R.P. Viator,
R.M. Johnson
E.P. Richard, Jr.

Green-cane Residue Management in a Non-tropical Climate

Green-sugarcane harvesting deposits 6 to 24 Mg ha-1 of extraneous matter (residue) that blankets the field's surface producing through which the sugarcane stubble of the subsequent ratoon crop must reemerge. Throughout the world, pressure has mounted from government and citizen groups to discontinue the use of burning as a residue management practice due to concern over health and environmental issues. Unlike the majority of sugarcane producing areas of the world, the full retention of residue often reduces subsequent ratoon crop yields in the temperate climate of Louisiana. In our climate cane remerges after harvest (fall emergence), reemerged shoots are winter-killed (dormancy). The actual growing season starts when cane reemerges in the spring when soil temperatures are about 64.4°F (primary emergence). After several weeks of primary shoot emergence, tillering begins (early tillering). Tillering often continues up to the start of the grand growth stage which occurs near the time of first internode formation. Yield losses are associated with cool, wet soil conditions along with toxic substances released from the residue during initial decomposition during primary emergence and tillering. A series of experiments were conducted by scientists at the USDA-ARS Sugarcane Laboratory in Houma, LA to develop management strategies to mitigate this yield loss.

In the first experiment, we focused on determining the effects of different residue removal methods and removal timings on the growth and yield of the subsequent ratoon crop. We also wanted to determine if residue management effects are consistent across ratoon crops of varying age grown on contrasting soil types. Removal timings consisted of the following physiological stages that were described above: fall emergence, dormancy, primary emergence, and early tillering. Removal methods consisted of mechanically repositioning the residue from the row top into the wheel furrow (partial removal), burning the residue off (complete removal), and no removal (control). Treatments were applied to first, second and third ratoons of LCP 85-384, a variety that at the time of these studies occupied over 90% of the Louisiana acreage. Tests were conducted on both heavy- and light-textured soils. For all ratoon sugar yields, burning during fall emergence (6800 kg ha-1) and dormancy (6610 kg ha-1) and mechanical removal during fall emergence (6500 kg ha-1) resulted in yields greater than the no-removal control (6190 kg ha-1). Burning at early tillering actually decreased cane and sugar yields by 3.4 Mg ha-1and 440 kg ha-1, respectively, relative to the control. Ratoon crops of different age responded similarly to the residue management practices evaluated, and effects were consistent on both heavy- and light-textured soils. Results suggest that the residue generated during the green-cane harvesting of sugarcane in Louisiana should be removed from harvested fields as soon after harvest as possible or at least prior to primary emergence to insure optimum yields of subsequent ratoon crops.

In another set of experiments, we focused on mechanical, residue removal techniques for LCP 85-384. Whole-plots consisted of full retention, complete removal by burning, or mechanical repositioning of the residue from the row top to the wheel furrow using several innovative pieces of machinery that have been designed or modified to aid in the removal of residue. Mechanical removal treatments, applied immediately after harvest, consisted of 1) a hydraulically driven street sweeper, or 2) a ground-speed driven, serrated rubber toothed sweep (Orthman Residue Remover®), or a ground-speed driven, serrated metal toothed sweep (Sunco Trash Tiger®). Split-plots consisted of either incorporation of residue in the wheel furrow with a bladed drum device (Lawson Canemaster®) or no incorporation. Burning produced yields (6750 kg ha-1) that were superior to all other removal options (6090 kg ha-1), and the control (5980 kg ha-1); incorporation of the residue did not increase yield compared to no incorporation. It is believed that not enough soil-to-residue contact was achieved with the current implements to promote microbial degradation and that residue in the wheel furrow prevented adequate drainage, especially since this study was conducted on a heavy-textured soil.

As the mechanical repositioning of the residue into the wheel furrow was not as effective as burning, we evaluated several other non-burning techniques including a modified hay bailer that removed the majority of the residue off of the top 0.8 meter of a 1.8-meter row. The bailer's gathering device running at the soil surface appeared to mechanically disrupt underground stubble, and yields were less than when residue was removed by burning. Another technique evaluated was increasing the nitrogen application rate by 22 and 44 kg ha-1 compared to the traditional nitrogen rate of 130 kg ha-1 applied during normal fertilization practices in mid-spring. This additional nitrogen did aid in achieving yields similar to burning with the standard 130 kg ha-1 rate of nitrogen, but due to the high price of nitrogen this is not an economically feasible option at this time.

Finding an economically feasible alternative to burning continues to be a research challenge. We are currently investigating new removal techniques that more effectively incorporate the residue into the soil. USDA scientists are also screening all commercial varieties, advanced lines, and basic germplasm for tolerance to these post-harvest residue blankets. The possibility of adjusting extractor fan speeds during harvesting to allow a portion of the residue to be removed from the field and utilized for biofuel production may also be a promising use for the residue. However, long-term effects of complete/partial removal of post-harvest residue on soil health and yield sustainability need to be investigated.

*R.P. Viator works for USDA, Houma Station, LA, USA.
Email: rviator@src.ars.usda.gov*