KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY, KUMASI

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DEPARTMENT OF AGRICULTURAL AND BIOSYSTEMS ENGINEERING

PERFORMANCE EVALUATION OF A TWO-ROW GROUNDNUT PLANTER

A THESIS SUBMITTED TO THE DEPARTMENT OF AGRICULTURAL AND BIOSYSTEMS ENGINEERING, FACULTY OF AGRICULTURAL/MECHANICAL ENGINEERING, IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR B.Sc (HONS) AGCRICULTURAL ENGINEERING DEGREE

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DECLARATION

I, hereby declare that this thesis is as a result of my own work towards B.Sc. degree in Agricultural and Biosystems Engineering and that to the best of my knowledge, it is entirely my own work and all help has been duly acknowledged.

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DEDICATION

I dedicate this work to my father Narh Harry, my loving mother, Juliana Narh my uncle, Andrews Akriku, my siblings and any other individual who supported me to pursue this first degree program. I say, GOD BLESS you all.

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My utmost gratitude goes to the Almighty God for his abundant Grace and Mercy for bringing me this far and for guiding me through this four-year degree program.

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God richly bless everyone who made my project a successful one.

ABSTRACT

A new manual two-row groundnut planter developed by the farmers at New Longoro was evaluated for its performance by conducting a field and test. The tests comprised of percentage seed damage test, determination of average number of seeds discharged, seeding rate, the average planting depth, inter-row and intra-row spacing, effective field capacity and the effective field efficiency. The tests revealed that the average number of seeds discharged from the feed hopper was 20 for every twenty revolutions of the ground wheels and the percentage seed damage was found to be 21.3 per cent. In the field evaluation, the planter had field capacity of 0.06 ha/hr with an inter row and intra row spacing of 29.7 cm and 30.1 cm respectively. The performance of the groundnut planter had a seeding rate of 0.061 kg/ha. The average planting depth of seed placement was observed to be 2.2 cm. The planter efficiency was observed to be 3 per cent which does not fall within the range of the required planter efficiencies for agricultural implements.

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ABBREVIATIONS

CSIR-SARI Council for Scientific Industrial Research – Savanna Agricultural Research Institute

cm	Centimeter
EFC	Effective field capacity
FAO	Food and Agriculture Organisation of the United Nations
FE	Field efficiency
g	Gram
ha	Hectare
hr	Hour
kg	Kilogram
min	Minute
mc	Moisture content
rev	Revolutions
sec	Second
S	Speed
TCC	Technology Consultancy Centre
USDA	United States Department of Agriculture

CHAPTER ONE

INTRODUCTION

1.1 Background Information

Groundnut (*Arachis hypogaea L.*) is a legume also known as peanut, earthnut, monkeynut. It is one of the major oil seed crops and popular source of food throughout the world. Groundnut originated from South America and is mainly produced in the tropical and subtropical regions of the world. Groundnut seeds contain 40 – 50% oil and 20 – 50% protein (Gaitonde, 2014). Groundnut was introduced to West-Africa (first the Senegambia area) by the Portuguese in the 16th century. Here it spread quickly, though faster in the interior of Africa than along the coast (Fyhir, 1998). Groundnut is one of the most important grain legumes in the northern Ghana in terms of the area of cultivation and the use and also, an essential component of many Ghanaians' diet (CSIR-SARI, 2014). In 2009, Ghanaian farmers produced nearly 500,000 metric tons of groundnuts (Ghana Statistical Service, 2011).

Groundnut is planted either manually by hand or mechanically with a planter but mostly with planters in developed countries. Planters were designed so many years ago to reduce the drudgery of planting and farming in general. The history of planters goes as far as civilization of the world. Planters are classified as farm implements which is also a subset of Agricultural machinery. A planter is a type of seeder that can be described as a farm implement towed behind a tractor or pushed manually which is used for sowing crops in precise manner along rows on a field. Currently, the largest sized planter has 48 plant rows designed by John Deere (Russnogle, 2009). There are so many kinds and types of planters depending on the type of crop and method of operation. For instance, planters that are used for groundnut, corn, and soybean have names as groundnut planter, corn planter and soybean planter respectively. With the method of operation,

it is classified as either a manual or mechanical planter. A groundnut planter is a farm implement for sowing groundnut seeds. Groundnut planters are used worldwide with most patronage in the USA, Canada, most parts of Europe and Asia as well. There is very little patronage in Africa in general. In Ghana, groundnut planters in general have not received much patronage considering its cost and complicated designs. However, about 60% of the population are engaged directly or indirectly in agriculture. It is also worth noting that most farmers across the country grow groundnuts either as a main crop or minor crop. Groundnut planters can also be put into two main categories with types; the manual and mechanical groundnut planters. Example is the twin or two-row groundnut planter and the 48-row planter by John Deere (Russnogle, 2009).

