Transport alternative for harvested sugarcane with 50% reduction in fuel consumption (diesel)

José Henrique Belei
Antonio Eustáquio Sirolli Ferreira
Tedson Luis de Freitas Azevedo
Antonio Abreu Junior
José Antonio Reche Marchetto
Alisson Gomes Rodrigues
Ieda Neubauer de Arruda Crepaldi
GRUNNER TECNOLOGIA AGRÍCOLA LTDA
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ABSTRACT

Agrícola Cana Caiana and Grunner have developed an innovative vehicle for sugarcane harvesting, focused on reducing fuel consumption. This optimization is vital and relevant for similar operations in the largest global producers: Brazil (724 mi t - 37%), India (439 mi t - 22%), China (103 mi t - 5.3%), Thailand (92 mi t - 4.7%), Pakistan (88 mi t - 4.5%), Mexico (55 mi t - 2.8%), Colombia (35 mi t - 1.8%), Indonesia (32 mi t - 1.6%), USA (31 mi t - 1.6%), and Australia (28 mi t - 1.4%). In Brazil, São Paulo leads with 383.4 mi t (54.1% of the 23/24 harvest), followed by Minas Gerais (81.3 mi t).

This innovative agricultural machinery, a result of the owners' experience, has already sold over a thousand units, proving its impact on the efficiency of the sugar-alcohol sector. The Belei family's expertise generated this solution that optimizes resources and increases harvesting productivity, with the potential to advance sustainability and profitability globally, driving agricultural innovation.

High market acceptance reinforces this machine's relevance to cost and efficiency challenges, representing a promising example for a more efficient and sustainable agribusiness, with advanced technology for harvesting practices. [e.g.1]

ORIGINAL SITUATION DESCRIPTION

For sugarcane harvesting operations, a tractor specifically designed for this task was used. However, it presented inconvenient characteristics that were detrimental to the crop.

Figure 1. Grunner Day [2]

OPTIMIZED SITUATION

To adapt a product for the harvesting operation, a standard cargo transport vehicle available in the market was selected. This vehicle allowed for better suitability to the operation, focusing on productivity and reduced fuel consumption, along with other characteristics that would not hinder the work.

The Mercedes-Benz Axor 3131 truck was chosen as the base vehicle to be adapted for harvesting, and Mercedes-Benz was a partner in this endeavor.

Figure 2. Trucking website [3]

Based on this truck, Grunner conceived the ATS X and S for operation in sugarcane harvesting.

Figure 3. Grunner Day [2]

Figure 4. Grunner Day [2]

The images above illustrate the significant extent of the modifications made to the original product, which transformed the truck into agricultural equipment.

Following this redesign of the vehicle, the following fuel economy result was achieved.

Figure 5. Grunner Day [2]

The change in the harvesting vehicle concept resulted in a reduction of nearly 50% in diesel consumption per ton harvested.

The experience with new transportation solutions, still utilizing diesel as an energy source, indicates that there are still many opportunities to be explored with this fuel.

As an additional point, two new pieces of equipment used in sugarcane agriculture have been created: vinasse and fertilizer application units.

CONCEPTUAL DETAIL

To achieve productivity in sugarcane harvesting, beyond equipment optimization, another fundamental detail is avoiding soil compaction and preventing the equipment from driving over planted sugarcane.

To achieve this, the tire track width was altered so that the equipment travels in the inter-row spaces (unplanted areas), and the tires have dimensions that mitigate soil compaction.

e.g. Figure 6. Grunner Day [2]

It is important that the harvesting equipment and the sugarcane planting are in harmony so that the production and productivity of the harvested cane are maximized and preserved.

The image below provides an understanding of the advantage of cultivating sugarcane in non-compacted versus compacted soil.

