RECENT DEVELOPMENTS WITH THE BSPA/McCONNEL HARVESTING SYSTEM

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ABSTRACT

The paper reports the main changes made to the BSPA/McConnel machines since they were described at the XVIth ISSCT Congress. In particular, the Stage I machine has been equipped with sharpened basecutter blades and mounted on a reversed tractor. Stage II now cleans trash and tops on the bottom "fan" only with significant improvements in performance. The cane is lifted to the conveyor from the gathering sweeps of a powered roller, instead of a stationary ramp, allowing work in more wet conditions. The "Loadster" has been simplified by eliminating the telescopic extension.

Recent figures on output, cleaning and fuel used are given. A change in ownership of the project is also announced.

INTRODUCTION

The system and the equipment were described by Hudson at the XVI ISSCT Congress. This paper briefly summarizes the changes it has gone through up to May, 1979. The system is now in its eighth year of development. However, because the development of this project is financed mainly from the sale of the machines, and because of the poor market conditions since the last ISSCT Congress, not as much progress has been made as was hoped for in 1977.

THE SYSTEM AS A WHOLE

It is now possible to state categorically that the Stage I and Stage II operations can result in the harvesting of, wholestick, unburned cane to an acceptable X.M. level, and economic output quantity provided certain conditions are met. These conditions include the present state of the system and the following:
(a) A more-or-less flat culture  
(b) Row spacings of 1.50 m or (preferably) greater  
(c) Non-brittle varieties  
(d) Cane not excessively tangled  
(e) Row lengths of at least 150 m

If the culture is sharply furrowed or ridged, if the row spacings are too narrow, and if the variety are brittle (or excessively tangled), unacceptably high losses of cane will result due to stalk breakage. The resulting scrapping costs in these circumstances eliminate any cost benefit likely to result from the use of the complete system.

THE STAGE I REAPING AID

Sharp-tipped blades have been introduced. Even at the relatively slow tip speed of 450 m/min, the fact that the blades are ground-following makes the sharp tip superior to the blunt blades previously used.

The use of the topper has declined in Barbados since it has been found to be cheaper to pay the labor extra for removing the tops than to deal with the problems of tractor overheating and high front axle loadings, resulting from its presence. As now used in Barbados, the reaping aid is therefore more in line with the concept employed in countries like Argentina. However, in situations where post-cutting burning can be used, a high labor output is achieved by cutting the unburned cane with topper working, and then burning the windrows on the ground. The flail-type topper works well in this context.

An important recent development has been to mount the Stage I on a tractor with reversed controls (Fig. 1). The main advantages of this are three-fold. First, that base cutting is much better in light soils (or with weakly-rooted stools). Secondly, row-following is much easier. Third, it makes the machine cheaper for lower-yielding areas which only need the base cutter unit (spiral dividers being necessary only at higher yields) and reversed tractor controls.

Although circumstances which result in appreciable cane breakage can be expected to limit the use of the complete system, the application of Stage I as a reaping aid is much wider since the retrievers are not much hindered by some cane breakage. Over 10% of the 1979 Barbados crop will be reaped via Stage I and in a very wide range of circumstances of yield, culture, topography and variety.

THE STAGE II CLEANER-PILER

Several important changes which have led to simplification and/or improved reliability have been made with this unit.

The most significant change is that, following work by the SASEX engineers, all the trash and tops are now removed from the bottom “fan” only. This is achieved by a modest downward airflow just rearwards of the “hurler” unit to ensure that
trash and green leaves move away from the top hurler roller. The air-flow is effected at present by simply rotating the shroud around the top fan by about 180° (Fig. 2). This change has resulted in better cleaning and in the elimination of the “sweep” or “carousel” unit (shown in the 1977 paper). The change also allowed for all trash to be deposited neatly under the machine. The shroud shape to achieve adequate air movement off the top “fan” is quite critical and future developments will, probably follow the SASEX use of an axial or centrifugal fan.

The second major change is the replacement of the stationary ramp behind the gatherer sweeps by a powered feed roller. This enables the machine to work in very wet field conditions and is much less sensitive to bent gatherer blades in rough conditions. This feed roller has four fins of rubber belting. It is built strongly enough that if the whole weight of the machine is rested on it, a shear bolt breaks in the chain drive.

FIGURE 1. The stage 1 reaping aid with sharp base cutter blades, mounted on a reversed IH 574 tractor. This machine was christened the “Carib” Cutter in Barbados.

The friction plate clutches, protecting the gatherer drive and the hurler/conveyor drive, are now themselves protected by Bondioli and Pavesi torque limiters which incorporate a shear bolt in a standard splined yoke. It was found that users consistently failed to maintain these friction clutches correctly, and corrosion and “stiction” problems in a humid island climate made their performance erratic. By adding the shear mechanisms, the rate of breakdown has been greatly reduced.

The bin offset is now operated hydraulically from the driver’s seat.