1.2 Problem statement

Planting of groundnut seeds manually has been identified by farmers at New Longoro to be cumbersome. Together with the community and some volunteers from TCC, a prototype of manual two-row groundnut planter has been produced. This is purposely to make groundnut planting by groundnut farmers at New Longoro and those in other parts of Ghana much easier.

Justification

There is the need to evaluate the performance of the prototype and upgrade it to a product to help other groundnut farmers.

1.3 Objectives of study

1.3.1 General Objective

The objective of this project is to evaluate the performance of a groundnut planter (New Longoro).

1.3.2 Specific Objectives

The specific objectives of this project are;

i. To determine the seeding rate and the depth of the groundnut planter.

ii. To determine the inter and intra row spacing of the groundnut planter.

iii. To determine the effective field capacity and field efficiency of the groundnut planter.

CHAPTER TWO

LITERETURE REVIEW

2.1 Groundnut (Arachis hypogaea L.)

It is one of the major oil seed crops and popular source of food throughout the world. Groundnut originated from South America and is mainly produced in the tropical and subtropical regions of the world. Groundnut seeds contain 40 – 50% oil and 20 – 50% protein (Gaitonde, 2014). Groundnut being an important oil and food crop is grown on approximately 42 million acres worldwide (Putnam et al., 1991). It is the third major oil seed crop of the world next to soybean and cotton (FAO, Food Outlook, 1990). India, China and the United States have been the leading producers for over 25 years and produce about 70% of the world crop. It was ranked the ninth in acreage among major row crops in the United States during 1982 and second in dollar value per acre. Due to its warm temperature requirement, groundnut has only occasionally been grown in northern states (Putnam et al., 1991). Groundnut was introduced to West-Africa (first the Senegambia area) by the Portuguese in the 16th century. Here it spread quickly, though faster in the interior of Africa than along the coast (Fyhir, 1998). Groundnut is one of the most important grain legumes in the northern Ghana in terms of the area of cultivation and the use and also, an essential component of many Ghanaians' diet (CSIR-SARI, 2014). In 2009, Ghanaian farmers produced nearly 500,000 metric tons of groundnuts (Ghana Statistical Service, 2011).

2.2 Planting of Groundnuts

Groundnuts or peanuts require a weed-free environment and a moderately fine seedbed providing good seed-to-soil contact. Groundnut production is very difficult using reduced or zero tillage methods compared to most other crops. For this reason, a loose sandy soil with neutral pH is required for the crop to peg into and make digging easier. Groundnuts are often planted on the

flat but in higher rainfall areas and where flood irrigation is used, they are often planted into hills or beds. Planting on hills makes irrigation more efficient and makes it easier for the cutters to penetrate into the soil when harvesting (Department of Primary Industries and Fisheries, 2007). Groundnuts take about 3-5 days to germinate and emerge from the soil at 30 ˚C (Parasad et al., 2011).

There are various methods of planting groundnut which are practiced in crop farming. These can be put under broad classifications such as, broadcasting, transplanting, row cropping and direct planting (Bareja, 2011). Planting is one of the most important cultural practices associated with crop production. To avoid the drudgery involved in groundnut production, a planter is recommended. "The planter is the most important piece of equipment on your farm, hands down," says Bill Hoeg, (2012). The best planter for use in groundnut production should have the following requirements: accurate and regular spacing of the seed, good depth control, does not damage seeds, does not consume much energy, the formation of a press wheel track ridge adjacent to the plant row is undesirable as it can lead to earthing up (Cilliers, 2014).

2.2.1 Broadcasting method of seeding

This is a method of seeding that involves scattering seeds by hand or mechanically over a relatively large area. Seeds sown in this manner are not evenly distributed which may result in overcrowding (Blackie 2011).

2.2.2 Transplanting

Transplanting, also referred to as replanting is a method of planting that only requires the practice of replanting in which an already established plant or seedlings is moved elsewhere (Bareja, 2011).

2.2.3 Direct seeding

Direct seeding can also be referred to as direct sowing. It refers to planting of seed pieces or underground vegetative planting materials directly into the soil (Bareja, 2011).

