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Effect of Planting Technique on Establishment of Cassava (*Manihot esculenta,* Crantz) in South-east Zimbabwe

F. T. Mugabe, [1]G. Mtetwa and F. Murungu
Department of Land and Water Resources Management, Midlands State University, P.O. Box 9055, Gweru, Zimbabwe
[1]Chiredzi Research Station, P.O. Box 97, Chiredzi, Zimbabwe

Abstract: An experiment was conducted at Chiredzi Research Station to evaluate the effect of planting technique on cassava establishment. Seven planting techniques: Inclined, forming 45 to 60° angle with the ridge, but leaving one-third above ground (I1/3); inclined, forming 45 to 60° angle with the ridge and the soil covering the whole cutting (ICOV); vertical planting leaving one third of the cuttings above ground level (V1/3); vertical with the soil covering the whole cutting (VCOV); horizontal, at 10 cm below the top of the ridge (H10); horizontal at 15 cm below the top of the ridge (V15); and horizontal 20 cm below the top of the ridge (H20) were evaluated in the experiment. Vertical planting leaving one-third above ground had significantly (P=0.05) the highest establishment. The low crop establishments were observed from horizontally planted cuttings where crop establishment decreased with depth of planting giving 36, 33 and 15% for materials that were planted at 10, 15 and 20 cm below ground respectively. Soil temperatures were within the optimum temperature range for sprouting and therefore did not affect sprouting.

Key words: Cassava, planting technique, semi-arid

INTRODUCTION

Droughts are common in the semi-arid areas of Africa and this results in many families suffering from starvation[1]. The two drought mitigation measures in such areas are making efficient use of the little rainfall by harvesting it for controlled use and growing drought tolerant crops[2] like pearl millet, sorghum and cassava.

Cassava is drought tolerant and its production is common in most of sub-Saharan Africa where it provides carbohydrates and vegetables from the tubers and leaf, respectively. However, despite the wide adaptability of cassava to the tropical African environment, its production is not common in Zimbabwe where food shortages are common especially in the semi-arid areas.

Cassava is suitable for production by the small-holder farmers because it is a drought tolerant crop that can survive and produce reasonable yields under water deficit conditions[3-5]. Cassava also requires little or no fertilization because of its massive leaf production which drops to form organic matter thus recycling soil nutrients[6]. It maintains a steady production trend over fairly long period of time in a continuous cropping system.

However, cassava establishment has been a problem especially in semi-arid areas where rainfall is low, erratic and poorly distributed and, where dry spells can be up to six weeks causing sprouting problems. The very high summer temperatures that could go up to 42°C quickly dries the soil leading to dry conditions that do not favor sprouting. There is therefore need to establish planting techniques that will give good crop establishment. Experience in medium to heavy soils with adequate rainfall (1000 to 2000 mm) in Tanzania and Nigeria shows that it does not matter whether cuttings are planted horizontally, vertically and slanting because the soil moisture will be adequate for sprouting[7]. The objective of this study therefore was to evaluate the effect of seven planting techniques on cassava establishment under a different environment of semi-arid Zimbabwe.

MATERIALS AND METHODS

The experiment was conducted at Chiredzi Research Station in the South East Lowveld of Zimbabwe at an altitude of 429 m.a.s.l. in February 2001. Chiredzi Research Station lies in Natural Region V of Zimbabwe that is semi-arid. The mean annual rainfall is 500 mm with a seasonal range of 250-1000 mm. The Natural Regions are a classification of the agricultural potential of the country, from Natural Region I, which represents the high altitude wet areas to natural region V which receives low and

Corresponding Author: F.T. Mugabe, Department of Land and Water Resources Management, Midlands State University, P.O. Box 9055, Gweru, Zimbabwe E-mail: ftmugabe@yahoo.co.uk

erratic rainfall averaging 550 mm per annum[8]. The soils at Chiredzi Research Station are dark-reddish brown clays derived from basic gneiss and are classified as the Triangle B2 series and typic rhodstuff in the Zimbabwean and USDA classification systems, respectively.

