DEVELOPMENT OF A SINGLE ROW MANUAL MELON PLANTER

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ABSTRACT: *The need to mechanize melon planting in Nigeria cannot be over emphasized. Melon seed planting in Nigeria is majorly done manually which is more tasking and involved drudgery. The objective of this research work was to develop simple and efficient manual melon planter to enhance the production and improve the livelihood of the Nigeria farmers. However, a single row manual melon planter was developed and evaluated in NCAM to encourage large expanse of melon planting, minimizes the drudgery involved and increase revenue generation. The total area used for the experiment was 0.075ha, the average values of theoretical field capacity, effective field capacity, field efficiency, speed of operation and percentage of seed germination are; 0.46ha/h, 0.44ha/h, 96%, 0.31km/h and 95% respectively. The result showed that manual melon planter performed satisfactorily and will solve the problem facing the Nigeria farmers on planting operation.*

Keywords: planting, manual, melon, planter, developed, evaluation

1. INTRODUCTION

Melon (*Colocynthis citrullus* L.) is one of the leguminous crops widely planted and consumed in Nigeria and West Africa [1]. The state of high production of egusi in Nigeria are Enugu, Benue, Nassarawa, Taraba and Kogi. However, Egusi has the names such as Egusi in Yoruba, agushi in Hausa, epingi or paragi in Nupe and eashi in Gwari [2]. Melon seed (Egusi) are highly nutritious in human diet with good quality protein [3]. It contains about 41.51% essential amino acids and other essential nutrients [4].

In many parts of Africa, where farmers lack access to meat or dairy, the high oil and protein content of melon can make an excellent dietary supplement [5]. Egusi seeds are oval in shape which is small, flat and one end of the seed is rounded while the other is tapered [6] thus making it more tasking to design its both planter and post harvest equipment.

Melon (egusi) is generally planted traditionally in Nigeria and most part of Africa countries. Many research works have been carried out on different planters for varieties of seeds such as maize, cowpea, guinea corn, soyabean, cassava with little or no attention on melon crop. However, the local market survey carried out showed that melon is one of the viable leguminous crop which has ready market for industrial and domestic use in Nigeria. Hence the need to fill the research gap by developing a simple, efficient and affordable manual melon planter to enhance the planting operation of melon seed and improve on the standard of living of the Nigeria farmers.

2. METHODOLOGY

2.1. Description of the Machine

The single row manual melon planter comprises seed hopper, metering mechanism, ground wheel made from mild steel, chains and sprocket, furrow opener and closer, handles and frame. The metering mechanism consist of seed plate which has two holes for seed drop at a preset interval, bevel gears, chain and sprocket which drives the seed plate through motion transmission from the ground wheel and the handle for controlling the machine. The melon planter is lighter in weight and easy to maintain as its components were locally sourced.

2.2. Working Principle of Single Row Manual Melon Planter

Single row manual melon planter is a push type, operated by a trained operator. The planter is set in operation through forward movement. As operator is pushing the planter forward the ground wheel provides the motion to all rotational parts of the machine connected to chain and sprockets, the seed plate picks the seed and deliver it to seed delivery chute, the furrow

opener opens the soil for the seeds to enter and covered by furrow closer. The speed of the machine is dependent on the operator who has to maintain steady speed to avoid missing hills. The plant spacing and the number of seed drop per hole is determined by seed metering plate, gear ratio and the size of the ground wheel. In this research work the designed plant spacing is 100 x 100 cm.

2.3. Factors Affecting Seed Emergence

Mechanical factors which affect seed germination are:

- Uniformity of depth of seed placement.
- Uniformity of distribution of seed along rows.
- Transverse displacement of seed from the row.
- Prevention of loose soil getting under the seed.
- Uniformity of burying the seed in the soil.

To achieve the best performance from a planter, the above factors were considered through proper design and selection of components required for the machine to suit the properties of the melon seed.

2.4. Design Calculation of Some Components of Manual Melon Planter
2.5. Seed Plate

Seed plate is made from material called Teflon it is a tough plastic which can withstand pressure to a certain level due to this property it was selected for this purpose.