The use of a standard two-wheel drive tractor with center pivot steering
has proved very satisfactory, giving much improved row-entering characteristics.

Several components of the machine described in 1977 were found to be inadequate and have now been modified accordingly. These include the center pivot joint, the attachment of the draw-bar to the main frame, the quality of conveyor belt and fasteners, and the attachment of the bin pivot to the main frame. There have also been some minor changes to the design of the rubber cushions, and their method of attachment to the "hurler" drums.

Because of a severe shortage of development resources, little further work has been done on the "hybrid" machine described in the 1977 paper either in Barbados or by F.W. McConnel. However, we are encouraged by the results so far, of a major investigation being carried out by the South African Sugar Industry Experimental Station.

The two-pass approach to burnt cane is only efficient if either (a) the burn has been poor and the excellent cleaning potential of the two passes is required or (b) if the two passes are compensated by doing two rows at a time (as in the J & L two-pass approach originated by Fowler). Although high rates of work have been achieved in burnt cane with Stages I and II, the system usually leaves far too much scrapping to be done because Stage I in its present form breaks a proportion of the cane when it is not protected by trash. Two row cutting of burnt cane with a gentler action could however make the system attractive, but little work has been done so far.

"LOADSTER"

The complete system can use most types of loader common in the worlds' cane industries. The "Loadster" was developed not primarily for the loading of
cane left by Stage II, but as an answer to the needs of the following:

(a) smaller farms unable to purchase a second tractor to draw carts besides a 90° slew loader

(b) farmers worried about soil compaction (the "Loadster", towing its own carts, results in one compaction lane every 8-10 rows only)

(c) farms where the tractor carrying the loader can be used for other purposes (the Loadster is easily removed) and

(d) sloping land.

The main change in design has been the elimination of the telescopic extension of the second boom (Fig. 3) since the low reach which made this possible has proved to be not worth the extra complexity and reduced rate of work.

FIGURE 3. The 2-arm version of the Loadster working on a small farm in Barbados.

TRACTORS

The basic philosophy of attaching the equipment to standard agricultural tractors is proving to be a good one. More emphasis will now be placed on making the attachment/detachment even easier and quicker.
TABLE 1. Outputs of Stage II and fuel use for the complete system in green cane

<table>
<thead>
<tr>
<th>Country</th>
<th>Circumstance</th>
<th>Output of Stage II — tons per tractor hour including travel to and from field</th>
<th>Fuel use for Stage I, Stage II and Loader. Liters per ton onto road transport including travel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barbados</td>
<td>Yields ranging from 20-100 tons per hectare. 5 machines 1979 crop.</td>
<td>machine A 10.9</td>
<td>1.10 (1978): 1.26</td>
</tr>
<tr>
<td></td>
<td></td>
<td>machine B 10.0</td>
<td>1.40 (1979)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>machine C 9.4</td>
<td>1.35</td>
</tr>
<tr>
<td></td>
<td></td>
<td>machine D 7.8</td>
<td>1.72</td>
</tr>
<tr>
<td></td>
<td></td>
<td>machine E 7.5</td>
<td>2.30</td>
</tr>
<tr>
<td>N.E. Brazil</td>
<td>Unmodified 1977 models of both Stage I and Stage II (11% overall)</td>
<td></td>
<td>c 1.5</td>
</tr>
<tr>
<td>Costa Rica</td>
<td>La Hilda Estate, unmodified Stage II</td>
<td></td>
<td>8 (in 1977)</td>
</tr>
<tr>
<td>S. Africa</td>
<td>Assessment by SASEX various trials with 1977 and 1978 models</td>
<td>10 — 20</td>
<td>1.3</td>
</tr>
<tr>
<td>Mauritius</td>
<td>Various trials with 1978 models</td>
<td>18 — 22</td>
<td>between c 1.2 and 2.3</td>
</tr>
</tbody>
</table>

OUTPUTS

The ceiling hourly outputs are still more or less as quoted at the previous Congress. All the machine in Barbados are limited by either quota or labor availability and judgements on output are not easy. “Real life” outputs, within the context of these limitations (and inadequate field conditions generally) are listed in Table I. Some ideas of the possible Stage II output may be gained from the fact that Stage II “A” is now in its second year of operation and is achieving a weekly average of approximately 80% of two combine harvesters working on contract in similar circumstances.