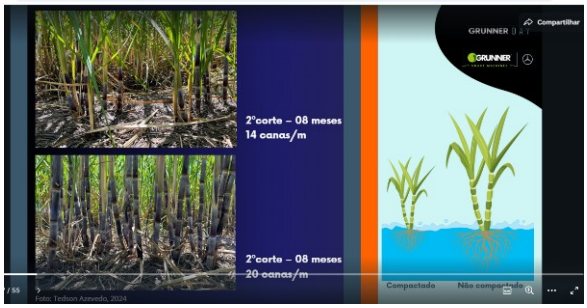

Figure 6. Grunner Day [2]

CONSTRUCTION DETAILS

The creation of the new equipment required adjustments to several items to optimize operation within enhanced conditions, catering to the operator and the vehicle's periodic maintenance and inspection services. These include:

- Cargo bed extension (visor)
- 200 mm increase in transshipment height
- Lubrication points
- Safety pin and identification
- Front grille
- Turning radius
- Hood opening
- Air conditioning
- 90-degree angle tipping body
- Hydraulic steering axle
- Suspension on the last axle
- Radiator
- Relocation of fire extinguishers
- Leveling bag
- Fiber protection on the engine

These were the additional modifications made to have equipment operating within the necessary conditions to optimally serve sugarcane harvesting operations.

To standardize terms used in sugarcane planting, the following information is shared, as one of the objectives in adapting the equipment is to preserve the ratoon, allowing for multiple harvests without damaging the ratooned cane.

Ratoon cane, also known as stubble cane or regrowth, refers to the regrowth of sugarcane after the initial harvest. The plant begins a new growth cycle from the ratoon, which is the base of the cane that sprouts after harvesting. This process can be repeated several times, generating different cuttings of the cane until the sugarcane is renewed.

In summary:

Plant cane: The sugarcane that is planted and harvested for the first time.

Ratoon cane: The regrowth of sugarcane after the initial harvest, which generates new shoots and stalks.

Ratoon: The base of the plant from which the new stalks of the ratoon cane sprout.

Regrowth (after multiple cuts): The regrowth of sugarcane after several harvests, also called the nth cutting leaf.

Ratoon cane is an important stage in the sugarcane cycle, allowing the same area to continue being harvested for several years without the need for replanting. However, it requires specific care, such as fertilization and weed control, to ensure harvest productivity and quality.

This detail is addressed by adjusting the track width of the equipment so that it uses the inter-row spaces between the ratoons. Equipment has already been manufactured with track widths of 2400 mm, 2500 mm, 2800 mm, and 3000 mm, ensuring that harvesting, fertilization, and other required services are carried out in a manner consistent with the cultivation.

An example follows below.

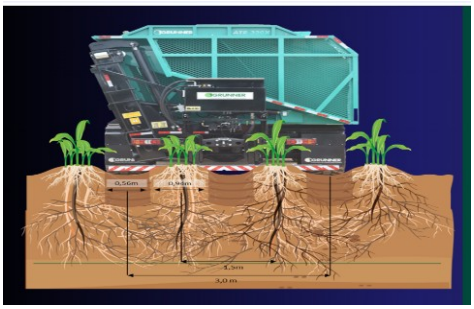

Figure 7. Grunner Day [2]

Among the features implemented in the new equipment was a smaller turning radius, as demonstrated in the image below. This facilitates and speeds up maneuvers within the sugarcane field.

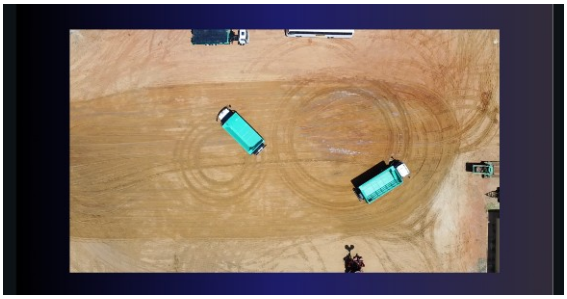

Figure 8. Grunner Day [2]

CONCLUSIONS

Much has been said about new renewable energies, but as shown, there is still significant room to mitigate polluting emissions even with fossil-based diesel until a zero-emission source becomes consolidated.

Even biodiesel like, which is a drop-in fuel (meaning it can be mixed with fossil diesel without any issues), allows for the use of the same equipment and engine without major restrictions.

In the case of the sugarcane sector, the most desired fuel is for engines that can use ethanol, since it is produced at the sugarcane harvesting site, and we know that advanced studies are underway.

From sugarcane production, we can obtain not only ethanol but also biomethane, and from the burning of residual straw, electricity.

It is clear that there are many opportunities to be investigated in the sugar-alcohol sector, and the government of the State of São Paulo has been encouraging these actions.

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[3] Axor 3131. (2022). https://offthetrucks.com/how-it-works/ (Accessed [05/05/2025]).