

Synthesis and analysis of solid fertilizer dispersion equipment

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Abstract

Any natural or synthetic material that encourages the growth of plants is fertilizer. Fertilizers are used in all crops with application levels, usually measured by the soil test and according to the different cultivation, according to the soil fertility. The tractor is mounted to the fertilizer propagators for large-scale cultivation. In small applications, costly tractor spreaders cannot be used. The conventional spread of small-scale fertilizers is done manually. It has certain issues, such as uneven fertilizer distribution, time consumption and high human effort. During the process, the farmer must carry heavy bags. A fertilizer spreader for small-scale agriculture must therefore be developed. A trolley type of mechanism is used for the proposed fertilizer spreader. The main part is a retailer that aims to distribute globally. The disk feed comes with a gear transmission from the wheels of the trolley. By using the disperser, it is possible to save a lot of time, reduce human energy to carry heavy bags of fertilizer and avoid wasting fertilizer.

Keywords: Solid fertilizer, Dispersion equipment, Impeller disk

1. Introduction

Agriculture is the largest economic sector demographically and plays a major role in India's overall economy. The main aim of agricultural mechanization is to improve production and productivity overall. About 83.29% of the Indian farm dependent families have land holding less than 2 to 3 acers in Figure4 we see that most of the lands are used for cultivations and in that most of that was cultivated by small scale formers about 88.3 present and 9.3percent of them are large scale forms [1].

Share of total farms and value of production by farm type, 2007
 Large-scale family farms account for 66 percent of production

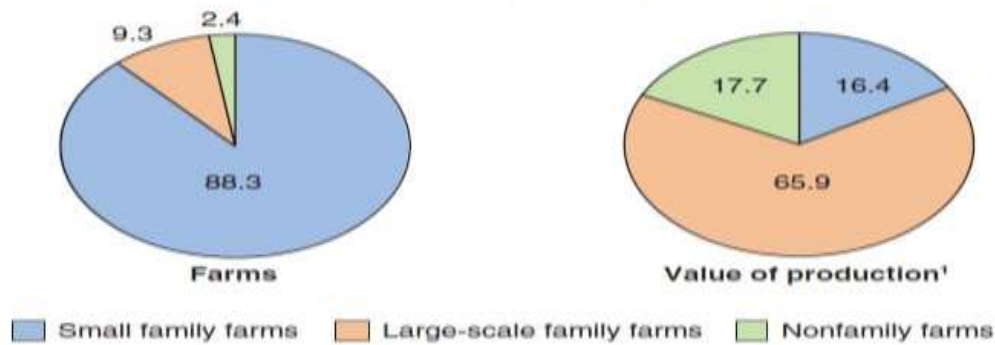


Figure 1: Small vs large scale farm

(Source: <https://thesocietypages.org/socimages/2011/07/23/concentration-in-u-s-agriculture/>)

A full featured existing farm machine of higher capacity is not required or economical for them. The idea is, therefore, to create a machine, which reduces labor and the necessary costs to produce crops, which would be easier to reach and also significantly cheaper. This machine has the capacity to meet and the cost-effective cost-effectiveness of maintenance & repairs for farmers with small-scale land tenure (less than 2 acres) [2]. The conventional fertilizer broadcasting is referring to spreading fertilizers all over the field by using a human hand as shown in Figure 1. Farmers are using to spread the fertilizers directly using their hands [3]. They may not spreading process properly are accurate in a fertilizer spreading process. In this Spreading process, it may lead crop to over yielding or may sometime get crop damaged. Fertilizer chemical may affect a farmer's health due to continuous spreading of fertilizer with their bare hands. Spreading of fertilizer may not be uniform and cannot perform well work in their field. It may increases the usage of fertilizer quantity to a field. Large quantity of yield growing field may require a more number of human labors. Conventional spreading may lead to usage of fertilizer while broadcasting process [4]. Figure 2 demonstrate that tractors is mounted with the fertilizer distributor which is having the impeller disc and the hopper and there is a simple mechanism is mounted between the impeller disc and tractor by using shaft ware as the fertilizer gradually dropping on the impeller disc which help in distributing the fertilizer equally throughout the form in the tractors it should be maintain equal velocity the main benefit of this distributor is it can manage high volume for larger fertilizer forms [5].



