Product development of a fertilizer dispensing machine

Choong Chee Guan[1*], Robert @ Kerk Swee Tian[2], Saw Chun Lin[3], Salvinder Singh Karam Singh[4]

[1)] Department of Mechanical Engineering, Politeknik Tuanku Syed Sirajuddin,
Pauh Putra, 02600 Arau, Perlis, Malaysia
[2)] Kolej Komuniti Kota Marudu,
Sabah, Malaysia
[3)] Department of Mechanical Engineering, Politeknik Ungku Omar,
Jalan Raja Musa Mahadi, 31400 Ipoh, Perak, Malaysia
[4)] Faculty of Engineering and Built Environment, Universiti Kebangsaan Malaysia,
43600 UKM Bangi, Selangor, Malaysia

[*]Corresponding e-mail: dr.choong@ptss.edu.my

Keywords: Dispensing machine, pineapple plantation, pallet

ABSTRACT – The concept of this machine design is based on the current phenomenal of fertilization methods used in today's agricultural field. The amount of fertilizer required to fertilize the plants is the key element for the plant to grow healthy. Such equipment for the exact amount of fertilizer pallets to be dispensed is needed. The new machine dispenser design consists of a cup which can contain 20 grams of fertilizer pallets. The cup is attached to a mechanism below the storage tank, which a trigger is fabricated to perform the dispensing action of the fertilizer pallets. Hence, fertilizer pallets which had been dispensed travel through a flexible hose and into a metal pipe that is made to pierce the soil with ease so the fertilizer pallets can be dispensed easily into the soil. The end of the metal pipe consists of a cone like sharp pointy edge which helps agricultural workers to pierce the soil with ease. With the aid of this equipment, a single worker is able to fertilized 1 plot of pineapple plants within 8.3 hours only, hence minimizing the time required to perform fertilizing of the plants in the agricultural ecosystem and industry. Lightweight materials such as aluminum and plastic were used to construct the fertilizer storage compartment and the injector to minimize effort.

1. INTRODUCTION

The concept of fertilizer dispensing machine is actually based on the current phenomenal in plantation system. Workers require a lot of forcing exerting during fertilizing plants and at the same moment a lot of time is being wasted. Due to that, workers at the plantation prefer force and time saving mechanism that can eventually improve the output of plantation products solid fertilizer dispensing machine can play a big difference in the whole fertilizing process. This machine is a dispenser that can dispense pallets fertilizer which the aid of a mechanical dispensing mechanism. It is designed for commercial use therefore it is very durable, versatile and easy to use and operate. This machine is a portable fertilizer dispenser which can be carried around in the agricultural field with ease. In addition, this mechanism can also save time of employees/workers in the agricultural field in analogy to the manual method that takes prolonged amount of time to complete the fertilizing task.

2. METHODOLOGY

The machine is used for fertilizing pineapple plants. The tank is placed as a backpack for the user and can be adjusted for comfort ability. The lever is designed upon the reach of palms to trigger the openings at the injector while below the tank there is an isolating mechanism to isolate 20g from 16kg of contained fertilizers. This designed trigger mechanism only needed around 10N of force to dispense the fertilizer. The 10N of force is sufficient to activate the spring and cord tensions that are used to support the injector (dispensing mechanism). For a perfect fertilizing process for the plant, it is recommended that the metal rod and injector should be bent slightly as 15° angle to inject the fertilizers into the soil. This is because the injector will pierce the soil in ease [1]. There is also a support (static pedal) provided to help the injector to pierce the soil [2]. The basic steps of fertilizing processes are explained in Figure 2.1.

