A REVIEW OF CHANGING CULTURAL PRACTICES TO IMPROVE PRODUCTIVITY OF SUGAR CANE IN MAURITIUS

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Abstract

Cultural practices in sugar cane have evolved since the introduction of this crop in Mauritius some 350 years ago, although cane agronomy research has been reported only since 1891. During the past three decades, several practices have been reviewed, modified or eliminated to cater for new objectives associated with improvement in cane productivity and a more environmentally friendly production system. Minimum tillage practice was introduced in the 1980s on sloping lands and subsequently on flat land to increase cane yield with a better control of soil erosion and perennial weeds. In the late 1980s, the advantages of adopting green cane trash blanketing (GCTB) over the traditional trash lining practices was demonstrated; GCTB has been practiced on more than 25% of the cane area by 2005. The reduction in the labour force in the late 1980s prompted changes in cane planting by partially mechanising some of the practices. Manual trashing of cane before harvest is no longer justified and cane cutters have been trained to harvest untrashed green cane since 1998. Cane burning, which was practiced on more than 35% of the area before 1995, has been reduced to less than 10%; a code of cane burning practice based on research results on cool burning has been adopted to minimise particulate matter emission. A new system to plant cane on ridges in high rainfall areas was recommended in 2004. Changes in cane row spacing, with the adoption of dual row planting since 2006, offers further potential to increase cane productivity and machine efficiency. Similarly, integrated weed management strategies to minimise the use of herbicides and costs of production are being recommended to growers. The process is expected to improve further in the near future with the development of new farming systems which will integrate practices such as controlled traffic, reduced tillage, and fallow or legume breaks.

Keywords: cultural practices, sugar cane, productivity, labour requirement, environment

Introduction

Sugar cane was introduced in Mauritius some 350 years ago and since then the cultural practices have evolved. However, cane agronomy research was reported only from 1891 onwards. The changes, particularly during the last three decades, have been greatly influenced by a reduction in the labour force, the need to reduce the cost of production and by the mechanisation of operations. Several practices have been reviewed and modified or eliminated after being found to be agronomically or economically not justified, to cater for new objectives associated with improvements in cane productivity and a more environmentally friendly production system. Some of the major changes, namely minimum tillage, dual row planting, partially mechanised planting, planting of cane on ridges, harvesting untrashed green cane, cool burning, green cane trash blanketing (GCTB) and weed management strategies are highlighted.

Minimum tillage practice

Mechanised land clearing and preparation started in Mauritius in the 1920s with the use of pneumatic tractors, and in the late 1940s bulldozers were introduced (McIntyre, 1984). However, sugar cane is also planted on about 5 000 ha of land with slopes that sometimes exceed 20%. The usual practice is to plant cane during the warm and rainy season when good germination and establishment is obtained. Planting cane under rainy conditions poses numerous problems; the cultural operations that include uprooting of old cane stools, furrowing and planting, are difficult. The absence of soil cover exposes steep fields to soil erosion, and during heavy rainfall fertilisers and cane cuttings can be carried downhill, resulting in extensive replanting and poor growth. Furthermore, the usual mechanical equipment cannot be operated, especially on the very steep slopes. There is thus the need to develop practices that will avoid these risks.

Minimum tillage practice (MTP) on sloping land was developed as from 1976 (McIntyre *et al.*, 1984) and has been recommended to producers since 1980. This practice is now well established on sloping land, and involves the use of a systemic herbicide such as glyphosate to kill the old cane stools, which are left *in situ* (Marshall, 1984). Furrowing and planting in the interrows of the preceding crop are then carried out. Although soil erosion is not normally a major problem on flat land, the increasing cost of land preparation prompted the evaluation of MTP in 1979 on flat land. Except on heavy clay soils, the practice was found to be comparable to conventional tillage (McIntyre and Barbe, 1990) and has been adopted. Advantages of MTP include reduced consumption of energy, a reduction in labour requirements and less soil erosion MTP also enables proper timing of planting, improves weed control and leads to higher cane yields (McIntyre *et al.*, 1984).

