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Evaluation of two jab planters for planting maize in the forest zone of Ghana

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ABSTRACT: On-farm experiments were conducted to evaluate two jab planters for planting maize in the forest zone of Ghana in 2014 major season. One of the jab planters was imported from China; and we fabricated the other. The experiments were conducted at 3 farmers' fields (sites) and the design was a factorial with sites as replications. Factor A was method of land preparation (ridges and no-till with stubble mulch) and factor B was planting device (Chinese jab planter, Local jab planter and cutlass). On the average, it took about 9 hours, 11 hours and 23 hours 37 minutes to plant one hectare of maize with the Chinese Jab planter, local jab planter and cutlass in that order. Consistently, there were more hills with maize seedlings on the ridges than on the no till plots. At one site, pests removed maize from the entire no-till plots, but removal was very low on the ridges. There was no significant (P>0.05) difference in yield among the treatments studied. Some farmers in Ghana now broadcast maize and cowpea seed due to scarcity and/or high cost of labour for planting. Economic analysis showed that it is about 100% cheaper to plant with the jab planters than with cutlass. The jab planters could be promoted to reduce drudgery, time and cost of planting maize.

KEYWORDS: Jab planter, planting method, maize, no-till, ridges.

1 INTRODUCTION

Planting is an important and critical operation in crop production. Farmers in Ghana rely on crude implements such as hoes, cutlasses and even sticks to plant maize and legumes (Adjei *et al.,* 2003). Planting with these implements is very difficult, time consuming labour intensive and not attractive to the youth. On the other hand it is difficult for the elderly who are in the farming profession to bend, and use these implements. There is therefore acute labour shortage in the farming communities which delays implementation of critical field operations. Timely planting is very important in crop production, particularly in rain fed agriculture. When it rains and a crop is not planted before the soil dries up, the next rain could be too late for it to be planted. Delay in planting reduces crop yields (Medeiros *et al*., 1980; Hodson, 1987; Zaki *et al*., 1994.

In Ghana many farmers rely on hired labour (planting gangs) to plant crops. These gangs often plant in a hurry resulting in poor plant spacing, population and yield. For example they could plant maize at a spacing of 120 cm x 50 cm with up to 10 seeds in some holes instead of the recommended spacing of 80 cm x 40 cm with 2-3 seeds per hole. Optimum plant density is a prerequisite for maximum maize yield (Trenton et al., 2006; Gustavo et al., 2006; Sangakkara *et al,* 2004).

Farmers who plant with hoes, cutlasses and sticks handle treated seeds with bare hands, which is risky to their health. There is the need for planting device that will reduce drudgery and time of planting crops by small scale farmers. This study evaluated 2 jab planters for planting maize on ridges and no-tilled fields.

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2 MATERIALS AND METHODS

THE JAB PLANTERS

One of the jab planters was made in China (Chinese planter), and we fabricated the other planter (local planter) in Ghana.

Plate 1 is a picture of the Chinese jab planter. It is capable of planting medium to large seeded crops such as cowpea, maize and groundnuts. It is adjustable to plant 1 seed, 2 seeds or 3 seeds per hole. It automatically plants if the planting tip is pushed into the soil and then lifted up from the soil.

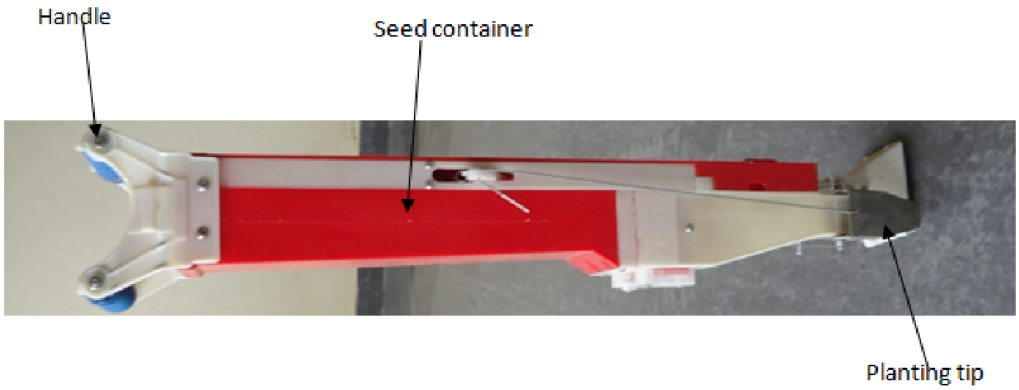

Plate 1: The Chinese jab planter.

