IMPROVING CANE CUTTERS' PRODUCTIVITY

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Abstract

Certain factors which can influence the productivity of cane cutters are highlighted. The results of experiments using alternative methods are discussed. The design criteria for an improved cane knife which is currently being developed are also included.

Introduction

Almost 20 million tons of cane are harvested in South Africa each year, using mainly traditional labour intensive methods. The benefits from any increase in the productivity of harvesting as a result of improved methods of working are therefore greatly magnified. An industrial engineering project was launched in December 1981 to investigate methods of improving cane harvesting productivity. This investigation concentrated on the existing manual methods of harvesting cane and did not cover mechanical alternatives or the relative merits of harvesting burnt cane or trashed cane.

Methods and Procedures

Factors affecting productivity

An analysis of data from an area at Sezela revealed that there was a wide range in the productivity of cutters. The distribution of mean daily output per cutter in the area analysed is shown in Figure 1.

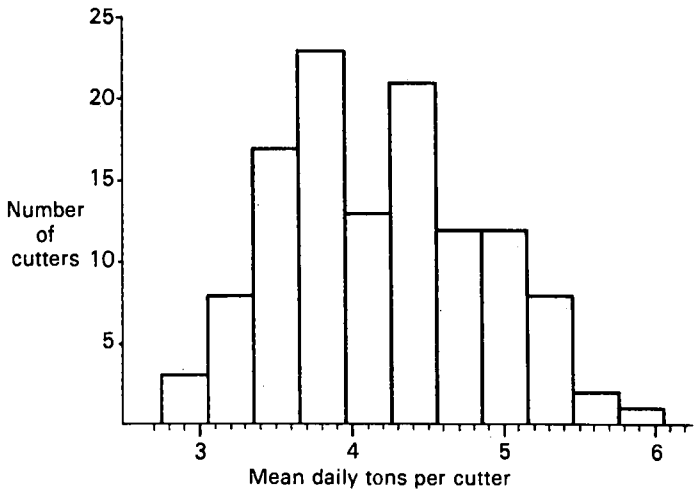

FIGURE 1: Distribution of mean daily output per cutter

Cane cutters were observed while they were cutting and the following factors which can affect their productivity were identified:

- cane factors: burnt or trashed, straight or lodged, row spacing, cane height, quality and variety
- standard of cutting accuracy: base cutting, topping and trashing
- methods of working: cutting action, number of cane rows undertaken simultaneously, rest pattern, stacking technique
- degree of sub-contracting to assistants (affects 'apparent' productivity)
- knife design and maintenance
- quality and quantity of supervision
- level of motivation
- supply of drinking water and food during the shift
- environment: climate and terrain.

Initial studies

Studies were initially made of cutters working in burnt cane at Illovo and trashed cane at Sezela. Cutting trashed cane involved more work than cutting burnt cane and therefore has greater scope for an improvement in productivity.

Three cutters with contrasting historical performances were selected for a detailed study while they cut, trashed and stacked cane so that the variations in the methods which were used could be identified. An analysis of their performance is shown in Table 1.

TABLE 1

Analysis of performance in cutting trashed cane

Activity	High output worker			Medium output worker			Low output worker		
	Total mins	% of shift	Mins per ton	Total mins	% of shift	Mins per ton	Total mins	% of shift	Mins per ton
Cut and trash	414	71,1	63,7	295	50,3	62,8	322	56,5	85,9
Dig trench	9	1,6	1,4	7	1,2	1,5	18	3,2	4,8
Carry cane	67	11,5	10,3	84	14,3	17,9	94	16,5	25,1
Maintain stack	13	2,2	2,0	17	2,9	3,6	5	0,9	1,3
Sharpen knife	6	1,0	0,9	0	0	0	11	1,9	2,9
Rest	73	12,6	11,2	184	31,3	39,1	120	21,0	32,0
Total	582	100,0	89,5	587	100,0	124,9	570	100,0	152,0
Tons cut		6,5			4,7			3,75	
Mean daily tons (season)		5,2			4,9			3,6	

The conclusions made from this analysis were that

- the outputs of the three cutters during the study were similar to their historical performance.
- the high output worker cut cane at the same rate as the medium output worker, but his output was 38% more by cutting for a greater portion of the shift. The low output worker cut cane at a slower rate.
- the medium and low output workers spent twice as much time carrying each ton of cane to the stack, as the high output worker. The high output worker prepared a site for his stack at the start of the shift, thereby enabling him to place his cane directly on to the stack. The other two workers stacked their cane when they had completed the cutting.
- the relaxation time of the high output worker was less than that of the other two workers probably because he worked more effectively; cutting more sticks per bundle at a slower pace.
- the amount of attention given to knife maintenance varied considerably between the workers.

Early stacking

The most significant observation made during the initial studies was that the high output worker preferred to commence stacking at the start of his shift. A subsequent survey conducted at Sezela confirmed that early stacking is common with the cutters whose performance is higher. This method has the ad-

vantage of reduced handling of the cane. In addition, there is a psychological motivation from seeing the stack 'grow'.

