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Short Communication

EVALUATION OF DIFFERENT PLANTING TOOLS FOR MAIZE STAND ESTABLISHMENT

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ABSTRACT

Planting is one of the most important tasks that maize growers undertake. It should result in a plant stand at the desired density that emerges quickly and uniformly. Resource poor smallholder farmers in Ghana normally plant maize (*Zea mays, L.*) using hand tools. Four planting tools were evaluated for their percentage seedling emergence, as well as their initial, total and late emergence rate. Additionally, the problems from planting with the cutlass, dibbler and hoe with that of the jab planter were compared. A randomised complete block design was used with four treatments. *Obaatanpa* maize variety was planted at two seeds per hill in 4 m x 4 m plots with spacing between plants and rows of 40 and 80 cm, respectively. The percentage seedling emergence in the jab planter plots was significantly greater compared with that of the cutlass, dibbler or hoe. These results indicate that planting maize with a jab planter leads to significantly greater seedling emergence compared with planting with a cutlass, dibbler or hoe. The results also show that the initial and total percentage seedling emergence were significantly greater with the jab planter than that with the cutlass, dibbler and hoe while the percentage late seedling emergence rate of the *obaatanpa* maize variety with the jab planter was smaller than that of the cutlass, dibbler and hoe. The problems identified from planting with the hoe, dibbler and cutlass compared with the jab planter were the need to bend down when planting, backaches, waist pains, palm blisters, and drudgery.

KEYWORDS: Maize, Planting, Planting tool, Emergence, Stand Establishment.

INTRODUCTION

Maize (*Zea mays, L.*) is an important crop in the Ghanaian economy and is the most important cereal crop produced in the country. The area sown to maize in Ghana increased from 464,800 ha in 1990 to 954,400 ha in 2009. Similarly, maize production in Ghana increased from 552,600 Mt in 1990 to 1,619,590 Mt in 2009 (FAO Statistical Databases, 2010). However, the production of maize in Ghana is not enough to meet the domestic demand of 42.5 kg/head/year (Asafo Agyei, 1995). In 2004, Ghana exported 48 Mt of maize for $7,000 and imported 50,000 Mt of maize at a cost of $10,000,000 (FAO Statistical Databases, 2006). Maize production in Ghana is very dependent on rainfall and is mainly rainfed. The distribution of rainfall during the growing season has been erratic. Consequently, the availability of water in the root zone of the crop during the growing period greatly impact on crop production and food security. Hudson (1987) indicates that early planting is one of the most basic requirements for good crop production. Early planting benefits from the higher soil fertility present at the beginning of the rainy season. As the season progresses, nutrients leach below the root zone and are therefore no longer available for uptake. Early planting also benefit from more days of sunshine. It is when drought stress occurs at flowering time that yield can be reduced to almost zero. Thus, maize needs to be planted in a timely manner. The majority of maize growers in Ghana are resource poor smallholder farmers. These farmers plant maize using a cutlass, dibbler or hoe depending on local tradition (Tweneboah, 2000; Adjei *et al*., 2003) The use of these hand tools decreases the timeliness and quality of farm work, results in drudgery and decreases the productivity of farmers. Additionally, the use of these tools results in non-uniform germination and seedling emergence, lodging due to shallow planting, rotting of seeds due to too deep planting and loss of seeds due to improper covering. Inadequate stands ultimately lead to lower than potential yields and are characterized by low ratio of plants emerged to seeds planted, inconsistency of plant stand (population, spacing, emergence) and low plant population, leading to increased weed pressure and low yield (Smith *et al*., 2002).

The jab planter appears to be a promising tool that could be used potentially for reducing the drudgery of planting maize in Ghana. It is an easy-to-operate dibble instrument used in various types of soil, including untilled soil with stubble and tilled soil with or without residues from previous crops. It is very portable. The amount of seeds to be planted per hectare can be adjusted. The planting unit comprises a seed hopper and a jabbing device. The hole is

punched by the jabbing device before it opens to release the seed (Kaul and Egbo 1985). Since hole-making and seed-dropping are done simultaneously, there is no bending or squatting. In using the jab planter, small holdings of 0.5 ha to 1 ha can be planted in a few days. It can also be used at sloping areas. The jab planter can also be used for fertiliser application and replanting dead hills (Calkins, 1977). A jab planter could enable the small-scale farmer work with improved timeliness and reduced drudgery (Ukatu, 2001).

