MECHANISING ANIMAL CANE

by

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INTRODUCTION

It seems to be generally agreed by the sugar industries in this hemisphere that the use of sugarcane and by-products for animal feed is the most generally promising diversification of all the various ideas tried.

Some years ago, Barbados was in the forefront of this development but we did not apply much of it. Others have now overtaken us. A few examples:

1. In Cuba, more than a million head of cattle are being fed with sugarcane or by-products; indeed approximately 35% of all animal feed in Cuba is now said to be derived from sugarcane.

2. Thousands of beef cattle are reared in the Dominican Republic on sugarcane and by-products, plus poultry litter. It has been shown that sugarcane can support up to four times the animal population as improved pasture, acre for acre.

3. Successful feeding of sugar or juice or syrups to poultry has been developed.

4. In Brazil there are dozens of feed lots based on hydrolysed bagasse, yeast and molasses; the largest has 18,000 head. One with which I am familiar is expanding from 5,000 to 15,000 head of cattle in one year. Thousands of smaller feed lots and dairies use whole cane. Similar work is going on at the Sugar Cane Feed Centre in Trinidad.

5. In several countries (including Haiti and Cuba) sugarcane juice and syrups are being fed commercially to monogastrics like pigs and ducks, and there are reports of better quality meat (with less fat) when virtually all the starch is replaced by sugar or molasses. In Cuba, cane syrups are used as a preservative for institutional food wastes and we understand that perhaps half a million pigs are now fed on cane-based diets.

6. At least seven countries in this hemisphere now make large quantities of a mixture recommended for trial here by Sir Frank Hutson many years ago - it is based on molasses, urea and minerals absorbed on to bagacillo (e.g. "Saco-mel").

7. In Colombia, research is far advanced and being applied on both large and small farms. Some ingenious protein supplements are being developed with cane juice feeding of pigs, whilst feeding "blocks" are being commercially supplied from at least one sugar factory.

In June of this year, three representatives from Barbados were invited to share experiences at a CIPAV-GEPLACEA workshop organised by Dr. T.R. Preston in Cali, Colombia. CAIL was asked to lead a discussion on the mechanising of cane for animal feed and this paper is based on that presentation.

STRATEGY

Before dealing with the details of mechanisation it is important to know its goals. Three important questions were being asked. (1) Should we be mainly looking towards specialist cane/animal systems, or should we be looking at the integration of animals into existing cane operations? (2) If the former, are we mechanising the right culture and the right variety? (3) Can we envisage a cheap enough product?

SPECIALIST OR INTEGRAL SYSTEMS

There are many enterprises where the animals are fed on sugarcane grown specially for that purpose. The nearest example is the Sugar Cane Feed Centre in Trinidad. But in Latin America there are thousands of small farms using cane for animal feed which are hundreds of miles from the nearest sugar factory. On the other hand, there are some exquisitely integrated sugar factory/animal operations in this hemisphere, such as those mentioned in the introduction (e.g. in Brazil and Cuba.) Sometimes it is cleaning station material, sometimes by-product use like hydrolysed bagasse or "scums", sometimes the partial use of juice for animals (e.g. syrups or low grade sugars) and partly for sugar or alcohol manufacture.

To illustrate the sort of integration which might one day be implemented, consider the following idea proposed in Barbados some years ago. Chopper harvesters are becoming increasingly competent in unburned cane but have a fundamental problem on which the animal people might capitalise. This problem is that it is virtually impossible to grow cane so

that the topping system can be 100% effective. So although you see a topper out in front of the machines, it is usually set so that it takes off the higher tops and the rest (and especially the young shoots) get chopped and thrown under the cleaning fans. The aerodynamic characteristics of coots are close to those of cane stalks and if the fans are set to pull out coot, a lot of cane is lost and if cane is not to be lost, most of the coot goes to the factory. Every cane has a coot.

Coot floats in water and cane does not. So perhaps one day choppers will not try to top the cane but deliberately put the coots into the bin. At the factory the feeder table would be in a huge water bath. Suitable sterilants would be used to prevent fermentation, and constant removal of the water would be effected by using it for the imbibition before the last mill. The thousands of tons of coot and residual leaves skimmed from the top of the water bath would be made into silage or fed directly.