The diameter and the number of holes required of seed plate was calculated using this expression given by [7].

$$C_c = \pi d \qquad\qquad\qquad 1$$

where

$C_c = cirfumference\ of\ the\ seed\ plate$

Assuming that diameter of seed plate is 100 mm

Then,

$$C_c = \pi d$$

$$C_c = 3.142 \times 100$$

$$C_c = 314.2\ mm$$

The diameter of seed plate selected was 16 cm to avoid unnecessary error during construction

The number of holes on the seed plate was calculated as;

$$N_{sc} = \frac{\pi D}{IZ} \qquad\qquad\qquad 2$$

Where

N_{sc} = number of holes on the seed plate

D = diameter of the ground wheel = 32cm

I = intral row spacing = 100cm

Z = speed ratio = 0.5

Therefore;

$$N_{sc} = \frac{3.142 \times 32}{100 \times 0.5} = 2.01$$

The selected number of holes on the seed plate was 2 for adequate distribution of seeds.

2.6. Design of Hopper

Hopper is a container on top of metering mechanism which accommodate seed for planting. It is conical in shape with upper base circle of 0.2m and the lower base circle of 0.15m.

Assuming the hopper contains 2kg of melon seed at a time, then,

$$\rho = \frac{M}{V}, kgm^{-3} \qquad\qquad 3$$

$\rho = density\ of\ melon = 315.2 kgm^{-3}$

$M = mass\ of\ melon\ seed, Kg$

$V = volume\ of\ hopperm, m^3$

therefore,

$$V = \frac{2}{315.2} = 6.3 \times 10^{-3} m^3 \qquad\qquad 4$$

For the hopper to have clearance above the melon seed the volume becomes

$$V = 1.3 \times 6.3 \times 10^{-3} = 8.2 \times 10^{-3} m^3$$

The volume of hopper is calculated as obtained from [8];

$$V = \frac{1}{3\pi} \times h(r^2 + rR + R^2) \qquad\qquad 5$$

Where,

V = volume of hopper = $7.8 \times 10^{-4} m^3$

h = height of hopper =?

r^2 = radius of circle = 0.15m

R^2 = radius of large circle = 0.2m

Then,

$$h = \frac{8.2 \times 10^{-3} \times 3 \times 3.142}{(0.15^2 + 0.15 \times 0.20 + 0.2^2)}$$

$$h = \frac{0.0778}{0.0925} = 0.84 m$$

EXPLODED VIEW

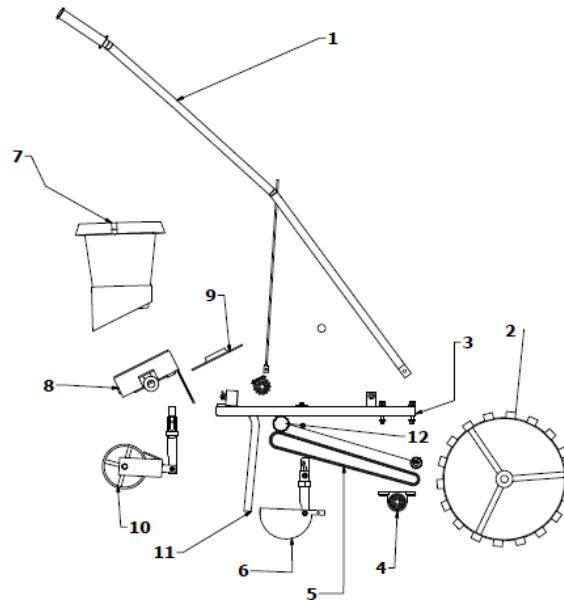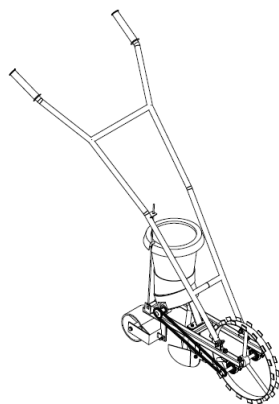| PARTS OF THE MELON PLANTER	
S/N	**PART LIST**
1	HANDLE
2	GROUND WHEEL
3	FRAME
4	BEARING
5	CHAIN DRIVE
6	FURROW OPENER
7	HOPPER
8	METERING MECHANISM
9	SEED PLATE
10	FURROW CLOSER
11	SEED DELIVERING CHUTE
12	SPROCKET

