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OPINION

Utilization of trash: a view from the agronomic and industrial perspective

Increased mechanization and harvesting without previous burning – also known as green cane - have introduced major changes in the operating system of agro industrial sugarcane, raising questions about the management of the trash that remains on the field, its uses, and the technological solutions' needs.

Shall the trash be removed from the field? How much trash should be left on the soil? How to remove it? Baling or transporting it along with the cane? What is the trash's destination? Bioelectricity? Cellulosic ethanol? The purpose of this text is to raise some questions, and present considerations, from the perspective of the sugar and ethanol industry, may contribute to better management and utilization of this important plant residue.

The amount of trash left after harvest depends on several factors, including sugarcane variety, plant yield, and the operating conditions of the harvest machine regarding trash and cane separation. Several studies have shown that trash represents about 20% of the stalk yield, or, on average, 15 tons of trash per hectare.

In the 1990s, when the mechanized harvesting of sugarcane without burning was starting to be adopted, trash preservation was challenged by three negative effects of maintaining the plant residues on the fields: the increasing incidence of the sugarcane root spittlebug, the occurrence of fires, and the low or delayed sprouting of ratoons under low temperature conditions, depending on the time of year or region where the cane was grown. An enhancement of the deleterious effect of frost, where it occurred, was also noticed.

The recent relative stagnation of sugarcane yields and decreased rates of stalks recoverable sugars have also been partially attributed to the expansion of unburned sugarcane. The main reasons for that are the trampling of sugarcane stools due to the traffic of heavy machines during harvesting, the need for systematization and adaptation of fields, damage to ratoons caused by dull or unsharpened cutters, and the increase of plant and mineral impurities in the harvested cane, which reduce the quality of the feedstock.

However, we have evidences that this initial burden or "toll" of unburned sugarcane harvesting can be transformed into a bonus, especially regarding the agronomic effects. Notably in the mills of São Martinho Group, one of the early adopters of mechanized harvesting of sugarcane, the correct handling of trash has provided, for example, greater availability of soil nutrients and increased soil organic matter content. Combined with other soil management practices such as reduced and localized soil tillage, the trash preservation has enabled effective control of erosion, reduced nutrient loss, and emission of greenhouse gases. Biological control with application of the fungus Metharrizium on the fields has maintained spittlebug infestation under control. In addition, the implementation of the "Live Cane Project", which, among other measures, readjusted the tire spacing of machines decreasing trampling on sugarcane rows, has enabled maintenance of high yields and longevity of ratoons.

There are, however, important interactions that have been recently noticed as a consequence of trash management, among them, the environmental concerns due to the increased level of soil K under trash in areas where vinasse is applied, especially around the mills. As K is rapidly released from trash, K accumulation and leaching, coupled with the application of vinasse, can cause and aggravated high K saturation in the soil.

Eventually, the possibility of recovery of all or part of the trash began to be considered at São Martinho Group, especially in farms in colder regions and on these specific situations, either because of the drawbacks associated with excess of trash described above, or to make use of the energy value of this residue. The few experimental data available suggest that, in the traditional growing areas of sugarcane in the center-south of Brazil, part of the trash may be removed after harvest without burning, with no significant effects on the soil-plant system. However, this is still an open issue.

Some sugar mills have chosen to remove the trash by baling, which requires additional operations and infra-structure such as the windrowing of the plant material in the field, baling, loading and transportation of the bales. Besides, the bales have to be unpacked in the industrial plant before the trash is processed. Some aspects also need to be improved to make this trash collecting system viable, such as the reduction of mineral impurities brought from the field, the control of cane stumps trampling due to the mechanized operations of trash recovery, and the additional cost and final destination of wires (or plastic or sisal ropes) used in the bales.

Removal of trash after harvest, besides being an additional operation, disrupts the successive layers of plant material deposited on the soil along the years, thus forming a structured fabric on the soil surface. The removal of part of the trash causes a discontinuity of the mulch cushion, leaving portions of the soil exposed at some points, thus reducing the effectiveness of the erosion and weed control provided by the uniformly distributed mulch.

An alternative to this is to take the trash from the field, along with the cane stalks, by decreasing the intensity of the cleaning and extraction of trash during harvesting, which can be done by changing the operating conditions of the harvest machines. However, the decreased truck load density by adding trash may significantly increase the cost of cutting, loading and transportation of sugarcane, already an expensive operation. An option being studied to mitigate this decrease in load density is to do an additional chopping of trash during harvesting, in order to produce smaller pieces and send them back to the elevators of the harvester, so that the load can be settled in a more compact way. This additional chopping may, however, increase fuel consumption.

The transport of the trash with the cane stalks, a concept that has been called "whole cane harvest", however, requires investments in the cleaning stations of the mill, to dry-clean the cane in order to remove the trash before the crushers. Without it, the increasing plant impurities would make juice extraction more difficult, increasing the proportion of fibers, carrying more sugar out with the bagasse, and reducing the amount of recoverable sugar.

The technological routes for the utilization of the trash depend on several factors, notably the economic returns. The most direct route is to burn the trash in boilers, in order to generate steam and hence electricity in thermal power units. This usage can be extended to allow diverting part of bagasse for purposes other than cogeneration. Some mills with pre-established energy supply contracts have already employed this strategy.

Another possibility is to use the trash in biodigestors, either alone or together with other solid waste. Through this process, the methane produced can then be targeted for combustion in engines or turbines, generating electricity, or can be destined for other commercial uses, such as biogas fuel for the mill vehicle fleet.

The trash can also be allocated, directly or indirectly, for the production of cellulosic ethanol. Direct use involves the pre-treatment and hydrolysis to degradation in pentoses and hexoses for further processing in co-fermentation or fermentation to ethanol production. In the indirect use, trash replaces the burning bagasse in the boilers, which can then be allocated to the various fermentative routes.

Cellulosic ethanol, a promising technology, potentially adds about 40% more ethanol per ton of cane, increasing production on the same acreage. However, for it to become viable, improvements in process yield are still necessary, especially cost reduction. Whether trash or bagasse is the feedstock, this technology would only compete against bioelectricity in a scenario in which ethanol has more realistic prices, reduced costs and fermentation yields are increased. It must also be taken into account that this technology generates many other products that can be commercialized, such as furfural, acetic acid, lignin, etc.

These possibilities have been extensively discussed worldwide, given the need for revision of the energy matrix, which tends to be increasingly diverse and regionalized. Moreover, the biorefinery concept has never been so close to reality: product diversification, especially those of high added-value, is vital to the sugar-energy sector, which is subject to the impact of price volatility, as most commodities are.

Thus, the possibility of trash utilization has to be discussed in a broader sense, balancing the tradeoffs between agronomic and long term benefits of preserving the plant mulch against economic gains of energy production. The peculiarities of each region or even micro-regions within the mill lands may lead to different options for different sites. But, surely, such decision will be heavily influenced by the technological developments that are in progress and the economic feasibility of each of these options.

One way or another, it can be concluded that trash increasingly becomes a bonus, an opportunity for considerable gains for the sugar and ethanol sector.

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