Dual row planting

For more than a century, sugar cane inter-row spacings have not changed significantly in Mauritius. At the beginning of the 20th century, cane setts were planted in holes with a row spacing that ranged between 1.20 and 1.50 m (De Sornay, 1936). These row spacings were maintained when cane was later planted in continuous furrows. Subsequent studies on the optimum row spacing have revealed no significant differences in yield between inter-row spacings of 1.0, 1.30 and 1.60 m, but there was a reduction in yield with inter-row spacing of 1.95 m (Rouillard, 1970). In the late 1970s, alternating spacing of 2.25 and 0.95 m was tested to intensify food crop production in the wider inter-row (McIntyre, 1984). Cane yield was equally good with that spacing, but the system was not generally adopted because of lack of interest among planters for food crop production in ratoon cane. Today the most common inter-row spacings used are 1.45 and 1.62 m, but this can vary between 1.20 and 1.62 m. In recent decades, the wider spacings have been increasingly adopted because inter-rows of more than 1.50 m facilitate infield traffic of standard tractors and loading equipment with hardly any stool damage.

Since 1999, closer spacings have been evaluated for improved cane productivity. Planting of sugar cane at higher densities has been studied in a number of countries, including India, USA, South Africa and Australia, with varying degrees of success depending upon the row spacings used, the prevailing environmental conditions, the level of mechanisation and the duration of the crop growth period (Bull and Bull, 2000). One of the techniques of high density planting, dual rows, was tested and it consisted of pairs of rows 0.5 m apart with 1.8 m spacing between their centres.

The potential of dual row planting as a means of increasing sugar cane productivity has been demonstrated (Seeruttun and Ismael, 2003; Ismael *et al.,* 2007). Cane yield may be increased between 8 and 12% depending on the variety. Dual row planting enables significant savings on weed management, and improves efficiency of chopper harvesters. This is achieved without increasing inputs (planting material and fertiliser). This new cane row spacing was recommended in early 2006 and many Mauritian growers have adopted the dual row planting system. More than 1500 ha have already been planted commercially with this spacing.

Planting cane on ridges

In some areas of the high rainfall regions poor drainage and waterlogging are common features, and have adverse effects on root and cane growth. Hence, in these areas planting cane on a ridge is important to drain the excess water from the cane rows and to minimise the effect of waterlogging on cane yield (MSIRI, 1999). However, disadvantages of this practice are higher labour requirement and costs (MSIRI, 2003). An alternative method has been developed where the cane is planted in conventional furrows and the ridge profile is created about ten weeks later by moving soil from the interrows onto the cane rows using a disc ridger or a 'furrower'.

This practice is less labour-intensive, as partially mechanised planting and mechanised harvest of cane is possible (MSIRI, 2004a). Moreover, the ridging operation will also bury any weeds present.

Partially mechanised planting

The traditional method of manual planting sugar cane is highly labour intensive and, with the reduction of the work force in the late 1980s, it was necessary to make more efficient use of the remaining labour whilst reducing costs. At the time, fully mechanised planting was not possible under local conditions with the planters available. A partially mechanised planting (PMP) system was thus established (Seeruttun *et al*., 1997), which involves placing whole-stalk nursery cane into the furrows, where the stalks are chopped into 50-60 cm setts and sprayed with fungicide before being mechanically covered with soil.

As the cane stalks are placed in the furrows with a 50% overlap, the amount of planting material used in PMP is the same as for the conventional method. The advantage of PMP is that it requires at least 13 women days less per hectare than manual planting.

Harvest of green untrashed cane

The trashing of cane is performed mainly to facilitate harvesting, reduce extraneous matter sent to the mill and control pest infestation. In the past, trashing was performed up to three times prior to harvest but, due to the increased cost of labour, the number of trashing operations has been reduced to one (MSIRI, 2002). However, early trashing between April and May, which is well before harvest, can reduce cane yield by about 5 to 10 t/ha (Seeruttun *et al*., 1999).

In order to avoid this loss in yield, a method of manually harvesting green untrashed cane was developed in 1998. The untrashed cane is cut at the base and topped, while some of the dried leaves adhering to the stalks are removed during the handling process or after cutting. The amount of extraneous matter is generally well below the acceptable level at the mill (MSIRI, 2002). This method of harvesting not only reduces the cost of production, but the efficiency of cane cutters does not appear to be significantly affected. However, the success of the practice depends on appropriate training and strict supervision of the cane cutters. This practice has been adopted in the humid and superhumid regions of Mauritius.

