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MECHANIZED PLANTINGS OF CASSAVA STEM CUTTINGS ON PEATS AND PEATY CLAYS IN GUYANA

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INTRODUCTION

Cassava is changing its status in Guyana from a traditional peasant crop to one of economic importance. Currently, four mills are being constructed to produce cassava flour. To ensure adequate supplies of cassava to these mills it appears necessary to establish several cultivations of over 500 ha each. In the event that labour is scarce which appears to be true at two of the plant locations it may be necessary to employ a combination of manual and mechanical cultural practices to achieve planned production rates. This paper describes (1) a machine for preparing cassava stem cuttings and (2) a device for planting on either ridged or flat beds. The characteristics of these machines are presented and compared with manual operations. Costs (based on local rates) and economic comparisons are developed.

MATERIALS AND METHODS

Equipment : Design Construction and Operation

A Stick Cutting Machine (SCM) has been developed for the preparation of standard length planting material. This device (Fig. 1) is constructed of an angled-iron frame stand 75 cm high and topped with 6 mm metal plate. Having 60 cm in width and 75 cm in depth. Two circular saws (25 cm) are fitted to the ends of a shaft 90 cm long. The shaft runs on pulley blocks bolted to the top of the stand 12,5 cm from the front edge, with the saws standing out on some 15 cm of shafting at either side. Each saw is enclosed in a metal sheet guard/chute secured to the side of the frame, and extending downwards to an open end some 40 cm above the ground. The shaft is driven by a vee belt from a 7 Hp general purpose motor mounted on the rear of the platform, to give 2000 rpm.

In use, two operators hold 3 or 4 cassava stalks at a time outside the guard box, and feed in towards the stand. The edge of the frame is udes as a stop guage on the free end of the work to give a cut lenght of ca. 15 cm. The cut material is delivered, via the guard/chute to portable bins (longitudinally split oil drums, with welded handles) placed on the ground. In operation, 5000 stem cuttings are produced per machine hour. Thus at a planting density of 0.9 m x 0.9 m, 4,8 man hours are required to supply enough planting material for one ha.

The device developed for planting cassava stems is the Three Row Planting Machine - TRPM (Fig. 2)*. It consists of a horizontal paralled frame (3 x 1 m) which is welded to a vertical 'A' frame for attachment to a three point linkage. On the paralledl frame is mounted a hopper ca. 3 x 1 x .5 m, which is subdivided into four compartements by three planting channels at .9 m centres. Each channel consists of a pair of vertical plates some 15 cm apart, decending below the frame where the leading edges join to form the tine. Behind each channel is a seat and foot-rest affording the operator a clear view of the furrow. Each channel trails a loop of chain. At either side of the TRPM a skid or foot. (.9 x .3 m surface) is attached by vertical rods running through clamp brackets.

(*) figure 2 is on page 385.