2.2.4 Row cropping

As applied in conventional horizontal farming or gardening, row cropping is the practice of growing crops in linear pattern in at least one direction rather than planting without any specified arrangement. It is practiced in most crops whether direct seeded, transplanted or grown from vegetative planting materials (Bareja, 2011). Row cropping can be broadly classified into precision seeding, drill seeding and hill dropping (Bobobee, 2016).

2.2.4.1 Precision seeding

Precision seeding is as placing a desired number of seeds at a precise depth and spacing. Precision seeding simply allows the farmer to reduce cost and increase reliability of his crop production (Sanders, 1994).

2.2.4.2 Drill seeding

Drill seeding is a mechanical means of creating a furrow in the soil's surface and metering the seed at a uniform rate (Ernst Conservation Seeds Inc, 2014).

2.2.4.3 Hill dropping

Hill dropping is the process of dropping a group of seeds at equal intervals in rows to guard against germination (Bobobee, 2016).

2.3 Traditional planting method

Groundnuts are planted traditionally by hand dropping and bending with 2-3 seeds per hole. The traditional planting method is characterized by clearing a new farm plot, tilling the plot by hand, planting on mounds or ridges. With this type of planting method, farmers usually have lack the necessary inputs for fertilizer application and crop protection resulting in low crop yields (Bergmann and Butler, 1985). One of the reasons attributed for poor yield is improper spacing between plants, besides crop is grown under dry farming situations where in moisture content is an additional constraint for achieving higher crop productivity (Anonymous, 2005).

2.4 Mechanized planting method

Groundnuts or peanuts are mechanically planted using a planter. A planter is a type of seeder also described as a farm implement towed behind a tractor or pushed manually which is used for sowing crops in precise manner along rows on a field. John Deere's 48 plant row, is currently the largest sized planter (Russnogle, 2009). There are many kinds and types of planters depending on their purpose. For example, planters that are used for sowing groundnut, corn, potato and soybean have names as groundnut planter, corn planter, potato planter and soybean planter respectively. Planting machineries are generally classified based on the:

i. The number of rows planted in one pass of the planter.
ii. The method of attachment to and the type of power source used to propel the planter e.g, animal-drawn planters, tractor-drawn planters, pneumatic planters and manual planters.
iii. The type of planting machine based on which crop the planter plants (Murray et al., 2006).

2.5 Groundnut planter

A groundnut planter is a farm implement for sowing groundnut seeds**.** The best groundnut planter has to comply with the following requirements: accurate and regular spacing of the seeds, good depth control, does damage seeds, the formation of a press wheel track ridge adjacent to the plant row is not desirable as it can lead to earthing up (Cilliers, 2014). A groundnut planter could be animal-drawn, tractor-drawn or motorized therefore making it labor saving. Most groundnut planters available have sophisticated and expensive technology therefore making it difficult for the small-scale farmers to patronize their usage. Introduction of simple and less expensive groundnut planters as an intermediate technology for local farmers is becoming increasingly necessary considering the portability and cost involved in purchasing a groundnut planter. This can affect the production of groundnut in the rural areas such as New Longoro positively through improving field efficiency and capacity, less labor, increasing crop yield and reducing the cost of production. Groundnut planters commonly plant in rows 75 mm apart at seeding rates of 100-125 kg/ha or approximately 32,500 plants/ha. Crop performance has been improved since the establishment of row-type arrangement so as to achieve an equally spaced arrangement (Wehtje et al., 1994).

2.5.1 Seeding rate

The number of seeds planted per hectare to ensure normal density of sprouts and a maximum yield. Proper utilization of seeding rates at the time of crop establishment is critical in producing groundnut. It is normally expressed by the number germinating seeds and weight of the seeds. It is determined by considering plant requirement for feeding space, the purpose of cultivation (grain, silage), climatic conditions and soil fertility. The current recommendation for field peanut seeding rates range from 133-222 kg/ha (Santra et al., 2017).

2.5.2 Planting depth

A correct planting depth of 50-75 mm ensures that the plant develops and produces optimally. Usually, seeds which germinates slowly are as a result of deep planting thus, takes a longer time to emerge and a poor-quality crop will be produced (Cilliers, 2014).

2.5.3 Spacing

Generally, 150,000 plants per hectare are suitable for dryland production while 300,00 plants per hectare are ideal for irrigation. Various planting patterns can be practiced, namely single row, double row, tram lines e.t.c. The particular pattern selected is not necessary as long as the growing space of plants is adequate. Groundnut should not be planted closer than 50 mm in a row. A better seed spacing can be achieved if planting is done at a low speed (Cilliers, 2014).