FUEL USE

Although the fuel cost per ton is not a high proportion of total costs, it has important long-term implications, including its value in assessing the general wear and tear on machinery since fuel consumed means power to be disposed of, and power disposal implies punishment of all moving parts. Table I gives figures collected so far. A typical figure for the complete systems seems to be less than 1.51 per ton loaded to road transport for unburned cane (Table I). Comparative figures for...
TABLE 2. Extraneous matter in loads delivered by the BSPA/McConnel system (with comparison figures for other systems in Barbados)

<table>
<thead>
<tr>
<th>Country</th>
<th>Circumstance</th>
<th>% Tops</th>
<th>% Trash</th>
<th>% Stumps soil etc.</th>
<th>Total % X M</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barbados</td>
<td>Hand cut, hand load (1,019)</td>
<td>1.61</td>
<td>2.34</td>
<td>0.01</td>
<td>3.96</td>
</tr>
<tr>
<td>(1979 crop to 11th April) (brackets show number of loads sampled)</td>
<td>Hand cut, machine (733)</td>
<td>1.37</td>
<td>2.96</td>
<td>0.44</td>
<td>4.77</td>
</tr>
<tr>
<td></td>
<td>Stage I + hand-pile + machine load (137)</td>
<td>1.17</td>
<td>2.94</td>
<td>0.48</td>
<td>4.59</td>
</tr>
<tr>
<td></td>
<td>Stage II + machine load (304)</td>
<td>1.91</td>
<td>4.02</td>
<td>0.54</td>
<td>6.47</td>
</tr>
<tr>
<td></td>
<td>Combine harvester A (102)</td>
<td>3.85</td>
<td>5.85</td>
<td>1.05</td>
<td>10.75</td>
</tr>
<tr>
<td></td>
<td>Combine harvester B (41)</td>
<td>3.90</td>
<td>4.50</td>
<td>0.52</td>
<td>8.92</td>
</tr>
<tr>
<td></td>
<td>Combine harvester C (82)</td>
<td>3.51</td>
<td>3.10</td>
<td>0.88</td>
<td>7.49</td>
</tr>
<tr>
<td>N.E. Brazil</td>
<td>Pile sampling (1977)</td>
<td></td>
<td></td>
<td>4½—5½</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Factory samples (1979)</td>
<td></td>
<td></td>
<td>c. 10</td>
<td></td>
</tr>
<tr>
<td>Costa Rica</td>
<td>Data for 1977 only</td>
<td></td>
<td></td>
<td>2.6</td>
<td></td>
</tr>
<tr>
<td>S. Africa</td>
<td>Various measurements</td>
<td></td>
<td></td>
<td>3—5</td>
<td></td>
</tr>
<tr>
<td>Mauritius</td>
<td>Pile sampling and Factory sampling</td>
<td></td>
<td></td>
<td>3½—8</td>
<td></td>
</tr>
</tbody>
</table>

Combine harvesters in Barbados in 1979 were between 1.61/ton and 2.91/ton depending on the machine and the farm. Considering that four tractors (Stage I, Stage II, Loader and accompanying haulage tractor) are involved, as compared with only three power units for the combine machines (harvester and two in-field tractors), this result has surprised many people. The main reason for the lower fuel consumption/ton are probably as follows: the Stage II cleaning mechanism is far less power-consuming than fans; no power is used for chopping the cane; the ground-following base-cutting blades can be less power-consuming than rigid discs when these bottom goes into the soil in non-ideal row preparation.

EXTRANEOUS MATTER

Properly used and with suitable varieties and land preparation, the Stage I operation plus manual retrieval and mechanical loading should deliver cane to the factory at less than 4% total/XM; while the complete system should be less than 5%. These figures have been made better frequently in Barbados, but many conditions are still far from ideal. Table 2 summarizes the factory sampling in Barbados for most of the 1979 crop, plus a few reported figures from other countries.
A typical figure of less than 6% is currently being achieved and further improvements are possible.

CHANGE IN MANAGEMENT OF THE PROJECT

This opportunity is taken to record appreciation for the way the Directors of F.W. McConnel took up the Barbados ideas and developed them in the face of great difficulties. The slump in cane machinery sales during the last few years was detrimental to such a development and although the exercise was profitable for the sub-contractors and the Barbados Sugar Producers’ Association, it was not so for McConnels. The project will now continue directly through the Barbados Sugar Producers’ Association, will manufacture by the same sub-contractors who make the machines at present, and via licensing agreements with Industries wishing to make their own units. “Challenger” Ltd. will make and distribute the Loadster.

REFERENCE


EVOLUCIONES RECENTES DEL BSPA/SISTEMA DE COSECHA McCONNEL

D. A. Scott y J. C. Hudson

RESUMEN

Este artículo trata sobre las modificaciones principales hechas a las máquinas McConnel BSPA desde el XVI Congreso de ISSCT. En particular la maquina STAGE I ha sido equipada con cuchillas de base y montada en un tractor revertido. STAGE II ahora limpia la basura y el cogollo con el “abanico” inferior únicamente, con mejoras significativas en su funcionamiento. Un rolo motorizado, en vez de una rampa estacionaria, levanta la caña apilada hasta el conductor, permitiendo así trabajar bajo condiciones mas humedas. El “Loadster” ha sido simplificado por la eliminación de la extensión telescópica.

Se presentan obras recientes de producción total, limpieza y consumo de combustible. Se anuncia un cambio de propiedad del proyecto.