Knife design

Cutting, topping and trashing cane are contrasting operations and ideally, there should be specialised tools for each. The cane cutter is expected to perform the three operations with a single tool but it would be impractical to change tools for each operation, as they are performed in rapid succession. A team of workers was used in an experiment where each worker specialised in one of the operations. The result was a dramatic drop in productivity.

It was therefore decided that the design of existing cane knives be examined and one which could perform the three operations more efficiently be developed. The following criteria for improving the design of existing knives were identified:

- the weight of the knife should be concentrated at the lower end. This will increase the energy available to chop through the fibrous base of the cane. (A similar principle is used in the design of golf clubs.)
- the mass of the knife should allow cutting, topping and trashing to be done efficiently without causing excessive worker fatigue.
- the knife should be lengthened slightly to reduce the strain on the cutter's back. If it is too long, however, topping and trashing are affected.
- the blade should be made of a harder steel so that it stays sharp for longer periods. Professional sharpening with a grinding wheel may be necessary after each day's work.
- the handle should be shaped to fit the hand; sharp edges and protruding rivets must be avoided.

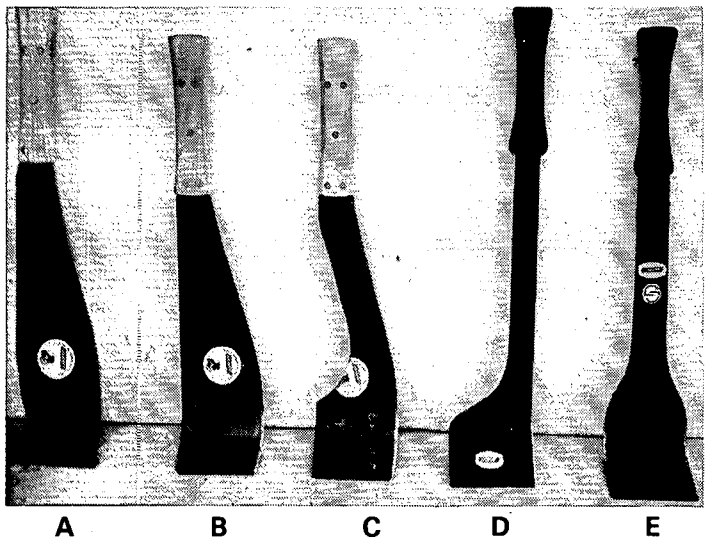

FIGURE 2: Various designs of short handled cane knives
A - Traditional knife with hook; B - Traditional knife with curved blade; C - Modified knife with added weight; D - Prototype knife 1; E - Prototype knife 2.

The traditional short-handled cane knives and various stages in the development of an improved knife are shown in Figure 2. Knife 'C' is a modification of the traditional knife 'B', the lower end of which was made 100 grams heavier. An equal amount was cut out of the upper portion of the blade to retain the mass and increase the shift of mass distribution. These modified knives were then used in experiments and there was some improvement in output. The knives were well received by the cutters but there was a period of resistance initially.

The design of knife 'D' is based on the same principle as knife 'C'. The shift of mass distribution is achieved by reshaping the blade, making it unnecessary to attach additional weight. The knife is lengthened by 40 mm and the thickness of the steel increased by 25% to improve rigidity. A comfortable polypropylene handle is moulded directly on to the blade, thus avoiding the problem of protruding rivets. A few of these knives were obtained from the suppliers and used in experiments. Productivity was improved by approximately 7% but further experiments are necessary before this can be confirmed.

Knife 'E' is a modification of knife 'D' in which the blade shape has been designed symmetrically to improve axial balance. The width of the blade is increased to improve sturdiness and a harder steel has been used. The blade is sharpened on both edges to suit left or right-handed workers or cutting on the return strokes. Samples of these knives will be distributed for experimental use this season.

Method experiments

Experiments were conducted by the agricultural staff at Sezela to determine the effect of various changes of method on the productivity of cane cutters. A total of 20 gangs (approximately 400 cutters) was involved, and each gang was allocated one of the following methods for a three-week period:

- early stacking (previously described) combined with training to trash in a single stroke and to construct standard sized stacks
- issued with modified type 'C' cane knives (Figure 2)
- issued with hooded long-sleeved smocks to provide increased protection when handling cane
- no change. These gangs were included to provide a control against which any productivity improvements could be measured.

The results of these experiments are shown in Table 2. In each of the three variations of methods there was some improvement over the control gang. Additional experiments are planned for the coming season to improve the level of statistical confidence in these results.

TABLE 2

Results of method experiments

Treatment	Mean daily tons per cutter	Increase % cf control
Early stacking	4,47	6,2
Modified knives	4,41	4,8
Protective clothing	4,38	4,0
Control (no change)	4,21	-

Conclusion

The initial studies and method experiments clearly indicate that there is considerable scope for improving the productivity of cane cutters. It is important to optimise the productivity of existing manual methods before making comparisons with mechanical harvesting alternatives.

Further studies and experiments are planned for the current season to substantiate the findings of the early work. Improved productivity of cane cutters will result in reduced labour costs and increased earnings for individual cutters, thereby improving worker satisfaction and workforce stability.

Acknowledgements

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