CULTURES AND VARIETIES

Where, however, it is better to specialise in animal/cane enterprises rather than integrating them with existing sugar production, then we must ask questions such as the following.

The culture suited to annual harvest for sugar may not be best for more frequent reaping for animal cane (or even for annual reaping for animals!). For example, a greater yield of TDN (Total Digestible Nutrients) may come from growing rows at 80 cm. spacings (as in India) rather than 1.60 m. spacings. At traditional row spacings, repeated harvest gave lower yields of tops plus stalk than annual harvesting (with the exception of B49119 where total production was about equal) in a trial at Vaucluse, 1970/71. These results were found with ground-level cutting, for a single row spacing and with canes specifically selected for annual sugar harvesting. Not only is similar work needed with different genetic material, row spacings and fertiliser levels, but even reaping methods must be questioned. For example, Mauritius, Haiti and the Philippines have experience with selective stalk harvesting by smallholders. With the right varieties this may result in even higher total TDN. But it would certainly pose a problem to mechanisation which is unlikely to be solved!

There are probably hundreds of varieties available in cane collections which would be more suitable for animal cane, but which had been rejected for sugar production because the selection criteria are so different. For example, animal cane can have the sugars in any form, so "purity" is not important. 66 varieties analysed by Pate & Coleman (1975) showed considerable variation.

Take another, and perhaps unexpected, example. Cane tops are of no interest to the sugar mill but varieties may differ significantly in the TDN of their tops as well as stalks. Up to relatively recent times, cane tops and molasses were the main fuel for the oxen during crop. But do cane tops analysed nowadays have TDNs which could have made their work of hauling cane carts and ploughing possible? Dr. Krishnamurthi, Head of the Cane Breeding Station in Fiji, claims that the modern varieties with their Saccharum spontaneum genes have a significantly different leaf structure to the old "noble" canes and are less digestible (personal communication). So when people come to me and say they want a machine to harvest cane tops before the cane itself is cut, I ask them to look carefully at the particular cane tops concerned. Dr. T. R. Preston (during discussions in the CIPAV/GEPLACEA Workshop) stated that the "coots" are much more valuable than the leaves anyway; so perhaps people should be asking for a "Coot harvester", not a tops harvester! In fact, the first stage II prototype* actually had a tops-saving device but because of the lack of nutritional value of the tops recovered at that time (Robert Quintyne, personal communication) we abandoned it, returning the tops to the land.

These examples should suffice to show the young state of the animal-cane art and there is obviously a lot for the farmers, economists, cane breeders, agronomists and livestock experts to discuss still. In the meantime farmers and sugar mills are getting ahead with a diversity of systems and most are proving reasonably successful.

COSTS OF PRODUCTION ARE CRUCIAL

Whatever the outcome of this discussion it is safe to say that expensive cane makes expensive animals and only reasonably well-off people can buy lots of animal products. Therefore a greater demand for the animal product must be linked to a society expecting higher wages. Therefore the success of the large scale use of animal cane will depend not only upon cheap production but high levels of mechanisation.

With regard then to mechanisation, if the trend is to integrate animals around existing field/factory arrangements, the techniques of "animal cane" production will be largely the same as for the existing sugarcane production. Perhaps this is the way that Barbados would take, but a lot of people are also asking about the specialist production of cane

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* Part of a BSTA/McConnell harvesting system in Barbados

for animal feed. As a starting point for discussing mechanisation, the workshop in Colombia envisaged a farm growing cane just for animals, or in a system where non-centrifugal sugar production is combined with animals, as follows.

CULTIVATION AND PLANTING

In a recent report (Anon, 1988) the Australian Sugar Industry has recommended that "strip" (= minimum) tillage considerably reduces costs and yields are maintained. Since Barbados was one of the pioneers of this technique we have to agree with their conclusion! Strip tillage can be adapted to all row spacings or even double-row planting and the Barbados-developed mechanical planter can cope with all the likely options.

For sloping land, where erosion is a problem, a furrow-tying unit can be used.