Seven cassava planting techniques were used in this experiment. These were Inclined, forming 45 to 60° angle with the ridge, but leaving one-third of cuttings above ground (I1/3); inclined, forming 45 to 60° angle with the ridge and the soil covering the whole cutting (ICOV); vertical leaving one third above ground (V1/3); vertical and the soil covering the whole cutting (VCOV); horizontal, at 10 cm in the soil below the top of the ridge (H10); horizontal 15 cm below the top of the ridge (V15) and horizontal 20 cm below the top of the ridge (H20).

A Randomized Complete Block Design (RCBD) with three replications was used. Cassava variety XM6 was used in this experiment. Ridges, aligned across the slope were constructed by a tractor using a duck foot ridger. Cross ties at 3 m intervals were made at the center of the plots to prevent the water from accumulating at one side of the plot.

The gross plot size was 30 m^2 (6x5 m). Plant spacing was 1 m within row and 1 m between row. No fertilizer was applied to the trial since cassava is know to do well with residual fertility. Planting holes were treated with thiodan wp at a mixing rate of 200 g/10 L of water and applied at the planting station. The plots were flood irrigated and then overhead irrigation was applied to make the ridges attain field capacity. Thereafter the experiment was not irrigated at all. Cuttings that were 20 cm long and of uniform thickness were selected from primary branches and used as planting materials. Weed control was by hand hoeing.

Soil temperature was measured by soil thermometers inserted at 10, 15 and 20 cm below the top of the ridge. Measurements were taken at 0600, 1400 and 1800 h for 12 days during the study period.

Four composite soil samples of three sub-samples were taken at four depths (0-6, 6-12, 12-18 and 18-24 cm below the top of the ridge) for measuring soil moisture. A sample from the mixture was then taken and placed into tins of known weight and weighed. The tins were oven dried for 48 h at 105°C and reweighed. Volumetric soil moisture was obtained by multiplying the gravimetric soil moisture by the bulk density.

Sprout count was taken at 25, 30, 35 and 40 days after planting. Stand counts were taken at different days to capture those plants that would emerge late due to soil moisture, soil temperature and depths limitations. The data was subjected to analysis of variance (ANOVA) according to the procedure for a Randomized Complete Block Design using MSTAT-C statistical package.

RESULTS

Soil temperature: Soil temperature ranged from 23- 40, 25-39 and 29-39°C at 10, 15 and 20 cm depths, respectively (Fig. 1). The lowest soil temperatures was observed at 0600 in the morning while the highest soil temperature was observed in the afternoon at 1400 hours. The differences in the highest soil temperature limits were very small. The lowest temperatures showed some slight differences.

Soil moisture: The highest soil moisture content of 44 mm was observed at 0-6 cm recorded depth while the lowest soil moisture of 32 mm was at 12-18 cm depth when the experiment commenced (Fig. 2). Soil moisture decreased gradually from start to end of the experiment and the rate of decrease was fastest at the 0-6 cm depth. The depth of 12-18 cm had the highest soil moisture content for the remainder of the experiment while the least soil moisture was observed in the 0-6 cm.

Crop establishment: Cuttings did not sprout before 25 days after planting (Table 1). For all the treatments crop sprout count was highest at 35 days after planting. Treatment 3 (V1/3) significantly ($p<0.05$) gave the highest crop establishment during all the three recording days. It was followed by treatment 2 (ICOV). There were no significant differences in crop establishment in treatments 2 (ICOV), 4 (VCOV), 5 (H10) and 6 (H15). Treatment 7 (H20) had significantly the lowest crop establishment for all the three recording days. Planting horizontally at 15 and 20 cm depth significantly affected crop establishment of cassava cuttings showing 33.3 and 15%, respectively 40 days after planting.