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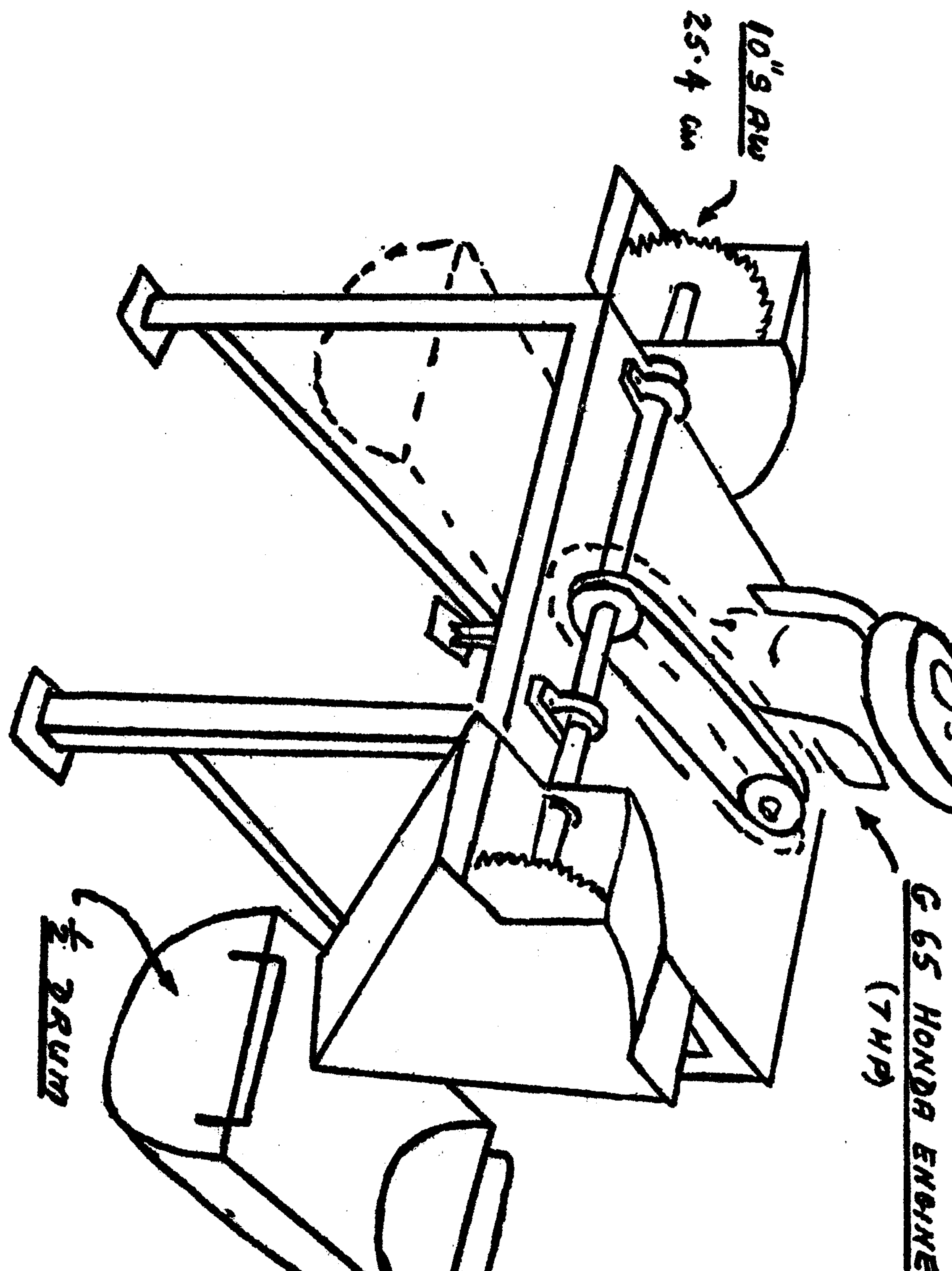
10" SAW
25.4 cm
G 65 HONDA ENGINE
(7HP)
½ DRUM

In use, the TRPM, with three operators and some 400 kg stem cuttings is drawn by tractor (60 - 75 Hp). Each operator takes sticks from the hopper on either side of him and drops them singly, via the planting channel, into the furrow opened by the time. The sticks lie more of less flat in the furrow, and are lightly covered by the trailing chain. Planting depth is controlled by adjusting the height of the s-kids ; and apacing within the row approximated 0.9 m. Making out is unnecessary after the first pass the inner skid is guided just inside the track of the last outer skid.

Field Trials : Soils, Land Preparation, Planting.

Trials were conducted on an empoldered, drained site at Enmore Estate, Guyane. The site contained two soil types localled classified as Anira Peat (20) and Inki Clay (100) on which much cassava research has recently been focussed. These soils are extremely acidic (pH 3-4) infertile, high in organic matter (10 %) and marginal for conventional agriculture. Four plots were ploughed and rotovated : one 11 x 137 m (.15 ha) on Anira peat ; and three 16.5 x 137 m (.227 ha) each, on the Inki clay, separated by drains (.65 x .5 m). One of the Inki Clay plots was ridged, lenthwise, with ridges .3 m high and .9 m apart ; but no ridges ware made on the peat because of its excessively light and loose property when dry or merely moist.

The plots were planted in April 1975, immediately after land preparation and three weeks prior to the arrival of the longs wet season. Within each plot, rows 137 m long and 0,9 m (36 inches) apart were market out using the TRPM. Groups of three rows were randomly selected for mechanized planting, and intervening rows were planted by hand. All planting material material was obtained from variety Brancha Butterstick, aged 9 months, grown at field nursery.

Planting operators, mechanical and manual, sought to maintain .9 m spacing between plants. For mechanized planting, 12 - 15 cm long stems were prepared on the SCM and planted from the TRPM. Planting depth on the TRPM was adjusted at ca. 12.5 cm and the tractor was driven in low gear on planting passes. Records were kept of the rate of production on the SCM ; and of the planting rate, including time to load the hopper with planting material and for turns.