Plate 2 is a picture of the local jab planter. It plants by pushing the planting tip into the soil. The movable lever is then pressed up. This turns the seed disk and opens the planting tip, which drops the seed into the soil. The planter is lifted up and the lever is released into position to close the planting tip. Planting is continued by repeating the process.

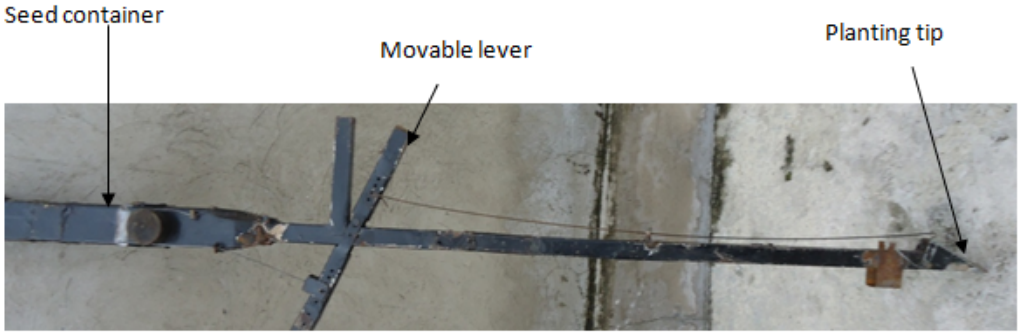

Plate 2: Local jab planter

METHODOLOGY OF THE EXPERIMENT

The experiment was conducted 2 farmers' fields at Boama Odumase and one field at Nsuta in the Forest Zone of Ghana. The experimental design was a 2 X 3 factorial with each farmer's fields (sites) as replications. Factor A was method of land preparation (ridge and no-till with mulch) and factor B was planting tool: Chinese jab planter (China P); locally made jab planter (Local P) and 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 83. Maize was planted at a spacing of 80 cm x 40 cm, with three seeds per hole. A planting rope marked at 40 cm intervals was use as a guide in the planting. All other cultural practices for planting maize were as recommended by The CSIR-Crops Research Institute of Ghana. A stop watch was used to determine the time used in planting each plot and the data was extrapolated to time for planting a hectare. Data were collected on number of hills (stand) with seedling, no of hills with 1 seedling, 2 seedlings and 3 seedlings. The partial budget and cost benefit analysis which showed the net benefit and returns to investment by the various treatment options were used to determine the benefits to farmers (CIMMYT, 1988)

3 RESULTS

There were no significant (p>0.05) interactions between method of land preparation and planting tool in any of the response variables taken. The effects of method of land preparation and planting tool on planting time and maize establishment are presented in table 1. There were significant (P < 0.01) differences in time used in planting which ranged from 8 hours 59 minutes per hectare to 23 hours, 58 munities per hectare (table 1). Planting with the Chinese planter on ridges took the least time, whilst cutlass planting on no-till plots took the most time. Consistently the least time was spent planting with the Chinese planter, followed by the local planter. Cutlass planting took most time. The time spent on planting on ridges was consistently lower than no-till planting, although the differences were not significant for the same planting tool (table 1 & 4).

Irrespective of method of land preparation, cutlass planting resulted in more hills with maize plants than jab planting although differences were not always significant (Table 1 & Table 6). Consistently, there were more hills with maize seedlings on the ridges than on the no till plots Table 1 & Table 4). At Nsuta, pests removed maize from the entire no-till plots, but removal was very low on the ridges. This necessitated replanting maize on the no-till plots. No-till planting with the Chinese planter resulted in least number (19583 hills/ha) of hills with plants (Table 1).

Planting on ridges with cutlass and the local planter resulted in lowest and highest number of hills with one plant respectively. Generally there were more hills with two or three maize seedlings, than hills with 1 seedling. The target plant population was 62,500 plants/ha but the achieved population ranged from 47083 pants/ha (Chinese planter on no-till plots) to 67917 (Cutlass planting on ridges).

The effects of method of land preparation and planting tool on plant population and yield are presented in table 2. There were no significant differences (P>0.05) in plant population and number of cobs harvested among the treatment options except planting with Chinese planter that had significantly lower population and cobs than cutlass planting on ridges. This notwithstanding, there were no significant differences in grain yield.