A significant reduction in cost could come through the use of stump material for planting. This planting material tillers more quickly and gives a more uniform stand. A trial carried out at Vaucluse in 1970/71 showed no yield loss from stump planting and possibly a small gain over two years. The cane saved by using stump material would be equivalent to perhaps an extra ton/acre in yield of cane plus tops.

WEED CONTROL

It is unlikely that weed control will differ significantly for animal cane, although there may be less weeding needed if the canes are grown at higher density (closer row spacing). Tractor-mounted boom sprayers can be made more effective by ground-following nozzles and there are improvements in VLV spraying which may be applicable. Perhaps ATVs can play a more important role.

FERTILISER APPLICATION

I do not know if animal cane needs more frequent fertiliser application. If it does, then we can offer a mechanism to give a late shot of fertiliser by driving in between the rows of cane (but of course before it lodges), using an ATV and small 2-row fertiliser applicator for the second application.

More importantly, much animal cane will be able to receive regular doses of the effluents inevitably produced by the eaters of the cane! There are many systems available and the vinasse disposal mechanisms in Brazil could be adapted. If the wastes are composted, machines exist to efficiently apply it to 3 rows of cane at a time.

The most interesting idea I have heard suggested for efficient application to animal cane is a tanker which jets the material 60 -70 meters to one side, so that it can drive on cart roads and never enter the fields (provided there is not much more than 140 meters between roads). In this way the effluent can be disposed of in all weather conditions and even at night. Similar equipment is used to apply lime in forests. Does it exist for effluent? It would be an ideal contractor's unit.

HARVEST - CUTTING

Typically the harvest and transport of agricultural crops can account for up to half the total cost and the big battle for cheapening animal cane will revolve around harvesting just as much as for the sugarcane producer. What advantage does the animal cane producer have? What ideas might be specially useful to him?

First, he may be able to forage-harvest the crop if the animals can use the whole crop or if it is going to be ensiled. This is the method of harvest in Trinidad at the Sugar Cane Feed Centre and their experience would be invaluable. However, there has been some question as to whether this unit is strong enough and whether the pick-up could be improved. In Barbados, CAIL has been leasing the prototype " cotton destroyer" to a dairy farmer. This unit cuts and transports the chopped material with a single tractor and operator in quite inclement conditions. It has done a limited amount of work with sugarcane and a small trial was carried out to demonstrate the possibility of foraging cassava tops before harvest.

Secondly, since animal cane can be harvested without removing the tops, there is a tremendous potential advantage in harvesting costs. As explained above, topping is an Achilles heel of mechanical cane harvesting and has a surprising influence on the cost and harvester performance. However, reaping aids already exist which simply cut unburned cane, leaving the tops on. Such reaping aids have been developed in Argentina, Mexico, South Africa, Japan, Australia, Barbados and Brazil.

Labour can retrieve unburned cane from the windrows left by these machines at over 8 tons/day if (and only if) the cane need not be topped. This is because when a retriever has to hold a knife, he can only hold one or two canes at a time. However, when topping is not necessary, both hands are free, and four to six canes at a time can be taken from the windrow. The choice of reaping aid depends on many factors but