Figure 2: Conventional Fertilizer Broadcasting

Figure 3: Impeller disc distributor

(Source: <http://www.knowledgebank.irri.org/step-by-step-production/growth/planting/direct-seeding>)

1.2 Current Scenario

This project is aimed at helping Indian small-scale farmers to meet increased demand for local grains via a mini-farmer that can more effectively design and manufacture a small scale farmer fertilizer broadcasting system. Moreover this project is also to design & fabricate a machine which can perform multiple operations. The objective of this project is to help farmers who hold small lands. This machine will mechanize the process and reduce the need and labor and time [6]. Smooth and even spreading of manure or fertilizer by hand over the entire field surface during cultivation or after the seed has been sown in a standing condition, which is referred to as broad casting. Based on the time of fertilizer application, broad casting can be of two types. Farmers make up nearly 80% of the population of our country [7]. Our economy relies on farm products as well. In conventional farming methods, such as seed planting, irrigation systems, pesticides and spray have undergone enormous changes nowadays. We also need to raise our agricultural productivity and quality in order to improve our economic situation. The agricultural cycle involves several phases, one of the most critical stages of which is the fertilization process which has not yet been explored [8]. Nowadays we are used to historically spread fertilizer, which takes more time and is also more costly. Also, there are some machines available which have been operated by tractors or machines for dispersion of fertilizer in the field.

A method was developed to distribute the fertilizer evenly over a fallow area by dripping the fertilizer over the impeller disc. This was helpful for the big-screen builders, but it's expensive for a small-scale farmer who owns over acres of land. We would like to develop this method for small-minded people. The system consists of 2 or 3 spokes, two on the front and one on the back. The fertilizer is driven by the two wheels on the front. The hopper is used to store fertilizer; this hopper is positioned from the wheel axle at some height to the impeller [9]. The way between hopper and the impeller disc will be controlled by stopping mechanism, it is used to control the flow of fertilizer and sends it to the impeller disc in adequate amount or it controls the over flow of the fertilizer. In principle, all the crops should get enough amount of fertilizer. It discloses the impeller of the system. It has an output shaft mounted [10]. Hopper opens eccentrically to Impeller and spreads the fertilizer in the farm because of the centrifugal action. The use of a suitable shift decrease ratio or chain-or ribbon-drive system in general gears is favored for this high value of the centrifugal force. Fertilizer broadcaster assists you providing pesticides (granular), fertilizer, and seed, etc., over the farmland. Sturdy & light in weight makes it easier [11]. The main motive of this project is minimizing the design of solid fertilizer which is used in tractors. This is economically difficult to the small cultivating farmers as we can see that, there is existing of solid fertilizer broadcaster in tractors of high scale farming land and this existing fertilizer broadcaster should have a minimized design to make it useful for small scale farmers who works on 1 or 2 acres of land [12]. It is not economical to them to use tractors for small area. And using, traditional sprinkling of fertilizer in fields leaves a greater chance of bulk amount of fertilizer falling over particular area as in high concentration and make the area defective [13]. In this solid fertilizer broadcaster is more helpful in this case by controlling the flow of the fertilizer in hopper.

1.3 Motivation of present work

The primary objective of the sowing fertilizer is to spread the fertilizer evenly over the whole region. The present trend in fertilizer broadcaster in India is based on manual method. It's time to replace the manual method by the mechanical way. It will decrease the manual effort and time to spread the fertilizer over the entire field. The present project work is concentrated on design and fabrication of fertilizer broadcaster which will use a simple manual mechanism or a battery to run the motor. This makes the work is easier, more efficient and less time to spread the fertilizer on farms.

2. Proposed Design

This was design for small scale former and not only for small scale formers and for home gardening this was designed by analyzing from the above conditions and this design were made with the help of fusion 360 software. From the Figures 8, we can observe that we have completed the design of the body and Figure 6 reveals that the drum is top part containing the fertilizer which we want to distributer or broadcast in the ground. There is impeller disc that one of most important part in this project which was used to distribute or broadcast the material to the land in equally (refer Figure 4). The container or hopper the material will fall gradually on the impeller disc this impeller will help in distributing the material.