2.5.4 Effective field efficiency

Field efficiency is not constant for any particular equipment or machinery but varies with size of land, shape of the field operation, crop yield, moisture and crop condition. It involves the measure of the relative productivity of an equipment, machinery or implement under field conditions such as the operating time of the farm machinery or implement, operator capacity and habit, operating policy and field characteristics (Bobobee, 2016). The effective field efficiency of most agricultural farm machineries range from 60 to 80 per cent (Bamgboye and Mofolasayo, 2006).

2.5.5 Effective field capacity

The effective field capacity of a farm machine is the rate at which it performs its primary function in a given time, based upon the total field time. Measurements or estimates of machine capacities are used to schedule field operations, power units, and labor, and to estimate machine operating costs. The most common measure of field capacity for agricultural machines is expressed in hectares covered per hour of operation (Bobobee, 2016).

2.5.6 Types of existing groundnut planters

Groundnut planters are classified based on the number of rows planted in one pass of the planter and the method of attachment to and the type of power source used to propel the planter. For example, we have six row groundnut planters, two or twin row groundnut planters and so on and so forth (Murray et al., 2006).

2.5.6.1 A six-row groundnut planter

A six-row groundnut planter is a type of planter that can plant six rows in one pass of the planter. Existing practices of sowing with human labor is tedious, expensive and time consuming. Regulation of spacing within and between the seed rows is one of the problem identified for poor crop yields. Tractors are available in their good numbers and therefore, not much effort is required in using a six-row groundnut planter. The introduction of a six-row groundnut planter reported timely operation and increased operational efficiency for establishing uniform and optimum plant population (Ashoka et al., 2012).

Fig 2.1 A six-row groundnut planter

2.5.6.2 A four-row groundnut planter

The four-row groundnut planter is a type of planter that can plant four rows in one pass of the planter. The four-row groundnut production was initially introduced to take advantage of the production benefits noted narrow or single, two or three row planting practiced traditionally by the local farmers. Studies on the four-row groundnut production when conducted was reported to have increased yields and less energy consumption when compared to the single, two and three row planting practiced traditionally by the local farmers. The four-row pattern allows for greater spacing between individuals which results in greater leaf indices, canopy

light interception and growth rate thus, improving the yield of crops (Ashoka et al.,2012). An example of the four-row groundnut planter is the Dingxin four row groundnut planter.

Fig 2.2 A four-row groundnut planter

2.5.7 A prototype of a two-row groundnut planter (New Longoro)

The local farmers at New Longoro in the Brong Ahafo region of Ghana, after considering the drudgery and cost involved in groundnut production invented a prototype of a two-row groundnut planter with the help of some volunteers from TCC, KNUST campus. Their main aim for introducing the prototype into their farming activity is because of the sophisticated and expensive available groundnut planters.

Fig 2.3 A prorotype of a two-row groundnut planter at New Longoro.

2.6 Soil mechanical properties

2.6.1 Soil moisture content

The water content of the soil is an important property that controls its behavior. As a quantitative measure of wetness of a soil mass, water content affects the level of compaction of soil, which is indicated by its bulk density (Agodzo and Adama, 2003).

2.6.2 Soil bulk density

USDA (1999) defines bulk density as the ratio of oven-dried soil (mass) to its bulk volume, which includes the volume of particles and the pore space between the particles. It is dependent on the densities of the soil particles (sand, silt, clay, and organic matter) and their packing arrangement. Bulk density is a dynamic property that varies with the structural condition of the soil (USDA, 1999). This condition can be altered by cultivation; trampling by animals; agricultural machinery; and weather; i.e., raindrop impact (Arshad et al., 1996). Compacted soil layers have high bulk densities, restrict root growth, and inhibit the movement of air and water through the soil (USDA, 1999). Usually, soil bulk densities range from 1.0 to 1.7 g/cm3, and generally increase with depth in the soil profile (Arshad et al., 1996).

CHAPTER THREE

MATERIALS AND METHODS

3.1 Experimental site

The experiment was carried out at New Longoro in the Brong Ahafo Region of Ghana, which is located at longitude 8˚ 03' 12'' W and latitude 01˚ 43' 37'' N. This area experiences the tropical continental or interior savannah type of climate. This is due to the fact that the area is in the transitional zone between the two major climatic regions in Ghana.

