BUREAU OF SUGAR EXPERIMENT STATIONS

QUEENSLAND, AUSTRALIA

THE EFFECT OF HARVESTER SETTINGS ON CANE LOSS AND SUBSEQUENT RATOON CANE YIELD

by

M A Smith

IC92006

BSES Publications
Information Circulars IC92006

May 1992

ABSTRACT

This replicated trial at Tully showed that harvester settings (basecutter height, forward speed, and direction of travel in relation to crop lodging) can significantly influence the amount of cane left in the paddock after harvest. The trial also showed that the yield components of the subsequent ratoon crop could be significantly affected by the same harvester settings.

BACKGROUND

The Toft 7000 cane harvester which is usually fitted with an angled underslung basecutter has a higher capacity than previous machines when cutting green. This higher capacity requires a faster ground speed than previous machines to satisfy the additional capacity. The increased ground speed and angled basecutter give a more ragged and visually damaged stubble than that which remains after harvest with the horizontal basecutter of earlier machines. Farmers were concerned that this damage was reducing subsequent ratoon yields.

Farmers also noted that setting of the machine (ground speed, basecutter height in relation to the ground, and direct travel in relation to crop lodging) affected the degree of visible stubble damage and harvest loss. This trial is one of a limited series being conducted by BSES to quantify these effects.

METHODS

Site

The trial was set out in Block 37A at Tully SES. A second ratoon crop of Q124 yielding about 80 t/ha was harvested on 14 September 1990 when the treatments were applied. The soil was identified by Murtha (1986) as a Thorpe series gravelly loam.

Growing conditions

The soil conditions were ideal for harvesting (dry and hard) when the treatments were applied. Cane growth was limited by dry conditions until December and by very wet conditions in the first quarter of 1991. Weather conditions reduced the 1991 crop yields to levels below average.

Treatments

All treatments were imposed using the BSES Harvester Research (Bundaberg), wheeled Toft 7000. Three factors were imposed at two levels:

Ground speed	-	fast (5 km/hr - as fast as the machine would go without choking)
	-	slow (3 km/hr)
Basecutter height	-	high (50 mm above ground level)
	-	low (at ground level)
Direction of travel	-	with lodging
	-	against lodging

Trial design

A factorial design incorporating all combinations of the three factors at two levels (8 treatments) was replicated four times in a randomised block design. Plots were single rows 130 m long.

Measurements

Photographs and notes describing the stubble remaining (ground job) were taken immediately after harvest.

Cane loss was determined by hand cutting, collecting, and weighing all the cane above ground level still attached to the stool after harvest on a 5 m length of row located 12 m in from the eastern end of each plot.

Shoot counts were obtained from ten 1.8 m transects taken systematically from each row. Shoot counts were taken 34 (October) and 192 (March) days after harvest.

Cane yields were determined on 19 August 1991 by weighing all cane harvested from each row using the Tully SES Toft 6000 set optimally and identically for each plot.

Data analyses

Attempts were made to analyse harvest loss, shoot count, and final yield data using standard factorial analyses of variance and covariance. These produced a number of significant two and three order interactions which showed that the three factors (speed, height, and direction) were not operating independently of each other. Our knowledge of machine operation supported this argument and for simplicity the data has been analysed as a simple randomised block with eight treatments. Variation between replicates was quite high and because of the suspected link between cane loss and subsequent ratoon performance, regression analyses were also performed on the data.

RESULTS

Observations

Descriptions of the ground job produced by each treatment combination and subsequent ratoon growth follow:

Fast, high, with	The basecutter tended to ride over the cane in the treatment leaving up to 500 mm attached to the stool. Many shoots emerged quickly from the stalks that remained but many of these did not produce millable cane.
Fast, high, against	The change in direction caused less cane to remain attached to the stool in this treatment as the crop lifters presented the cane to the basecutters in a more upright manner - stubble to 100 mm. The forward motion of the machine and the croplifters tended to pull out some stool in this treatment. This led to lower than average shoot populations in October.
Fast, low, with	Best ground job - little cane remained. The low shoot population present in October made ratooning in this treatment look weak.
Fast, low, against	The change in direction compared to the previous treatment caused cane loss to increase markedly. This greater quantity of lost cane promoted a much higher October shoot population.
Slow, high, with	Shattered stubble to 100 mm height remained in this treatment. This produced a high shoot population at the October sampling.
Slow, high, against	Once again the change in direction reduced the cane loss when cutting high. Stubble was shattered and steps were evident in the cut stalk ends.
Slow, low, with	Surprisingly, slowing the machine increased cane loss. Forward motion is obviously necessary for efficient presentation of cane to the basecutters.
Slow, low, against	This treatment produced low cane losses but stool was removed by the combined action of the croplifters and forward motion. Removal of the stool led to low October shoot populations.

Measurements

Harvester settings had a major effect on the amount of cane remaining attached to the stool after harvest. The difference between the best and most wasteful treatment combination was 15.7 t/ha or about one sixth of the crop. Significantly, the most efficient settings were those for which machines are designed - fast, low, and with the direction of lodging (Table 1). Changing the machine to the most wasteful combination required only adjustment of the basecutter height.

Table 1

The effect of harvester settings on cane loss and the subsequent ratoon crop of Q124 at Tully SES

Arranged in decreasing order of cane loss

Treatment	Cane loss (t/ha)	Shoots/ha (X 000)		Cane yield (t/ha)
		October	March	
Fast, high, with	17.3a	110.8a	62.1	51.5abc
Fast, low, against	13.0ab	102.9a	73.8	50.9abc
Slow, high, with	10.6ab	106.2a	69.2	45.4cd
Fast, high, against	10.6ab	91.8bc	68.7	46.6cd
Slow, low, with	8.7bc	96.4abc	73.0	48.6bc
Slow, high, against	7.0bc	99.8ab	70.2	54.2ab
Slow, low, against	2.2c	80.2c	67.9	41.2d
Fast, low, with	1.6c	83.5bc	66.4	56.0a
Least significant difference (5%)	7.4	18.5	NS	7.1

Data in the same column followed by the same letter are not significantly different.