Figure 4: Container



Figure 5: Impeller Disc

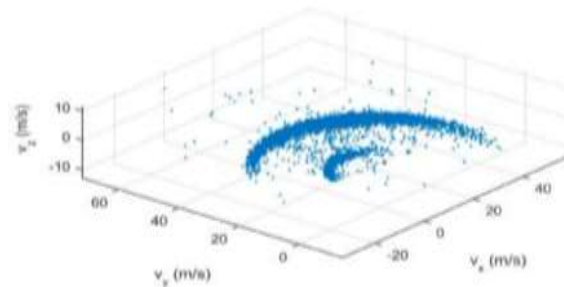


Figure 6: Fertilizer distribution in conventional way

In Figure 6, the graphical representation of conventional way of fertilizer distribution has been shown and we can observe that the fertilizer was spreading in one particular area or highly concentrated in particular area this may lead to the damage of the life time of the plant due to high concentration at particular area or surface

- human hands are used to spread the fertilizer
- Skilled persons are required to spread the fertilizer in a proper and equal manner
- Un-even distribution of seeds or fertilizers
- Required more time for distribution
- Health problems occurred in conventional broadcasting process
- Traditional application

From the analysis the area that which was to be spread can be divided in a part as in the Figure 7 it depends on the capacity of the impeller that the area that can cover or distribute the land

- Fertilizers spreading by fertilization distributor machine using electrical power
- No need to require for any type skilled persons for operating
- Less health problems occurred when compare with conventional broadcasting process
- Uniform distribution
- working Model
- Required less time for spreading

3. Fabrication and Testing

3D printing has been used for making the object this one of the best process for making the design so which help in understanding how does it will look in the environment. We know that plastic was

one of the common materials of making the any type of body parts by this we can easily compare the differences by both of them.

3.1 Type of printing

A number of different methods are available for making 3D printing but a method called Fused Deposition Modeling (FDM) is the most commonly used. For three-dimensional artifacts, FDM printers use a thermoplastic filament that is heated until its melting point and then removed layer by layer.

3.2 Material

Polylactic acid was one of the most commonly used materials for 3D printing and was mostly recognised as PLA. For many extrusion 3D printers it is the default filament to choose from, as it can be printed at a low temperature without having to use a heated pad. The product is fed into the extruder's mouth, in the form of a tube, where the plastic is melted and fine dropped on the printing sheet. This fiber is normally transparent, but spools of colored filament can be used in various colors to make objects.

3.3 Software used

Cura is one of the applications we often call 3D models of Cura slices. The 3D STL, OBJ or 3MF files are translated in an understandable format for the printer. 3D printers print a layer after a layer to create a 3D model. Fusion filament manufacturing (FFF). Slicing can convert virtual 3D models into a G-code that a 3D printer can recognize, which is a generic name for a control language. Slicing is one of the most important 3D printing features, as 3D printers can not itself convert a CAD drawing. Here we only use g-codes, mostly because m-code printers are seldom found.

3.4 Infill

Infill refers to the structure which is shown in Figure 7 in the object. They are extruded in a defined percentage and pattern that the cutting code specifies. The weight material use, intensity, print time and, often, decorative properties directly influence percentage and pattern infill. The higher the level of fill, the greater the pressure, but the longer the pressure is. 10%–20% infill in

most cases is adequate. Very seldom used is 100% infill. Here we use the container 20% infill and impeller 50% as we can see the most of difference in their weight. Object after 3d printing the main motive of our project to use 3D printing was to how does it be look in the real environment conditions.