3.2 Materials

These are the materials and instruments that were used for the field evaluation of a two-row groundnut planter.

i. A prototype of a two-row groundnut planter
ii. Groundnut seeds
iii. Tape measure
iv. Stop watches (2)
v. Plastic containers
vi. Machete
vii. Dibbler
viii. Watering can

3.3 Description of prototype

The prototype of the two-row groundnut planter was invented at New Longoro, in the Brong Ahafo region of Ghana by the local farmers with the help of some volunteers from TCC, KNUST campus. The dimensions of the planter read 30 × 45 × 73 cm. It is manually operated. The components of the prototype include; two furrow openers, two delivery tubes, two seed cover, four ground wheels, a hopper and a handle. The hopper has a height of 34.5 cm and a diameter of 15.5 cm.

3.4 Planter mechanism

The seed delivery tubes have a rectangular cross section that is linked to the hopper from which the seeds drop into the furrow. The furrow opener penetrates into the soil to create furrows for the groundnut seeds. The ground wheels are integral parts of the seed metering components. At every revolution of the wheels, the spindles attached to the ground wheels engages with the delivery tubes to release the seeds into the furrow. A revolution of the wheels was also designed such that, it gives the required inter and intra row seed spacing which enables the planter to deliver the seeds once in a revolution. The seed covering components does the final work by covering the holes with the seeds as the planter moves.

Fig 3.1 Prototype of a two-row groundnut planter, New Longoro

Fig 3.2 Computer aided drawing of the prototype of the two-row groundnut planter.

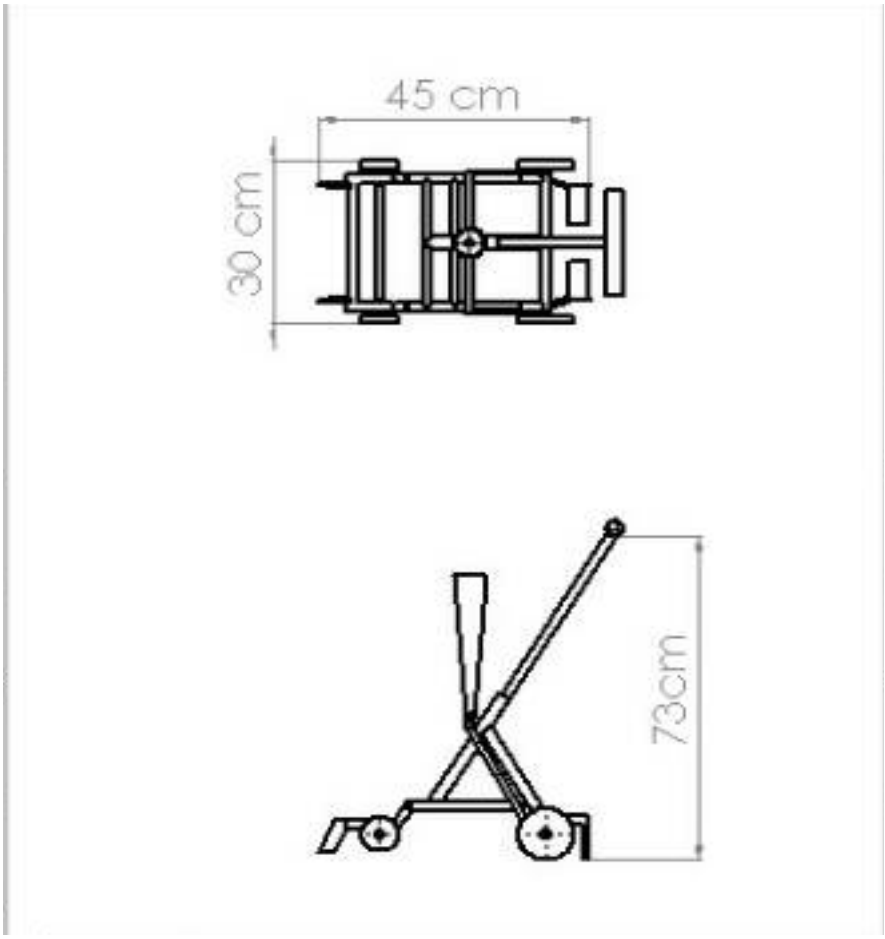

Fig 3.3 Computer aided drawing of the prototype of the two-row groundnut planter in 2D.

