Effect Of Planting Device And Seed Sorting On Yield Of Maize.

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ABSTRACT: Experiments were conducted at the CSIR-Crops Research Experimental station at Kumasi, Ghana, to determine the effects of seed sorting and planting device on yield of maize in the 2014 major growing season. Two jab planters were used to plant sorted and unsorted seeds. The control treatment was cutlass planting of unsorted seed. One of the jab planters was imported from China; and the other was fabricated in Ghana. The experimental design was a randomized complete block with 3 replications. Planting one hectare of maize with the Chinese planter took about 10 hours, 36 minutes; the local planter took 12 hours 39 minutes, whilst cutlass took 29 hours 36 minutes. Seed sorting and planting device had no significant effect on maize yield. However it was faster, cheaper and economically more viable to plant with jab planter than with cutlass.

Index terms: Maize, jab planter, seed sorting, economic analysis, cost benefit ratio.

INTRODUCTION

Crop production in developing countries highly depends on primitive and inefficient tools such as hoes and cutlasses. This makes implementation of critical operations difficult and time consuming. In Ghana, one critical operation that farmer use hoes and cutlasses to perform is planting of maize and legumes [2]. Migration of the youth from the farming communities to the cities in search of non-existent jobs had created labour shortages for crop production. And it is difficult for most of the elderly who are in agriculture to bend and use hoes, cutlasses or sticks to work. Delays in implementation of critical field operations such as planting reduces crop yields [8], [7], [11]. In Ghana, farmers who cannot plant themselves depend on hired labour (planting gangs) to plant. These gangs plant in haste resulting in poor plant spacing and populations. Optimum plant density is a prerequisite for obtaining maximum maize yield [10], [5], [9]. Thirty samples of the same jab planter that were fabricated by [2] in Ghana for planting maize and found that delivery of fertilizer and seed were poor. Poor delivery was attributed to poor metering unit of the jab planters. The seed used in the study were not sorted therefore seed size was not uniform. The seed delivery system of a jab planter is a hole with fixed size. It was therefore hypothesized that seed sorting could improve efficiency of seed delivery of jab planters. This study evaluated two jab planters for planting sorted and unsorted maize in the forest zone of Ghana.

MATERIALS AND METHODS

One of the jab planters was made in China (Chinese planter), and we fabricated the other planter (local planter) in Ghana. Plate 1 (left) 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.

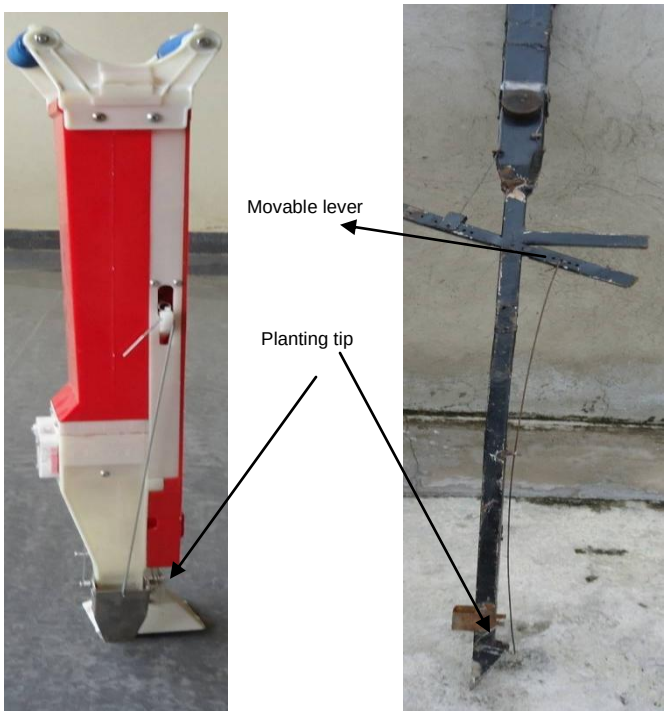

Plate 1: *The Chinese jab planter (left) local planter (right)*.

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Plate 1 (right) 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 to turn the seed disk and the open the planting tip. This 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.

TESTING THE JAB PLANTERS

Methodology: The experiment was conducted at the CSIR-Crops Research Institute experimental station, Kumasi (forest zone), Ghana in 2014. The experimental design was a randomized complete block with 3 replications. Two jab planters (Chinese Jab planter and local jab planter) were used to plant sorted or unsorted maize. The control treatment was unsorted maize planted with cutlass. Field for the experiment was ploughed once and harrowed. The quality protein maize hybrid variety Mamaba, developed by the CSIR-Crops Research Institute was used in the trial. Test conducted before planting 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 hill. 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 field capacity (the time used in planting each plot) and the data was extrapolated to time used in planting 1 hectare. Data were collected on number of hills with seedling, number of hills with 1 seedling, 2 seedling 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)

