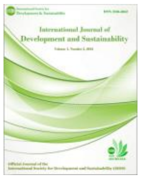

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Four planting devices for planting no-till maize

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Abstract

An experiment was conducted at the CSIR-Crops Research Institute (CSIR-CRI) Experimental station at Ejura in Ghana to compare the efficiency of four devices for planting no-till maize: Tractor drawn seeder, Chinese made jab planter, Locally made jab planter and a Cutlass. It took two (2) hours 48 minutes to plant one hectare of maize with the tractor drawn seeder, which was significantly ($p<1\%$) faster than all the planting methods. Cutlass was the slowest planting device lasting more than 14 hours per hectare. There was no significant difference in planting time between the Chinese planter and local planter. Economic analysis showed that cutlass planting produced the highest net benefit, whilst tractor drawn seeder produced the least benefit. In this study cutlass planting was done with precision by collaborating farmers. In actual farm situation however, hired laborers (planting gangs) often plant in haste which often results in poor plant population leading to low yields. Tractor drawn seeders or jab planters could reduce drudgery in planting and encourage farm expansion.

Keywords: Planting Device, No-Till, Maize, Jab Planter, Economic Analysis

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1. Introduction

Migration of the youth to the urban centers in search of non-existent jobs has created severe labour shortages in the farming communities in Ghana. This is worsened by that fact that farmers rely on crude implements to perform critical field operations. One of such operations is planting which is done using hoes, cutlasses or dibbling sticks (Adjei et al., 2003). Planting with these implements is time consuming, tedious and back-breaking. Many farmers depend on the services of a few of the youth (planting gangs) in the farming communities for planting. Apart from charging exorbitant fees, the planting gangs plant in a haste resulting in poor plant establishment. In order to reduce this drudgery, some farmers broadcast seeds of maize and cowpea and plough with a tractor to cover the seeds. Almost invariably broadcasting results in non-uniform plant spacing in the field. Significant yield reductions due to non-uniform plant spacing have been reported in several crop species such as sunflower (Wade, 1990), maize (Pommel and Bonhomme, 1998) and sorghum (Larson and Vanderlip, 1994).

One strategy that could be exploited to reduce drudgery in planting crops in small scale farms is promotion of tractor drawn seeders through agricultural mechanization service delivery. Some of the single biggest increases ever observed in total factor productivity in farming have been achieved through the introduction of agricultural machines (Reid 2011). Agricultural mechanization can increase the welfare of farm households and create positive dynamics and opportunities for economic growth in rural areas. Yet according to the FAO 'Farm mechanization have become, to a certain extent, the neglected waif of agricultural and rural development' (FAO, 2013).

Another strategy that could alleviate drudgery in planting is the use of efficient hand held tools such as jab planters. Several types of jab planters have been developed but adoption is very low. Reasons for low adoption have not been documented but in-efficiency in planting cannot be ruled out. Most of these jab planters are manufactured by local artisans using crude implements. A study conducted in Ghana on 30 samples of the same jab planter developed by a local artisan showed significant differences in maize seed and fertilizer delivery rates between the jab planters (Aikins et al., 2010). The authors concluded that there was no control of quality in the manufacture of the metering unit of the jab planters.

In 2011, an industrially manufactured jab planter from China was introduced into Ghana and found to be very efficient in planting medium to large seeded crops such as groundnuts, maize and mucuna (Bonsu et al., 2015). One disadvantage of the Chinese planter is that it is expensive. Moreover it is complex in construction and hence prone to malfunction. In view of the disadvantages associated with the Chinese planter, a modified jab planter (local jab planter) was developed locally in Ghana.

This study compared the efficiency of a tractor drawn seeder with the Chinese and locally made jab planters for planting no-till maize. The control treatment was cutlass often used for planting by local farmers.

2. Materials and methods

A description of the jab planters used in this experiment is documented (Bonsu et al., 2015) and the pictures are shown in Plate 1 and Plate 2.