The mean effects of land preparation on planting time and plant establishment are presented in table 3. Method of land preparation had no significant effect on planting time, no of hills with 1 plant or 2 plants. However there were significantly (P<0.05) more hills with 3 plants on the ridged than no till plots. Furthermore the number of hills with plants, total number of plants (plant population) and cobs harvested were significantly (p < 5%) more on the ridged than no-till plots This however did not affect yield (Table 4).

The mean effects of planting tool on planting time and maize establishment are presented in table 5: Least time was spent planting with the Chinese planter (9 hours, 01 minutes/ha) and most time was spent planting with cutlass. Planting tool had no significant effects on hills with 1 plant or 2 plants, but cutlass planting had significantly more hills with 3 plants than planting with the Chinese planter. Similarly cutlass planting had higher number of hills with plants and plant population than planting with Chinese planter but grain yield was not significantly affected by planting tool.

Presented in table 7 is the economic analysis of the various treatments studied. The partial budget analysis showed that no till with local planter yielded the highest net benefit of ₵2184 per hectare whilst no till with Chinese planter yielded the lowest net benefit value of ₵1710. Nevertheless, the benefit cost ratio showed that the returns to investment on both the Chinese planter and local planter with no till were highest amongst the various treatment options. Benefit cost ratios of 40:1 and 43.29:1 for Chinese planter no till and local planter no till respectively shows that a farmer investing ₵1.00 in the planters will recoup his/her ₵1.00 plus an additional ₵39 and ₵42.29 on Chinese planter no till and local planter no till respectively Benefit cost ratio of no-till planting with the Chinese and local planter were 61% and 56% more than cutlass planting. Benefit cost ratio was about 4 times higher by planting maize on no-till land than on ridges.

4 DISCUSSIONS

The least time was used to plant with the Chinese planter because it plants automatically. The local jab planter however is semi-automatic; therefore planting with it is slower. Cutlass planting took the most time because it requires a lot of human effort. It must however be noted that in Ghana, different people plant with cutlass at different speed. In the major food producing areas planting is a profession of some people (planting gangs) and they plant very fast with cutlass but efficiency is often very low. Cutlass planting in this study was done very efficiently by the collaborating farmers and we estimate their planting speed as average.

Cutlass planting resulted in highest number of hills with plants probably because the farmers ensured that seeds were properly covered. In jab planting the seeds may or may not be covered depending on factors such as soil type, land

preparation and soil moisture. Although maize was planted at 3 seeds per hole in this study, significant number of hills had 1 or 2 seedling because the seed was only 83% viable. It is possible that some of the planted seeds and emerged seedlings were destroyed by pests. In jab planting, the required number of seeds may not drop because seed delivery is purely mechanical.

Plant population was generally high (ranging from 75 -108%) because 3 seeds were planted per hole to compensate for non-viable seeds and pest damage. The no-till plots planted with the Chinese planter gave lest plant population. This planter plants poorly on no-till fields with stubble mulch.

The low plant population recorded on the no-till plots planted with the Chinese planter reflected on no of cobs harvested. However this did not affect yield, which was not significantly different among the treatments. This result is inconsistent with findings of Abuzar *et al* (2011) and Casini (2012) which showed significant differences in maize yield due to plant population.

In practice the optimum plant population that resulted from cutlass planting and the resultant yield is not likely to be attained by farmers who hire planting gangs to plant. Currently some farmers in Ghana broadcast seed of maize and cowpea. These farmers acknowledge that broadcasting leads to low yield but they are compelled to broadcast because of the drudgery involved in cutlass planting. And they will not hire planting gangs to plant because it is too expensive and the gangs often plant poorly which also leads to low yield.

Land preparation had no effect on yield of maize in this study probably because the experiments were conducted in the forest zone where farmers had practiced no-till for centuries and there is not problem of soil compaction.

The farmers who collaborated in these experiments indicated that it is easier to plant with the jab planters than with cutlass. Jab planting does not involve bending; therefore waist pains are minimized. Furthermore treated seed could be planted without coming in contact with the person planting.

Economic analysis of the study showed that it is less viable to plant maize on ridges compared with no-till. The analysis also indicates that jab planting is an economical and viable alternative to cutlass planting. Jab planting was about 100% cheaper than cutlass planting.

