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EDITORIAL

How much sugarcane trash should be left on the soil?

Large amounts of crop residues are preserved when sugarcane is harvested mechanically, without previous burning. When all this started, many problems associated with trash (or straw, treated here as synonyms) preservation emerged. Later, it was realized that this residue is a valuable asset for both energy production and soil preservation. There is not a well established tradeoff as to whether the trash should be used for energy production or be left in the field. Are these conflicting options? Therefore, there is an unanswered question about if and how much sugarcane trash could be removed from the cultivated fields without jeopardizing long term soil quality and plant productivity. The ethanol industry wants to remove as much trash as possible from the field but this decision must take into account many factors and variables.

In this context, the present special edition of *Scientia Agricola* aims at tackling the central question: "How much sugarcane trash should be left on the soil?" To accomplish this task, a Workshop promoted within the FAPESP BIOEN Program was held at the Brazilian Bioethanol Science and Technology Laboratory (CTBE) in May 2012, in Campinas, Brazil. We invited the main research groups that have been working on the different aspects of this topic in Brazil. During the workshop about 10 technical talks were presented and approximately 40 participants attended the meeting, helping with the discussions that followed. Participants were invited to submit manuscripts to compose this special issue.

The articles published herein address a wide range of subjects associated with the roles of trash and its destinations. Members of the ethanol and sugar industry, who have to make decisions, were invited to present their views. Sordi and Manechini outlined a clear picture of the pros and cons of trash removal and the great possibilities opened to the industry.

Landell et al. showed the large variation in the amounts, proportions and composition of trash among sugarcane varieties, indicating that not only the presently available genotypes can be chosen according to the mills energy production plans, but that sugarcane can be bred to generate varieties with different trash characteristics for the future. The effect of soil tillage and trash preservation was examined in different papers because soil quality, greenhouse gases emissions, and soil carbon (C) sequestration are key indicators of environmental impact. In the study of Teixeira et al., emission factors of CO_2-C from trash were estimated as affected by several soil tillage options and showed that, on average, 2.3 to 2.4% of the C were lost up to 15 days after tillage operations. In another study, Segnini et al. measured C stock and humification after seven years in a sugarcane field where replanting was done with or without soil disturbance, comparing no-tillage and conventional tillage combined with trash preservation. The maintenance of the plant residues greatly increased soil C stock; however, significant differences in soil C were observed only in the 0-5 cm layer. Carvalho et al. examined the role of sugarcane roots to supply C to the soil – a much neglected contribution. Although they found that the major source of C to soils is the trash, about one third of the C of the crop residues after harvest came from the roots.

The nutrient cycling capacity of plant residues is a relevant feature of trash preservation. Fortes et al. applied 15N-labeled trash to the soil and showed that only 7.5% of the N were present in the above-ground parts of the subsequent ratoon cane. In three years the recovery by sugarcane plants of the trash N was about 17% but this figure almost doubled when N fertilizer was applied along with the trash. Most of the N present in the trash ended up in the soil organic matter. Trivelin et al., using a simulation model, showed that, in the long term, this N accumulated in the soil will result in less N fertilizer use in sugarcane fields, although their calculations indicate that the trash preservation will require about 40 years for a new equilibrium in the soil system to be reached.

As the environmental aspects play an important role in the decision making process regarding bioenergy production, Trivelin et al. and Franco et al. suggested that, if part of the trash is to be collected, the dry leaves should be harvested and the tops left on the field: tops concentrate most of the nutrients that can be recycled. In addition, the dry leaves cause less harm to the furnaces and boilers used to produce energy and, if the trash is employed for second generation ethanol, the yields obtained in the pre-treatment of dry leaves are higher than those of the tops. However, collecting only the dry leaves represents a challenge and costs must be carefully evaluated.

The costs and options of trash collection were discussed in the work of Cardoso et al., although these authors did not contemplate in their study the separation of tops and dry leaves. Cardoso et al. found that when a high proportion of the trash needs to be recovered, under conditions of high stalks yields and long transport distances, the baling system should be preferred to the combined harvesting and transportation of stalks and trash – but baling may not be a viable alternative if the trash fractions are to be separated, as recommended by Trivelin et al. and Franco et al.

Methodological aspects for the evaluation of environmental impacts were discussed by Cerri et al., concerning soil C stock and greenhouse gases measurements, much needed for proper inventories and life cycle calculations of bioenergy production.

Finally, Dinardo-Miranda and Fracasso revised the recent – but limited – literature on sugarcane pests and nematodes incidence in unburned fields. Several important pests, among them the spittlebug, the sugarcane weevil, and the sugarcane borer, are benefited by the green cane system. Thus, trash preservation may increase the damage these insects cause to plants. Parasitic nematodes seem not to be affected by green cane. The authors point out the removing all or part of the trash may help to decrease the pest problem but will not lead to a condition similar to that of the previous cane burning system due to the absence of fire, which was an important factor to lower pest population.

As expected, the articles published here do not allow a definitive answer about the ideal amount of sugarcane trash that should be left on the soil. Some of the important aspects associated to our central questions were not addressed here, such as soil biology, nitrous oxide emissions, weed infestation, water etc. Nevertheless, extremely interesting information was presented, bringing not only insights about this topic but also stimulating the scientific community to discuss such strategic issue for the Brazilian agribusiness sector.

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