangerous places, lack of parking space or that in any way put safety at risk of collections.

At each collection point an area of 1 m² was fixed with the aid of a fixed frame of wood with the same area, at a distance of 1.3 m from the highway margin, in the north-south direction of the highway, which is the direction of the grain flow in BR 163 in the section considered, as exemplified in Figure 1; from this first collection area, two more areas to be collected were selected, one 30 m before and the other 30 m after the first area fixed at the point. In the areas were collected all residues of grains present and demarcated with white spray paint, in addition each collection point was georeferenced with a GPS Garmin model Etrex legend. The markings of the points and areas were carried out on 07/19/2016 and the collections were held weekly on 07/25/2016, 08/01/2016 and 08/08/2016.

Figure 1. Area of corn grain collection on the shoulder of BR163 highway.

The grains were collected on the side of the road, along the gutters and near the lawn, with a broom, brush and dustpan. The collected material was placed in plastic bags properly identified and taken to the laboratory for separation and weighing.

The experiment was carried out in subdivided plots, 21 plots (collection points), 3 subplots (collection times) and 3 replicates (collection areas at points). Statistical analyzes were performed using software Assistat (2016), version 7.7 pt. To verify the differences between the treatments, the analysis of variance (ANOVA) was used by means of the F test. When significant to the comparison of means for the treatments was performed by the Scott-Knott test.

3. RESULTS AND DISCUSSION

The data were first submitted to analysis of variance of the data, as can be verified in Table 1, which shows significance at 0,05 only for the 21 collection points, with no significance for either the evaluation times or the interaction.

Table 1. Analysis of Variance for Volume of losses as a function of the points along the course in BR 163 – MT, Brazil

| FV | GL | SQ | QM | F |
|----------|-----|-------------|------------|--------------|
| Treat. A | 20 | 203.310,607 | 10.165,535 | 20,337 ** |
| Res. A | 42 | 20.993,224 | 499,838 | - |
| Parcel | 62 | 224.303,831 | - | - |
| Treat. B | 2 | 504,425 | 252,212 | 2,019ns |
| Inter. | 40 | 5.008,261 | 125,206 | 1,002 |
| TA x TB | | | | ns |
| Res. B | 84 | 10.488,668 | 124,865 | - |
| Total | 188 | 240.305,187 | - | - |

The coefficient of variation presented high values, this is explained by the fact that, however great the control performed in the choice of points, the factors that directly influence the loss of grains are not controllable, such as the different conditions of road quality along the evaluated route and the grain haul trucks.

After the analyzes, we can observe the averages of all the collection points in BR 163 in Table 2, where we found a greater grain loss in points 6 and 12 of the highway. In these points of the highway, a high number of punctual tailings of holes were verified, as verified in

101 Figure 3, the process of covering holes generates a condition of instability for the truck.
102 According to the authors cited in the reference [8].

103 Which explains that this generated trepidation causes the grains to seek accommodation
104 points in the body, and in cases where the body has some kind of gap or opening these
105 grains tend to move to these points and get lost. Of the six points that stood out with the
106 lowest losses (P18, P17, P15, P16, P19 and P21), four are located in the Serra da Caixa
107 Furada, in the stretch that includes the exit of the city of Rosário Oeste - MT and Posto Gil ,
108 this stretch being duplicated with good quality asphalt.

109 **Table 2. Average grain losses of corn in grams of the points collected in BR 163 – MT,**
110 **Brazil**

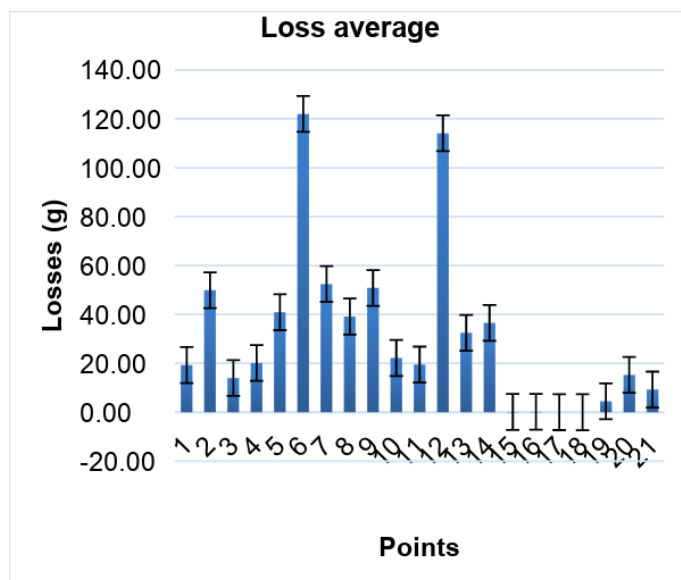
| Points | Averages |
|--------|-----------|
| P6 | 122,018 a |
| P12 | 114,092 a |
| P7 | 52,426 b |
| P9 | 50,848 b |
| P2 | 49,923 b |
| P5 | 40,914 c |
| P8 | 39,148 c |
| P14 | 36,541 c |
| P13 | 32,495 c |
| P10 | 22,197 d |
| P4 | 20,160 d |
| P11 | 19,507 d |
| P1 | 19,301 d |
| P20 | 15,251 d |
| P3 | 13,976 d |
| P21 | 9,287 e |
| P19 | 4,498 e |
| P16 | 0,148 e |
| P15 | 0,142 e |
| P17 | 0,034 e |
| P18 | 0,000 e |

111 *Means followed by the same letter do not differ statistically from each other at the 5% level of*
112 *significance by the scott-knott test*
113



114 **Figure 2. Corn kernels fallen on the highway in the section of point 6 of collection.**
115

116
 117 Figure 3 shows the graphical representation of the losses at the collection points studied
 118 with their respective standard errors.



119
 120 **Figure 3. Representation of the means of the points of the course with their respective**
 121 **standard errors.**

122 Grain haulers are not designed to run on asphalt of poor quality, as is verified in most of the
 123 section evaluated, the tires, wheels, springs and the bodywork do not support the
 124 undulations of the roads, thus causing damages to the Carriers, truck drivers and the owners
 125 of the grain transported. A very important factor responsible for much of the loss is the
 126 government's unwillingness to invest in road infrastructure, since trucks suitable for this
 127 activity have a higher cost.

128 4. CONCLUSION

129 Points 6 and 12 were where there were greater losses in volume of corn grains in road
 130 transport; points 15, 16, 17, 18, 19 and 21 were the ones that obtained the lowest grain grain
 131 loss.

132 Roads quality is the predominant factor for the mitigation of corn grain losses.

133 The solution for the reduction of grain losses in the flow of the crop goes through
 134 investments in improvement of the road network. Lower soil phosphorus levels favors
 135 arbuscular mycorrhizal colonization.

136 COMPETING INTERESTS

137
 138 We declare that no competing interests exist.

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