The main advantage of the Chinese jab planter is that planting with it is easy and fast. However it is made almost entirely of plastic, therefore it not very durable. Furthermore it is complex in construction and prone to malfunction, and it is relatively expensive. The local jab planter is very simple in construction. Under mass production the cost could be about 100% cheaper than the Chinese planter.

5 CONCLUSION

The jab planters are viable alternative to planting with cutlass, sticks or hoes. They could reduce drudgery, time and cost of planting.

Table 1: Effects of land preparation and planting tool on planting time and maize plant establishment.

Planting tool and method of land preparation	Planting time (hours/ha)	Total no of hills with plants (ha)	Hills with 1 plant (Ha)	Hills with 2 plants	Hills with 3 plants
China ridge	8.59	27083	4167	12292	9375
Local P ridge	10.56	26458	6042	9375	8751
Cutlass ridge	23.37	30000	1875	10833	13125
Chinese P no-till	9.01	19583.	5833	8542.	4583
Local P no till	11.06	22500	5417	7708	8749
Cutlass no-till	23.58	24583	4375	11458	8125
CV (%)	8.12	10.2	27.1	24.4	21.7
LSD	5.03	5262	NS	4046	4380

Table 2: Effects of land preparation and planting tool on plant population and yield of maize

Planting tool and method of land preparation	Plant population (plants/ha)	No of cobs harvested	Grain yield (kg/ha)
Chinese P ridge	62708	44167	2819
Local P ridge	57708	41875	2555
Cutlass ridge	67917	47500	2681
Chinese P no-till	47083	34167	2166
Local P no till	56042	42292	2761
Cutlass no-till	57500	41042	2687
CV (%)	19.0	13.3	14.7
LSD	18701	12991	NS

Table 3: Effect of method of land preparation on planting time and plant establishment of maize.

Method of land preparation	Planting time (hours)	1 plant/hill (per Ha)	2 plants/hill (per ha)	3 plants/hill (per ha)
Ridge	14.51	4028	10833	10417
No-till	14.70	5208	9236	7153
CV %	12.2	17.1	18.9	29.0
LSD (0.05)	NS	NS	NS	2679

Table 4: Effect of method of land preparation on plant population and yield of maize.

Method of land preparation	Total hills/ha	Total plants/ha	Cobs /ha	Grain yield/ha
Ridge	27847	62778.	44514.	2685
No-till	22222.	53542	39167	2536
CV %	16.6	18.2	21.1	26.6
LSD (0.05)	2820.	6115	NS	NS

Table 5: Mean effects of planting tool on planting time and maize establishment

Planting tool	Planting time	1 plt/hill	2 plts/hill	3plts/hill
Chinese	9.01	5000	10417	6979
Local	11.02	5729	8542	8750
Cutlass	23.48	3125	11146	10625
CV%	12.2	17.5	18.9	29.0
LSD 0.05)	4.1	NS	NS	3281

Table 6: Mean effects of planting tool on plant stand, plant population and grain yield of maize.

Planting tool	Total hills/ha	Total plants/ha	Cobs /ha	Grain yield/ha
Chinese	23333	54896	39167	2492
Local	24479	56875	42083	2658
Cutlass	27292	62708	44271	2681
CV%	16.6	18.2	21.1	26.6
LSD 0.05)	3454	5812	NS	NS

Table 7: Partial budget and cost benefit analysis of method of land preparation and planting tool effects on maize

	Chinese ridge	Local P Ridge	Cutlass ridge	Chinese no till	Local P No till	Cutlass no till
Average yield	2819	2555	2681	2166	2761	2687
Adjusted yield	2537.1	2299.5	2412.9	1949.4	2484.9	2412.0
Gross benefit (GH₵/ha)	2283.39	2069.55	2171.61	1754.46	2236.41	2170.8
Cost that vary						
Cost of labour for planting (GH₵/ha)	33.71	41.03	88.54	33.86	41.66	89.85
Renting jab planter(GH₵/day)	10	10	0	10	10	0
Ridging (GH₵/ha)	160	160	160	0	0	0
Total cost that vary (GH₵/ha)	203.71	211.03	248.54	43.86	51.66	89.85
Net benefits (GH₵/ha)	2079.68	1858.52	1923.07	1710.60	2184.75	2086.62
Cost benefit ratio	11.21	9.80	8.74	40.00	43.29	24.22

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