3.5 Methodology

3.5.1 Soil Chemical and Mechanical Analysis

Soil samples were collected randomly from the plot after ploughing. Three replicates were taken for soil moisture content and bulk density determination at depths of 0-5, 5-10 and 10-15 cm. Three soil core samplers of height, 5 cm and diameter, 4 cm and a mallet were used to take samples for bulk density determination. A soil auger was used to take samples for moisture

content determination. Each sample was stored in a rubber seal and labelled m_1, m_2, and m_3 respectively. Each sample's initial mass was taken with an electronic balance. The samples were oven dried at a temperature of 105 ˚C for 24 hours in accordance with the soil moisture determination method (DeAngelis, 2007). Soil bulk density was determined using equation 1 and the soil moisture content was also determined using equation 2. Additionally, composite soil samples were taken to the lab to test for soil pH and soil organic matter. The soil samples were chemically analyzed for soil pH and organic carbon content (%).

$$\text{Bulk density (g/cm}^3\text{)} = \frac{Mass\ of\ dry\ soil\ sample}{Soil\ volume}$$

Equation 1.

$$MC_{wb} = \frac{Initial\ weight - Final\ weight}{Initial\ weight}$$

Equation 2.

Where;

MC_{wb} = Moisture content on wet basis (%)

3.5.2 Calibration

The hopper was fed with 0.2 kg of groundnut seeds. The planter was jacked up to allow for free rotation of the ground wheels. A mark was made on the wheels to serve as reference points to count the number of revolutions when turned and a polythene bag was used to collect the seeds discharged from each delivery tube. The drive wheels were rotated 20 times at low speed as would be established on the field. A stop watch was used to measure the time taken to complete

each revolution. A steel tape measure was used to measure the inter row and intra row spacing. The seeds in each polythene bag was weighed. This was repeated for five times.

3.5.3 Percentage seed damage test

The percentage seed damage test was done with the manual two-row groundnut planter also jacked up to allow for free rotation of the ground wheels, with 0.2 kg of groundnut seeds loaded into the hopper. The ground wheels were rotated twenty times and the time taken to complete each revolution was recorded using a stop watch. The seeds discharged from the delivery tubes were observed for any external damage.

$$\text{Percentage seed damage (\%)} = \frac{Number\ of\ seeds\ damaged}{Total\ number\ of\ seeds\ discharged} \times 100\%$$

Equation 3.

3.5.4 Land Preparation

The study site was cleared and a mattock was used to loosen the soil to produce a finer soil tilt. Seed beds were created afterwards

3.5.5 Field evaluation of a two-row groundnut planter

The field performance evaluation of the two-row manual groundnut planter was performed in March 21st, 2017. The parameters measured included time, speed, effective field capacity, field efficiency, plant population, planting depth and seeding rate. Planting was performed using three treatments namely; planting with a machete, a dibbler and the prototype of the manual two-row groundnut planter. The groundnut variety used was "Nkosuor". An experimental area of 0.015 ha was used and was divided into three plots for the field evaluation. Planting was done by hand dropping and bending with the use of a machete and the dibbler and later, the prototype of the

two-row groundnut planter was also used for planting. There were five trials for each planting practice. A planting spacing of 1 foot for both inter row spacing and intra row spacing was used for planting with the machete and the dibbler. Holes were created in the soil using the cutlass and 2 seeds were dropped into each hole. Likewise, planting with the dibbler. A total number of 12 holes per row was obtained using the machete and varied between 11 and 12 using the dibbler. Observation of the field efficiency and field capacity of the planter involved continuous timing of each activity involved in the planting operation. Two stop watches were used to time all activities while three people were involved in the determination of the field efficiency. One person operated the planter on the prepared field, while the others observed, took and recorded the time for the activities such as the time taken to continuously cover every two-row and the time losses such as those for turning at field ends, removal of clogs and adjustment was also recorded.

The average depth of seed placement of the planter was determined by randomly measuring the depth of five sampled holes. A steel tape measure was used to measure the depths. Exactly 5 days after planting, the spacing between successive seedlings within and between rows was recorded using a steel tape measure. This was because groundnuts seeds takes three to five days to emerge. The operational and adjustment difficulties were recorded during the field evaluation to assess the handling characteristics of the manual two-row groundnut planter. 0.2 kg of groundnut was used for each trial.

3.6 Performance Parameters

3.6.1 Seeding Rate

This was established considering the number of seeds planted per hectare.

Seeding rate (kg/ha) = $\frac{mass}{area\ of\ plot}$ **Equation 4.**

3.6.2 Planting Depth

The depth of the planter was determined by measuring with a tape measure, how deep the furrow openers could dig into the soil.