Considering the differences in the nature and design of the jab planter in comparison with the cutlass, dibbler and hoe into account, a comparative evaluation of the different tools for stand establishment of *obaatanpa* maize variety was conducted. The objective of the study was to compare the percentage maize seedling emergence, initial, total and late emergence rate of the jab planter with that of the cutlass, dibbler and hoe, and to document the problems from planting with the cutlass, dibbler and hoe in comparison with that of the jab planter.

MATERIALS AND METHODS

Study Area

A study was conducted at the field near the Agricultural Mechanisation Workshop of Kwame Nkrumah University of Science and Technology, Kumasi, Ghana. The study was conducted in 2006 during the major growing season according to tillage methodology recommended by the ASABE (ASAE Standards, 2003). The experimental site has a gentle slope. The climate at the site is distinguished by a bi-modal rainy season from March to July and from September to November, when most of the rain falls as heavy convectional storms, followed by a dry season from November to February/March. The average rainfall is about 1300 mm. The average daily temperature is 26^{o}C with a range between 18 and 35^{o} C. The field had been cropped with maize for at least two years before starting the experiment. The experimental field was disc ploughed on 14th March, 2006 and disc harrowed on 16th March, 2006. Selected soil properties at the experimental field are presented in Table 1. The soil texture at the experimental site was sandy loam.

TABLE 1. Soil Properties at the Experimental Site

Soil Properties	Soil Layer (cm)	
	0 – 10	10 – 20
Sand (%)	74	72
Silt (%)	12	12
Clay (%)	14	16
Organic Matter (%)	2.2357	2.064
Organic Carbon (%)	1.2968	1.197
P^{H}	6.45	6.38

Experimental Design and Treatments

A randomised complete block design was used with four treatments including planting with a cutlass, hoe, dibbler and jab planter. *Obaatanpa* maize variety seeds were obtained from Crops Research Institute (CRI) of the Council for Scientific and Industrial Research (CSIR) at Fumesua, Kumasi, Ghana. The seeds were planted on 21st March, 2006 at two seeds per hill in 4 m x 4 m plots with spacing between plants and rows of 40 and 80 cm, respectively. The final plant density was 100 plants per plot corresponding to 62,500 plants per hectare.

Data Collection and Analysis

Plant population counts were taken every day until emergence was deemed complete. Percentage seedling emergence was calculated by dividing the number of emerged plants counted by the number of seeds planted. In addition, plant population counts taken at 6 and 14 days after planting (DAP) were used to compare differences in initial, total and late percentage emergence rate between the different planting tools following the approach used by Roth *et al*., (2002). The problems from planting with the different planting tools were noted. The data collected was subjected to analysis of variance (ANOVA) following Balanced Analysis of Variance procedure in MINITAB Statistical Software Release 15 (MINITAB Inc., 2007). When the analysis resulted in a significant treatment effect, the means were compared using the least significant difference (LSD) test at $p<0.05$.

RESULTS AND DISCUSSION

Effect of Planting Tool on Percentage Maize Seedling Emergence

Fig. 1 depicts the percentage *obaatanpa* maize seedling emergence of the cutlass, dibbler, hoe, and jab planter. The jab planter consistently gave the highest percentage seedling emergence in comparison with the cutlass, dibbler and hoe. There was statistical significant difference ($p<0.05$) in percentage seedling emergence between the four manual planting tools. Seedling emergence in the jab planter plots was statistically significantly greater than that of the cutlass, dibbler and hoe plots over the period of the experiment. This emergence difference between planting tools may have been the result of the effective seed depth (Aikins *et al*., 2006). Since each tool is very different in its design and operation, it was probably difficult to achieve the same effective seed depth. There was no statistical significant difference in *obaatanpa* maize emergence between the cutlass, dibbler and hoe. The results show that the tool used for planting influenced the percentage seedling emergence.