Manual planting was effected by experienced sugar cane planters (a not dissimilar process). A stalk, (intially 1 - 2 m long) was held in one hand a cutlass in the other. The soil was disturbed to ca. 12.5 cm depth, and one end of the stem was placed in the depression. The cutlass severed a length of some 15 - 23 cm which lay, rather than stood along a side of the depression where it was loosely covered with soil by the foot. Record was kept of the time taken per row (137 m), including time to bring the sticks from the edge of the field.

Management and Observations

All plots and all rows were similiarly limed, fertilized and intensively managed throughout the experiment. Established plants were counted, at 35 and 52 days, in five arbitrarily selected row lenths of 27.5 m for each treatment in each plot. This permitted a comparison of average planting density achieved with standard density intended (100 plants per 91 m). Fresh root yield was sampled at 12 months, from five arbitrarily selected sequences of 25 plants in a row for each treatment, and extrapolated to ton/ha via the sampled row lengths.

RESULTS AND DISCUSSION

Timings established for the various elements of the mechanized planting operation (table 1) indicate an overall rate of .32 hectare per hour or 3.125 hrs per hectare planted. There was no difference in the mechanized planting rate on ridged and on flat beds. The times would of course vary with other circumstances, including row length, spacing, and length of sticks (i.e no. of sets per hopper load). Table 2 indicates that mechanized planting is indeed labo ur saving, absorbing only 17.3 man-hours per hectare inclusive of tractor, TRPM and SCM operators. This compares with 62 and 75 man-hours for manual planting on ridged and on flat beds respectively. Neither figure includes supervision or marking out, in the case of the manually planted operations.

On this basis mechanized planting costs the same as manual planting of flat beds but exceeds manual planting costs on ridged beds by 21 %. Also this comparison reflects institutional factors, machine utilisation rates, and costing principles employed in the Guyana Sugar Industry and which would not necessarily apply to cassava production, and therefore is not conclusive. Futher, in repetitive cassava cultivation, planting material is a virtually free byproduct of the previous crop. However when new cultivations are established, or new varieties introduced, the supply of cassava stalks may be costly. In Guyana for exemple, at the going price, plant material sufficient for the mechanized planting procedure (ca. 12 000 x 15 cm per ha) would have cost twice as much as the mechanized planting operations (at sugar industry rates) ; not counting transport cost.

Since in theory, the set was entirely covered as it was planted, it was not possible to make direct observations at sowing of the spacing actually achieved with the TRPM. Several sets (not recorded) were visible wholly or partially on the surface after planting, indicating that despite adjustments, the control of planting depth and operation of the trailing chain were not fully satisfactory. This was particularly the case on the Ridged Clay beds, and on the Peat, where the seed beds were less level than on the flat clay beds. The Authors believe that uniform coverage could have been achieved by the use of heavier trailing chain.

The main test of planting performance was the count of live plants at 35 and 52 days. (Table 3). Overall, mechanical planting established stands at 86.4 % of the intended planting density (at 52 days) ; compared with 105.1 % for hand planted rows. At the earlier count, the manually planted stands had achieved 93 % of their final density, whereas machine stands were less advanced at 74 % of inal density. Mechanically planted stands were thinner than hand planted ones on the Ridged Clay and Peat beds, where problems in planting depth and stem coverage had been most noticeabla. However, on flat clay beds, the mechanically planted stands were as dense as the hand planted ; and conspicuously denser than those mechanically planted on ridged beds of the same soil type.

Unfortunatley the method of measuring planting success did not distinguish between the actual planting rate, stem viability and/or subsequent mortality following germination as determinants of stand establishment. It is likely that all of these factors played a part. Also, a three week dry spell following planting might have impeded germination and/or subsequent seedling establishment. However, the comparison suggested that on well levelled flat beds, mechanical planting is as effective as the manual method ; but where the planting surface is uneven, the manual method secured a more uniform planting depth and better soil contact, thus resulting in slightly earlier and substantially higher germination.

Since the initiation of these trials, Makanjuola (1) has published details of a semi-automatic cassava planting device. The device accomplishes both ridging and vertical planting in the same operation. Spacing is controlled 'Fairly accurately' by wheel speed, and only 3 % of stalks were misplanted as to depth. Stand establishment at 3 weeks was 99.5 %. Presumably, soil moisture was optimum for germination. This is a two row device, and the quoted planting rate of .216 ha/hr compares well with the .35 ha/hr for the Three Row Planting Machine, described in this paper.