3.6.3 Inter Row Spacing

The inter row spacing of the planter was determined by measuring with a tape measure the space within rows.

3.6.4 Intra Row Spacing

The intra row spacing of the planter was determined by measuring with a tape measure the space between rows.

3.6.5 Planting time

The time taken for each trial when planting with the machete, dibbler and the two-row groundnut planter was recorded. Time for each turn at the end of the plot, adjustments and removal of clogs when planting with the two-row groundnut planter was also recorded.

3.6.6 Determination of operating speed

The operating speed was computed as follow

S (m/sec) = $\frac{L}{t}$ **Equation 5.**

Where,

S = operating speed, (m/sec).

L = Length of the plot, (m).

t = time required to cover one pass, (sec).

3.6.7 Effective field capacity

This is the actual rate of performance of the planter in a given time, based upon the total field time.

$$\text{EFC} = \frac{Area\ of\ plot}{10 \times total\ time\ required\ to\ cover\ the\ plot} \qquad \textbf{Equation 6.}$$

Where;

10 is a constant

3.6.8 Field efficiency

This is the measure of the relative productivity of an implement under field conditions and it accounts for failure to utilize theoretical operation width of an implement.

$$\text{Field efficiency } (\eta) = \frac{Time\ taken\ for\ actual\ planting\ operation}{Total\ time\ taken\ on\ the\ field} \times 100 \qquad \textbf{Equation 7.}$$

CHAPTER FOUR

RESULTS AND DISCUSSION

This chapter gives the results and discussions of the field performance of the study. That is, planting with a machete, a dibbler, and the prototype of the manual two-row groundnut planter. The results are presented in tables. In the planting process, the time taken for each planting practice was recorded.

4.1 Soil mechanical and chemical properties

Soil at New Longoro was tested to be sandy loam. The soil bulk density was found to be 1.62 g/cm^3. Approximate range of expected bulk density values:1 .0g/cm^3 for clay soils to 1 .8g/cm^3 for sandy or compacted soils. Soil moisture content of 3% was recorded. Groundnuts grow best in well-drained, red-colored, yellow-red and red, fertile, sandy to sandy loam soils with a pH range of 5.5 to 7.0. Saline soils are not suitable because groundnuts have a very low salt tolerance. The pH value recorded was 6.02 thus, suitable for groundnut production. The soil organic carbon content was found to be as low as 2.2 % which is not suitable for groundnut production.

4.2 Data Collection

Table 4.1 shows the results obtained from the calibration of the manual two-row groundnut planter. It could be seen from the table that the average number of seeds discharged from the feed hopper was 20 seeds within an average time of 27 seconds for every 20 revolutions.

Table 4.1: Calibration of the manual two-row groundnut planter

Trial	**Number of seeds discharged from the feed hopper**	**Time for 20 rev (sec)**

Trial 1	25	32
Trial 2	12	17
Trial 3	30	40
Trial 4	16	22
Trial 5	19	24
Average	20	27

Table 4.2 shows the result of the percentage seed damage test of the manual two-row groundnut planter. The feed hopper did not give a better result due to the maximum clearance between the delivery tubes and the spindles on the ground wheels. The high value of percentage seed damage was as a result of the low speed of the planter and the geometry of the delivery tubes not considering the geometry of the groundnut seeds. The low speed was as a result of the wrong choice of ground wheels.

Table 4.2: Percentage seed damage test of the manual two-row groundnut planter

Trial	**Number of seeds discharged from the planter**	**Number of seeds damaged by the planter**	**Time for 20 rev (sec)**	**Percentage seed damaged (%)**
Trial 1	20 seeds	3 seeds	28	15
Trial 2	15 seeds	4 seeds	23	26.6
Trial 3	34 seeds	7 seeds	45	20.5
Trial 4	12 seeds	3 seeds	19	25
Trial 5	26 seeds	5 seeds	30	19.2
Average	21 seeds	4 seeds	29	21.3

Table 4.5 shows the results of the time taken to finish planting with the manual two-row groundnut planter using 50 seeds for each trial of groundnut seeds for each trial. The total area covered was 0.05 ha. It was observed from the field test that planting with the two-row groundnut planter consumed more time as compared to planting with a machete and a dibbler. This was due to the wrong choice of ground wheels which made movement through the soil difficult. This was due to the absence of a treaded surface.

Table 4.3: Time taken for planting with the manual two-row groundnut planter.