The highest October shoot populations were recorded in treatments which also recorded large cane losses. The following regression explained a large proportion of the variation in October shoot population:

$$\text{Shoots/ha} = 78\ 000 + 2\ 850 \text{ cane loss (t/ha)} - (43.6 \text{ cane loss (t/ha)})^2$$
$$R^2 = 0.80$$

Although there was no significant difference in March shoot populations between treatments, much of the variation in the parameter could also be explained by the following regression with cane loss:

$$\text{Shoots/ha} = 63\ 900 + 1\ 807 \text{ cane loss (t/ha)} - 107 \text{ (cane loss)}^2$$
$$R^2 = 0.64$$

The highest final cane yield was recorded in the treatment combination which also gave the lowest cane loss at the preceding harvest (Table 2). Again the treatment for which the machine is designed.

Table 2

The effect of harvester settings on cane loss and the subsequent ratoon crop of Q124 at Tully SES

Arranged in decreasing order of final cane yield

Treatment	Cane loss (t/ha)	Shoots/ha (X 000)		Cane yield (t/ha)
		October	March	
Fast, low, with	1.6c	83.5bc	66.4	56.0a
Slow, high, against	7.0bc	99.8ab	70.2	54.2ab
Fast, high, with	17.3a	110.8a	62.1	51.5abc
Fast, low, against	13.0ab	102.9a	73.8	50.9abc
Slow, low, with	8.7bc	96.4abc	73.0	48.6bc
Slow, high, against	10.6ab	91.8bc	68.7	46.6cd
Slow, high, with	10.6ab	106.2a	69.2	45.4cd
Slow, low, against	2.2c	80.2c	67.9	41.2d
Least significant difference (5%)	7.4	18.5	NS	7.1

Data in the same column followed by the same letter are not significantly different.

The lowest yielding (slow, low, against) treatment combination also had the lowest shoot population at both sampling dates which suggests that stool buds were lost during harvest (Table 2).

The ratio of shoot population in October/shoot population in March shows that a high initial shoot population may not ensure a high population of millable stalks (Table 3). Between 20 and 44% of the shoots present in October failed to make millable cane. The difference (October - March) in population was greatest where cane loss was highest:

$$\text{Difference} = 14\ 200 + 773 \text{ cane loss (t/ha)} + 63 \text{ (cane loss)}^2$$

Table 3

The effect of harvester settings on the subsequent ratoon crop of Q124 at Tully SES

Arranged in decreasing order of final cane yield

Treatment	Shoots/ha (X 000)			Cane yield (t/ha)
	October	March	October/ March	
Fast, low, with	83.5bc	66.4	0.80	56.0a
Slow, high, against	99.8ab	70.2	0.70	54.2ab
Fast, high, with	110.8a	62.1	0.56	51.5abc
Fast, low, against	102.9a	73.8	0.72	50.9abc
Slow, low, with	96.4abc	73.0	0.76	48.6bc
Fast, high, against	91.8bc	68.7	0.75	46.6cd
Slow, high, with	106.2a	69.2	0.65	45.4cd
Slow, low, against	80.2c	67.9	0.85	41.2d
Least significant difference (5%)	18.5	NS	-	7.1

Data in the same column followed by the same letter are not significantly different.

DISCUSSION

The significant differences detected in this trial demonstrate the potential of this method of basecutter damage investigation.

The results of this trial, associated trials comparing horizontal, leg-driven, Toft 6000 basecutters with the Toft 7000 design (Smith, in prep), and trials by Ridge (personal communication) all show that cane losses and subsequent ratoon growth are not affected when the machines are set correctly and operated under ideal conditions. Ridge (personal communication) established in a 1988 trial with Q124 at Mourilyan where strips were fast and slow with the Toft 7000 and small plots handcut. Shoot populations assessed three months later followed the order: fast 7000 > handcut > slow 7000. It was noted that the fast cut plots had been cut high leaving badly shattered long stumps. These stumps then produced a number of surface shoots. In the slow cut plots the cane had been cut at ground level.

No yield differences were detected at the following ratoon crop harvest.

Ridge (personal communication) also found in a 1988 observation strip of lodged Q124 at Tully that approximately 150 mm long, badly shattered, stumps were left when cane was cut with the direction of lodging. A clean cut at ground level resulted when the machine operated in the opposite direction.

However, problems can arise when operators do not adjust the machine at optimum levels. The most common problems are:

(a) harvesting cane against the direction of lodging. In heavy crops, operators can afford the empty running associated with harvesting in one direction. This is not possible in lighter crops or with tracked machines.

(b) harvesting crops with uneven row profile. At fast ground speeds it is essential that the basecutter operate as close as possible to the optimum height ie ground level. As the basecutter is raised to reduce dirt levels or to satisfy uneven hill formation, harvest and subsequent crop yield losses increase.

While further work is required, the results show that poor harvester setting and operation can significantly affect subsequent ratoon yield and that farmers should supervise harvester operations closely. A possible solution to harvesting lodged crops is to cut fast at ground level with the lodging and slower with the basecutter above ground level in the opposite direction. These were the two treatments giving the highest subsequent yields shown in Table 2.

REFERENCES

Murtha, G G (1986). Soils of the Tully-Innisfail Area, North Queensland. CSIRO Div. of Soils Div. Rept. No. 82.