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COMPARATIVE FIELD STUDY OF FERTILISER APPLICATION METHODS

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ABSTRACT
This research was undertaken to evaluate the performance of the jab planter in applying inorganic fertiliser in comparison with other fertiliser application methods. The jab planter was tested alongside cutlass, dibbler and bare hand. Factors taken into consideration were timeliness of application using cutlass, dibbler, bare hand and jab planter, consistency of quantity of fertiliser applied using bare hand and jab planter and problems from use of the various tools. Times taken to apply NPK 15-15-15 fertiliser to sub plots of land each using the various treatments were recorded. Also a number of jabbing and hand deliveries were done, and the fertiliser that came out of each jab or hand was weighed. (ANOVA) was used to analyse the results. The results indicated, a shorter duration of fertiliser application using jab planter than dibbler, bare hand and cutlass. Consistency of fertiliser application using jab planter compared with bare hands was higher with relatively fewer problems but demanded higher level of skills for its operation and often gets clogged easily on wet soils. A conclusion from this research is that, the jab planter is an innovative mode of technology transfer that meets the double requirements of improved farming methods and poverty reduction.

KEY WORDS: Timeliness, Jab-Planter, Hand, Dibbler, Cutlass.

INTRODUCTION

Little over 50% of the workforce in Ghana is engaged in agriculture for their livelihood (CIA, 2013). A sizeable number of these are small scale farmers who use simple farm tools like cutlasses and hoes for farming operation. According to the Millennium Challenge Account Ghana (MCA, 2006), about 90% of farms in Ghana are less than two hectares in size. In spite of the high percentage of the population of the workforce being farmers, the nation is still unable to produce enough to feed its population. For instance the production of maize in Ghana is not enough to meet the domestic demand of 42.5kg per head per year (Asafo-Agyei *et al.*, 1995). Power availability from the agricultural labour force has been discussed by several research workers and the values always used are 0.07kW, which is the power that could be sustained for lengthy periods by a person (Ashburner, 2000).In Ghana power inputs into the farming business is very low and highly insufficient in that more energy is spent on farms using simple farm tools but the production is often low. According to Cooper (1992), a man normally works with an energy value of 0.069kW working continuously, he produces about 0.078kW. This means he cannot produce much during the working time available to him. This could be one of the numerous reasons for the lower productivity in Ghana, since majority of farmers use manual means for farming activities. According to Srivastava *et al.* (2006) the success of modern agriculture depends on correct application of inorganic fertilizers. In Ghana fertiliser application is one major farming operation that consumes most of the farmer's time with its drudgery effects on the farmer (Tweneboah, 2000). Farming operations specifically fertiliser application in Ghana are characterised by, mixed cropping in which different types of crops are grown simultaneously on the same plot making the use of machines for fertiliser application very difficult. Lack of experience and technical knowhow on the use of machines for fertiliser application, high cost of fertiliser machines and the use of hands (SRID, MoFA, 2000)**.** Most smallholder farmers in Ghana apply inorganic fertiliser using the cutlass dibbler or the bare hand. The use of these tools results in untimely fertiliser application, drudgery, low labour productivity and low output. The untimely application could results in less time available to other sectors of the economy and hence potentially depriving the economy of the necessary development due to labour shortage (Tweneboah, 2000). Another problem is associated with the health of the farmer, as more time spent in the farm using traditional tools, may lead to fatigue and overworking on the part of the farmer leading to ill health. According to Cooper (1992), using a machine an individual can perform the work that over hundred people will do at a particular time. The machines (mechanical machines *e.g.* tractors) on the other hand are very expensive; hence poor rural farmers cannot afford to buy them. It therefore becomes necessary to find other cheaper means of mechanising farm operations in order to help these farmers. One such innovation is the use of jab planters in the application of solid inorganic fertilisers such as Nitrogen, Phosphorus and Potassium (NPK 15-15-15).Poor farmers spend long tedious hours fertilising their farms. The task is laborious, time consuming, unpleasant

and tiring. The use of the jab planter could help to improve the output per human hours and enable the small-scale farmers work with improved timeliness and reduced drudgery (Ukatu, 2001).