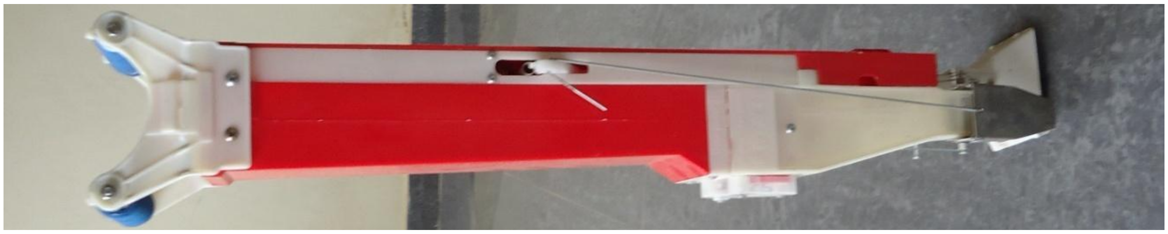

Plate 1. Chinese jab planter

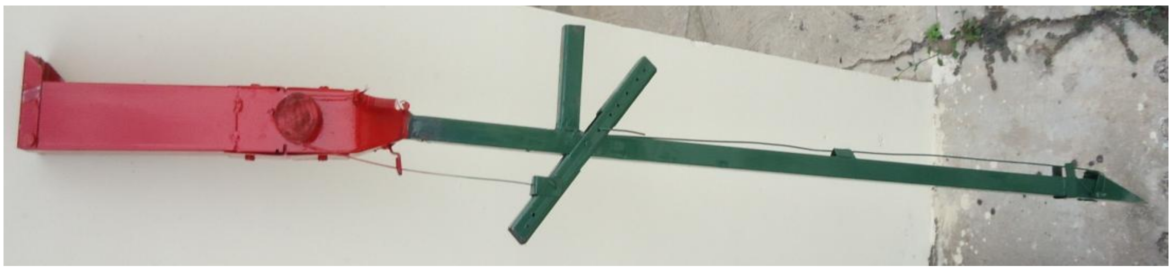

Plate 2. Local jab planter

The experiment was conducted at the CSIR-Crops Research Institute of Ghana (CSIR-CRI) Experimental station at Ejura in the transition Zone The experimental design was a randomized complete block with 3 replications. The plot size was eight (8) rows of maize 30m long. The treatments were planting with i)tractor mounted seeder (Tractor); ii) Chinese jab planter (China P); iii) locally made jab planter (Local P) and iv) cutlass. The quality protein maize hybrid variety Mamaba, developed by the CSIR-Crops Research Institute was used in the trial. Test conducted before panting indicated that the germination percentage of the seed was 91. Maize was planted without tillage after controlling the existing weeds with glyphosate at a rate of 3 litres/ha. Spacing of maize was 80 cm x 40 cm, with a target of three seeds per hill for the jab planters and cutlass. A planting rope marked at 40 cm intervals was used as a guide in the planting. The tractor mounted seeder was calibrated to plant at 75 cm x 20 cm, 1 seed per hill. All other cultural practices for planting maize were as recommended by the CSIR-CRI. A stop watch was used to determine the time used in planting each plot and the data was extrapolated to 1 hectare. Data were collected on number of hills with seedling, no of hills with 1 seedling, 2 seedling and 3 seedlings. The cost benefit analysis which shows the returns to investment of the various treatment options, was used to determine the benefits to farmers (CIMMYT, 1988)

3. Results

Table 1 shows the effect of planting device on planting time and maize plant stand. It took 2 hours 48 minutes to plant one hector of maize with the tractor drawn seeder, which was significantly ($p<1\%$) faster than all the planting methods. Cutlass planting was the slowest method of planting lasting more than 14 hours per hectare. There was no significant difference in planting time between the Chinese planter and local planter. The target total number of hills per hectare was 31,250 plants. As expected, tractor planting resulted in significantly ($p<1\%$) higher number of hills than all the other planting methods. The local planter gave the lowest number of hills. The trend was similar for number of hills with 1 plant. Conversely tractor planting resulted in least number of hills with 2 plants, 3 plants and more than 3 plants. The Chinese planter resulted in highest number of hills with 2 plants (8958 plants/ha) and the local planter the least number of hills with 2 plants. On the other hand the local planter had more hills with 3 plants and more than 3 plants than the other planting methods (Table 1). No of seedlings thinned ranged from 694 seedlings/ha for the tractor planting to 7917 seedlings/ha, for the local planter. The target plant population was 62,500 plants/ha. The achieved population was lowest for the Chinese planter (39513 plants/ha) and highest for the local planter (47569 plants/ha).