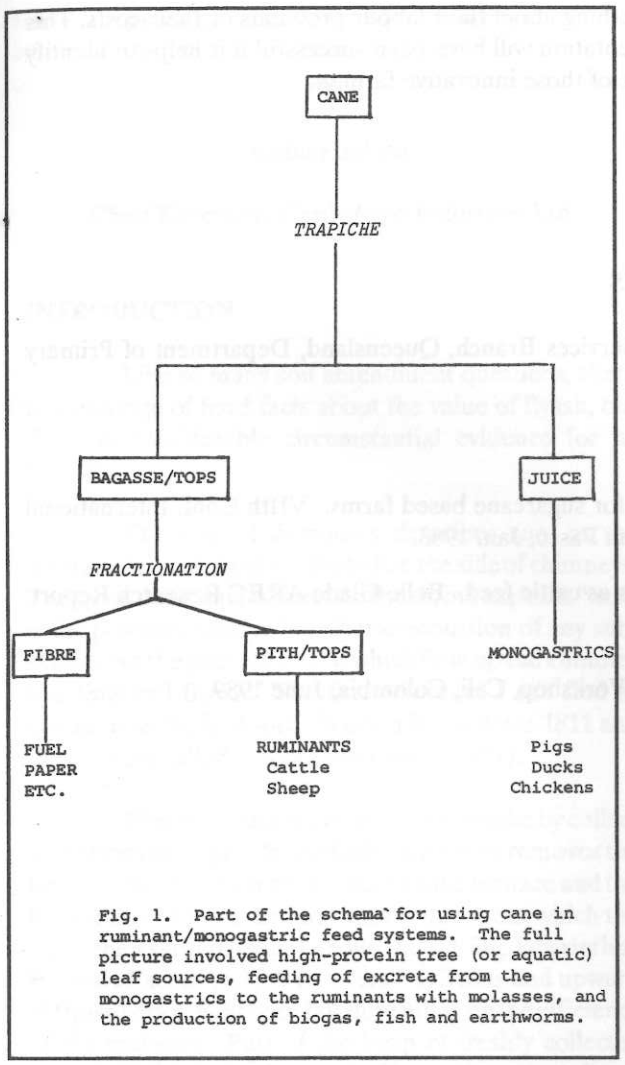

Fig. 1. Part of the schema for using cane in ruminant/monogastric feed systems. The full picture involved high-protein tree (or aquatic) leaf sources, feeding of excreta from the monogastrics to the ruminants with molasses, and the production of biogas, fish and earthworms.

primarily on the soil conditions and likely yield at time of cutting. Simple reaping aids are fine in light cane and stone free soils. If tonnages are heavier, or soil conditions are adverse, the Barbados type of machine is needed.

More complex machinery exists which cuts and leaves heaps of cane to be picked up by a loader. Most of these machines only work in burned cane, but one has demonstrated the possibility of handling unburned cane (the "Centurion").

HARVEST - LOADING

The forage harvest approach accomplishes loading during cutting (as with chopper harvesters). For cane cut by hand or retrieved behind a reaping aid, there are many loaders available. However, the 360° type is likely to be most appropriate (Hudson, 1985). The advantage of such a loader is brought out in the following scenario.

Imagine a farm of 100 ha. feeding animals with, say 20 tons of cane plus tops each day. Each evening a tractor attaches a reaping aid which spends about one hour cutting the cane for retrieval next morning by three to four workers. These workers make heaps suitable for the loader. In wet weather cane would be cut close to roads; in dry weather rows further into the fields would be cut.

Next morning the same tractor hitches up a 360° loader which, with its 20ft. reach, tows a specialised trailer into the fields and picks up piled cane from both sides.

At the feeding area the loader is used to place the cane for easy feeding into either a "trapiche" (small mill) or a chopping machine. Four trips bring all the cane from the field. The loader then exchanges its cane grab for a bucket grab, which removes the dung from the pens. Ideally a second tractor would operate the trapiche or chopper unit with its PTO. Both tractors are available for cultivation, spraying, collecting loads of molasses (in low brix periods), applying slurry, fertilizing, etc. If one tractor is broken down the operation can still go on by working longer hours. Thus a 100 ha. animal cane farm could be managed with only two tractors and six to seven people, including the manager.

A dream? Every component of that system exists. It only needs putting together as a complete package.

CANE FRACTIONATION

The last point at which an agricultural engineer may be able to help, concerns the product of the trapiche. If a device could be developed, attached to the output side of the rollers, which could knock or cut the bulk of the inner pith cells from the rind, then the feeding value of the cane is considerably enhanced. This is a similar line of thought to that originally proposed by the "comfith" (= "cane separation") process, but could be achieved with far less sophisticated equipment. The diagram summarizes this total use of cane for animal feed in countries like Colombia and the Philippines (Preston et al, 1989; Mendoza, 1988 Fig. 1.)

CONCLUSION

The substantial, even complete, mechanisation of animal cane is not only possible, but every component actually exists within the sugar industries of this region, as well as the skill and ingenuity to apply the ideas, with the exception of the fractionation device.

However, good agricultural mechanisation never came from enthusiasts telling farmers what they might/could/should do, but from working alongside enterprising and innovative farmers who are forced to do something about their labour problems or their costs. This presentation will have been successful if it helps to identify some of those innovative farmers.

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