Table 1: Effect of planting technique on cassava establishment in semi-arid Zimbabwe

	Percent stand count after planting		
Treatments	25 days	30 days	35 days
I1/3	47.80b	55.60b	60.00b
ICOV	32.20c	40.00bc	43.30c
V1/3	66.70a	76.70a	82.20a
VCOV	23.30cd	33.30c	36.70c
H10	28.90c	33.30c	36.70c
H15	15.60de	26.70cd	33.30c
H20	3.30e	13.30d	15.70d
Mean	31.10	39.80	44.00
CV%	22.20	17.10	13.50
LSD 0.05	12.31	12.14	10.57
SD	6.92	6.82	5.94

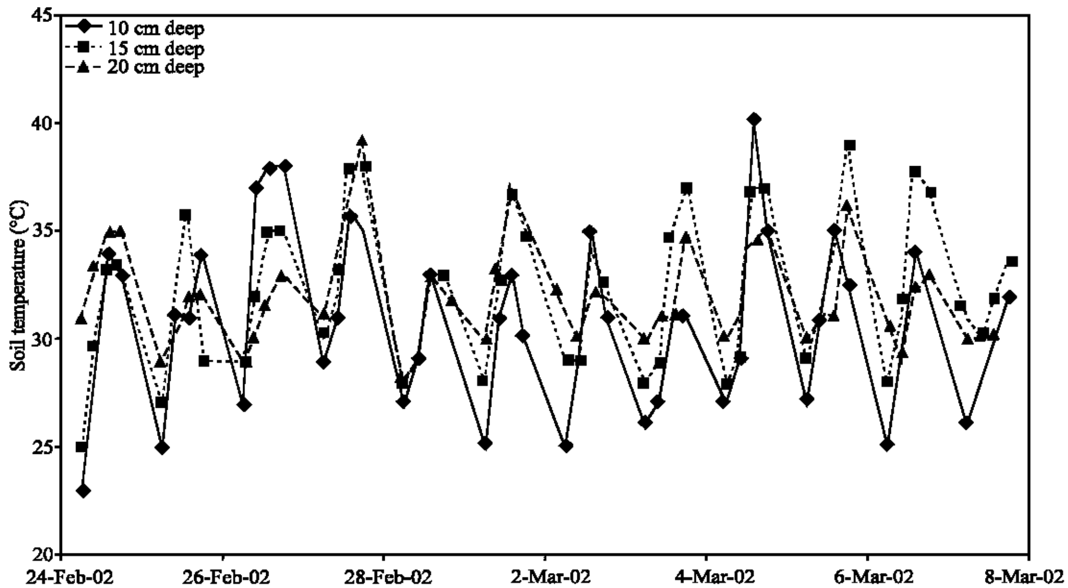

Fig. 1: Variation of soil temperature with depth during the study period

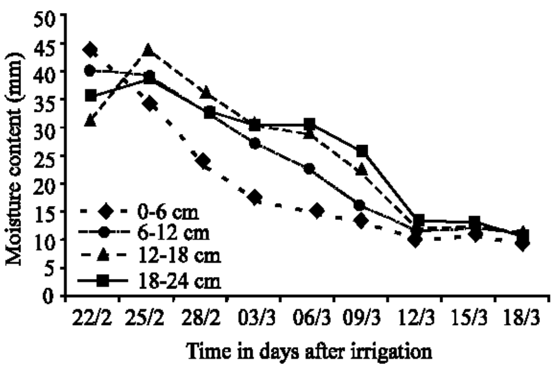

Fig. 2: Variation of soil moisture with depth during the study period

DISCUSSION

In the horizontal planting the deeper the cuttings were the lower the plant establishment. Weight of soil over the cuttings increased with increasing depth of planting and this probably had an effect on crop establishment. The shoots could not probably push through the soil because of weight. Soil moisture variation cannot be attributed to poor stand because soil moisture increased with depth (Fig. 2). Temperature did not vary much with depth hence the recorded differences in cassava establishment could not be attributed to soil temperature. The cuttings that were planted either vertically and inclined did not have problems because the cuttings were showing at the soil surface or very close to the surface.

Treatment 4 (vertical but covering the whole plant) showed significantly lower stand counts than the control (H1/3), but did not show any significant difference from treatment 2 (slanting but covering the whole plant). This shows that covering the whole plant does not favor sprouting of cassava cuttings. However, treatment 3 (vertical leaving one-third above ground) proved to be the best method due to light and availability enough of soil moisture. These results show significant differences due to method of crop establishment. Gurnah[9] who worked under high rainfall regimes did not notice any difference emanating from horizontal, vertical or inclined planting of cassava. This highlights that planting technique is very important in the semi-arid areas where rainfall is low, erratic and poorly distributed.

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