RESULTS

There was a highly significant ($P<0.01$) difference in the field capacities of the different planting devices. Planting one hectare with the Chinese planter took about 10 hours, 36 minutes; the local planter took 12 hours 39 minutes, whilst cutlass took 29 hours 36 minutes (Table 1). Using the Chinese planter to plant sorted seed resulted in significantly lower ($P<0.05$) number of hills with one plant, than using it to plant unsorted seed. Similarly cutlass planting resulted in few hills with one plant. Planting sorted seed with the Chinese planter resulted in highest number of hills with two plants (15208 hills/ha), but this was not significantly different from the other treatments. Similarly, planting device and seed sorting had no significant difference on number of hills with 3 plants (Table 1). The target plant population was 62,500 plants per hectare, the achieved population ranged from 43718 to 47987 plants/ha (Table 2) representing about 70% of the target population. Seed sorting and planting device had no significant effect on plant population, number of cobs harvested and grain yield. Presented in Table 3 is the economic analysis of the study. The average cost of labour for planting with the Chinese planter, Local planter and cutlass were GH₵ 38.46, GH₵47.65 and GH₵ 110.10 respectively. The partial budget analysis showed that planting sorted seed with the Chinese jab planter yielded the highest net benefit of GH₵ 3298.95 per hectare whilst cutlass planting yielded the lowest net benefit value of GH₵2846.4. Cost benefit ratio for planting unsorted seed with the Chinese and local planters were 65.62 and 52.56 respectively, the values for sorted seed were 68.63 and 53.92 respectively. Cutlass planting resulted in least cost benefit ratio of 26.85.

DISCUSSION

Least time was spent planting with the Chinese planter because it plants automatically with less human effort. Planting with the local jab is slower because it is semi automatic, requiring human effort to drop the seeds and open the planting tip. Cutlass planting is slowest because a lot of human effort is required compared with the two planters. It must however be noted that in Ghana, different people plant with cutlass at different speeds. 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 field staff of the Resource and Crop management Division of the CSIR-Crops Research Institute and we estimate their planting speed as average. Although three seeds were put in a hole in cutlass planting and the jab planters were calibrated to plant 3 seeds, a lot of hills had just one plant and relatively few had 3 plants. This could partly be due to the fact that the seed was only 83% viable. Cutlass planting had lest number of hills with one plant probably because, those who planted ensured that the seeds were properly covered. The target was to obtain 2 plants per hill but in general only about 40% of the hills had 2 plants. In jab planting, seed delivery is purely mechanical. We observed that if the planters were calibrated to deliver 2 seeds, only one seed is delivered sometimes. This explains why the planters were calibrated to deliver 3 seeds. Poor seed delivery of jab planters could be due to poor metering unit of the planters [2] . The target plant population of maize in the study was 62500 plants per hectare, but the achieved ranged from 43718 plants/ha to 47987 plants/ha representing about 70% of the target population. Results of the study indicate that seed sorting had no effect on maize yield. This agrees with findings of [6] in which maize seed size did not affect yield. Jab planting in this study resulted in similar yields as cutlass planting. The jab planters are therefore viable alternatives to cutlass in areas where labour for crop production is scarce. Benefit cost ratios of 65.62 and 52.56 for Chinese and local planters un-sorted seed respectively shows that a farmer investing GH₵1.00 in the planters will recoup his/her GH₵1.00 plus an additional GH₵64.62 and GH₵51.56 on Chinese and local planters respectively. For cutlass planting only GH₵ 25.85 will be gained in addition. Thus it is about 253% and 200% more beneficial to use the Chinese and local planters respectively.

CONCLUSION

Results of the study indicate that jab planting is faster, cheaper and economically more beneficial. The planters are therefore viable alternatives to cutlass especially in the farming communities where labor for planting is scarce.

Table 1: Planting time of plant stand of maize as affected by planting device and seed sorting.

Planting tool/ seed type	Planting time (h/ha)	1 plt per hill/ha	2 plts per hill/ha	3plts per hill/ha
Chinese unsorted	10.36	9167	11667	3750
Local un-sorted	12.39	8125	10625	5000
Chinese sorted	10.34	5833	15208	3780
Local sorted	12.02	8542	11458	4375
Cutlass	29.36	5325	10833	6833
CV%	7.2	13.5	28.3	15.3
LSD (0.05)	2.06	2849	NS	NS

Table 2: Plant population and yield of maize as affected by planting device and seed sorting.

Planting tool/ seed type	Total plants/ha	No of cobs/ha	Grain yield (kg/ha)
Chinese unsorted	43718	44958	3958
Local un-sort	44,359	47802	3907
Chinese sorted	47492	54978	4133
Local sorted	44580	48208	3667
Cutlass	47987	49021	3650
CV%	19.7	10.8	24.5
LSD (0.05)	NS	NS	NS

Table 3: Partial budget and cost benefit analysis of planting device and seed sorting effects on maize

	Chinese unsorted	Local un-sorted	Chinese sorted	Local sorted	Cutlass
Average yield	3958	3907	4133	3667	3650
Adjusted yield	3562.2	3516.3	3719.7	3300.3	3285.0
Gross benefit (GH₵/ha	3205.98	3164.67	3347.73	2970.27	2956.5
Cost that vary					
Cost of labour for planting (GH₵/ha)	38.85	50.21	38.78	45.08	110.1
Renting jab planter(GH₵/day)	10	10	10	10	0
Total cost that vary (GH₵/ha)	48.85	60.21	48.78	55.08	110.1
Net benefits (GH₵/ha)	3157.13	3104.46	3298.95	2915.19	2846.4
Cost benefit ratio	65.62	52.56	68.63	53.92	26.85

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