Number of trials	**Number of seeds discharged from the planter**	**Time taken for each trial**	**Time taken for adjustments, turning at field ends and removal of clogs**
Trial 1	20 seeds	12 mins	5 mins 25 secs
Trial 2	10 seeds	10 mins 11 secs	3 mins 52 secs
Trial 3	16 seeds	15 mins 34 secs	4 mins 35 secs
Trial 4	12 seeds	13 mins 26 secs	6 mins 15 secs
Trial 5	26 seeds	10 mins 30 secs	3 mins 10 secs
Average	**17 seeds**	**13 mins 41 secs**	**4 mins 27 secs**

4.3 Summary of data showing measured variables of the three planting practices.

At the end of the field experiment, the planting depth of the machete, dibbler and prototype of the two-row manual groundnut planter recorded were, 5.63 cm, 3.5 cm and 2.2 cm respectively. Also, the planting space of the machete, dibbler and prototype of the two-row groundnut planter recorded were, 32 cm, 29.5 cm and 29.7 cm respectively. The seeding rate recorded for planting with the machete, the dibbler and the prototype of the two-row groundnut planter was 0.096 kg/ha, 0.092 kg/ha and 0.061 kg/ha respectively. The time taken to finish planting using the

machete, the dibbler and the manual two-row groundnut planter was 12 mins 57 secs, 28 mins 17 secs and 45 mins 48 secs respectively for a land size of 0.05 ha.

Table 4.4: Summary of data showing results of the performance parameters of the manual two-row groundnut planter.

No.	**Parameters**	**Observation**
1	Actual area covered, (ha)	0.05
2	Travelled speed, (m/sec)	0.0204
3	Effective field capacity, (ha/h)	0.06
4	Field efficiency, per cent	3
5	Seeding rate, (kg/ha)	0.061
6	Depth of seed placement, (cm)	2.2
7	Inter row spacing, (cm)	29.7
8	Intra row spacing, (cm)	30.1

It was observed from the field test that much time was spent on adjusting, clogging and turning the planter which resulted in lower field efficiency and field capacity. The inter row and intra row spacing values were affected by clogging and the operator's level of experience. That is, taking inevitable stoppages into consideration. This is because the ability of the operator to operate the machine at a uniformly low speed would achieve better spacing.

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

The following conclusions were drawn based on the specific objectives of the field evaluation of the manual two-row groundnut planter developed by the farmers at New Longoro in the Brong Ahafo Region.

- The planter was found to have a seeding rate and planting depth of 0.061 kg/h and 2.2 cm respectively.
- The inter and intra row spacing of the planter was found to be 29.7 cm and 30.1 cm respectively.
- The effective field capacity and field efficiency of the planter was found to be 0.06 ha/h and 3 per cent respectively. The value of the field efficiency shows an unsatisfactory performance of the planter as it does not fall within the range of values obtained from planting operations by various investigators (Bamgboye an Mofolasayo, 2006).

5.2 Recommendations

Following the results obtained from the field evaluation, this recommendation was made:

- Further testing of the manual two-row groundnut planter should be carried out in all groundnut growing regimes in Ghana to promote nationwide adoption.
- The ground wheels of the planter should be treaded to enable easy movement of the wheels through the soil.
- The delivery tube of the planter should be made circular with a reasonable diameter to enable easy flow of seeds from the hopper into the ground.

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APPENDICES

Appendix 1: Tables of recorded data

Table 1: Time taken for planting with a machete.

Trial	**Number of seeds dropped into holes**	**Time taken for each trial**
Trial 1	48 seeds	1 min 46 secs
Trial 2	48 seeds	1 mins 50 secs
Trial 3	48 seeds	2 mins 56 secs
Trial 4	48 seeds	2 mins 49 secs
Trial 5	46 seeds	3 mins 36 secs
Average	**48 seeds**	**2 mins 38 secs**

Table 2: Time taken for planting with a dibbler.

Trial	**Number of seeds dropped into holes**	**Time taken for each trial**
Trial 1	46 seeds	4 mins 35 secs
Trial 2	48 seeds	5 mins 59 secs
Trial 3	48 seeds	6 mins 57 secs
Trial 4	46 seeds	5 mins 50 secs
Trial 5	46 seeds	4 mins 56 secs
Average	**47 seeds**	**6 mins 15 secs**

Appendix 2: Field images

Fig 1: An oral interview with some farmers at New Longoro

Fig 2: Soil moisture content and bulk density determination

Fig 3: Groundnut variety used (Nkosuor)

Fig 4: Raising of beds for planting

Fig 5: Planting of groundnut seeds