At harvest it was apparent that mechanized planting resulted in near precision inter-row spacing (90 cm) on all plots sampled (Table 3) whereas manually planted sticks were invariably closer spaced (83 cm). Fresh root yields expressed as a

ABSTRACT

Cassava is changing its status in Guyana from a traditional minor crop to one of economic importance. Currently, four mills are being constructed to produce cassava flour. To ensure against sole reliance on manual labour for planting, efforts to mechanize this operation has resulted in the design, construction and successful trial of (1) a cassava stem cutting machine ; and (2), a three-row planter.

Comparative field studies were conducted on manual is mechanized operations in flat and ridged fields. Irrespective of soils, type of field preparation and planting method, overall plot stands at 52 days ranged from 86 to 105 % of the expected standard density. Also, there was no significant difference in overall fresh root yield at 12 months (18.5 ton/ha using an unimproved local variety) irrespective of the planting method and the field lay-out. The characteristics of these machines are reported and compared with manual operations. Costs (based on local rates) and economic comparisons are developed.

function of stand density achieved indicated that irrespective of planting method overall plot yields were the same at 18.3 ton/ha. On the Anira peat plot, machine planting resulted in yields of 20.4 vs 17.3 tons/ha for manually planted sticks. However, on the flat Inki clay plot this situation was reversed in that machine planting resulted in 5 ton/ha less than the manual (18.5 tons/ha). During harvest, it was observed that on the flat Inki clay beds machine planted sticks produced root tubers at a soil depth 15 cm deeper than roots arising from manually planted sticks. It is plausible then that during recurring periods of sustained heavy rainfall between the eight and 12 th month high water table impeded accumulation of root dry matter on the mechanically planted flat clay plots thereby resulting in a distinct yield loss.

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LITERATURE CITED

MAKANJUOLA G.A. - The Semi-Automatic Device for Planting Cassava Stem Cuttings on Ridges. Appropriate Technology, 2, 4, 24, 25, 1976.

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Table 1 - Timing of planting operations using a Three Row Planter (TRPM) and Cassava Stem Cutting Machine (SCM).

	Planting (3 x 134 rows)	Turning	Total
TRPM (per pass)	5.0 min	1.0 min	6.0 min
TRPM (per full hopper using 15 cm long stems)	6.6 passes	= 0.24 ha	40 min
TRPM (per full hopper using 15 cm long stems) plus time to load hopper		5. min	45 min
TRPM Planting rate (137 m rows spaced 0.9 m spart)		= 0.32 ha/hr	3.125 hr/ha
SCM Time to cut 15 cm sticks to fill hopper = 36 min		= 2.4 hr/ha	

Table 2 - Comparative inputs and costs (per hectare) for manual vs machinized planting of cassava stem cuttings.

Planting Method	Field Layout	Physical input (man-hours)	Current rate (G$/hr)[a]	Cost G$
Manual (labour)	Ridged beds	62	0.90[b]	56
	Flat beds	75	0.90	68
Machanized (labour)	Ridged or flat beds	14.175	0.90	12.76
Tractor cost inclusive of operator, fuel lubricants and TRPM[c]	"	3.125	16.00	50.00
SCM[d] (inclusive of fuel)	"	4.80	1.00	4.80
	Total cost	for machanized	planting	67.56

a G$2.57 = US $1.00
b Current hourly rates prevailing in the Sugar Industry
c Three Row Planting Machine
d Stem Cutting Machine.

Table 3 - Stand establishment at 52 days after planting and fresh root yields (ton/ha) at twelve months of Hand vs Machine planted stem cuttings on ridged and flat Anira Peat and Inki Clay plots.

	F L A T B E D				Ridged Bed		All Plots	
	Anira Peat # 20		Indi Clay # 100		Inki Clay #100			
	Hand	Machine	Hand	Machine	Hand	Machine	Hand	Machine
Stand Establishment								
% of expected standard density	125.3	88.7	94.7	92.7	96.0	78.0	105.1	86.4
(plants/ha) x 1000[1]	15.0	10.6	11.2	11.1	11.5	9.3	12.6	10.3
Mean Intex-row spacing (cm) of 5 x 25 contiguous plants within a row at harvest	79.7	91.4	82.9	89.5	85.8	89.0	82.8	90.0
(Plants/ha) x 1000	13.7	11.9	13.2	12.2	12.8	12.3	13.2	12.2
Yield (tons/ha)	17.3	20.4	18.5	13.4	19.0	21.0	18.3	18.3

[1] Theoretical density at a plant spacing of 0.92 m x 0.92 m = 12 000 plants/ha.

3 ROW PLANTING MACHINE (FIG 2)