Cool burning

The burning of sugar cane before harvest has been a common practice in the humid and subhumid regions of Mauritius. It has the advantages of eliminating trash and reducing the amount of extraneous matter reaching the mill, and it increases the efficiency of cane cutters and harvesters. Additionally, the cost of transport, milling and labour is reduced.

Traditionally the cane is burnt in late afternoon but, despite the advantages, this has some adverse impacts on the environment resulting from the emission and deposition of particulate matter or ash in neighbouring urban areas (MSIRI, 2001). This practice is considered by 78% of the public and 86% of hotel managers as being a serious nuisance (Seeruttun *et al*., 2003). Moreover, burning reduces the thickness of the trash available for trash blanketing, which results in an increase in the quantity of herbicides required to control weeds. The complaints from the public have prompted the authorities to review this practice.

Cool burning involves burning the fields early in the morning when the wind is low and dew is usually present on the green leaves. The latter helps to retain particulate matter, and emission is reduced by more than 60% (Seeruttun *et al*., 2003). More trash remains in the field as only the dry leaves are burnt and the green leaves are left because of the higher humidity. A code of burning practice which includes the adoption of cool burning was proposed in 2002. These changes seem to have satisfied the public and have hence preserved the practice of cane burning in the humid and subhumid regions.

Green cane trash blanketing (GCTB)

After harvesting the cane, the trash remaining in the field is usually lined along alternate or every inter-row. However, with a reduced labour force and increased costs, this practice was found not to be justified in the dry non-irrigated regions (Seeruttun *et al*., 1992). Instead a new method introduced in 1992, whereby trash is spread evenly over the surface, was found to be more appropriate. The advantages of trash blanketing are that it requires less labour, less herbicides are used and cane yields may be increased. GCTB has consequently been rapidly adopted in the subhumid areas, especially with the expansion of mechanised harvesting. Nevertheless, the practice could not be extended to the superhumid zones where annual rainfall exceeds 3 500 mm because of an adverse effect on cane yield (MSIRI, 1998).

Weed management strategies

In Mauritius, manual weeding was practiced exclusively until the 1940s. Since the early 1950s, however, chemical control of weeds has gradually become the dominant method (McIntyre, 1984). Weed control in sugar cane has been practiced with the aims of eliminating all weeds from the time of planting or harvesting up to complete canopy closure. This can involve two or three herbicide applications, and is sometimes complemented by manual weeding (MSIRI, 2004b). In order to reduce the cost of production, new weed management strategies have been developed based on critical periods of weed competition (Seeruttun *et al*., 2007).

In general, critical periods were found to vary between 6 and 27 weeks after planting or 12 and 26 weeks after harvest in the humid areas (Seeruttun and Lutman, 2004). The new strategies involve delaying the first herbicide application to coincide with the beginning of the critical periods of weed competition. However, the success of this approach depends on the efficacy of available herbicides to control all weeds present on the day of spraying whilst also providing a relatively long residual activity against a broad spectrum of weeds. The efficacy of such a practice offers a new perspective for managing weeds, as delaying the first herbicide application will result in savings of at least one herbicide treatment per season (Seeruttun *et al*., 2007).

New farming systems

In line with more recent economic and agronomic developments in the industry, new cropping systems are being investigated to meet the challenges. The new systems involve more integrated practices with the basic principles of reduced tillage, controlled traffic (by matching row spacing to vehicle track width) and a leguminous fallow break. The benefits of these practices to improve productivity have been demonstrated in Australia, where a yield plateau was observed (Kingston *et al.*, 2007). The new systems must be adapted to Mauritian conditions, particularly with the increase in area being harvested mechanically.

Conclusions

Several agronomic practices have been improved or developed and each has contributed towards the profitability of the sugar industry in Mauritius. Future progress will depend on a more holistic approach to the problems of the industry, especially with the significant reduction in the price of sugar. One of the priorities will be the development of more integrated, sustainable and environmentally friendly cropping systems which are more profitable. Particular emphasis will be placed on minimum or reduced tillage, controlled traffic and allowing a fallow period or legume break.

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