Presented in Table 2 are number of plants thinned, plant population and yield of maize as affected by planting device. T here was a significant difference in number of cobs harvested ranging from 30416 cobs/ha for tractor planting to 3900 cobs for cutlass planting (Table 2). Grain yield ranged from 3039 kg/ha to 4372 kg/ha. Cutlass planting resulted in significantly higher yield than that of tractor and Chinese jab plantings. The yield obtained from cutlass planting was however not different from those of the local planter.

The economic analysis of the study is presented in Table 3. The highest gross and net benefits of GH¢3148 and GH¢ 3094.10 respectively were obtained from cutlass planting whilst the lowest benefits were from the Chinese planter. Conversely, tractor planting resulted in least cost benefit ratio (52.8) and the local planter gave the highest cost benefit ratio (70.2).

4. Discussion

Scarcity of labor for implementation of critical field operations is one of the biggest challenges in crop production in Ghana. When it rains and planting is not done promptly due to labor bottleneck, the soil may dry up and farmers have to wait for the next rain before planting. Delayed planting is a major cause of failure in crop production (Amjadian et al., 2013). Results of the study have shown that planting time could drastically be reduced by tractor drawn seeder. Many small scale farmers cannot afford to purchase tractors and seeders. The way out is to encourage tractor service provides to include planting in their service delivery. In areas where the fields are not accessible to tractors due to tree stumps, jab planting could be the solution to delays in planting. Jab planters are relatively affordable, but not all farmers can own some just like farm equipment such as knapsack sprayers. In this regard, renters of knapsack sprayers could be encouraged to purchase and rent out jab planters to farmers. It was expected that tractor drawn seeder would result in highest number of hills and hills with 1 plant because it planted at intra row spacing of 20 cm;1 plant per hill. It was also expected that planting with jab planter and cutlass would result mainly in 2-3 plants per hill. The expectations from jab planter and cutlass were however not achieved since significant number of hills had 1 plant and more than 3 plants. Aikins et al. (2010) observed similar digression in seed and fertilizer delivery by jab planters and attributed it to imperfect metering unit of the planters. In the case of number of plants thinned, the local planter was the worst followed by cutlass planting, the Chinese planter and tractor drawn seeder. In this study, cutlass planting was done with precision with exactly 2-3 seeds per hill. This may explain why cutlass resulted in comparatively good plant population and high yield. In actual farm situation however, those who plant for farmers on contract (planting gangs) plant very fast but efficiency and yield are often very low.

The economic analysis suggested that cutlass planting produced highest net benefit, whilst the Chinese planter produced lowest net benefit. In actual farm situation farmers often plant late due to labour bottlenecks, and this results in low yield and benefits. Based on cost benefit ratio, the jab planters appear to be the most economical planting options.

Table 1. Planting time and maize plant stand as affected by planting device

Planting device	Planting time (Hr/Ha)	No hills/ha	1 plt per hill/ha	2 plts per hill/ha	3 plts per hill/ha	>3plts per hill/ha
Tractor	2.48	38472	33611	2917	208	69
Local planter	8.05	22916	5972	6875	4930	3264
Chinese planter	6.32	23055	7986	8958	3611	694
Cutlass	14.37	23889	6042	8055	6180	1667
LSD	3.07	6823	4256	1521	1353	891
CV%	22.5	17.3	22.8	20.0	23.5	17.2

Table 2. Number of plants thinned, plant population and yield of maize as affected by planting device

Planting device	No of plts thinned (/ha)	Plant Pop. (plts/ha)	No cobs/ha	Grain yield Kg/ha
Tractor	694	40347	30416	3300
Local planter	7917	47569	36874	3917
Chinese planter	2639	39513	34999	3039
Cutlass	6667	47360	38194	4372
LSD	3079	621	3900	807
CV%	31.2	13.9	7.9	12.3

Table 3. Economic analysis of planting device effect on maize yield

	Tractor	Local planter	Chinese planter	Cutlass
Average yield	3300	3917	3039	4372
Adjusted yield	2970	3525	2735	3935
Gross Benefit	2376	2820	2188	3148
Cost that vary				
Cost of labor for planting	-	30.2	23.7	53.89
Renting jab planter	-	10	10	-
Tractor planting cost	45	-	-	-
Total cost	45	40.2	33.7	53.89
Net Benefits	2331	2779	2154	3094
Cost benefit ratio	52.8	70.2	64.9	58.4

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