Figure 1: Exploded view of manual melon planter

ISOMETRIC VIEW 2

ISOMETRIC VIEW 2

Figure 2: Isometric and Pictorial view of manual melon planter

2.7. Parameters Evaluated

Plant population of a single row manual melon planter was determined using the equation given by [9].

$$plant\ population = \frac{10,000}{S_a S_b}$$

where

S_a = intral row spacing distance (m) = 1.0 m

S_b = inter row spacing distance (m) = 1.0 m

$$plant\ population = \frac{10,000}{1 \times 1} = 10,000\ stands/ha$$

2.7.1. Theoretical Field Capacity

Theoretical field capacity is the rate of coverage of the planter based on 100 percent of the rated speed and covering 100 percent of its rated width.

$$T_{fc} = \frac{area}{actual\ time}$$

where;

area covered during the experiment (ha)

actual time taken during the experiment (h)

2.7.2. Effective field capacity

The effective field capacity is calculated by recording the actual area covered by the implement, total time taken and its width.

$$E_{fc} = \frac{\mathcal{E}(3600)}{F}, ha/h$$

where,

$\mathcal{E}$ = Area of land (ha)

F = Total time of operation (h)

2.7.3. Field Efficiency

It is the ratio of effective field capacity and theoretical field capacity expressed in percent.

$$E_f = \frac{Efc}{Tfc,}, \%$$

where,

Efc = Effective field capacity, ha/hr.

Tfc = Theoretical field capacity, ha/hr.

E_f = Field efficiencies, %

2.7.4. Speed of Operation

The operating speed is the distance covered by the machine over a period of time. The operating speed can be expressed as;

$$S = \frac{D}{T} \times 3.6$$

where,

S is the speed of operation (km/h)

D is distance covered during harvest (m) = 50 m

T is time taking during harvest (sec) = 597.6sec

$$S_1 = \frac{50}{597.6} \times 3.6 = 0.30 km/h$$

$$S_2 = \frac{50}{579.71} \times 3.6 = 0.30 km/h$$

$$S_3 = \frac{50}{586.8} \times 3.6 = 0.31 km/h$$

3. RESULT

Table 1: Result Obtained for Melon Planting Using NCAM Developed Single Row Manual Melon Planter

S/N	Crop	Total area for used (ha/)	Operation time (sec)	Total time (sec)	Theoretical field capacity (ha/h)	Effective field capacity (ha/h)	Field efficiency (%)	Percentage seed germination (%)
1		0.075	597.60	630.00	0.45	0.43	96	95
2	Melon	0.075	579.71	610.05	0.47	0.44	94	94
3		0.075	586.80	608.20	0.46	0.45	98	96
	Average	**0.075**	**588.04**	**616.08**	**0.46**	**0.44**	**96**	**95**

4. DISCUSION

A single row manual melon planter was developed and evaluated at NCAM. Table 1 showed the total area covered during the experiment as 0.075ha, the average values of theoretical field capacity, effective field capacity, field efficiency and percentage of seed germination are 0.46 ha/h, 0.44 ha/h, 96% and 95% respectively. It was observed that the efficiency of the machine was satisfactory and also the percentage seed germination at 100 x 100 cm plant spacing was impressive when compared to the result obtained by [10] who planted sweet melon on three different plant spacing which are 25x25, 30x30 and 50x50cm. He observed that sweet melon performed well in terms of number of leaves, nodes and branches as well as the length of vines and fruit yield at 50 x 50 cm plant spacing. Therefore, manual melon planter performed satisfactory.

5. CONCLUSION

A single row manual melon planter was developed and evaluated at NCAM to address the challenges of planting operation facing the Nigeria farmers. the total area used for the experiment was 0.075ha. the efficiency of the machine and the percentage seed germination are 96% and 95% respectively. This showed that manual melon planter performed satisfactory and can solve the problems of planting operation by the Nigeria farmers. The machine was fabricated from locally available materials which makes it cost effective, efficient and easy to maintain.

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