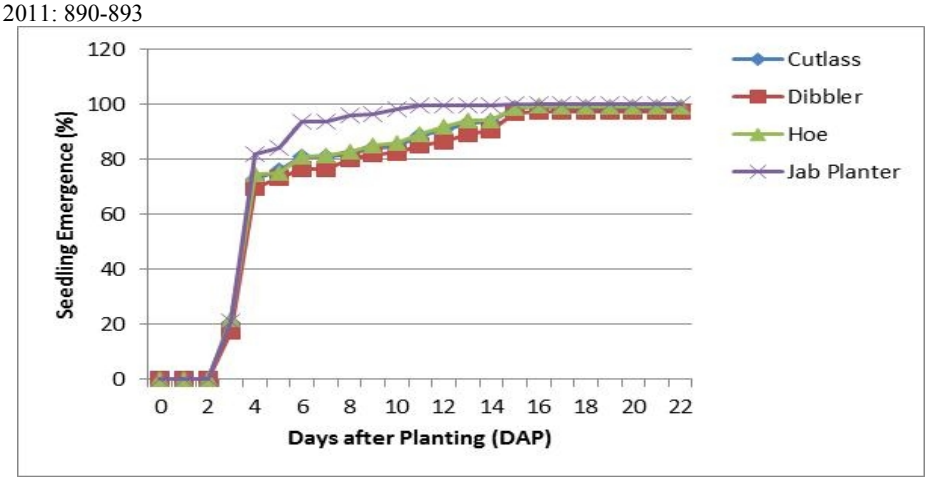

FIGURE 1. Effect of planting tool on percentage maize seedling emergence

Comparison of Initial, Total and Late Emergence Rate

Table 2 gives the summary of the initial, total and late seedling emergence rate of the *obaatanpa* maize variety. The initial percentage seedling emergence was significantly greater with the jab planter than that with the cutlass, dibbler and hoe. Similarly, the total percentage seedling emergence with the jab planter was statistically significantly greater than that with the cutlass, dibbler and hoe. On the other hand, the percentage late seedling emergence rate of the *obaatanpa* maize variety with the jab planter was smaller than that of the cutlass, dibbler and hoe. It can be therefore be deduced that the tool used for planting has significant influence on the percentage late seedling emergence rate of maize.

TABLE 2. Initial, Total and Late Emergence Rate

Source	Initial Emergence 6 DAP (Stand Count/ha)	(%)	Total Emergence 14 DAP (Stand Count/ha)	(%)	Late Emergence Rate (%)
Jab Planter	58,438	93.50	62,188	99.50	6.03
Cutlass	50,625	81.00	58,594	93.75	13.60
Dibbler	47,656	76.25	56,563	90.50	15.75
Hoe	50,625	81.00	58,750	94.00	13.83
Average	51,836	82.94	59,023	94.44	12.30
LSD ($p<0.05$)	4,453		2,495		

Problems from Planting with the different Planting Tools

There are three steps when planting maize with a cutlass, dibbler or hoe. The steps include making a hole, dropping the seeds and covering the hole. In the first two steps, there is the need to bend down. Thus, in order to plant a piece of land there is the need to continually keep bending down leading to drudgery. In contrast, there is no need to bend down when using the jab planter to plant maize.

Due to the need to bend down in order to plant, there are considerable backaches and waist pains with planting maize when using a cutlass, dibbler or hoe. The backaches and waist pains are even more pronounced when using the hoe in comparison with the dibbler and the cutlass as there is the need to bend even lower. In addition, in comparison with the jab planter, the use of a hoe, dibbler or cutlass for planting could lead to palm blisters depending on the individual doing the planting.

CONCLUSION

The jab planter produced significantly higher *obaatanpa* maize variety percentage seedling emergence compared with that of the cutlass, dibbler or hoe. The results also show that the initial and total percentage seedling emergence were significantly greater with the jab planter than that with the cutlass, dibbler and hoe while the percentage late seedling emergence rate of the *obaatanpa* maize variety with the jab planter was smaller than that of the cutlass, dibbler and hoe. The results show that planting maize with the jab planter would lead to higher seedling emergence compared with that of the cutlass, dibbler or hoe. The main problems identified from planting maize with the cutlass, dibbler and hoe compared with the jab planter were the need to bend down when planting, backaches, waist pains, palm blisters, slow pace of work and increased drudgery.

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