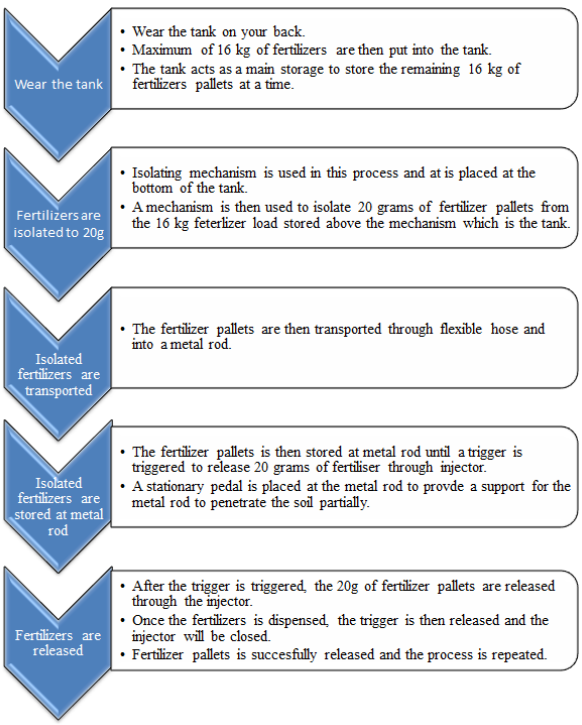

Figure 2.1 Basic steps of fertilizing processes.

3. RESULTS AND DISCUSSION

Manual fertilizing method consumes more time and energy compared to solid fertilizer dispensing machine as more manpower is needed. This is because there will be 2 separate methods done by 2 people. The first man will be pocking the crop making a small compartment for the fertilizers followed by another man spreading fertilizers into the compartment. This method is done for many acres fertilizing more than ±10,000 pineapple plants. The storage for this machine will be 16kg and dispenses 20g every time fertilizing.

3.1 How many plants can 16 kg of fertilizers cover?

1 acre = 43560ft^2,
1 plot = 0.5 acre (21,780ft^2)
1 acre = 10,000 plants
∴ 0.5 acre = 5,000 plants
20 g fertilizes 1 plant
16,000 g fertilizes 800 plants

3.2 Approximately, how long does it take to fertilize 1 acre of plantation?

Require 6 seconds to fertilize each plant using this method.

For 1 acre (10,000 plants) = 60,000 seconds = 1000 minutes = 16.7 hours
For 0.5 acre (5,000 plants) = 30,000 seconds = 500 minutes = 8.3 hours
800 plants = 4,800 seconds = 80 minutes = 1.3 hours

16,000 g of fertilizers can fertilize 800 plants in 1.3 hours. 1 acre (10,000 plants) will be fertilized in 16.7 hours whereas 0.5 acre (5,000 plants) can be fertilized in 8.3 hours.

3.3 What is the amount of fertilizers needed?

16000 g fertilizes 800 plants
1 acre = 10,000 plants
200,000 g fertilizers = 10,000 plants
200,000 g = 200 kg of fertilizers needed to cover 1 acre of plantation

3.4 How many times the worker has to refill the tank to cover 1 acre of pineapple plants?

16,000 g fertilizers needed to fertilize 800 plants
1 acre = 10,000 plants
10,000÷800 = 12.5 times = 13 times

The tank should be refilled with fertilizers for 13 times to fertilize 1 acre of pineapple plants.
The worker will be working 8 hours a day,

16.7 hours = 2 days and 7 hours

The worker needs around 2 days and 7 hours only to fertilize 1 acre of pineapple plants.

8.3 hours = 1 day and 3 hours

The worker needs around 1 day and 3 hours only to fertilize 1 plot of pineapple plants.

4. CONCLUSIONS

The agricultural industry has developed many kinds of agricultural products and evaluation process to fulfil objectives used with all kinds of energy sources, mechanical tools and equipment design, construction development, distribution, marketing, publishing, education, operation and user-related issues.

The fertilizing dispenser is a machine that requires minimal effort to fertilize the plants in agricultural fields. Different levels of mechanization and application development had been implemented. The proposed design is able to fertilized 1 plot of pineapple plants within 8.3 hours by a single worker with dispensing rate of 20g per time, and has a storage capacity of 16kg.

Other advantages of the proposed fertilizer dispensing machine discovered in this project were:-

(i) Minimize human labor
(ii) Time saving
(iii) Mobility
(iv) Detachable
(v) Reduce cost of hiring labours

REFERENCES

[1] Baker, C.J., Saxton, K.E., Ritchie, W.R., Chamen, W.C.T., Reicosky, D.C., Ribeiro, F., Justice, S.E., and Hobbs, P.R. (2007). No-tillage Seeding in Conservation Agriculture (2nd Edition). Food and Agriculture Organization of the United Nations. Cabi, USA.
(ISBN: 1-84593-116-5, 978-1-84593-116-2)

[2] Krishna, K.R. (2013). Precision Farming: Soil Fertility and Productivity Aspects. CRC Press. London.
(ISBN: 78-1-4665-7829-6 (eBook - PDF))