This study serves as information on the potentials of the jab planter in applying fertiliser. With an ever increasing population, Ghana will also have to increase her food production and hence farming operations must be mechanised, and improved upon in order to meet the growing demands for food. The study aimed at evaluating the performance of the jab planter in the application of solid inorganic fertiliser in comparison with other fertiliser application methods, specifically to determine the timeliness of fertiliser application using cutlass, dibbler, bare hand and the jab planter and also to find out the consistency of the quantity of fertiliser that can be applied by the jab planter and the bare hands as well as problems arising from the use of any of these methods (cutlass, bare hand, dibbler and jab planter).

MATERIALS & METHODS

Experimental Site Description

The experiment was conducted at the arable field near the Agricultural Mechanisation workshop of the Kwame Nkrumah University of Science and Technology, Kumasi (Latitude 6° 41' 0" N, longitude 1° 33' 3" W and altitude 295.7 m above sea level). The field was cleared of weeds using cutlass and hoe and then divided into sixteen sub-plots of 4 metres in length and 4 metres in width with 1 metre in between the various sub-plots and blocks. Four blocks and four treatments (bare hand, cutlass, dibbler and jab planter) were used for the sixteen sub-plots randomly with each block getting one of the treatments.

Obaatanpa maize seeds were sown on each of the sixteen sub-plots using cutlass at 80cm by 40cm between and within rows respectively with two plants per hill given a stand population of 100 plants per sub-plot and a total of 1600 plant population for the entire experiment. NPK 15-15-15 was used for the experiments. The NPK 15-15-15 was applied at a rate of 250kg/ha using the bare hand, dibbler, jab planter and cutlass as treatments when the maize seedlings were six weeks old. Ammonium sulphate was also applied at a rate of 250kg/ha three weeks after the experiments using bare hands.

Data collection

A stop watch was used to record the time taken to apply NPK 15-15-15 fertiliser to the soil using the various treatments. The results were collected for each sub-plot and then grouped according to the various treatments and blocks and then analysed the Randomized complete block design was used as an experimental design.

Statistical analysis

Analysis of variance (ANOVA) was used for the analysis of the results and the statistical test used was the F-test at 5% significance level for all analysis Using MINITAB Statistical Software Release 15 for Windows.

RESULTS & DISCUSSION

Rate of fertiliser application using different methods

From table (1), the rate of fertiliser application using the jab planter was the shortest when compared with the other methods. The mean rate of fertiliser application using the jab planter was 41hrs/ha while that of bare hand, the control tool was 53hrs/ha. The means the rate of fertiliser application using the dibbler and the cutlass were even greater at 65 and 72 hrs/ha respectively.

TABLE 1. Rate of Fertiliser application using different methods

Fertilizer Application tool	Mean rate of fertilizer application hr/ha	Standard Deviation (hr/ha)	Coefficient of Variation (%)	Range (hr/ha
Jab Planter	41	1.87	4.56	39-43
Bare Hand	53	0.64	1.21	52-54
Dibbler	65	0.57	0.88	65-66
Cutlass	72	1.38	1.92	70-73

There was a significant difference between the four manual methods of fertiliser application at the 5% significant level following the analysis of variance. The mean rate of fertiliser application using the jab planter was significantly shorter than that of the bare hand, dibbler and cutlass. The least significant difference was calculated to be 1.65hrs /ha. There was also significant difference between the mean rate of fertiliser application using the bare hand, dibbler and cutlass. In the order bare hand<dibbler<cutlass in the mean rate of fertiliser application.