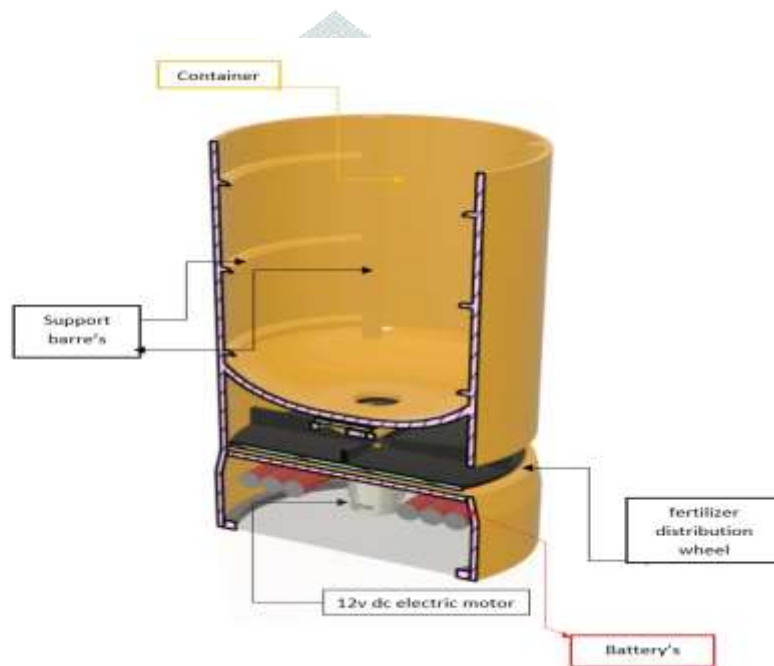


Figure 7: Cross-sectional view of dispersion equipment

the analysis of equipment has been done by using the material PAL and size of meshing is we set to 5 cm were we have given the fixed end in bottom and load in container having that 25 N which was equal to 3 to 4 kg of load and which was sustainable and we can observe the Figure 8 and Figure 9.

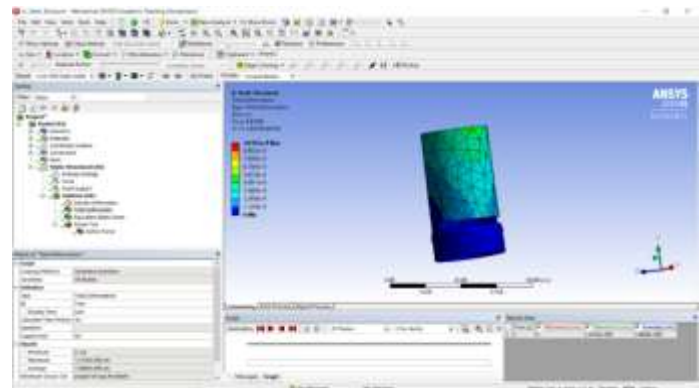
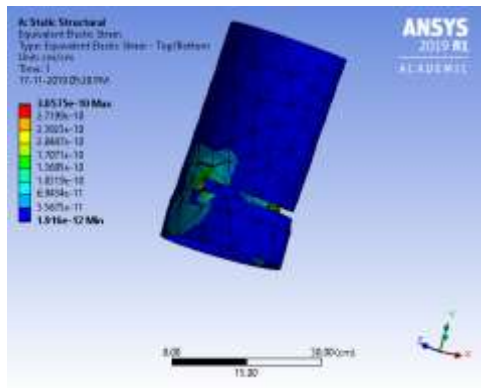


Figure 8: Static structural

Figure 9: Loading under static structural

4. Conclusions

Now a day, spraying of pesticides it becomes important task in agriculture for protecting the crops from insects. Farmers use hand operated or fuel operated spray pump for this task. This conventional sprayer causes user fatigue due to excessive bulky and heavy construction. Fossil Fuel operated spray pump emitted carbon dioxide as pollutant which has a negative effect on our eco system. Hence, these conventional sprayers are not very efficient. This research facilitated the synthesis and development of a model for fertilizer dispersion that utilizes electrical energy for spraying pesticides. In this study, the hand lever has been eliminated to reduce the user's fatigue level. Elimination of engine of fuel operated spray pump leads to reduction in vibrations and noise and will make our spraying system eco-friendly. Present research will be beneficial for practitioners and farmers, now, they can easily deal the solid fertilizer dispersion. Present research also provides ecofriendly solution to the practitioners by eliminating the role fossil fuel required to operate the dispersion equipment.

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