TABLE 2. Time saving between using the jab planter and other methods

Fertiliser Application Tool	Time saved in hours per hectare
Bare Hand	12
Dibbler	24
Cutlass	31

Time saving between the use of jab planter and the other methods

Table (2) depicts the results of time saved from using the jab planter for fertiliser application per hectare of land compared to using the bare hand, dibbler and cutlass respectively for applying fertiliser to the same size of a piece of land. It can be seen that the time saved in using the jab planter for fertiliser application of one hectare of land compared with that of the bare hand, dibbler and cutlass is very important. This time could be used to do other activities such as earning extra income from off-farm work, having time for leisure or attending to family affairs.

Consistency of the quantity of fertiliser application

Table (3) gives a summary of the results of the consistency of fertiliser application using the jab planter and the bare hand respectively. The mean quantity of NPK 15-15-15 fertiliser applied using the jab planter was similar to that of the bare hand. The two sample t-test was used to investigate if there was significant difference between the quantity of fertiliser applied between using the jab planter and the bare hand. At 5% level of significance, the quantity of fertiliser applied in kilogram per hectare between using the jab planter and the bare hand was not significant. However, there was more variability using the bare hand to apply NPK 15-15-15 fertiliser compared to the jab planter. The results show that, the quantity of NPK 15-15-15 fertiliser delivered using the jab planter is more consistent compared to that of the bare hand. Where the delivery rate of the jab planter is lower than the recommended rate, there can be stunted growth as well as potential crop yield losses. Excess fertilizer application on the other hand, would cause more than necessary vegetative growth, slow crop maturity, and reduce grain yield (Aikins *et al.*, 2010). In addition, excess fertilizer application can cause drifts into sources of drinking water (EPA, 2001). This would eventually lead to health problems to people and financial loss to the farmer.

TABLE 3. Consistency of quantity of Fertiliser Application.

Statistic	Jab Planter	Bare Hand
Mean Quantity of fertiliser (Kg/ha)	255	250
Standard Deviation (Kg/ha)	21	39
Coefficient of Variation (%)	8	15

Palm dehydration, blisters, backaches and waist pains.

With the use of the bare hand, dibbler and cutlass for inorganic fertiliser application, the problems identified were dehydration of the palm, palm blister formation, the need to bend down, backaches, waist pains and high concentration of the mind when applying the fertiliser. Furthermore, when using a cutlass or dibbler for fertiliser application, one needs to carry the fertiliser in a bowl or in some container. This can be uncomfortable. No problems of dehydration of the palm, backache and waist pains were identified when using the jab planter for fertiliser application. There was also no need to worry about how much fertiliser to apply as the jab planter is self-regulating.

Skills in fertiliser application

There is the need to learn how to use the jab planter before using it for inorganic fertiliser application. With the bare hand, cutlass, or dibbler, no skills are required. Anyone applying fertiliser for the first time can do it easily without any training.

Clogging of the jab planter

When the soil is too wet there is clogging of the jab planter very often resulting in poor delivery of fertiliser.

CONCLUSIONS

It is timelier to apply NPK 15-15-15 fertiliser using the jab planter than the bare hand, dibbler and cutlass. The time saved from using the jab planter for NPK 15-15-15 fertiliser could be used to do other activities that could earn an extra income from off farm work, having time for leisure or attending to family affairs.

There was more variability in the quantity of fertiliser applied using the bare hand than the jab planter. The quantity of NPK 15-15-15 fertiliser delivered using the jab planter is more consistent compared to that of the bare hand. The quantity of NPK 15-15-15 fertiliser delivered per hill could potentially influence the yield of crops.

Problems identified with the use of the bare hand, dibbler and cutlass were palm dehydration, blisters, backaches and waist pains. Other problems include the need to bend down and high concentration of the mind when applying the fertiliser.

Problem identified with the use of the jab planter is the need to learn how to use it before using it for fertiliser application and when the soil is too wet, the jab planter gets clogged resulting in poor delivery of fertiliser. The jab planter is an innovative mode of technology transfer for the improvement of farming methods and poverty reduction.

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